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Association Between Conscious Knowledge and Performance in Normal Subjects: Reply to Cohen and Curran (1993) and Willingham, Greeley, and Bardone (1993)

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Several studies (e.g., Nissen & Bullemer, 1987) claimed that reaction times to a repeating sequence may improve although subjects are not aware of the repeating sequence. Perruchet and Amorim (1992) pointed out that the measure of awareness involved in these studies was inadequate (e.g., subjects were not even explicitly asked to retrieve the repeating sequence), and they showed that the dissociation in normal subjects no longer held when awareness was assessed by recall or recognition tests. In this reply, we show that Cohen and Curran's (1993) criticisms of the validity of Perruchet and Amorim's tests and of the theoretical implications of their results are either without foundation or unfalsifiable. We also show that the new experiment by Willingham, Greeley, and Bardone (1993) does not demonstrate dissociation. Both comments further illustrate the widespread uncritical acceptance of dissociation, which probably originates from, but is not theoretically justified by, evidence available for dissociation in amnesic patients.

Reaction times of subjects in a multiple-choice serial response time (SRT) task decrease more quickly when the same sequence is continuously repeated than when the series are randomly generated (e.g., Nissen & Bullemer, 1987; Perruchet & Amorim, 1992). A number of studies claimed that this improvement in performance may be observed in normal subjects even though they are not aware of the repeating sequence (Cohen, Ivry, & Keele, 1990; Nissen & Bullemer, 1987; Willingham, Nissen, & Bullemer, 1989). Perruchet and Amorim (1992) argued that this claim was dependent on the use of inadequate tests of conscious knowledge. Using what they thought to be a better method, they showed a close parallelism between conscious knowledge of fragments of the repeating sequence and performance in the very same experimental settings that were used previously to demonstrate dissociation.

Cohen and Curran (1993) and Willingham, Greeley, and Bardone (1993) put forward various arguments that they claim invalidate the Perruchet and Amorim (1992) demonstration. This reply addresses the two comments in turn, and concludes again in favor of parallelism. The final section will be devoted to an examination of how this conclusion in normal subjects may be reconciled with neuropsychological data evidencing a dissociation.

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Cohen and Curran's Criticisms

In their critique, Cohen and Curran (1993) dealt with two main points.[1] First, they argued that the test of awareness used in prior studies was in fact worthwhile, and that the new tests proposed in Perruchet and Amorim (1992) were flawed. In a second series of arguments, they addressed the problem of interpreting correlations between reaction times (RTs) and measures of explicit knowledge.

Assessment of Conscious Knowledge

The standard generation task. In the studies supporting dissociation, conscious knowledge is typically assessed by two methods. The first is a postexperimental interview, in which subjects are asked to report if they have noticed that the target signals were sequenced. Because of the lack of sensitivity of free reports, advocates of dissociation essentially rely on a second method in which subjects are required to generate the next target rather than to respond to the present target as they would during training.

Perruchet and Amorim (1992) questioned the use of the standard generation task as a measure of explicit knowledge, primarily because subjects were not told to generate the repeating sequence that was displayed during the training phase. They also questioned the correction procedure used with the standard generation task in that the trial-by-trial

[1] Cohen and Curran also construed as one of the main concerns of the Perruchet and Amorim study the examination of the Cohen et al. (1990) claim regarding the importance of unique associations. In fact, we only used the data collected in Experiment 3 to make some observations that we thought of as discordant with the Cohen et al. hypothesis. Given space limitations, we do not address the point in this reply, in order to concentrate on the main issue at hand.

correction of errors may have interfered with retrieval for those subjects who guessed that they should reproduce the training sequences. In addition, the correction procedure severely limits the number of trials available for analysis (typically, only one or two cycles of the sequence are considered, the assumption being that subjects have not yet benefited from this new opportunity of learning the sequence).

Cohen and Curran (1993) acknowledged that "given that subjects were not told to produce the same repeating sequence on which they were trained in the SRT task, it is not fully clear whether the task can be classified as explicit or implicit" (p. 1432). However, they also asserted that classifying tasks as explicit or implicit on the basis of the instructions given to subjects is, in fact, an "assumption," to take their word, on which neither Nissen, Knopman, and Schacter (1987) nor Cohen et al. (1990) relied. Instead, these researchers relied on other considerations. Three arguments can be found in the Cohen and Curran comment, which will be examined in turn.

The first argument is that Willingham et al. (1989) showed that accuracy on the generation task varied with verbal reports of awareness. This objection would be appropriate if verbal reports of awareness varied more with generation performance than with RTs. However, empirical data do not support the point. On the one hand, verbal reports are predictive of RTs. For instance, Willingham et al. (1989, Experiments 1 and 3) showed that "subjects who acquired explicit knowledge of the sequence (as assessed by verbal reports) showed greater improvement in performance with practice" (p. 1058). On the other hand, relationships between verbal reports and generation performance are not perfect, to say the least. For instance, Cohen et al. (1990) noted that "reporting awareness did not translate into strong performance on the generation task" (p. 27). (Incidentally, it is strange that the inability of the generation task to reveal knowledge available by free reports—a measure known for its insensitivity—has never led to question the capacity of this task to reliably assess explicit knowledge.)

The second Cohen and Curran (1993) argument is rooted in a study by Nissen et al. (1987), in which the injection of scopolamine in normal subjects is shown to have a detrimental effect on the generation task. Cohen and Curran argued that scopolamine is known to affect performance on explicit tasks, hence validating the use of the generation task as a test of explicit knowledge. However, in this early study involving the generation task, performance was analyzed over the whole first block of trials, which represents 10 repeating sequences. As was pointed out earlier, later studies have restricted analysis to the first two cycles of the sequence, because informative feedback provides a new opportunity to learn. Thus, in the Nissen et al. study, performance on the generation task partly reflected the explicit learning that occurred during the generation task. The influence of scopolamine on this task has no relevance with regard to the issue at hand. Furthermore, even if the effect of scopolamine could be revealed during the first trials of the generation task, Cohen and Curran's (1993) argument would be worth considering only if scopolamine selectively affects explicit knowledge. Contrary to this assumption, Nissen et al. reported that scopolamine exerted a very strong effect on a word-stem completion test, the most common test of implicit memory.

As a third argument, Cohen and Curran (1993) used the results of an experiment briefly reported in Cohen et al. (1990). As a departure from prior practice, subjects received explicit instructions before the generation task, and still performed poorly. However, Cohen and Curran ignored the fact that, in this study, simple verbal reports, which were collected before the generation task, revealed clear explicit knowledge whereas the generation task did not. It is somewhat paradoxical to use one experiment in which an improved version of the generation task still failed to provide evidence for knowledge revealed in interviews in defense of the conventional version of the task. The lesson of this experiment is that although explicit instructions are necessary to make a task explicit, they are not sufficient. As hypothesized by Perruchet and Amorim (1992), continuous distraction provided by corrective feedback may prevent expression of explicit knowledge, despite subjects' intentions.

Surprisingly, Cohen and Curran (1993) included within their arguments two other, irrelevant considerations. The first aims to illustrate that the generation task does not assess implicit knowledge. This argument stems from the fact that subjects may show learning in the SRT task, which presumably taps implicit knowledge, despite chance-level performance in the generation task. Conversely, generation performance is not predictive for RTs. For instance, Cohen et al. (1990, Experiment 4) showed that groups formed on the basis of generation task performance did not differ in the SRT task. Cohen and Curran argued that this result cannot be imputed to the lack of sensitivity of the generation task. They reasoned that if the generation task was a less sensitive measure of implicit knowledge than RTs, any difference between groups in the generation task should be amplified, instead of being suppressed, in the SRT task.

Cohen and Curran's (1993) line of reasoning includes a statistical pitfall: When groups are formed from a given measure, between-groups differences on another correlated measure can only be reduced, whatever the relative sensitivity of the two measures, in application of the so-called regression phenomenon (e.g., McNemar, 1969, p. 176). Regardless, we share the view that the generation task is not a genuine measure of implicit knowledge. However, the point is irrelevant, because asserting that a task is not a good implicit test does not entail that it is an explicit test. Presumably, the conventional generation task is sensitive to a variety of factors. Although these factors may include implicit and explicit knowledge about the sequence, there are also other elements to consider. One attractive possibility is that performance essentially differentiates subjects who have guessed that they have to reproduce the training sequence from others, hence assessing a feature that bears no clear relation with either implicit or explicit knowledge of the sequence.

The second irrelevant consideration included in Cohen and Curran's (1993) arguments is the fact that neurologically impaired subjects show RT improvement in the SRT task. This consideration is again irrelevant, given that the issue at hand

is not the implicitness of the SRT task, but the reliability of the generation task as a measure of explicit knowledge. This digression can mislead the reader to infer that there is a selective deterioration of performance of amnesic subjects in the generation task. If this phenomenon was demonstrated, it would lend support to the assertion that the generation task taps explicit knowledge. However, we are not aware of any study comparing normal subjects and neurological patients on the generation task. In fact, the generation task seems to have never been involved in experiments with neurological patients (see also Shanks & St. John, 1992, for a similar observation).

The conclusion of the foregoing analysis is that Cohen and Curran (1993) failed to provide any valid argument supporting the claim that the conventional generation task is a reliable test of explicit knowledge. Given that the empirical evidence for occurrence of learning in the SRT task without concurrent explicit knowledge in normal subjects relies on the use of this task, we infer that the alleged phenomenon is without support.

The explicit tests in Perruchet and Amorim (1992). Perruchet and Amorim (1992) used both a recognition test and a version of the generation task as their measures of explicit memory. In both cases, subjects were explicitly told to retrieve their memories of the training sequence. In addition, the tests were designed to be sensitive to knowledge of fragments of the repeating sequence. Cohen and Curran (1993) speculated that changing the level of analysis from the whole sequence to fragments may have made the measure sensitive to implicit knowledge. Unfortunately, they provided neither empirical nor theoretical support for their claim. Recall that this change was introduced to fulfill what Shanks and St. John (1992) called the information criterion. This criterion stipulates that the information the experimenter is looking for in the awareness test needs to match the information responsible for the performance change.[2] In sequence-learning situations, Cleeremans and McClelland (1991) showed that RTs to the current event may be sensitive to the predictive value of the two or three preceding events. However, even after 60,000 practice trials, there was no evidence for an effect of the event four-steps away from the current trial, hence justifying our focus on the knowledge of short fragments.

In their version of the generation task, Perruchet and Amorim (1992) provided no corrective feedback. Cohen and Curran (1993) speculated, again without any supporting evidence, that suppressing feedback may also have made the test sensitive to implicit knowledge. We fail to understand why feedback, which is never provided in usual explicit tests of memory, should be a condition to tap explicit knowledge in this particular context.

Cohen and Curran (1993) also contended that recognition judgments may be grounded on the subjects' perception of their fluency[3] in responding to old and new sequences, given that subjects had to press keys in response to the to-be-recognized sequences. This argument finds support in theories of recognition positing a dual component for recognition judgments (e.g., Jacoby, 1991). We do not repeat here Perruchet and Amorim's (1992) counterarguments presented in the original article, in order to leave space for new evidence. Indeed, Willingham et al. (1993) evaluated and rejected the fluency hypothesis in their critique. They reported an experiment in which one group of subjects was submitted to the same recognition task as in the Perruchet and Amorim experiments. Two other groups were not asked to respond again to target signals. The to-be-recognized sequences were presented either as a set of asterisks, as in the SRT task, or as a series of digits from 1 to 4 (with 1 denoting the left-most position and 4 the right-most position). Recognition scores did not differ between the three groups, hence indicating that subjective perceptual or motor fluency did not affect recognition judgments in this situation.

The lack of any particular reason to challenge the relevance of the free generation and recognition tests of explicit knowledge does not mean (as is implied by Cohen and Curran, 1993) that Perruchet and Amorim (1992) conceived of their tasks as "pure" measures of explicit knowledge, nor that they equated tests and knowledge. The idea that any task may be influenced by several forms of knowledge was discussed long ago, and among many others, by one of us (Perruchet & Baveux, 1989). There is no reason to assume that the tests used in Perruchet and Amorim constitute an exception.

However, this issue is not crucial in the present debate. To reclaim the validity of the dissociation evidenced with the conventional generation task despite the conflicting evidence provided by Perruchet and Amorim (1992) with new awareness tests, it is not enough to assume that they may include some implicit aspects; one has to demonstrate that the Perruchet and Amorim tests were more sensitive to implicit knowledge than the conventional generation test. As indicated in the foregoing discussion, asserting that our tasks, in which subjects are instructed to recall or recognize previously displayed sequences, could be more sensitive to implicit knowledge than the conventional generation task, in which subjects are simply asked to generate a sequence, appears highly paradoxical and unrealistic.

Correlations, Dissociations, and Falsifiability

Cohen and Curran (1993) developed a second line of argument, which was intended to be worthwhile even if one admits that Perruchet and Amorim's (1992) recall and rec-

[2] Conventional postexperimental interviews, aside from their lack of sensitivity, are typically ill-suited with regard to the information criterion, because they are looking for the knowledge of the repetition of a sequence. Subjects may have acquired knowledge about fragments composing the sequence without knowing that the very same long sequence is continuously repeated, and vice versa (e.g., if they are informed by instructions of the presence of a repeating sequence).

[3] Cohen and Curran used the term *familiarity* instead of *perception of fluency*. However, given that they referred explicitly to the Perruchet and Amorim article at this point, we assume that they unintentionally confused the two concepts. Although the point could warrant discussion, we believe that only perceived fluency is relevant here.

ognition tests are genuine tests of explicit knowledge. These criticisms addressed the part of the Perruchet and Amorim data involving correlational analyses. Perruchet and Amorim reported that correlations over the sequence trials between RT and explicit knowledge ranged, in three experiments, from .63 to .98. They inferred from these correlations that most of the factors that make some fragments of the sequence easier to learn than other fragments (relative saliency, position within the sequence, etc.) influence implicit and explicit tasks in the very same way, a fact consonant with the proposal that performance and conscious knowledge tap a common knowledge base.

Cohen and Curran (1993) argued that this inference is unwarranted because explicit knowledge may influence performance in the SRT task, hence making RTs sensitive to both implicit and explicit knowledge. The crucial point, according to Cohen and Curran, is that "some" (p. 1435) or "many" (p. 1431) experimental manipulations affect performance in one task, but not in another. These data, Cohen and Curran claimed, attest to the reality of dissociation between implicit and explicit knowledge.

Unfortunately, Cohen and Curran (1993) do not provide even one example of an experimental variable eliciting a dissociation. Our own reading of the literature leads us to assert that all the variables investigated up to now elicit parallel effects in tasks devised to reflect implicit and explicit knowledge. For instance, increasing practice duration improves both RT and explicit knowledge (e.g., Willingham et al., 1989), and increasing the length of the repeating sequence has a detrimental effect on the two measures (D. V. Howard & Howard, 1989). Likewise, adding a secondary task elicits parallel effects. This latter point warrants emphasis, because Cohen and Curran's comment could suggest that this variable elicits a dissociation. In fact, superimposing a secondary task exerts a detrimental effect on RT and explicit knowledge, whether the secondary task is introduced during the training session (Nissen & Bullemer, 1987) or during a subsequent transfer phase (Curran & Keele, 1993, Experiment 4).

J. H. Howard, Mutter, and Howard (1992) recently reported a pattern of results that they presented as a dissociation. They compared a condition in which subjects responded with a keypress to the target signal, as in the standard procedure, with a condition in which subjects simply observed the sequence during the first block of training. They reported that observation elicited significantly better performance in the generation task (about .94 vs. .72 correct response, estimated from their figure and taken from the results of Experiment 2, which provided the clearest results) but that equivalent learning occurred for responding and observing in the SRT task. In fact, the improvement in RTs that was due to the repeating sequence was 170 ms in the observation group and 108 ms in the response group. The alleged dissociation proceeds from the fact that this difference failed to reach the conventional significance threshold (in fact, $p = .11$). It is worth noting, however, that the effect of the factor under examination, as assessed by proportions to make the data roughly comparable, was in fact stronger for RTs than for performance in the generation task.

The ubiquitous parallelism between implicit and explicit measures of sequence learning contradicts the claims of Cohen and Curran (1993). However, as outlined shortly, their line of reasoning may be extended in order to accommodate empirical results to a theory positing independence between implicit and explicit knowledge. Measures of explicit knowledge are not pure; they are also sensitive to implicit knowledge. Conversely, RTs are not a pure measure of implicit knowledge, because they are also sensitive to explicit knowledge. As a consequence, RTs and measures on tests of conscious knowledge are impossible to disentangle, even though implicit and explicit knowledge are fundamentally independent.

Although the theory may be right at the end, it has the damaging property of being unfalsifiable. If correlations around .80 and the ubiquitous parallelism in the effects of experimentally manipulated variables do not challenge a theory positing independence, is this theory really amenable to empirical testing?

The Willingham et al. (1993) New Experiment

Rather than challenging the relevance of the changes introduced in the conventional procedure by Perruchet and Amorim (1992), as did Cohen and Curran (1993), Willingham et al. (1993) implemented some of these changes in a new experiment. They argued that dissociation survives this manipulation. Subjects performed an SRT task in which a 16-trial sequence was repeated five times in each of five successive blocks. Following the task, the subjects were interviewed, and they performed a recognition task. Willingham et al. provided three pieces of evidence that they claimed demonstrated independence between implicit knowledge and explicit knowledge as assessed by their two tests. We will examine each set of data in turn.

As a preliminary remark, we note that Willingham et al.'s (1993) procedure departed from Perruchet and Amorim's (1992) procedure on a crucial point. Although Perruchet and Amorim stressed the need to assess explicit knowledge of fragments of the sequence, Willingham et al. asked for the recognition of the whole repeating sequence. Subjects saw five 16-trial sequences, including the studied sequence, and they had to rate their level of recognition on a 100-point scale. This procedure is a priori insensitive to fragment knowledge.

Learning in Unaware Subjects

Willingham et al. (1993) argued that a subgroup of subjects without explicit knowledge nevertheless learned the sequence. Perruchet and Amorim (1992) pointed out that this kind of argument consists of drawing an inference from a single cell of a fourfold contingency table. The problem is that, in such a table, a proportion of subjects are misclassified as a simple consequence of the (inevitable) lack of reliability of measures. The presence of subjects in a given cell can only be evaluated with regard to the coefficient of reliability of the measures. Although Willingham et al. did not provide

information on this point, there is substantial evidence that neither unawareness nor learning were reliably assessed.

The lack of reliability of their tests of awareness is revealed by the low level of between-test consistency. It is especially striking that 5 of the 7 subjects who failed in the recognition test—arguably the most sensitive test—were found to be aware with at least one question from the interview. This pattern of results makes it likely that if, for instance, the interview had involved a few more questions, explicit knowledge would have been revealed in the 2 (of the 45 initial) subjects that Willingham et al. (1993) classified as unaware.

The demonstration of learning in the two selected subjects is also questionable. Willingham et al. (1993) pointed out that the two no-knowledge subjects improved RTs more quickly than the random subjects, a difference that was confirmed by a block-group interaction (significant to .047).

Note first that the F test is not robust with respect to inequality of variances with unequal sample sizes (see, e.g., Lindman, 1974, p. 43). Also, the authors did not take into account the possibility of heterogeneous correlations among the repeated measurements (e.g., Ekstrom, Quade, & Golden, 1990). Looking at Figure 2 in Willingham et al. (1993) reveals other problems. For instance, the overall performance of the two no-knowledge subjects differed from that of the knowledge subjects and did not differ from that of random subjects. Willingham et al. did not comment on this aspect of the data. In addition, it appears that the interaction on which Willingham et al. focused is essentially due to 1 of the 2 subjects, who started training with a very slow RT (around 540 ms during the first block of trial, i.e., at more than two standard deviations above the group mean, as estimated from the figures). It is in fact the progressive evolution of this unique, highly atypical subject, toward more common RT values, that is qualified in the conclusion of the article as a "robust implicit learning of the sequence" (p. 1429).

Correlational Analysis

The second Willingham et al. (1993) argument relies on between-subject correlations between each of the two measures of explicit knowledge (free reports and recognition scores) and differences in RTs between adjacent blocks of trials, which provided a measure of implicit learning.

As shown in Table 3 of the article, the correlation between the number of recalled fragments of the repeating sequence and the improvement in RT during the last block of training was fairly high (.52). Again, Willingham et al. (1993) did not provide any measure of reliability, but it is well known that the reliability of difference scores is low, especially if the two original variables are correlated (Cronbach & Furby, 1970). Therefore, it appears possible that the observed correlation between one measure of explicit knowledge and RT improvement is as high as allowed by the reliability of the variables. In any case, a fact of special relevance is that this correlation is better than the correlations observed between recall and recognition measures, which both assessed explicit knowledge.

However, Willingham et al. (1993) did not comment on this crucial result, and emphasized the fact that measures of explicit knowledge were not correlated with the improvement in performance during the first blocks of training. They concluded that these results provide evidence of a dissociation between implicit and explicit knowledge in the early phase of training.

Note, first, that Willingham et al.'s (1993) interpretation presupposes that learning occurred during the first blocks of training. If there was no evidence of learning early in training, the low correlation between explicit knowledge revealed in postexperimental tests and RT collected during the first blocks of trials does not testify for a dissociation. Willingham et al. provided no block-by-block analysis of RT, but their Figure 1 shows that the performance curves for sequence and random subjects are roughly parallel during the first blocks of training, hence questioning the occurrence of reliable learning before Block 5.

Although this account is sufficient to rule out Willingham et al.'s (1993) claim for dissociation, it remains somewhat incomplete. Indeed, Perruchet and Amorim (1992) showed, in their Experiments 2 and 3, that conscious knowledge and performance correlated strongly early in training, even though there was still no clear indication of learning in the RT data. Why did Willingham et al. fail to replicate this result?

The two studies, in fact, differed on a crucial point. Perruchet and Amorim (1992) correlated RT and explicit knowledge collected early in training, whereas Willingham et al. (1993) correlated RT collected early in training with explicit knowledge assessed at the end of training. Willingham et al., who pointed out this difference, reasoned that this factor does not account for their low correlations, because it is unrealistic to think that subjects forget early elements of knowledge during later practice with the task. However, there is no need to assume forgetting to account for the observed pattern of correlations. It suffices for the learning curves of different subjects not to be parallel, a condition that is fulfilled in virtually any learning experiment.

Learning for Unreported Segments

As a final analysis, Willingham et al. (1993) separated RTs for segments reported in the postexperimental interview from RTs for unreported segments. They observed that RTs in Blocks 3, 4, and 5 were lower for reported than for unreported segments.

Willingham et al. (1993) focused on two other results. First, RTs in the early blocks of training did not differ for reported and unreported segments, and second, RTs for unreported segments were still lower than RTs of random control subjects late in training. The former point was discussed in the preceding section. The latter point supports the claim for dissociation insofar as the capacity of free reports to provide a sensitive measure of explicit knowledge is taken for granted. However, as alluded to earlier, this prerequisite is challenged, even among advocates of dissociation (e.g., Reber, 1989, p. 231).

Conclusion

The Willingham et al. (1993) experiment failed to reveal an amount of dissociation that exceeds what the probable reliability of their tests leads us to expect. Of special interest, one measure of explicit knowledge, namely the number of reported fragments of the repeating sequence, tended to correlate better with RTs (.52) than with the other measure of explicit knowledge, namely the recognition scores (.35).

Regardless, Willingham et al. (1993) asserted, in the first sentence of their conclusion, "The most important point in this experiment is the confirmation of the dissociation between implicit and explicit measures" (p. 1429). Still more strikingly, the only reference Cohen and Curran (1993) made to the Willingham et al. study mentions that they "did not find correlations between the SRT task and a recognition task" (p. 1435).

Confronting Data in Normal and Amnesic Subjects

Parallelism in Normal Subjects

The foregoing sections lead us to reinstate the close parallelism between RTs and explicit knowledge in normal subjects. What exactly does this conclusion mean?

First, we do not claim that the parallelism is perfect. For instance, correlations between performance and explicit knowledge across subjects never reach unity. This entails the fact that some subjects who learn in the SRT task and do not exhibit awareness of the sequence can always be found, especially when the initial sample is large. We also take for granted, for instance, that in a given experiment, a factor may exert a significant effect on a measure of explicit knowledge and a nonsignificant effect on a measure of implicit knowledge, and vice versa. Our claim for parallelism means that those departures from perfect associations are entirely accountable for by the inevitable amount of random variation and error of measurement that plague any experimental measure.

Second, we do not intend to claim that the available evidence demonstrates that genuine dissociations are not possible. Such a demonstration goes beyond any direct experimental inquiry. It is quite possible that further work involving a still unexplored variable does show dissociation. However, whatever the outcome of future investigations, a conservative conclusion is that a very large number of variables similarly influences RTs and conscious knowledge.

Dissociation in Amnesics

The fact that patients with a sharp deficit in explicit memory improve their performance in the SRT task as much as normal subjects is well documented. Although the inability of these patients to acquire conscious knowledge of the repeating sequence has never been directly examined with reliable and sensitive tests, our background knowledge of the memory impairment of these patients appears to be sufficient to take for granted that a genuine dissociation occurs in amnesic syndromes.

There is little doubt that the uncritical acceptance of dissociations in normal subjects, of which Cohen and Curran's (1993) and Willingham et al.'s (1993) comments provide the most recent illustrations, originates from these data. This attitude would not be justified even if empirical results in normal and neurological subjects were difficult to encompass within the same interpretive framework. However, in the present case, there is no theoretical inconsistency in claiming that conscious knowledge does parallel RT improvement in normal subjects and does not in amnesics. As a consequence of various types of dysfunction, some subjects lose the ability to move one of their eyes. This does not imply that, in normal people, the two eyes move independently. Parallelism is the rule, and independence is the effect of the disorder. Without doubt, the distinction between explicit and implicit knowledge bears little analogy with binocular vision. But in that case also, it is not paradoxical to claim that pathological disorders elicit a dissociation between systems or processes that are, in normal subjects, closely related.

That is not to say that neurological observations are irrelevant with regard to the interpretation of the relation between explicit knowledge and RTs in normal subjects. Arguably, conscious representation of the sequence can exert causal influence on RTs. For instance, as suggested by Willingham et al. (1989), conscious knowledge may be responsible for anticipatory responses after prolonged practice. But in our opinion, preserved performance in amnesics in the SRT tasks runs counter to the generalization of this perspective. By and large, the improvement in performance is probably not causally dependent on conscious and controlled processing. The parallelism observed in normal subjects indicates simply that, when these subjects are explicitly questioned about their knowledge of the sequence, they access the very same knowledge base they used automatically while performing the SRT task. If this perspective is correct, it would be more convenient to conceive sequence learning as the formation of a single knowledge base, directly responsible for RT improvement and available to consciousness in normal subjects, rather than as the independent acquisition of so-called implicit and explicit knowledge. One of us speculates elsewhere (Perruchet, in press) on the role attributable to nonconscious and conscious processes evolving from these views.

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