tion of iconic activity. For example, contrast Ruchkin et al.'s Figure 3 with Figure 1 in Phillips (1983a), which is based upon the single-unit neuronal activity reported in Singer and Phillips (1974). Third, "activation" connotes the selection of old things, not the creation of new things. Even pre-attentive perceptual processes must involve the latter (Watt & Phillips 2000).

There is space here to outline only two paradigms in support of my view that the creation of new descriptions cannot usefully be viewed as simply the activation of old items. The first involves the use of matrix block patterns to compare VSTM and VLTM (Phillips 1983b; Phillips & Christie 1977a). To focus on visual memory, these patterns were designed to be difficult to verbalize adequately. To focus on the use of novel descriptions, rather than on the use of old items, novel patterns were used on every trial. The results clearly showed that accurate descriptions of novel patterns could be voluntarily maintained for as long as the subject could keep attending fully to them, providing the matrix patterns were below measured levels of complexity. Some VLTM for those patterns was produced by a single presentation, but with much less accuracy than for VSTM. I cannot see how it is useful to think of these VSTM descriptions as activation of long-term memory items, unless by "activation," Ruchkin et al. mean the use of descriptive capabilities stored in VLTM to create novel descriptions.

The second paradigm involves mental rotation. To see whether rotated images formed within VSTM operate upon the long-term representations of the items rotated, we modified a paradigm that studies discrimination between normal and mirrored versions of familiar alphanumeric characters displayed in various orientations (Shepard 1978). Our results show that when subjects image a familiar alphanumeric character upside down they still have the upright character in VLTM available for use (Roldan & Phillips 1980). This shows that mental rotation uses knowledge of the form of the upright character and transformational rules to create a novel description within VSTM. They do not transform the VLTM of the familiar form.

I assume that there will be general agreement with Ruchkin et al.'s view that many modality-specific brain regions embody both VSTM and VLTM. I do not see how the concept of "activation" advances our understanding of these issues, however. That said, my reservations concerning the conceptual framework within which Ruchkin et al. interpret their data do not imply that measures of the kind they emphasize are without value. Many, such as those of EEG coherence, may well be of value, if validly related to the underlying neuronal activity.

Models versus descriptions: Real differences and language differences

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Abstract: We argue that an approach that treats short-term memory as activated long-term memory is not inherently in conflict with information recycling in a limited-capacity or working-memory store, or with long-term storage based on the processing in such a store. Language differences aside, real model differences can only be assessed when the contrasting models are formulated precisely.

The authors of the present target article introduce their proposal in an attempt to draw a distinction between the idea of short-term or working memory as a separate store and the idea of short-term or working memory as activated representations in long-term memory. We note that these views are not inherently opposed to one another. In particular, it makes a great deal of sense to assume that short-term memory corresponds to activated representations in long-term memory, but that does not mean that a model for short-term memory that is based on the notion of stores or buffers is useless or even incorrect.

In this respect, it is of some interest to note that the Short-Term Store (STS) system in the modal model of memory proposed by Atkinson and Shiffrin (1968) has long been formulated as the temporarily activated portion of Long-Term Store (LTS) (e.g., Atkinson & Shiffrin 1971). This reformulation was based on theoretical grounds: in particular, the idea that it made more sense to assume that perceptual stimuli contact information in long-term memory, rather than to assume a sequence from sensory registers to short-term store to long-term store. This idea was further elaborated in Shiffrin (1975; 1976). Of course, the idea of short-term memory as activated representations in long-term memory considerably predates Atkinson and Shiffrin, going back, at least, to James (e.g., 1890).

More importantly, this idea is easily reconciled with a model that assumes that STS or working memory may be viewed as a store that temporarily holds a small amount of information for further (more elaborate) processing. As argued by Shiffrin (1975; 1976), perceptual information activates a large amount of long-term memory information. However, the information is rapidly lost from STS (i.e., becomes inactive) unless it is maintained in STS through rehearsal and other coding processes. As a result, only a few items may be maintained simultaneously in a highly active state in STS. A STS buffer, such as that proposed by Atkinson and Shiffrin (1968), is a simple model used to describe this process of maintenance of information in STS.

The history of the psychology of memory has shown a number of examples where ideas that are not necessarily mutually exclusive lead to unfruitful debates. Perhaps the clearest example is the way in which the Atkinson–Shiffrin modal model of memory is usually discussed in textbooks and put into opposition with the levels-of-processing framework (Craik & Lockhart 1972) or the working-memory model of Baddeley and Hitch (1974; 1977). The target article echoes these textbook accounts when it mentions that "the modal model . . . does not provide an accurate account of how short-term and long-term memories interact, nor does it correctly predict performance for certain dual-task experiments" (sect. 1.1). However, Raaijmakers (1993) and others (Bjork 1975; Glanzer 1977; Shiffrin 1977) have argued that the conflict between the levels-of-processing approach and the Atkinson–Shiffrin model is artificial and not based on a detailed analysis of the Atkinson–Shiffrin model. In particular, it does not take into account the role assigned to the control processes of rehearsal and coding (or maintenance and elaborative rehearsal). In a similar vein, it has been argued that the evidence that was put forward by Baddeley and Hitch (1974) does not really contradict the modal model (see Raaijmakers 1993).

We are afraid that the present target article might similarly promulgate a false dichotomy and help initiate a flood of papers showing either the fruitfulness of the "store"-approach or arguing for the temporary-activation approach. Although some might see such a state of affairs as a sign of healthy progress, active debate is not always a good thing when the debaters are talking "past one another." We believe that such theoretical controversies are best resolved by careful and precise formulation of the different approaches, so that the fundamental and underlying similarities and differences can be assessed. Our personal approach has been to produce such specification by formulating mathematical and computer-simulation models. We predict that such formulations would show that the two model types are not in conflict, but rather that each type has many differing variants that would be amenable to experimental testing. In addition, the choice of model representation may be more a matter of style than substance. The preferred choice of "stores" or "activated subset" will probably depend most on the nature of the data that one tries to accommodate, and an assessment of which approach proves more fruitful, parsimonious, or productive. As such, the situation is reminiscent of the wave versus particle viewpoints in contemporary physics.

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