6 Mental Systems, Representation, and Process

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In the target chapter (chap. 1, this volume), Donal Carlston presents his Associated System Theory (AST). The goal of this theory is to provide a framework for identifying the relevant dimensions of information that are used in deriving impressions of other people as individuals, although this framework could be extended to nonhuman animals and inanimate objects as well. His chapter can be roughly divided into two sections. In the first section, the different types of representational systems that are employed in deriving impressions of other people, as well as how those systems interact, are described. In the second section, the types of processes and conditions involved in the creation, organization, and use of these representations are described. The current chapter focuses on the issues raised in the first section—that of the representational systems—because this is where the AST model, as it is outlined here, has its greatest problems as a theory of associated mental systems.

According to Carlston, the AST model is concerned with the form of the mental representations used in the formation of impressions of other people, not with their content, and with how these different forms are employed in different situations where people gain impressions of other people. Each *system* in the AST framework is presented as relying on a unique representational form, as well as a set of processes that operate on those forms. These unique representations and procedures are tailor-made for each system to satisfy the system's particular needs. Carlston identifies four primary systems that compose the model, as well as four secondary systems. The secondary systems are hybrid combinations of the activities from two primary systems. The representational forms and processes of the

secondary systems are emergent properties arising out of the combination of two of the primary systems. Carlston also implies that up to 25 different systems may be identified if a more fine-grained approach is taken. This increases the degrees of freedom for the model, allowing it to explain a larger dataset. However, because the more elaborate scheme is not considered a fundamental aspect of the model, only the eight central systems are considered here.

The representational forms that are used by the AST model are abstract, although their features correspond to the input and output needs of each particular system. Each of the four primary representational systems operates independently from the other systems at lower levels of processing, with no exchange of information. However, at higher levels of processing, some degree of overlap and interaction among the systems is assumed to occur. At these higher levels, each of the representational systems is assumed to retain its representational form, although the systems may share common processes and organizations. It is also at these higher levels of processing that the interaction of the primary systems gives rise to the secondary systems. This interaction and creation of the secondary systems provides a bridge across which the information from the separate systems can be shared during the formation of impressions of other people.

The following sections of this chapter describe three aspects of the representation and organization of information, as presented in the AST model, that need to be considered more fully. First, I discuss some of the problems the AST model has in the identification and organization of the different representational–processing systems. Second, I detail some problems with how the AST model presents the representational forms of the different systems. Third, I cover some notions concerning the differentiation between representation and process in building a theoretical model.

MULTIPLE MENTAL SYSTEMS

The purpose of delineating multiple memory systems is to identify sets of representations or processes that handle different types of information, are independent of one another, and that serve different functions. Different mental systems are often identified through some dissociation in their functioning, where a given manipulation affects one system but not another. Some of the most convincing evidence of system dissociation comes from neurological evidence, particularly when a particular neural structure is damaged or destroyed. In such case, the particular functions of a certain system may become compromised, or even disappear entirely, whereas the functions of other systems remain undisturbed. By identifying the different mental systems involved in a given processing task, such as

forming an impression of a person, one can better understand the nature of the information being used, how it is represented, and how it is processed by the system.

In general, when researchers identify different mental systems, they make a distinction between the different types of representation and/or the different types of mental processes that are involved within each system. For example, in the most simple conception of the human information-processing system, the so-called standard or modal model of Atkinson and Shiffrin (1968), information was thought to pass through several different processing stages—a sensory register, a short-term store, and a long-term store. Information was represented in the sensory register in terms of a code corresponding to the initial input mode (visual, auditory, etc.), whereas information in the short-term store was represented in a verbal–linguistic code. Like the modal model of cognition, a theory that supposes different mental systems should relate the different representational and processing mechanisms unique to each system. A brief overview is given of some of the more successful theories of multiple systems in terms of how they satisfy these criteria.

Theories of Multiple Mental Systems

Some theories assume that information stored in different mental systems has different representational forms. There is a fundamental difference in the way that information is mentally coded, such as in the distinction between the procedural and declarative systems (e.g., Zola-Morgan & Squire, 1988). In general, the procedural system handles information pertaining to nonverbal actions or activities, such as knowing how to ride a bicycle or how to shift while driving a car. In contrast, the declarative system handles knowledge that can be readily articulated, such as the name of a favorite movie or where a friend was first met. This distinction is supported by neurological evidence that shows that some amnesic patients suffer from a loss in their declarative system, while the production system remains largely intact.

One of the major distinctions between declarative and procedural systems is the form in which information is represented in each of them. For example, in the ACT* model of human memory (Anderson, 1983), declarative knowledge is stored in the form of a complex of propositional structures, whereas procedural information is stored in a collection of if–then procedures that "fire" when needed.

Another example of theory of separate memory systems that relies largely on a difference in representational forms is Paivio's (1971) dual-code theory. In that model, verbal and imagery information are stored and processed in two separate systems, each possessing a unique representa-

tional code. Verbal information is thought to be represented by a propositional code, whereas imagery information is represented by more analogical mental images. Regardless of the theory supposing the different mental systems, they all agree that the information represented in each system should have a unique structure in order to best take advantage of the information's content.

In addition to the specification of different representational codes, theories of multiple mental systems specify that each mental system relies on a different set of processing mechanisms, although a few processing mechanisms may be common across systems. According to these theories, it is *how* information is processed that separates one system from another. One currently popular distinction is between implicit and explicit memory systems (Graf & Schacter, 1985, 1987). The implicit memory system is conceived of as being composed of the set of processes that influence the current stream of processing or task without any explicit intention to do so. Such influences include priming and performance on memory tasks, where the person is unaware that memory is being tested, such as perceptual identification or fragment–stem-completion tasks. The explicit memory system is conceived of as being composed of the set of processes used during active memory retrieval, such as recall or recognition. What distinguishes the two mental systems is not the content of the information, but how it is processed. In studies comparing amnesic patients with normal controls, it has been found that the two groups of individuals did not differ on tasks that used the implicit system, but did differ on tasks that used the explicit system and the same experimental materials, thereby supporting the notion that these are, in fact, two distinct mental systems.

The episodic–semantic distinction (Tulving, 1972, 1985, 1993) is another popular distinction between multiple mental systems that illustrates how different processing mechanisms are involved in each system. According to this theory, the episodic and semantic systems store information in similar representational forms. However, information that is processed in the episodic system is operated on so that the information is related to an individual's life experience (e.g., *when* the information was encountered, *where* the information was encountered, etc.). In contrast, information that is processed in the semantic system is handled with respect to how the information relates to other information that is known about the world in general. The critical feature that defines both the explicit–implicit and episodic–semantic theories, is how the information is processed with regard to the functional operation of the system.

One aspect that all of the theories have in common, whether explicitly stated or not, is the notion that these mental systems are arranged in a hierarchical fashion, with more sophisticated or complex systems dependent, in some respect, on more primitive systems. The more sophisticated

systems are thought to have arisen over the course of evolution with an increase in specialization and to meet otherwise unmet needs (Sherry & Schacter, 1987). As such, the manner in which information becomes available to different mental systems, and how that information is shared by the different mental systems, is dictated to some degree by such a hierarchical structure.

How AST Differs From Other Theories

The AST model provides a framework composed of a complex of primary and secondary mental systems. Most of the primary systems can be identified with aspects of other theories, although there are clear differences. The sensory/perceptual system is identified explicitly in the modal model of information processing (Atkinson & Shiffrin, 1968), and is assumed to be operative in many of the other theories that distinguish multiple mental systems. The verbal system corresponds to the declarative systems, including semantic and episodic systems (e.g., Tulving, 1985). Finally, the action system bears a close correspondence to the procedural system (e.g., Zola-Morgan & Squire, 1988). Although none of the theories of mental systems mentioned here identifies a separate affective systems, it is unlikely that most researchers would disagree with the notion that some specialized system for handling emotions does exist. Carlston also agrees with the other theories when he states that the AST model should suppose that information processed by the separate mental systems should have both a separate and unique representational form, as well as separate processing mechanisms.

One of the most striking differences between the AST model and the other multiple system theories I have described is the assumption that all of the systems covered by the theoretical model have equal status in processing. There is not the hierarchical structure that is stated or assumed by many of the other theories. Instead of a hierarchical organization of its mental systems, the AST model organizes its systems in terms of a two-dimensional plane, with concrete–abstract defining one dimension and self–other relevance defining the other. This organization presumably allows for a more even exchange of information across the systems.

In addition to this arrangement of the primary mental systems, the AST model asserts that there are other systems that can be derived through hybrid combinations of the primary systems. These hybrid systems necessarily arise from the interaction of two of the primary systems. However, none of these secondary systems has a clear counterpart in the other multiple system theories described here. Regardless of this fact, Carlston states that each of these secondary systems has its own unique set of representations and processes, and are unique systems in their own right. It is with these secondary systems that I take issue first.

The AST Secondary Systems

One troubling aspect of Carlston's AST model is that the secondary systems that he proposes do not seem to be systems at all. The primary systems are clearly different mental systems because they each derive from a separate set of input sources, operate on different contents, and require different mechanisms to process that information (Sherry & Schacter, 1987; Tulving, 1985). In contrast, the secondary systems (i.e., categorizations, evaluations, orientations, and behavioral observations) seem to be less mental systems and more the products of information processing.

For example, categorizations are a result of a classification mechanism. There is no evidence to support the notion that categories derive from a specific input source. The input for a categorization mechanism can come from any of the four primary systems, and does not need to be a combination of perceptual and verbal processing (we can categorize affect and actions quite well). In terms of representational form, there is not a specific category representational form much beyond some organization of existing representational forms, such as an arrangement of concepts in a network. In addition, it is unclear what specific processes would be involved in a categorization system, except the actual process of categorization. Although categorization is a unique process, that alone does not raise it to the status of a mental system. Specifically, it lacks independence from other mental systems, does not have a unique representational code, and can accept a variety of input and output sources. Similar arguments can be made for the other secondary systems.

One source of evidence presented by Carlston for the reality of the secondary systems are neurological studies of brain-damaged individuals. The neurological evidence for the mental systems proposed for the AST model shows some misunderstanding of these afflictions. First, Carlston conflates several types of unrelated amnesias that are a result of damage to a variety of different neurological substrates. For example, retrograde amnesia is typically caused by general cerebral or other physical trauma where a memory trace has not been allowed to consolidate, whereas anterograde amnesia is caused by damage to the hippocampus. Few researchers would be willing to say that these different types of amnesias are part of the same system. The disorders of categorization could be attributable to the sensory perceptual system alone, and the neurological evidence underlying the disorders of orientation are unclear as they are presented in the chapter. The aprosodias appear to be the only disorders in the secondary systems that fit well into the AST framework. Given the lack of theoretical justification and neurological support, it would be best to conclude that the secondary systems of the AST model are not systems at all, but the result of processing mechanisms on a variety of mental contents.

Does AST Need Multiple Systems?

Given the large amount of research and effort on the other multiple system theories, does the AST model's division of labor add anything new and of value? The secondary systems are not really systems at all, but certain functions that are identified as either being part of other systems or functions that cut across several systems. As for the primary memory systems identified by the AST model, there is nothing new here. All of the functions performed by these systems have been identified by other multiple system theories.

However, in fairness, AST's primary intention does not seem to be to provide an account of a new division of mental systems, but rather to provide an interpretation of how these systems relate and interact. The most novel aspect of the theory is its organization of the systems. Instead of the typical hierarchical arrangement, Carlston chose a cluster of the systems based on the nature of the information being processed. This choice is in the spirit of recent massively parallel and interactive systems, such as the parallel distributed processing (PDP) networks, in which information from several different sources or systems is available to all of the other systems at once. The arrangement of these systems in the AST model's organization is quite effective at capturing some relevant properties involved in the formation of impressions of other people, namely, whether the information is concrete or abstract, and whether the information pertains to the self or the some target other.

But is this multiple system organization needed? Probably not. Although it is clear that there are different kinds of information being processed, it is not clear that much is added to the predictive power of the AST model by supposing that different mental systems are involved. The notion that different types of information are subject to different types of processing can be made without supposing different mental systems. The need to suppose different mental systems occurs only when there is some functional incompatibility in the different processing mechanisms (Sherry & Schacter, 1987). For the AST model, there is always the common goal of forming an impression of a person. The remainder of the AST model, which follows from the description of the multiple systems, would not suffer much if the notion of multiple systems was abandoned in favor of a collection of processing mechanisms that operated with regard to the information's concreteness–abstraction, self–other relevance, and possibly even level of processing. The important distinctions among the processing mechanisms, in terms of the formation of impressions of other people, are based on these dimensions, not on whether there are actually separate memory systems.

Even when the multiple system notion is removed, the AST model does not introduce anything new in terms of dimensions on which people classify

information. All of these dimensions are among the most well known to influence human memory and processing. This is evident by Table 1.1 in Carlston's chapter. Perhaps the only new thing that the AST model does provide in this vein is the manner in which these dimensions are identified, combined, and applied to situations where the formation of impressions of other people would occur.

REPRESENTATIONAL FORMS

As mentioned, if a theoretical model is going to specify the operation of a number of mental systems, it must specify the different representational forms employed by each of the systems. This allows the researcher to better understand how information is structured, and how the processes attributed to each system operate on that structure.

The Representational Forms of AST

One claim made by Carlston is that "AST focuses on the forms of impression-related (or impressional) representations, rather than on their contents." This claim is in line with the notion that each of the systems in a theory should rely on a representational form that differs from the other systems. In this way, the needs of each system are met, in part, by the form of the representations used by that system. For example, the form of representation used in the sensory system should differ in substantial ways from the form of representations used in the affective system. The first should capture qualities and relations of the environment as they are experienced sensorily, whereas the second should capture the qualities of human emotion. This difference in representational forms is almost required because of the vastly different nature of the information processed in each of the separate systems.

However, the AST model, as presented by Carlston, never stipulates what the different representation forms for each system are, nor is it specified how the representations would be required to differ from one another. Based on the claim cited in the preceding paragraph, the differentiation of different representational forms for each mental system would seem to be a requirement of a presentation of the model. Instead, all of the information that is assumed to be processed by the AST model is characterized by a single representational form—a network representation (either a propositional or a PDP network). As such, what distinguishes the different mental systems in the AST model is not any difference in the representational forms, but is in the information content of each system, as well as the processing mechanisms assumed to operate in each of those systems. The

representational forms in the AST model are identical in all of the systems—even the so-called secondary systems.

One of the identifiers of separate mental systems, aside from the use of different types of representations, is that each system is relatively independent of the others. However, as can be seen in Carlston's Fig. 1.5, the representation used for the impressions of *Ed* is a highly interactive network. The only identification of the different systems is that each of the boxes in which a concept has been graphed identifies in which system it is. Figure 1.5 also illustrates that the organization of systems and the description of how they interact by the AST model is violated by connections of concepts across nonadjoining areas, such as the link between *belligerent* and *yells a lot*, as well as *friend* and *likable*.

Realizing that there is no differentiation of representational form and little system independence brings up the issue raised in the last section: Is it necessary for Carlston to suppose multiple systems to explain the formation of impressions of other people? In the AST model, the differences among the various systems are primarily attributable to differences in information content. The difference in processing mechanisms that operate on the different types of information can be disregarded as a means to distinguish the different systems because the primary mechanisms involved in the AST model are general activation and inhibition mechanisms that operate on the entire impressional structure. In addition, any efficient single mental system should employ different mechanisms for a variety of information contents. Thus, little seems to be gained by actually specifying multiple mental systems to understand the formation of impressions of other people. Instead, as mentioned earlier, the important distinction the AST model seems to make is that the different types of information that are processed using these impressions of other people can be characterized by simply relying on two or three feature dimensions: concrete–abstract, self–other relevant, and possibly depth of processing.

Is a Network Representation Necessary?

Although the AST model does not contribute anything with regard to differences in representational form, and relies on only a single representational structure, it is necessary to assume some sort of representational structure in order to properly understand the mental processes involved in determining how people form impressions of others. The specification of a particular representational structure helps the researcher understand how information is organized in memory, how that information is retrieved, and how the activation or retrieval of some concepts prime or inhibit other related concepts. The network representational form presumed by the AST model can serve this function quite well. The selection of this representa-

tional form has the advantage that network structures are relatively well understood, and it gives memory the appearance of being a well-organized system with easily understood storage and retrieval properties.

However, the major contribution of the AST model is not in terms of representational form, but with how information is organized. Although a network structure provides a ready understanding of how such an organization could be accomplished, it is not the only type of representational form that can be considered. Other sorts of representational schemes can capture many of the same properties as network structures, as well as produce unique predictions concerning the nature and efficiency of mental processes (e.g., Hintzman, 1986; Radvansky & Zacks, 1991). One example of a nonnetwork representational scheme is multiple trace theory, such as the MINERVA 2 model (Hintzman, 1986, 1988). In a multiple trace theory, it that supposed that memory is an unorganized collection of memory traces. Each of these traces is the product of an external episodic experience or some internal mental processing. The organization that memory exhibits is a result of the manner in which these traces are accessed by the different processing mechanisms that access them. For example, memory traces that are used during the formation of impressions of other people, and related to visual appearance and a certain person, would appear to be organized if the traces were accessed by procedures that select out memory traces that have to do with the person and their appearance. One advantage of an alternative view, such as a multiple trace theory, over a network theory is that there is no need to specify how information from several sources is organized at encoding because the organization can occur at retrieval.

Because representational form is not central to the AST model, as outlined by Carlston, the model should be open to the possibility of other types of representational forms, although a network representation is just fine for developing some working assumptions of the processes that the model must be able to handle. The primary contribution of the AST model is in how the different types of information interact during the formation of impressions of other people, not how different types of information are represented. Focusing on determining a specific representational form only detracts from this effort.

PROCESS AND REPRESENTATION

The Distinction Between Process and Representation

There are two general goals in Carlston's AST model that typify much of the research in both social and nonsocial cognition. These are the goals of

understanding the form of the representation in which information is stored, as well as the processes that operate on these representations. The concerns presented here echo those of Barsalou (1990) in an earlier volume in this series. Because mental representation and mental process are so intertwined, it is often extremely difficult to separate these two components from one another. Mental representation cannot be evaluated without considering the processes that act on it, and mental processes cannot be tested without some idea of the representations that are being processed. For a model of human cognition to succeed, the conjunction of mental representation and process must adequately describe the actual phenomenon.

Because of the inseparable nature of these two aspects of cognition, as well as a general desire for parsimony, a researcher should only include features into a model that provide some necessary contribution. The major contribution of the AST model, as described here, is in terms of the processes involved in the derivation and integration of information from several sources that can be used while forming an impression of a person. Little to nothing is gained through the supposition of several mental systems and their associated representations. The inclusion of such unnecessary components to the model leaves it weaker and obscures the contribution of relating how different types of information, so classified based on their content, may be related, and how these different types of knowledge and the processes that operate on them may interact. Because of these difficulties, perhaps it would be best to transform the AST model into an APT (Associated Processes Theory) that relates the different processes that operate on different information sources during the construction of a representation to be used in impression formation.

SUMMARY

The AST model presented by Carlston is an attempt to provide a framework for interpreting the representational forms and processes involved in the formation of impressions of other individuals in terms of the mental systems that the representations and processes originate from, as well as how they interact at higher levels of processing. The model supposes four primary systems and four secondary systems. The secondary systems are hybrid combinations of two primary mechanisms. I have argued that the secondary systems are not systems at all, but are the results of processing. The primary systems are generally accepted divisions of processing, but the unique contribution of the AST model is the conception of how these systems relate and interact during the formation of impressions of other people. I have argued that similar predictions can also be derived if the

multiple system approach is abandoned and the model merely relates how information is processed with respect to where the information lies on the two or three feature dimensions that characterize the organization of the processing systems in the AST model. Finally, the AST model is presented as a theory that characterizes how developing an impression of another person is accomplished with regard to the form of the representation, rather than the information content. I have argued that the model does not specify any variations in representational form. Instead, all the differences in information processing during impression formation are due to the nature of the content of the information being processed.

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