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Associative and Rule-Based Processing

A CONNECTIONIST INTERPRETATION OF DUAL-PROCESS MODELS

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As the other chapters in this volume demonstrate, dual-process models offer powerful accounts for empirical phenomena in several areas of social psychology, including such core topics as processing persuasive messages and forming impressions of other people. Our goals in this chapter are, first, to point out some of the most important common features shared by these existing models; and, second, to describe in general terms how these models may be integrated within a new connectionist framework. We believe that this novel conceptualization can account for the broad patterns of empirical findings in different content domains, bringing them under a common umbrella and potentially highlighting previously unrecognized parallels. We also believe that our model not only yields important new insights in many of these domains, but opens up new topics for investigation. Although connectionist models have been widely applied in cognitive, developmental, and other areas of psychology, they are only beginning to be investigated within social psychology. Examination of the implications of connectionism for dual-process theories, which are some of the best-developed theories in all of social psychology, should provide an example of the power and potential fruitfulness of connectionist models for our field.

COMMON FEATURES OF DUAL-PROCESS MODELS

Dual-process models have been advanced in numerous specific areas of social psychology and cognitive psychology (see Epstein and Pacini, Chapter 23, this volume, or Abelson, 1994, for lists). Many of these models (though not all models using the term "dual-process," some of which rest on different distinctions) share central features and, we will argue, amount to only minor variations on a common set of themes. Using Chaiken's (1980) model as an example, we contend that these models all share three basic assumptions:

1. One type of processing involves the use of simple, well-learned, and readily accessible decision rules, such as "Experts are always right," "The majority is correct," or "Statistics don't lie." This type of low-effort processing (termed "heuristic" by Chaiken) is

the default processing mode; people will process in this way unless special circumstances intervene.

2. People can also perform a second type of processing, termed "systematic" by Chaiken. This involves the active, effortful scrutiny of all relevant information, and therefore demands considerable cognitive capacity. For example, people may evaluate arguments by considering their logical coherence or by comparing them to existing knowledge. Systematic processing (compared to heuristic) leads to attitude change that is more enduring and more resistant to further persuasion attempts. When it occurs, systematic processing takes place simultaneously with, and in addition to (rather than replacing), heuristic processing.

3. When will systematic processing take place? As described by Chen and Chaiken (Chapter 4, this volume), a person may have any of several goals activated in a given situation: to form valid attitudes that will accurately guide thought and action; to defend currently held attitudes that are congruent with the person's interests or important self-definitions; or to hold attitudes and beliefs that will serve current social goals (such as creating a positive impression on others). People process systematically to the extent that they (a) feel an unusually great need to be accurate, to defend an attitude, or to create a positive impression; and (b) have enough time and cognitive capacity to permit more effortful processing.

Chaiken's model and virtually all of the dual-process models described in this book share similar assumptions about the nature of low-effort processing, the nature of more effortful processing, and the conditions (particularly cognitive capacity and motivation) that determine which type of processing is used. (For more detailed discussion of the parallels among a subset of these models, see Smith, 1994.) The models do differ in some details—particularly in whether the two types of processing operate simultaneously (as Chaiken assumes), in sequence, or as alternatives, and in whether motivational or capacity determinants of more effortful processing are emphasized. Still, the similarities are more important than these detailed differences among the models.

One additional dual-process model also shares the same general assumptions. We briefly describe it here, because it is not otherwise represented in this volume, but is important for its coverage of a distinct set of topics and for its background in cognitive rather than social psychology. In addition, we adopt this model's terminology because the terms seem most descriptive of the two basic processing modes.

Sloman (1996) has outlined a two-process model of reasoning and problem solving, though without citing any of the social-psychological work represented in this volume except for Epstein's. His two processes are labeled "associative" and "rule-based." Associative processing is quick, intuitive, and relatively effortless. It involves the retrieval of information that has become associated with currently available cues. Associations are structured by similarity and patterns of temporal co-occurrence, rather than by logic. Thus, in the associative mode people use concepts that are related through well-learned associations to cues found in a problem or stimulus. In the area of categorization, this process gives rise to similarity-based categorization, whether based on previously learned category exemplars or on abstract prototypes.

In contrast, rule-based processing involves the use of symbolically represented rules to manipulate problems and derive solutions. The laws of logic and causal inference, rather than simple associations, are brought to bear. These rules are abstract, incorporating variables that can be bound to specific contents. Importantly, this mode is assumed to make use of explicit symbolic representations of rules in the course of processing; it *uses* or *follows* rules (Sloman, 1996), explicitly representing them and using them to guide processing. This contrasts with simply *conforming* to rules or exhibiting behavior that can be described by rules, in the sense that a thrown ball conforms to the law of gravity. Rule-based processing underlies theory-based categorization, including the occasions when a theory overrides similarity-based categorization.

Sloman holds that in general the two modes work together, not as alternatives. Sometimes the two modes provide different answers; in other cases they work more coop-

eratively. For example, in proving a mathematical theorem, one "sees" intuitively what step is needed next and then uses symbolic rules to check that the proposed step actually works.

Table 16.1 summarizes the common points of several dual-process models to illustrate what we see as their essential similarity. These models all fit an outline like the following.

Associative Mode

The fundamental process involved in the associative mode of processing is the automatic access from memory, based on a cue that is salient in the current stimulus or context, of knowledge or affective reactions that have become associated with that cue. The learning of such an association is assumed to take repeated experiences over a long time—a point on which Devine (1989), Fazio (1986), and Sloman (1996) are particularly clear. Activation of the knowledge is automatic and preconscious, so that it becomes subjectively part of the stimulus information (rather than being seen as part of the perceiver's own evaluation or interpretation of it). This emphasis is perhaps clearest in Fazio's (1986) and Epstein's (1991) models. The associated knowledge, once activated, has the potential to affect judgments and behavior.

Using this mode, people automatically access such things as their well-learned attitudes toward specific attitude objects (Fazio, 1986); stereotypes that are culturally associated with particular social groups (Devine, 1989; Brewer, 1988; Fiske & Neuberg, 1990);

TABLE 16.1. Summary of Key Points of Existing Dual-Process Models

Model and domain of application	Terminology and properties of low-effort processing mode	Terminology and properties of high-effort processing mode	Assumptions about relations between processing modes
Chaiken (1980); Petty & Cacioppo (1981): Persuasion	Heuristic: Use learned associations of salient cues (e.g., source attractiveness or message length) with positive–negative evaluations.	Systematic: Effortfully search for relevant information and logically evaluate arguments.	Systematic processing occurs when need for subjective confidence is especially high and processing resources are available. Both modes occur simultaneously.
Fazio (1986): Attitude access	Associative: Use evaluation associated with attitude object through repeated pairings.	Construct attitude: Search for and summarize attitudinally relevant information.	Associative processing occurs when strongly associated attitude exists. Modes are alternatives.
Brewer (1988); Fiske & Neuberg (1990): Person perception	Categorization: Use information and evaluations associated with person's salient category membership (gender, race, etc.).	Individuation: Process and summarize multiple individual characteristics.	Individuation requires specific motivation (e.g., due to interdependence) or perceived lack of fit to category. Modes are alternatives.
Gilbert (1989): Person perception, attributional inference	Correspondent inference: Use trait associated (through semantic similarity) with person's observed behaviors.	Attributional thinking: Process range of attributionally relevant information, such as situational causes of behavior.	Attributional thinking requires cognitive capacity. Modes are sequential stages; attribution follows correspondent inference.
Trope & Gaunt (Chapter 8, this volume): Attributional inference	Assimilative identification: Use context automatically to help identify behaviors.	Diagnostic evaluation: Consider context as potential alternative explanation for behavior.	Context always affects judgment, but diagnostic evaluation requires motivation and capacity.

concepts that suggest particular solutions to reasoning or categorization problems (Sloman, 1996); traits that are related to observed behaviors performed by oneself or others (Bem, 1967; Gilbert, 1989); associations with the situational context to aid in the identification of behaviors (Trope & Gaunt, Chapter 8, this volume); or favorable or unfavorable evaluations of persuasive messages based on easily noticed cues, such as message length or source attractiveness (Chaiken, 1980; Petty & Cacioppo, 1981). Once accessed, these knowledge structures, often with an affective or emotional tinge, can affect people's thoughts, feelings, or overt behaviors.

Rule-Based Mode

In general, these dual-process models assume that rule-based processing is consciously controlled and effortful, involving search, retrieval, and use of task-relevant information (see Petty & Cacioppo, 1981; Sloman, 1996; or Fiske & Neuberg, 1990). The "rules" that govern processing in this mode range from formal or normative rules (like those of logic) to informal maxims (e.g., "Consider people as unique individuals, rather than just stereotyping them"). Rule-based processing is assumed to be strategic, and its exact nature will vary depending on the specifics of the task, the individual's goals, and situational constraints. When it occurs, this type of processing generally gives rise to a higher level of perceived validity and to longer-lasting effects (Chaiken, Liberman, & Eagly, 1989).

Using this mode, people may consider the details of persuasive arguments and evaluate their validity on the basis of logic and general knowledge (Chaiken, 1980; Petty & Cacioppo, 1981); use logical or mathematical reasoning to solve problems (Sloman, 1996); engage in attributional thinking to determine the causes of their own or others' behaviors (Gilbert, 1989; Trope & Gaunt, Chapter 8, this volume); summarize a number of known facts about a person or object into an individuated impression or attitude (Brewer, 1988; Fiske & Neuberg, 1990; Fazio, 1986); or effortfully override automatically generated judgments with alternative responses deemed more appropriate (Martin, Seta, & Crelia, 1990; Devine, 1989).

Relations between Modes

The dual-process models outlined above generally agree on the characterizations of the two processing modes themselves. However, differences among the models are more evident in their accounts of the relations between the processing modes. First, the models differ somewhat in their emphasis on the role of motivation versus cognitive capacity in determining how people process. Several models put greater stress on motivation, though they make varying assumptions about the specific nature of the relevant motives (Brewer, 1990; Fiske & Neuberg, 1988; Fazio, 1986). Other models emphasize factors affecting cognitive capacity, whether in the form of time pressure, distraction from external stimuli or simultaneous tasks, or resources such as task-relevant background knowledge (Gilbert, 1989; Sloman, 1996; Trope & Gaunt, Chapter 8, this volume). Still other models give relatively equal weight to motivation and ability (Chaiken, 1980; Petty & Cacioppo, 1981; Martin et al., 1990; Devine, 1989). Despite differences in emphasis, all these dual-process theorists would presumably agree that both capacity and motivation are in fact required.

The theories also differ somewhat in their account of the temporal and logical relationships between the two processing modes. Some models hold that the two are alternatives—that people process either one way or the other, but not both (Petty & Cacioppo, 1981; Fazio, 1986; Brewer, 1988). Other models assume sequential processing, with automatic associative processing occurring first and rule-based processing optionally following (Fiske & Neuberg, 1990; Gilbert, 1989; Martin et al., 1990; Wegener & Petty, 1995; Devine, 1989). Still other theories hold that both processing modes occur simultaneously (Chaiken, 1980; Sloman, 1996; Epstein, 1991). In this case their effects may be additive (if they lead to the same conclusions), or associative processing may bias ongoing rule-based processing, or the two modes may work in opposition (see Chen & Chaiken, Chapter 4, this volume).

NEW DUAL-PROCESSING MODEL

With this overview of the models' similarities as background, we now present a new

connectionist-inspired dual-processing model that is intended to integrate these specific theories. In this section, we first present the structural basis of the two processing modes—two memory systems with systematically different properties. Then we describe how the associative and rule-based processing modes use each of these systems.

Dual Memory Systems

In recent years, theorists have advanced generally similar proposals focused on the idea that humans have two separate memory systems with distinct properties (Alvarez & Squire, 1994; Milner, 1989; Murre, 1995; see Schacter & Tulving, 1994, for additional discussion). A major article by McClelland, McNaughton, and O'Reilly (1995) presents one such proposal on which we will focus. As a rationale for their theory, the authors argue that human memory must meet two conflicting demands that are functionally incompatible. One demand is to record information slowly and incrementally, so that the total configuration in memory reflects a large sample of experiences. This is important so that general expectancies and long-term organized knowledge can be based on the average, typical properties of the environment. This slow-learning memory system matches the typical properties assumed for schemas in social and cognitive theories (see Fiske & Taylor, 1991; Rumelhart, Smolensky, McClelland, & Hington, 1986). A second demand is for rapid learning of new information, so that a novel experience can be remembered after a single occurrence. After all, people can at least sometimes learn things after hearing them once.

As a solution to this problem, McClelland et al. (1995) propose that these demands are handled by independent "slow-learning" and "fast-binding" memory systems.[1] This idea may seem unparsimonious, but many types of psychological and neuropsychological evidence, described in detail in McClelland et al. (1995), point to the existence of two memory systems with the postulated properties. For example, this model makes sense of the patterns of memory impairment exhibited by patients with damage in specific brain areas (Squire, 1992).

McClelland et al. (1995) hold that the slow-learning system learns only gradually and incrementally with experience, and is more automatic and less sensitive to the allocation of conscious attention. In contrast, the fast-binding system learns rapidly in order to acquire new memories quickly. The latter system is responsible for one-shot learning, particularly about novel and unexpected events and stimuli, in a way that depends on selective attention and thus on conscious awareness.

The two systems interact in several ways. One key process is "consolidation," by which a newly formed memory is transferred by repeated presentations from the fast-binding to the slow-learning system. Consolidation is known, on independent grounds, to take considerable time in humans (weeks to years), and the authors suggest that it is necessarily slow so that new knowledge can be integrated into the stably structured representations maintained in the slow-learning system without disrupting previous knowledge.

Thus, one memory system is responsible for learning stable, general representations of the typical properties of the environment (i.e., schematas) and using them preconsciously to interpret new information by categorizing, filling in unobserved details, and the like. The other system is responsible for constructing new representations (i.e., episodic memories) that bind together information about different aspects of an object or experience in its context (Wiles & Humphreys, 1993). This second system seems to mediate conscious, explicit recollection. In addition to differences in speed and conscious accessibility, McClelland et al. (1995) hold that the two systems differ in the type of information to which they attend. The slow-learning system is chiefly concerned with regularities, so it primarily records what is typical and expected. In contrast, the fast-binding system records the details of events that are novel and interesting; it attends more to the unexpected and unpredicted.

Dual Modes of Processing

Our model of two processing modes has similarities to an earlier formulation by Smolensky (1988). It also draws heavily on the evidence regarding dual modes of processing in many areas of social and cognitive psychology

(reviewed earlier), as well as the recent evidence and theorizing (just discussed) regarding the properties of two memory systems. In brief, we believe that the associative processing mode is based directly on the properties of the slow-learning system and operates essentially as a pattern completion mechanism. After knowledge has been accumulated from a large number of experiences, this memory system can quickly and automatically fill in information about characteristics that have previously been observed or affective reactions that have previously been experienced in situations that resemble the current one.

The rule-based processing mode uses symbolically represented and culturally transmitted knowledge as its "program" (Smolensky, 1988). It rests on human linguistic abilities, which in turn draw on both underlying memory systems. The slow-learning system is needed to store long-term, stable knowledge (e.g., knowledge of the meanings of words), while the fast-binding system is crucial for its ability to construct and store new structures rapidly (e.g., building a representation of the meaning of a sentence as it is comprehended).

Properties of the Associative Processing Mode

Associative processing takes the form of pattern completion or similarity-based retrieval in a connectionist schematic memory. This mode provides information both quickly and automatically. Associative processing operates preconsciously (Bargh, 1994); we are generally only aware of the results of this processing, not of its performance. The associative mode generates what are experienced as intuitive and affective responses to objects or events. We may look at a mug and know that it is used to hold coffee, or we may look at a friend and feel warmth and affection.

Associative processing is reproductive rather than productive; it uses currently available cues to retrieve representations stored on past occasions when similar cues were present. Through associative processing, information that has been repeatedly linked to an object in the past is automatically brought to mind whenever we perceive or think about the object again. This information can fill in unobserved details or can even change the way we perceive existing features of an object. The term "association" may suggest a learned connection between two items or concepts, as when people study word pairs such as "table–blue" in a paired-associates learning task and then try to recall one word, given the other as a cue. However, associative processing is better regarded as performing a *pattern completion* function. An associative memory system can learn an entire set of characteristics that frequently co-occur, such as the visual appearance of a hammer, its name, the actions one performs with it, one's emotional reactions to it, and so on. This entire configuration can then be retrieved or reconstructed when a subset of the characteristics (say, just the name) is again encountered; the complete pattern is brought forth from a sufficiently distinctive part.

Associative processing uses general, overall similarity between the cues and stored memory representations as the basis for retrieval. Past knowledge can be used because of superficial or irrelevant similarities to the current cues, rather than only for structurally important or logical reasons (see Gilovich, 1981, and Lewicki, 1985, for social-psychological demonstrations of this property).

As described here, associative processing is a natural result of the operations of a connectionist memory system. Recurrent-network models are especially well suited to the task. Using appropriate connectionist learning rules, recurrent networks can construct representations of the "typical" properties of a set of input patterns. When a novel input pattern is then presented, the network's state will evolve over time into the previously learned pattern that the input most closely resembles (McClelland & Rumelhart, 1986). Technically, the learned configuration acts as an attractor state of the network's activity (McClelland & Rumelhart, 1986; Smith, 1996). An associative processor thus uses the new stimuli as cues and can access its memory to fill in unobserved details or even to correct expectation-inconsistent information. Elsewhere (Smith & DeCoster, 1998), we demonstrate that a recurrent connectionist network can function in this way—for example, by learning a "group stereotype" (the typical properties of a set of stimuli) from exposure to input patterns representing a number of

specific group members. When given a new member of the same group, the network infers that this individual possesses the group's typical characteristics.

Properties of the Rule-Based Processing Mode

The defining feature of rule-based processing is that it uses symbolically represented knowledge as rules to guide processing. Unlike a data base of associative knowledge that must be built up over a long period of time, symbolic knowledge can be rapidly learned from a single experience. Symbolic knowledge can then be used as rules to guide inferences and judgments—in other words, as the "program" for rule-based processing. This interpretive process is necessarily sequential and relatively slow (in contrast to the fast parallel-constraint-satisfaction process that can be used with associative knowledge representations). The reason is that only one rule can be explicitly used to guide processing at a time.

Symbolic rules may be socially learned, by comprehending language input from other individuals, the mass media, or other cultural sources. We humans do not have the ability to directly transmit what we think or experience to each other, so we must choose commonly accepted symbols (words) to express ourselves. Each time that we talk to another person, we have to fit what we want to say into words. Most knowledge shared between individuals therefore exists in symbolic form. Symbolic rules may also be constructed through explicit, conscious thought by an individual, rather than being socially learned. In either case, we can learn symbolic information after just a single exposure. The process of learning, however, requires conscious attention and can be strategically directed and controlled—in contrast to learning in the associative memory system, which is more automatic and less dependent on attention.

Because the rule-based processing mode rests on culturally shared rules, its results have greater perceived validity (Smolensky, 1988). We are more likely to trust a statement made by someone when it is based on logical reasoning than when it is based on intuition. It is the wide sharing of the rules of logical inference that generates this feeling of validity (Levine, Resnick, & Higgins, 1993). Ultimately, validity stems from consensus. When many of us agree on a rule or on a conclusion generated by applying shared rules, we tend to attribute the agreement to objective reality rather than to possible errors or misinterpretations made by the individuals concerned.

We have stated earlier that associative processing rests directly on the properties of the slow-learning system and can be easily modeled with standard and well-understood types of connectionist networks. In contrast, connectionist models of symbolic processing, which underlie the rule-based system, have been the subject of great controversy to date. Some early models were naive and inadequate in various ways, and elicited vigorous criticism. Critics even claimed that the failings of these models demonstrated that in principle connectionist networks cannot account for human linguistic abilities (e.g., Pinker & Prince, 1988). However, modern work is gradually remedying many of the earlier theories' defects. A full connectionist account of symbolic processing is clearly not yet at hand, but strides are being made in this direction (see Seidenberg, 1997, for a review).

Fundamental Differences between the Two Processing Modes

This model embodies the assumption that the two processing modes tap separate data bases representing knowledge in distinct formats. The associative mode draws solely on links between features built up over time in the slow-learning memory system. Rule-based processing, while it also makes use of the slow-learning memory system for the storage of long-term knowledge of word meanings and the like, also uses the fast-binding memory for holding symbolically encoded propositions and other linguistic materials. Many dual-process models within social psychology, while recognizing that the two processing modes differ in efficiency, automaticity, and conscious awareness, nevertheless have held that both forms of processing are of essentially the same kind. For example, both have been thought of as "schematic processing" in more and less efficient versions (see Fiske & Taylor, 1991). From our perspective, the two

modes differ much more fundamentally. The two processing modes are not accurately characterized as involving just "more or less extensive processing"; rather, they embody qualitatively different types of processing (but see Kruglanski, Thompson, & Spiegel, Chapter 14, this volume, for a different view).

Each processing mode has its own strengths. Associative processing provides useful information, including evaluations and affective reactions, very quickly and without much attention from the perceiver. Because this type of processing relies on similar past experiences, knowledge can easily be used to make judgments about new objects. The system can also learn to operate in any environment; given enough experience, an associative processor can extract useful information about an environment simply through exposure to its regularities. Rule-based processing is useful because it can retain information after a single exposure. It also allows knowledge to be transmitted from one individual to another, and ultimately provides a format for the long-term external storage of data in the form of cultural traditions and written documents. The social sharing of knowledge allows for the creation of standardized systems of information, allowing people to answer questions in ways that can generally be seen as true within delimited cultural groups.

Alternative, Sequential, or Simultaneous Processing?

Like Chaiken (1980), Epstein (1991), and Sloman (1996), we assume that the two processing modes generally operate simultaneously rather than as alternatives or in sequence. However, because rule-based processing is assumed to be slower than associative processing, it may be argued that both processing modes operate initially but then the fast associative processing finishes, leaving only rule-based processing. Such a partial-overlap model would be difficult to distinguish empirically from a pure sequential model in which first associative processing and then rule-based processing take place, without any overlap. In terms of our model, both partial overlap and sequential processing seem unlikely. True, rule-based processing is relatively slow, but as rule applications generate new concepts and representations, those will elicit associative retrieval from the slow-learning memory system. In other words, the relative automaticity of associative processing means that it will continue to operate, rather than ceasing before rule-based processing begins (in the sequential model) or is completed (in the partial-overlap model). In support of this interpretation, Chen and Chaiken (Chapter 4, this volume) have found evidence of the ongoing impact of associative processing during persuasion.

Roles of Motivation and Capacity in Determining Processing

In many cases, associative and rule-based processing will arrive at the same answer. This can occur, for instance, when people originally use a symbolic rule but over time learn to produce the same response associatively (e.g., Logan, 1988). However, there will also be times when the two modes produce different responses. In fact, Sloman (1996) treats this type of "simultaneous contradictory belief" as a key criterion for demonstrating two independent processing systems. For example, in certain types of logic puzzles, two different answers seem appealing (though for different reasons). Conflicting answers arising from the two systems have also been extensively investigated in the domain of persuasion, where a message may be constructed that contains strong or weak arguments, together with cues that lead people to agree or disagree with it through well-learned associations (Chaiken, 1980). A message containing weak arguments, for example, may be presented by an attractive or an expert source. When the two modes tend to give different responses, what factors affect the way people weight them and arrive at an overall response? The dual-process models reviewed earlier point to motivation and capacity as key factors.

As we have outlined earlier in this chapter, using the rule-based system is subjectively effortful, requiring attentional resources. Thus, if people are not motivated to use rules, the response will generally be controlled by the relatively effortless associative system. Several distinct motives may spur rule-based processing. Perhaps the most obvious of these is a desire for accuracy. The socially shared and subjectively valid nature of rule-based processing means that people believe it provides more accurate answers than low-effort

associative processing (Chaiken et al., 1989). However, other motives can also encourage rule-based processing. Chen and Chaiken (Chapter 4, this volume) discuss the processing effects of motivation to defend important existing beliefs or attitudes, or to meet important social goals such as creating a positive impression on others. Note that rule-based processing driven by these motives may not be evenhanded and unbiased; in fact, it may decrease (rather than increase) the accuracy of overall conclusions, compared to the results of associative processing.

Cognitive capacity as well as motivation is required for rule-based processing. "Capacity" refers to available processing time as well as attentional resources. Rule-based processing generally takes longer than the associative system to operate (Logan, 1988), and because it requires attention, it is more subject to disruption by distraction or interference. Thus, responses that are made quickly or when the perceiver is busy or distracted are likely to be controlled by the associative system. However, given adequate time and freedom from distraction, rule- based responses (because of their greater subjective validity) may override associative responses (Chaiken et al., 1989).

Implications for Specific Topic Areas

The unified conceptualization presented here has implications for several prominent dual-process theories within social psychology. These are briefly described here, followed by a few additional implications for significant research issues within social psychology.

Chaiken's Dual-Process Model of Persuasion

Chaiken's (1980) model is closely aligned with our perspective in most ways. For example, it assumes that the two modes operate simultaneously, and it takes a broad view of the potential motives that can encourage systematic processing. One terminological difference is Chaiken's use of the term "simple decision rules" or "heuristics" to describe the representations that guide processing in the heuristic or associative mode. The term "rule" should probably be avoided in this context, for a key assumption of the current model is that associations and rules are quite different. If the representations used in heuristic processing were described as "well-learned associations" rather than as "rules," the distinction would be clearer.

Petty and Cacioppo's Dual-Process Model of Persuasion

Petty and Cacioppo's (1981) model overlaps greatly with Chaiken's, as numerous reviews have observed. One key difference is that the central and peripheral processing modes are characterized as endpoints of a processing continuum, and thus effectively as alternatives. Instead, from the perspective of our theory, the two processing modes can operate simultaneously (as in Chaiken's model). Another difference is the model's general emphasis on accuracy motivation as the driving force behind effortful processing.

Fazio's Model of Attitude Access

The two postulated modes of attitude access in Fazio's (1986) model (i.e., using a well-learned association vs. effortfully retrieving relevant information and constructing an attitude) probably operate simultaneously instead of as alternatives. Thus, a previously formed attitude may be associatively retrieved and bias a simultaneously occurring search for further information. Also, this model has emphasized the capacity requirements of the effortful attitude construction process, but we should note that motivation is also required.

Models of Categorization and Individuation in Person Perception

The models of Brewer (1988) and Fiske and Neuberg (1990) maintain that the two types of processing occur sequentially, with relatively effortless categorization preceding more effortful individuation. From the perspective of our model, the two forms of processing occur simultaneously.

Gilbert's Dual-Process Model of Person Perception

Gilbert's (1989) model holds that attributional reasoning may follow, and possibly correct, an initial correspondent inference. Gilbert's research emphasizes that the correction process requires more resources than

does correspondent inference, though he has acknowledged that motivation is also required. From our perspective, however, the two processes occur simultaneously rather than in sequence.

Trope's Model of Attributional Inference

Trope and Gaunt's (Chapter 8, this volume) presentation is generally consistent with our model, although, like Gilbert (1989), they have focused more on the role of capacity than on that of motivation.

Martin's Dual-Process Model of Social Judgment and Correction

Martin's model (Martin et al., 1990) recognizes the requirements of both motivation and capacity to correct for automatically occurring judgmental effects. However, like Gilbert's two-stage model of person perception, it holds that the processes occur sequentially, whereas from our perspective simultaneous operation seems more likely.

Devine's Model of Stereotyping and Suppression

Exactly the same points may be made regarding Devine's (1989) model. Both motivation (stemming from guilty feelings about using stereotypes) and capacity are stressed, but automatic access to stereotypes and conscious suppression processes should probably be considered to occur simultaneously rather than sequentially.

Our proposal may also solve a puzzle that is implicit in Devine's theory. Her model (among others) assumes that people possess "implicit" beliefs (e.g., as group stereotypes) that contradict their "explicit" (i.e., verbalizable, consciously held) beliefs. How an assumed single memory system can represent both of these contradictory beliefs is not made clear. Under our model, stereotypes are represented by associations built up in a connectionist distributed memory, while explicit beliefs are symbolically represented; this solves the representational puzzle. The term "association" is probably clearer in cases like this than clumsy terms such as "implicit beliefs," because of the qualitative difference between associations and explicit symbolically represented beliefs.

Epstein's Cognitive–Experiential Self-Theory

Epstein's (1991) model generally fits well with the outlines of the model advanced here, except that he gives more attention to capacity than to the motivational determinants of rational processing. Epstein also emphasizes that the results of processing in the experiential mode (which we term "associative") are particularly subjectively compelling. We agree that in some cases, such as food preferences, experientially based reactions override rational responses. However, in general validity arises from social sharing, and therefore it is higher for the rational system (Levine et al., 1993). Moreover, reactions that are initially generated by the rule-based/rational system come over time to be embodied in associations. This process means that socially shared reactions will generally also have the phenomenologically "given" quality that the preconscious associative (or experiential) system affords. The idea "Spinach is good for you," originally derived from symbolic, socially shared knowledge, eventually becomes just as compelling and subjectively valid as the idea "Spinach tastes awful."

Sloman's Dual-Process Model of Reasoning

Sloman's (1996) model fits well with the one we advance here, except that (like Epstein) he emphasizes cognitive capacity, failing to discuss the necessity for motivation for rule-based processing.

Explanations for Various Dissociations

Besides its implications for existing dual-process models, our theory may also explain some frequently observed dissociations between measures that appear to be closely related. In general, the explanation involves the assumption that one measure taps the associative processing system (and therefore the contents of the slow-learning memory system), while the other measure is generated by rule-based processing.

For example, a well-known dissociation is commonly seen between judgment and explicit

memory (usually recall) of the information upon which the judgment was based. A perceiver may encounter a mix of positive and negative information about a target person, and then may both report an overall evaluation of the person and attempt to recall the provided information. In many cases, the correlation between the judgment and the recalled information (weighted by its evaluative implications) is near zero (Hastie & Park, 1986). From the perspective of our model, the judgment reflects the net association of the target person with positivity or negativity—an association that is gradually built up "on-line" as the information is initially processed. Thus, this information is held in the slow- learning memory system. In contrast, explicit recall draws on the content of the fast-learning memory system. The typical dissociation is thus explained as a function of the considerable degree of independence between the two memory systems.

Another dissociation is often found between explicit memory and repetition priming. Having processed a particular stimulus in a particular way facilitates a repetition of that same processing for a long period of time (Tulving, Schacter, & Stark, 1982; Smith, Stewart, & Buttram, 1992). This facilitation is generally found to be independent of measures of explicit memory, such as the ability to recognize that the stimulus has been previously processed. We explain this dissociation by attributing repetition priming to small changes in connection weights in slow-learning memory, whereas explicit recall or recognition draws on the fast-learning memory system (see Schacter & Tulving, 1994; Wiles & Humphreys, 1993).

CONCLUSIONS

We would like to emphasize two main points based on our conceptualization of dual-process models within a connectionist framework.

First, this way of thinking makes it very clear that the two processing modes are qualitatively different, both in terms of the data bases on which they draw and in terms of their operating principles. The associative mode draws on representations that may be perceptual or affective in nature, that are not necessarily linguistically encoded, and that are structured and interrelated by the principles of association (i.e., similarity and contiguity). The representations are the substrate for an automatic, preconscious pattern completion mechanism. This "subconceptual" processing is context-sensitive and flexible, such that its operation cannot be fully captured by a conceptual-level description (Smolensky, 1988; Clark, 1993). In contrast, rule-based processing draws on symbolic representations, which are structured and interrelated by the laws of language and logic (Smolensky, 1988). Processing in this mode is sequential and generally accessible to consciousness.

The fundamental differences between the processing modes bear emphasis, because many current theories in social psychology assume that all mental representations are composed of conceptual-level or semantically meaningful units (schemas, or nodes joined by associative links). Therefore, both processing modes are assumed to draw on a common data base or memory store of representations. Two types of processing may be assumed to differ in speed, efficiency, and availability to conscious awareness, but nevertheless to follow basically the same principles. For example, effortless "heuristic" processing and conscious "systematic" processing may both be considered to involve the "application of schemas" to input information, with the schemas drawn from the same memory repository; the two types of processing may be thought to differ only in speed and efficiency. Or the two modes may be considered to involve simply "more extensive" or "less extensive" processing, with the processing assumed to be of the same sort in either case. We reject these views, as do other theorists who have pointed out the fundamental differences between the two processing modes (see especially Epstein & Pacini, Chapter 23, this volume; Sloman, 1996).

The second major point that we wish to emphasize is the value of the connectionist approach in providing theoretical integration. Integration does not mean that differences among specific dual-process models are to be ignored. Clearly, each of the models discussed in this volume involves a number of specific details, and each has been fine-tuned to account for empirical findings in its own topic domain. Our connectionist approach abstracts from that level of detail, though the details are important for under-

standing how people process persuasive messages, form attitudes, suppress stereotypes, and so on. However, we believe that putting the diverse models into a common framework provides new insights and ultimately will benefit theorists in each area by providing multiple sources of strong constraints. If the basic nature of the two processing modes is constant across all these empirical domains, then a theorist working in a particular area can directly make use of findings from other areas, drawing on a common framework that is supported not only by research in all those areas but also by more basic work in memory (e.g., McClelland et al., 1995) and cognitive science (e.g., Smolensky, 1988). In this way, theoretical integration promises to strengthen researchers' ability to elucidate the special and unique processes that operate in each particular area, not to blur all such distinctions.

This integrative approach should also encourage the application of dual-process models to additional areas of social and cognitive psychology. Within social psychology, for example, it is possible to imagine dual-process models of conflict in close relationships, or bystanders' decisions to intervene and offer help in emergencies, or stereotype change through intergroup contact. As an illustration, it may be reasonable to assume that stereotypes can sometimes change in a relatively automatic way through the gradual buildup of new associations over time, driven by repeated contacts with group members and observations of their counter-stereotypic attributes. Alternatively, stereotypes may change when people consciously and effortfully reflect on their stereotypes and the new evidence provided by contact to change their explicit, verbalizable beliefs, perhaps bringing attributional principles to bear (e.g., deciding that a group's stereotypic tendencies to criminality may reflect that group's poor economic standing because of prevalent societal discrimination). If researchers can draw on theories and research methods from other areas in which dual-process models have been applied, rapid progress may be made in understanding difficult issues in diverse domains such as stereotype change. For example, researchers can apply thought-listing tasks and/or distraction manipulations (which have often been used in persuasion studies) to clarify which type of process contributes to stereotype change under what conditions.

Theoretical integration represents an increasingly important trend in psychology. In the past, theories in social psychology were typically formulated for specific topic areas (e.g., attribution, attitude change, etc.) and used topic-specific theoretical constructs. As a result, such theories tended to be incommensurable and could not easily be placed within more comprehensive conceptual frameworks (see Smith, 1998). The social cognition movement of the 1970s and 1980s brought a strong trend toward increased integration within social psychology, as theories in various topic areas drew on a common conceptual vocabulary (of schemas, exemplars, prototypes, automatic and controlled processing, and the like; Devine, Hamilton, & Ostrom, 1994). This vocabulary was largely shared with cognitive psychology as well, so the integration went beyond the boundaries of social psychology. In important ways, the emergence of connectionism takes the same process one step further. Connectionist models are being used in many areas of psychology, including most notably cognitive psychology (Humphreys, Bain, & Pike, 1989), developmental psychology (Elman et al., 1996), and psycholinguistics (Seidenberg, 1997). Beyond psychology, the trend includes social anthropology (Hutchins, 1995), cognitive neuroscience (McClelland et al., 1995), and philosophy (Clark, 1997). These trends suggest that connectionism is particularly conducive to broadly integrative theorizing. Thus, to the extent that social psychologists participate in the development and testing of theoretical models that are framed in connectionist language, they will be participating in an integrative and cumulative enterprise that ultimately promises to unify psychology with several of its neighbor disciplines.

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NOTE

1. Note that these proposed memory systems are not equivalent to short-term and long-term memory; both are long-term in nature. Most current models hold that short-term memory is not a separate store, but is the activated portion of information held in long-term memory.

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