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COMMENTARIES

Three Models of Information Processing: An Evaluation and Conceptual Integration

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The three models of information processing advanced in this symposium have been developed by eminent scholars with divergent theoretical perspectives. Although the theorists apply their formulations to a wide range of empirical phenomena, the research they cite in their target articles is largely nonoverlapping. Perhaps this, as much as anything, testifies to the fact that the three formulations may not be incompatible and that, when considered in combination, they have far-reaching implications.

It seems unlikely that any single formulation will ever provide a complete account of social information processing. The formulations presented in this issue have limited generality, as the authors themselves are the first to acknowledge. These formulations, like all theories of cognitive functioning, are metaphorical in nature and do not pretend to mirror the physiology of the human processing system. Therefore, they must be evaluated on the basis of their ability to explain known phenomena at the level of abstractness at which the models are defined and not on the basis of their validity. Each of these formulations calls attention to new and important theoretical issues and suggests new directions for empirical investigation. To this extent, they clearly accomplish their primary objective.

The purpose of my commentary, therefore, is not to raise questions about the validity of these theories. However, I would like to place them within a more general conceptualization of social information processing that potentially allows their combined implications to be conceptually integrated and facilitates the identification of additional areas in which the theories might be applied. I first describe a general theoretical formulation that allows for multiple processes at several different stages of cognitive functioning en route to a judgment or decision. I then consider each of the three conceptualizations and its position within this broader framework. In doing so, I hope to identify some areas in which further research and theorizing could be fruitful.

A General Conceptual Framework

As Sherman (this issue) points out, most dual-process theories attempt to distinguish between processes that are performed consciously and deliberately in the pursuit of a particular goal and those that occur spontaneously in the absence of any specific objective. As he also notes, more than one process of each type is likely to exist. I certainly agree with this general view. In fact, I would argue that *many* processes of each type exist. Moreover, they operate at several different stages of judgment-relevant activity: comprehension, retrieval, inference and response generation. Not only are different processes involved at each stage, but these processes may occur either automatically or deliberately. Furthermore, the latter processes depend on the goal toward which the cognitive activity is directed.

Despite the advent of connectionist models (Smith & Decoster, 1998; Van Overwalle & Siebler, 2005), which attempt to conceptualize a number of cognitive activities within a single general, memory-based framework, the preceding observations are fairly noncontroversial. To this extent, the issue is not whether one or several different cognitive processes underlie judgments or decisions. The real question is how to specify the range of cognitive operations that are involved at each stage of processing, the conditions in which each process is likely to operate, and the manner in which processing at one stage interfaces with processes at other stages.

Most conceptualizations that have been "officially" designated as dual- or multiple-processing theories have typically been developed to account for rather circumscribed sets of empirical phenomena. Thus, they have rarely if ever been conceptualized with a broader framework of information processing that permits their implications and limitations to be understood. One such formulation, proposed by Wyer and Srull (1989), may be useful in this regard. The conceptualization in its original form has some serious deficiencies (see Wyer, 2004; Wyer & Radvansky, 1999). Nevertheless,

I have always been unclear why the conceptualization, which is *inherently* a multiple-process theory, has been largely ignored by proponents of more restricted dual-processing formulations (for reviews, see Chaiken & Trope, 1999; Smith & DeCoster, 2000). This is hardly the place to describe the Wyer and Srull conceptualization in detail. However, a number of its features may be worth noting, as they seem to overlap those of the theories discussed in this symposium.

Architecture of the Information-Processing System

The features of the Wyer and Srull model of primary relevance to the concerns of this symposium can be summarized as follows:

1. Information processing occurs in several stages. The first, comprehension stage is fully automatic, making use of concepts that happen to be relevant and accessible in memory. If information cannot be comprehended on the basis of the automatic mechanisms that occur at this initial stage, more deliberative processes are activated and used.

2. Processing beyond the initial comprehension stage is governed by an executive system (i.e., an *Executor*) and a series of special purpose information-processing units whose function is to perform high-order (goal-directed) cognitive activities (e.g., higher order comprehension and organization of information, inferences about an object or event, the integration of the implications of several pieces of information to make a judgment, the generation of an overt response, etc.). These units (like the model in general) are obviously metaphorical, used to organize the different sets of cognitive activities that occur at various stages of goal-directed processing. Each processing unit is equipped with a library of procedures that can be called upon to attain its objectives. These processes are performed automatically.

3. The Executor bases its instructions on the content of "goal schemas" that specify the sequence of cognitive activities that are necessary to attain the goal being pursued. When more than one goal schema is applicable, the one that is most accessible in memory is applied.

4. The goal schemas specify the sequence of cognitive steps that are required to attain an objective. (If the goal were to form an impression of someone on the basis of information about the person's behaviors, for example, the schema might indicate that the behavior should first be encoded and organized in terms of more general trait concepts, that an evaluative concept should be formed of the individual by combining the evaluative implications of the information, that the behaviors should be evaluated in terms of their consistency with this concept, etc.). However, the specific cognitive mechanisms that are necessary to accomplish these steps are specified in the libraries of the processing units involved.

5. Consciousness resides in the Executor. Thus, the Executor is aware of the steps involved in attaining a particular objective (interpretation, integration, etc.) and calls on the various processing units to perform these steps. It is also aware of the output of this processing. However, the processing that occurs in the different processing units (comprehension, integration, etc.) is not subject to conscious awareness. (Thus, for example, people may be aware that they have interpreted a particular behavior as dishonest but might not be aware of how or why they arrived at this interpretation.)

6. The goal schemas that guide the operations at any given time are retrieved from memory and deposited in a "goal specification box." The box can often contain more than one schema, which means that more than one goal can be pursued simultaneously. However, its capacity is limited. Consequently, when the schema that is required to attain a particular objective is complex and detailed, there is less room for other schemas and, therefore, fewer other goals can be simultaneously pursued.

7. When no specific goal is currently being pursued, the system enters a continuous feedback loop in which information is retrieved from memory, features of this information serve as retrieval cues for other information, and so on, until a goal concept either enters the system from external sources or is retrieved from memory. Thus, the model conceptualizes the free flow of thought that occurs between externally induced or internally generated goal pursuits.

8. The cognitive material that is involved in the aforementioned operations is retrieved from memory according to specified operations that apply at all stages of processing. Furthermore, the output of processing is stored in memory according to specified operations. In combination, these procedures govern the subsets of knowledge and cognitive procedures that are most accessible in memory at any given time and, therefore, are most likely to be involved in attaining the goals to which they are relevant.

The goal schemas that the Executor uses as instructions for goal-directed processing are drawn from declarative knowledge and have the form of a sequence of general actions that culminate in a desired end state. Scripts and plans of the sort postulated by Schank and Abelson (1977) provide examples. The procedures involved in automatic cognitive activities of the sort that compose the libraries of specific purpose-processing units may be akin to cognitive *productions* of the form postulated by Anderson (1983; see also Smith, 1984, 1990). That is, they constitute "if [X] then [Y]" rules, where [X] is a configuration of situational or internally

generated stimulus features and [Y] is a sequence of cognitive or motor acts that is associated with the stimulus configuration through learning and is performed automatically when the configuration is experienced. The components of the stimulus configuration can include sensory stimulation that is either situationally induced or internally generated, encodings of stimulus inputs in terms of preexisting concepts or knowledge, or thoughts that happen to come to mind. Whatever their source, the configuration of features spontaneously elicits the sequence of responses that is associated with it, and the sequence proceeds with a minimum of cognitive deliberation.

These assumptions concern the *structural* features of the Wyer and Srull model. As can be seen, the conceptualization provides for both automatic and deliberative processing at all stages. Moreover, it allows for several different automatic and deliberative processes at each stage, depending on the goals that are being applied or the situational conditions that influence their accessibility. Finally, it potentially accounts for the effects of processing demands of the cognitive activity directed toward one objective on the operations that are performed in pursuing other objectives. The model's utility is limited, however, unless the specific cognitive operations that occur at each stage can be specified. These operations often depend on the goal that is being pursued and the type and form of the information to be used in attaining this goal. Specific theories of comprehension, inference, or integration can be viewed as attempts to specify these operations and when they are applied (Wyer, 2004; Wyer & Srull, 1989).

Deficiencies of the Model

The model has several deficiencies, one of which is particularly relevant to the issues of concern in this symposium. Although the conceptualization distinguishes between deliberative and automatic processes, it does not clearly specify the manner in which deliberative processes (which typically involve the use of declarative knowledge) become replaced by automatic processes of the sort that are governed by productions. It also does not indicate clearly how deliberative and automatic processes interface. The processes involved in driving a stick shift car provide an example. Initially, these processes are deliberative, based on memory for what one needs to do in order to shift gears and to stop at a light without stalling. Over time, however, the sequences of actions involved in these activities are performed with a minimum of cognitive deliberation, presumably being guided by productions that are activated in part by external events (seeing a light turn red, or a car unexpectedly switching lanes, or a street at which one has to turn right). Thus, driving is governed by a complex of deliberatively goal-directed processes and automatic processes that occur over the course of getting to one's destination.

One possible conceptualization of this transformation is suggested by the "race" model proposed by Logan (1988).That is, when a goal is identified, several alternative goal-relevant strategies are activated simultaneously, and the results of the process that is completed most quickly (i.e., that wins the race) is typically applied. One can imagine that both productions and deliberative processing strategies proceed in parallel. When a production is newly developed, the "if [X] then [Y]" association is weak, and so the use of declarative knowledge and goal schemas is likely to predominate. As the production becomes stronger, however, it may ultimately win the race, overriding the impact of declarative knowledge processing. Although this conceptualization is plausible, however, it cannot be easily incorporated into the Wyer and Srull model in its present form.

Many other assumptions of the more general model need to be articulated more precisely. Some of them may ultimately be proven wrong. Indeed, research by myself and others since the development of the original model has led to a more precise specification of the initial comprehension processes that are performed spontaneously and has required modifications of the model's assumptions about the structure of memory (cf. Wyer, 2004; Wyer & Radvansky, 1999). The three conceptualizations proposed in this symposium may fill additional gaps in the more general formulation. In other cases, they may provide challenges to the theory's validity. In still other cases, however, the formulation proposed by Wyer and Srull may help to identify more clearly the conditions in which the more circumscribed theories are applicable and to point out areas in which a refinement and extension of the theories might be fruitful.

Sherman's Quad Model

Basic Assumptions

As Sherman (this issue) correctly points out, dual-processing models have traditionally failed to distinguish between differences in the cognitive operations that are employed in pursuing a particular objective from differences in the content of the material on which the operations are performed. Sherman's conceptualization attempts to define more clearly the effects of both processing differences and content differences. He focuses on a particular one of Bargh's (1994) "four horsemen" of automaticity (awareness, intentionality, controllability, and efficiency), namely, the controllability of responses to information inputs. In anticipation of presenting the formal model, Sherman distinguishes two controlled (deliberative) processes and two uncontrollable (automatic) processes.

Controlled processes. One controlled process, *detection*, is apparently localized at the inference stage of processing as conceptualized by Wyer and Srull (1989). It might be reflected in the assessment of a persuasive argument as strong or weak, or in the evaluation of a piece of information as favorable or unfavorable. This process requires the retrieval of prior knowledge that can be used to evaluate the validity of an argument or the potential consequences of a behavioral decision. The second process, *regulation*, often occurs at a later stage of processing, at which an individual must decide what course of action to take (e.g., whether to purchase a product, or whether to take a particular criterion into account when making an evaluation). The two processes are often interdependent, in that processing at the output stage may be determined by the results of processing at the earlier, inference stage. (The decision to use the content of a communication as a basis for evaluating its referent may depend on judgments of its persuasiveness at an earlier stage of processing.) Nevertheless, different situational factors can influence the operations performed at each stage.

However, although Sherman's discussion of regulation focuses on the output stage of processing, similar processes can operate at earlier stages. For example, people who perceive that their spontaneous interpretation of information is inconsistent or biased may deliberatively search for alternative interpretations of the information (Martin, Seta, & Crelia, 1990). Regulatory processes could also operate at the retrieval stage of processing when people must decide what type of information to search and use as a basis for judgment, or how much its implications should be weighted. Thus, unlike detection, which appears to be limited to the inference stage of processing, regulatory processes can come into play at several different stages. On the other hand, the specific nature of these processes and the factors that determine their applicability may depend on the stage of processing involved.

Automatic processes. One automatic process postulated by the Quad Model is the result of an association that has been formed between a stimulus configuration and a cognitive or motor response (Sherman, this issue). This association seems equivalent to a production of the sort proposed by Anderson (1983; see Smith, 1990) and described earlier in this commentary. That is, it refers to a sequence of learned responses to a set of stimulus features that occurs spontaneously when the set of features is experienced. In this regard, the features that elicit the response may be responded to configurally without articulating the individual features. Moreover, not all of the features in the set may be subject to conscious awareness. Thus, as shown by Bargh, Chen, and Burrows (1996), features of a stereotyped group that are activated subliminally, in combination with features of the situation one happens to be in, can combine to elicit behavior that participants manifest automatically, without conscious awareness. Chameleon effects (Chartrand & Bargh, 1999) provide other examples.

The productions that are elicited by automatic activation presumably occur spontaneously. The magnitude of these effects may therefore be more or less evident, depending on whether the results of controlled processing override them. The second automatic process identified by Sherman (this issue) is postulated to come into play only as a *default*, when the results of controlled processing fail. Thus, for example, people who cannot identify a memory trace of an item they are evaluating may use its subjective familiarity as a basis for reporting that they have encountered it before. Sherman conceptualizes this process as "guessing" in the absence of a more directly relevant criterion.

I understand this process less clearly than the other three processes identified by the Quad Model. To the extent that guessing is based on familiarity, the automatic component of the process does not reside in the *use* of the criterion per se. Instead, it resides in the accessibility of the criterion that people use as a default when they have to make a guess. That is, people in the absence of other criteria may in fact "guess," and this guess may be influenced by concepts and knowledge that they have not clearly articulated and the accessibility of which is not known. To this extent, however, the guess may reflect the impact of *content* accessibility and not process accessibility.

It is conceivable that my conclusion results from the use of the term *guessing* to describe the process. In the particular paradigm in which the Quad Model has been tested (Conrey, Sherman, Gawronksi, Hugenberg, & Groom, 2005), the guessing bias does not reflect the use of familiarity as a default in making a judgment. Rather, it refers to a motor response set (e.g., the use of the right vs. left hand in generating a response). This motor response set is undoubtedly nonconscious yet in some contexts can contribute substantially to judgments that are made and the conclusions drawn from them (Schwarz & Wyer, 1985; Tversky & Kahneman, 1974; Wyer, 1969). However, these response sets, which occur only at the output stage, differ in kind from those that may underlie the use of subjective familiarity as a basis for judgment (Jacoby, Kelley, Brown, & Jasechko, 1989). In this regard, Sherman (this issue) points out that in other applications of the Quad Model, guessing need not be automatic but could reflect a deliberative processing strategy. The use of familiarity as a basis for judgment could be one manifestation of a controlled guessing strategy.

This qualification helps to alleviate another source of confusion. That is, Sherman conceptualizes guessing as a default that operates "only in the wake of failed control" (Sherman, this issue). This assumption seems inconsistent with what it means for a process to be au-

tomatic. That is, if a process is uncontrollable, it presumably operates whenever the predisposing situational conditions arise. The controlled process may predominate, or override the automatic process. Nevertheless, the automatic process necessarily produces an increment in the response that is made unless participants are consciously aware of the effects of this process and adjust for it.

An Empirical Test

As noted earlier, one of the controlled processes identified by Sherman (regulation) can operate at different stages of processing, whereas the other (detection) is largely restricted to the inference stage. Similarly, one of the uncontrolled processes (association activation) may operate at all stages of processing, whereas the other (guessing) may be restricted to the output stage. To the extent that the model permits these processes to be isolated, it is important both theoretically and methodologically, as it permits the effect of situational and individual differences variables to be localized in different model parameters.

Initial tests of the model's applicability in understanding responses to the Implicit Association Test (IAT; Greenwald, McGhee, & Schwartz, 1998) are provocative. The test was initially assumed to assess persons' unconscious attitudes toward an object or concept without being contaminated by conscious attempts to report attitudes that are social desirable. Contrary to this assumption, however, responses are influenced by respondents' perceptions of what responses are socially desirable in the situation at hand (e.g., Czellar, 2006; for a review and evaluation of the IAT and its implications, see Brunel, Tietje, & Greenwald, 2004). This conclusion was confirmed by Conrey et al. (2005). Rather than using response time measures, they applied the Quad Model to response probabilities and generated parameter estimates for each of the four processes the model assumes. In this paradigm, the model parameters were interpreted as reflecting the preexisting association between the target concept and evaluative concepts (association activation), the likelihood that this bias is overcome by conscious processing (regulation), the actual detection of a correct response (detection), and the motor response bias that existed independently of the information presented (i.e., the bias to press the right-hand rather than the left-hand button on the response console). In a series of studies, they found that although association activation had an effect on judgments, regulation exerted an influence as well. In other words, deliberative processes contributed to judgments over and above the automatic effect of previously formed associations to the concept being evaluated. To this extent, the methodology provides a more diagnostic assessment of the spontaneous associations it was designed to measure than the response time index that is usually employed.

Additional Considerations

Although Conrey et al's application of the Quad Model is provocative, it simultaneously calls attention to possible limitations of the model and its applicability to judgment processes in general. First, the application of the model appears to be restricted to conditions in which participants make a number of dichotomous responses over a series of conceptually similar trials. In this case, model parameters reflect the probabilities that the processes postulated by the model come into play on any given trial. Many judgments that result from the processes of the sort the model assumes, however, vary in magnitude (i.e., the favorableness of an evaluation of a person, object, or social issue). Furthermore, they are made only once by each participant. There is obviously a relation between the probability or certainty of a judgment and its magnitude (Wyer, 1973; see also Rotte, Chandrashekaran, Tax, & Grewal, 2006). However, the manner in which the probability of engaging in the various processes maps into the magnitude of each process's contribution to any particular judgment is not immediately obvious. To make this transition, one must be able to specify the magnitude of the judgment that results from each alternative process a priori. It is not clear how this is accomplished.[1]

In summary, some of the processes postulated by Sherman may potentially operate at several stages of processing, whereas others are restricted to specific stages. Moreover, one of the processes that purports to be automatic (guessing) may often be governed by the accessibility of concepts on which conscious decisions are based and may not really be a reflection of the automaticity of these decisions. Nevertheless, to the extent that the Quad Model permits these processes to be isolated at the stages in which all are potentially applicable, it makes an important contribution to both theory and methodology.

Kruglanski et al.'s Unimodel

Whereas Sherman argues for finer distinctions between the deliberative and automatic processes than have usually been made, Kruglanski, Erb, Pierro, Mannetti, and Chun (this issue) argue for fewer. They

[1]One strategy might be to dichotomize each participant's judgment above and below some relevant standard (e.g., the population average) and to use these data to estimate model parameters. This, however, would not eliminate the need to obtain numerous judgments from the same individual over a series of trials.

point out that many behavior decisions can be viewed as applications of a single inference rule that people use to make judgments on the basis of information they happen to have available at the time.

The unimodel is particularly applicable to research on communication and persuasion. Chaiken (1987), Petty and Cacioppo (1986), and others assert that two different (heuristic/peripheral vs. systematic/central) processes underlie the effects of persuasive messages. People who engage in heuristic processing typically base their judgments on the source of the message they receive or the affect they are experiencing and attribute to their feelings about a the position advocated. People who engage in systematic processing typically base their judgments on an analysis of the arguments contained in the message. However, Kruglanski et al. note that in each case, judgments could reflect the application of a single "if X then Y" rule of inference, the only difference being in the nature of "X" to which the rule is applied. Thus, for example, X could consist of either the proposition "The source of this message is credible" or, alternatively, "The arguments presented are hard to refute." In each case, the *process* of inferring the validity of the position advocated from the information being considered could be similar.

This observation gives a different complexion to many of the findings that have been obtained in previous research. In particular, it directs attention away from a consideration of differences in the processes that come into play and focuses on the types of information that enter into these processes. To this extent, Kruglanski et al reinforce Sherman's (this issue) observation concerning the importance of distinguishing between processing differences in judgment and content differences.

The effects of several factors on judgments (task demands, cognitive resources, information ambiguity, etc.) are attributed by Kruglanski et al. to their mediating impact on the relative salience of different judgmental criteria, the perception of their relevance, or the difficulty of applying them in the situation at hand. A number of more general considerations become salient when considered in the context of the framework proposed earlier. They concern (a) the cognitive representation of the if–then rule, (b) the extent to which the rule is applied automatically or deliberatively, (c) the sufficiency of the rule in accounting for cognitive functioning at different stages of processing, and (d) whether the rule actually captures the mental processes that people perform.

Automatic Processes

On the surface, the if–then rule postulated by the unimodel appears similar to cognitive productions of the sort suggested by Anderson (1983) and described earlier in this commentary. However, this similarity may be superficial. A production describes a learned association between a configuration of stimulus features and a sequence of cognitive or motor behaviors that are elicited spontaneously whenever the configuration of features is encountered. Although the features of a production can be *described* in terms of an "if [stimulus] then [response]" rule, it is not a rule of inference. Rather, it is a complex conditioned response that is acquired through repetition.

These considerations become relevant n conceptualizing the unimodel's applicability to stages of processing other than the inference stage. For example, the effect of trait concepts on the interpretation of behavioral information might reflect the application of a "trait-encoding" production at an early, comprehension stage of processing (Smith, 1990). The if–then rule that Kruglanski et al. propose might describe this production. It is important to note, however, that *any* causal relation can be described in terms of an if–then relationship regardless of how it is constructed. The description does not in itself constitute an explanation of the underlying process that is described. I elaborate this point presently.

Controlled Processing

For these reasons, the primary applicability of the unimodel lies in its characterization of the rules of inference that apply in making a judgment or decision. In terms of the Wyer and Srull (1989) model, the if–then rule the unimodel postulates could exert an influence in two ways. First, it could be stored in the library of a special purpose processing unit and applied automatically under conditions in which it is applicable. Second, the rule could be a goal schema that is stored in memory as part of declarative knowledge and is recalled and applied in drawing conclusions on the basis of new information one receives or other knowledge retrieved from memory. To this extent, it is instructive to view the unimodel's assumptions in the context of McGuire's (1960, 1981) syllogistic inference model. McGuire assumed that people organize their beliefs syllogistically. Therefore, their belief in a proposition that occupies the position of the conclusion of a syllogism, C, can be predicted from beliefs in the premises that imply its validity (e.g., premises of the form "A" and "if A then C"). In an extension of the original model, Wyer (1970, 1974) noted that, in fact, C is the conclusion of *two*, mutually excusive syllogisms, the other having the premises "not-A; if not A then C." If this is so, and if beliefs in the two sets of premises are converted to units of probability, the belief in C, P(C), can be described by the equation:

$$P(C) = P(A)P(C/A) + P(\sim A)P(C/(\sim A), \qquad [1]$$

where P(A) and P(~A) [= 1-P(A)] are beliefs that the proposition A is and is not true, respectively, and P(C/A) and P(C/~A) are beliefs that C is true *if* A is and is not

true, respectively. Numerous studies (e.g., Henninger & Wyer, 1976; Wyer, 1970, 1975) show that the equation provides a very good quantitative description of the relations among the beliefs and the effect of information bearing on the validity of A on beliefs in the conclusion, C, that is associated with it. On the other hand, C could be the conclusion of more than one syllogism, and beliefs in the premises of these syllogisms might differ. Then, beliefs in the conclusion depend on which of several alternative sets of propositions happens to be salient at the time the beliefs are reported (Henninger & Wyer, 1976; Wyer & Hartwick, 1980, 1984).

Therefore, the unimodel appears consistent in many ways with McGuire's (1960) conceptualization of syllogistic inference. However, two considerations arise. First, the unimodel appears to consider only one of the two mutually exclusive syllogisms that must be taken into account. Wyer (1970, 1975) showed that a consideration of both sets of premises is necessary to generate accurate predictions of beliefs in the conclusion, suggesting that people take both sets into account. A reasonable amount of cognitive work is necessary to consider the implications of both sets, however. When processing demands are high, or when people are unmotivated to think carefully about the judgments they report, they may in fact only consider the first set of propositions. This, perhaps, could account for the conjunction fallacy (Berman & Kenny, 1976; Kahneman & Tversky, 1973) as well as other phenomena noted by Kruglanski et al. (this issue).

A second consideration may be of greater theoretical importance. Wyer and Hartwick (1980) pointed out that although Equation 1 provides a reasonable accurate quantitative description of the relations among syllogistically related beliefs, quite different cognitive processes could give rise to this accuracy. First, people may make syllogistic inferences of the sort proposed by McGuire (1960) and implied by the unimodel. An equally plausible possibility, however, is that people are engaging in a simple averaging process. That is, they first estimate the likelihood that a conclusion is true if A is and is not true and, if these two estimates differ, average them, weighting them by the belief that A is in fact true or not true, respectively. As Wyer and Hartwick contended, the latter process may actually be the most appropriate characterization of the processes captured by the equation.[2]

These matters may seem very tangential to the issues at hand. My purpose of providing the example, however, is to reinforce a point made earlier. That is, although a syllogistic rule can *describe* causal inferences, this does not necessarily mean that the processes underlying the rule's applicability are in fact syllogistic. In the present context, the if–then rule postulated by the unimodel may be useful in describing causal inferences, this does not necessarily mean that these inferences are governed by a single mental process. Further research may be necessary to establish this.

Indeed, other conceptualizations that are not syllogistic in nature need to be considered. The role of implicit theories (Dweck, Chiu, & Hong, 1995; Ross, 1989) and implicational molecules (Abelson & Reich, 1969; Wyer, 2004) that people use to make inferences is worth noting. As suggested earlier, these theories may be applied in conceptualizing inferences not only of the consequence of an event from information about its antecedents but also of an event's antecedents from information about its consequences. Note that a syllogistic inference rule is not clearly applicable in the latter case. In general, although the inference process postulated by the Unimodel may be part of the story, it seems likely that other processes operate as well.

Summary

The unimodel proposed by Kruglanski and his colleagues presents a provocative challenge to dual-processing models of communication and persuasion as well as other models that focus on the use of heuristics versus systematic processing (Chaiken, Liberman, & Eagly, 1989). The authors' analysis of the literature within the framework of their conceptualization is very compelling. However, the unimodel is unlikely to provide a complete description of social information processing. For one thing, it is not clear whether the processes it captures are automatic or controlled. Second, its applicability may be limited to inference phenomena; its implications for processes at other stages of cognitive functioning remain to be explored. Finally, although the syllogistic rule the model assumes is consistent with conceptualizations of inference described elsewhere (e.g., McGuire, 1960), the extent to which the rule describes the mental processes of the people who generate the inferences remains to be established.

Deutsch and Strack's Reflective-Impulsive Model

The first two conceptualizations I have discussed were generally applied to specific sets of phenomena. In contrast, Deutsch and Strack (this issue) propose a more general conceptualization of information processing that applies at all stages of processing. To this extent, its range of applicability is similar to that of the

[2]Note that if the terms of equation were true probabilities, the equation would be a mathematical tautology. Thus, its fit could be a manifestation of a more general tendency for people to organize their beliefs in a manner that is consistent with the laws of mathematical probability. In fact, however, Equation 1 is the only one of several relations among beliefs that conforms to the relations among mathematical probabilities (Wyer, 1976). Thus, this possible interpretation is not very plausible.

Wyer and Srull (1989) model. The two theories have somewhat different implications, however.

Specifically, Deutsch and Strack (see also Strack & Deutsch, 2004) postulate two general processing systems. One, *reflective* system comes into play in goal-directed processing and is governed by processes of which individuals are well aware. The other, *impulsive* system operates automatically and is governed largely by associative processes. Processing by the impulsive system, for example, is similar in many respects to the processing that Sherman (this issue) attributes to association activation. The operations performed by the reflective system presumably depend on the particular goal being processed but include both the processes that Sherman (this issue) identifies as detection and regulation and the if–then inference processes postulated by Kruglanski et al's unimodel. However, the Reflective-Impulsive Model is not restricted to these processes but potentially takes into account other processes at the various stages proposed by Wyer and Srull.

Reflective and impulsive processes are postulated to operate interactively. The impulsive system directs behavior "by linking perceptual stimulation to behavioral schemata based on previously learned associations" (Deutsch & Strack, this issue). To conceptualize this process, Deutsch and Strack invoke a spreading activation metaphor. Cognition-behavior associations that compose the system are acquired through learning. Once acquired, however, their activation is governed by principles of knowledge accessibility similar to those that are proposed to govern the accessibility of knowledge more generally (Förster & Liberman, in press; Higgins, 1996; Wyer, in press). In contrast, the reflective processing system is goal directed and generates judgments, decisions, and intentions (Deutsch & Strack, this issue). The processes governed by this system are deliberative and depend on the particular type of goal at hand.

These types of processing have their analogues in the conceptualization activated at the beginning of this commentary. The impulsive system, for example, might be viewed as consisting of a number of "if [X] then [Y]" productions of the sort postulated by Anderson (1983), the activation of which depends on the configuration of stimulus features that happen to impinge on the system at the time. The procedures that come into play in the reflective system may be analogous to goal schemas that are stored as part of general knowledge and are consulted deliberatively when a goal to which they are relevant is being pursued. There are nonetheless differences between the two conceptualizations. For one thing, the Reflective-Impulsive Model assumes that the various activities performed by the impulsive system proceed in parallel, in much the same manner suggested by Logan (1988). Thus, at any given time, the external and internal stimuli that are present in a given situation could activate several actions simultaneously. The implications of this possibility are unclear.

On the other hand, the goal-directed processes assumed by Deutsch and Strack appear to be completely governed by goal schemas that exist as part of general knowledge, and the activities that are performed are controlled. In contrast, the Wyer and Srull model allows for automatic (unconscious) processes to occur in the pursuit of conscious goal-directed activity. Specifically, the processes that are stored in the library of the various processing units that are activated by the model are goal directed but nonetheless operate automatically without consciousness of the specific cognitive operations that are involved.

A primary contribution of the Deutsch and Strack conceptualization nonetheless lies in the attempt to specify the way in which automatic and deliberative processes interface. This effort distinguishes it from the other conceptualizations proposed in this symposium. As I understand it, the impulsive system operates as a default, when conscious goal-directed actions performed by the reflective system are not operating. One implication of this assumption is that much of the behavior that occurs in the course of daily life is likely to be automatic, with deliberative processing only intruding on it when a particular goal comes to mind.

However, the processing mechanisms that govern the interface of reflective and impulsive systems could be specified in greater detail. To return to our car-driving example, an experienced driver on the work might see a red light and initiate the behavior routine that is necessary to stop. Recognition of the light and the goal of stopping are governed by the reflective system. However, the specific activities involved in attaining this objective might be performed automatically with little conscious deliberation. Thus, in the Deutsch and Strack conceptualization, the latter actions, although goal directed, would presumably be governed by the impulsive system. More generally, the reflective system may govern the specific subgoals that are involved in the pursuit of an objective, but the routines that are necessary to attain these subgoals may be governed by the impulsive system. This seems contradictory to the assumption that the impulsive system is not goal directed. Note that the Wyer and Srull conceptualization, which assumes that automatic processes are involved in the course of goal-directed activity, has an easier time of conceptualizing these processes.

Concluding Remarks

The three formulations discussed in this symposium are provocative. Although proposed from different theoretical perspectives, they provide many valuable insights into the way that different cognitive processes may interact to mediate judgments and decisions.

However, their value extends beyond the somewhat uninteresting debate as to whether one processes, two processes, or many processes underlie these phenomena. As my earlier comments suggest, I believe this debate to be misplaced. When we developed the Wyer and Srull model and its forerunners, we considered it self-evident that several different cognitive processes come into play in the course of making a judgment, some of which were automatic and some of which were deliberative, and that the nature of these processes depended on the type of goal in question, the type of information available, and constraints of the situation in which the processing occurred. Fifteen years later, and connectionist models notwithstanding, this still seems rather self-evident. The theories advanced in this symposium, considered separately or in combination, provide insights into the precise nature of some of these processes and how their relative contributions might be assessed. To my mind, these insights are far more important than the debate as to how many processes are involved.

Notes

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What Should a Process Model Deliver?

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The target articles in this symposium represent not only a variety of models but a variety of views about what a model is and what scientists should want from a model. Kruglanski, Erb, Pierro, Mannetti, and Chun (this issue) suggest that a model should be judged by what it delivers, and we agree. But we also agree with Deutsch and Strack (this issue) and with Sherman (this issue) that dual-process models deliver quite a lot and that, in the future, they promise to deliver more than will a single-process unimodel. We begin by considering cases when people experience conflicts in how to respond, because these cases highlight differences between single- and dual-process models. We then show why models that provide a means of quantifying the processes they refer to provide advantages for theory testing. We end with a discussion of similarities and differences between the multinomial model advocated by Sherman and the dual-process model we have applied to understanding conflicts between intended and unintended bases for behavior.

Deutsch and Strack (this issue) provide an excellent overview of the reasons that dual-process models have been attractive in psychology. Chief among these are instances where impulsive, automatic, or "nonjudgmental" bases for responses conflict with more analytic judgments. Deutsch and Strack describe several classes of such situations, such as when behavior is driven by unwanted habits, associations, or affective impulses. As an example, people sometimes experience a conflict when racial stereotypes differ from objective evidence. We have studied such a conflict in cases where race stereotypes lead people to falsely claim to see a gun in the presence of a Black person (Payne, 2001). Al-

though most responses are accurate, when people make errors those errors are disproportionately influenced by race. The tendency to make such false claims is robust, difficult to avoid, and not limited to individuals with overtly prejudiced beliefs (Payne, Lambert, & Jacoby, 2002). The models proposed would account for such effects in very different ways.

By Deutsch and Strack's (this issue) model, a conflict between stereotypic associations and knowledge of the actual object can be accounted for because stereotypic associations are classified within the impulsive system, whereas the intentional use of knowledge is within the reflective system. As noted by Deutsch and Strack, these two bases for responding sometimes conflict with one another.

The Reflective-Impulsive Model shares many of the strengths of other dual-process models (e.g., Chaiken & Trope, 1999). By distinguishing between one class of responses based on automatic impulses and associations and a second class of responses based on intentional planning and reasoning, such theories can begin to account for conflicts between underlying processes. However, like other verbal dual-process theories, the model does not specify how such conflicts are resolved or how reflective and impulsive processes are related to each other more generally. The main roles for controlled processes in the model are described as "overcoming habitual responses," "correcting judgments," or "[integrating activated] contents into qualified judgments" (Deutsch & Strack, this issue). Although they do not offer a formal model, Deutsch and Strack acknowledge the importance of quantifying models so that theoretical processes outlined by a model can be mapped onto performance. As we describe, doing so allows one to distinguish between different models, and it requires theorists to be explicit about how processes relate to each other and to behavior.

In contrast to distinguishing between different underlying processes and specifying the relations between them, Kruglanski and colleagues (this issue) propose that judgments of all kinds can be explained as the result of a single process. However, as Kruglanski et al. note when forwarding their "unimodel," the value of a model depends on "what it actually delivers" (Kruglanski et al., this issue). The unimodel gains its unity by adopting the production system if–then terminology used by Anderson (1983; e.g., ACT model) and others and showing that the terminology can be widely applied. But by itself, widely applicable terminology delivers very little.

Although psychologists might describe very different kinds of behaviors by the same if–then terminology, the psychology behind the behaviors may be different. The problem can be illustrated by considering results from stereotypic weapon misidentifications that we have treated as evidence for a dual-process model. Racial bias amid generally good accuracy can be understood in terms of a dual-process model in which a person with a (potentially threatening) object affords two different bases for responding. One basis is a deliberate response based on an analysis of the object's features, and the other is an unintended response driven by stereotypic expectations. By that model, when a person has full control, he or she responds based on the features of the object. However, when control is limited, as by hurried responding, responses are not random. Instead, responses are influenced by accessible stereotypes. The differences between these two processes can be illustrated by a study that varied the amount of time that participants had to respond (Payne, 2001). When participants were required to respond faster than they normally would, their accuracy decreased, whereas their reliance on stereotypes increased.

This result is understandable if constraining responses to the relevant evidence (i.e., features of the objects) required time and effort, whereas responding based on stereotypes was fast and efficient. The aforementioned results could be described using if–then statements. Such an approach would also have to include two different if–then statements, such as (a) "if it has gunlike features then call it a gun" and (b) "if there is a Black person present then assume it's a gun." The relative use of the two "rules" would then need to be explained, including why the former rule is more likely to be used when individuals have time to carefully consider their response. Of course, this begs the question of why one rule is more difficult or resource demanding than the other. We would argue that it is because responding in the first way requires controlled attention, whereas responding in the second way can be achieved by relying on automatic influences. Such a description amounts to a dual-process model that distinguishes between automatic and controlled uses of information but describes the different processes in the same language. Although both aspects of behavior can be described by if–then statements, there seems to be little gained by treating them as the same, as they are affected by different manipulations and have different correlates, as described in more detail next.

The Value of Quantifying Models

Many of the questions surrounding single- and dual-process models concern knowing where to draw the lines between different underlying processes, as compared to different outcomes of an underlying process. We have used a quantifiable dual-process model (Jacoby, 1991) to identify when components of behavior follow different principles and are related to distinct variables, and hence deserve to be considered separate bases for responding. As an example, race bias in false claims to see a gun can be understood by separating responses into two estimates. The model claims that

when people have full control over their responses, they respond as they intend to and hence claim to see a gun only when one is present. However sometimes control fails because, for example, resources are in short supply. When control fails, responses are based on stereotypic habits, which drive responses regardless of intent. As a result, people are likely to falsely respond "gun" in response to a Black man regardless of whether they intend to or not. Given a model that specifies how these processes relate to the kinds of correct and incorrect responses participants may make, estimates of the processes can be gained.

The value of such an approach is that a small number of process estimates can reveal simplicity underlying what seem to be complex results. A study comparing several implicit cognition measures serves to illustrate the point. Payne (2005) examined the relationship between the weapon misidentification priming task, an Implicit Association Test (IAT; Greenwald, McGhee, & Schwartz, 1998), and an evaluative priming task(Fazio, Jackson, Dunton, & Williams, 1995). Past research has tended to show little or no correlation between different implicit measures of race bias. As in past research, the three measures were uncorrelated. If there are as many different forms of implicit bias as there are different measures, such complexity suggests pessimism for the prospect of understanding the topic in a relatively simple way.

However, that pessimistic conclusion depends on the common practice of treating these tasks as pure measures of automatic or implicit responding. But according to the model described, tasks such as these reflect both automatic biases and the ability to control responses. The conclusion changes when these underlying contributions are separated using a model. As a standard of comparison for controlled responding, the study also included an antisaccade task, which is a measure of voluntary attention control. Supporting the idea that these tasks involved control, participants with greater attention control performed better on the priming tasks and showed less race bias on the IAT. Critically, when process estimates were generated for the implicit tasks, two distinct clusters emerged, each showing consistent correlations. Estimates of automatic race bias from the implicit tasks were on one factor, and estimates of controlled responding from the implicit tasks plus the antisaccade task were on the other factor. Far from the complexity suggested when looking at the measures themselves, the dual-process model revealed a simple pattern in which all measured lined up on two key dimensions: the ability to exert control over responses, and the tendency to respond based on stereotypes when control fails. These two basic dimensions go a long way toward explaining the kinds of conflicts between competing tendencies we began with.

How Many Processes? Utility of Multinomial Models

As noted in our comments regarding Deutsch and Strack's (this issue) model, there is a plethora of dual-process models (see Chaike & Trope, 1999). An advantage of a quantitative approach, such as ours, is that it forces one to specify the relation between processes and, after having done so, allows one to gain estimates of the contribution of the different processes. Questions about relations among processes are difficult (Gilbert, 1999) but are important for clarifying one's thinking about issues such as the influence of stereotypes on behavior. As an example, what are the details of the means by which controlled processes serve the role of "overcoming habitual responses" (Deutsch & Strack, this issue)? Answering that question necessitates specifying the relation(s) between automatic and controlled processes.

Jacoby, Kelley, and McElree (1999) suggested that there are multiple modes of cognitive control with the modes differing in the relation between controlled and automatic processes. By a "late-correction" model of the sort typically adopted by dual-process theorists (e.g., Deutsch & Strack, this issue), cognitive control serves as an editor whose task is to allow one to withhold inappropriate responses after they have come to mind. In contrast, an "early-selection" model suggests that cognitive control is gained by constraining what comes to mind. For instance, attention can be directed in ways that limit what information is processed and constrain what information is used in the first place. In many cases the two forms of control are difficult to distinguish by examining behavior alone. Formal models are useful for distinguishing alternative forms of control.

The dual-process model used to analyze results from the guns/tools task is an early-selection model in that a stereotype is held to have an effect only when controlled processing fails. An advantage of that simple model is that it allows process estimates to be gained by means of simple algebra. However, it seems likely that there are multiple modes of cognitive control, which vary in their contribution across situations. This suggests going beyond a simple dual-process model to a more complex model that acknowledges the multiple basis of cognitive control so as to measure their contribution. Use of multinomial modeling techniques provides a way of doing this.

Multinomial models are useful because they allow researchers to test hypotheses about cognitive processes underlying behavior in ways that traditional analysis methods do not. Multinomial models assume that more than one process can lead to a given behav-

ior. By specifying various processing paths that lead to responses, the relative contributions of different processes can be quantified. Like the process dissociation model, multinomial models have the advantage of avoiding the (often incorrect) assumption that a given task is "process pure" (Jacoby, 1991; Payne, Jacoby, & Lambert, 2005).

We have recently forwarded a multinomial model that incorporates multiple modes of cognitive control (Jacoby, Bishara, Hessels, & Toth, 2005) and have shown the utility of distinguishing between modes of cognitive control to explain age differences in memory performance. The value of a quantifiable model is recognized in Sherman's (this issue) target article, which focuses on a four-process multinomial model that also posits multiple bases of cognitive control. There are important differences between our model and theirs. However, rather than concentrate on those particular models, we consider more general issues for choosing between models. In doing so, we mean to express our agreement with Sherman regarding the value of quantitative models, although we have disagreements regarding his particular model. Indeed, one of the major values of a more quantitative approach is to allow disagreements that are more productive than those arising in verbal descriptions of dual-process models. In agreement with Sherman, we suggest that a more quantitative approach allows one to better specify such models so as to reveal similarities and differences. Because quantitative models are more precise than verbal models, they can more easily be compared for the purpose of choosing the best model.

Choosing Between Models: What Does Adding Parameters Deliver?

Multinomial modeling procedures allow one to add parameters, and doing so often seems justifiable given the complexity of underlying processes. Surely, a dual-process model sometimes will be too simple, as is the case for understanding age differences in false memory (Jacoby et al., 2005). However, how does one measure what is delivered by adding parameters? We provide one answer to this question by comparing Sherman's (this issue) Quad Model to our simple dual-process model. As previously described, our dual-process model delivered a means of revealing common factors that underlie different measure of implicit attitudes (Payne, 2005). Does the Quad Model deliver more, or even as much?

The process dissociation model previously described and the multinomial approach that Sherman advocates share the central goal of distilling complex behavior into its underlying processes. The main distinction between the model advocated by Sherman and the sort of model we have described is that Sherman's model separates automatic and controlled processing into four parameters rather than two. He acknowledges that there is nothing fundamental or special about four process estimates, but he prefers to analyze implicit bias tasks of the sort we described using his four-process model rather than our two-process model.

For Sherman, adding more process estimates is an issue of greater "accuracy/detail" (Sherman, this issue). For example, Conrey, Sherman, Gawronski, Hugenberg, and Groom (2005) reanalyzed an experiment of Lambert et al. (2003), which found that individuals who thought their weapon identification responses would be known by others made more stereotypical mistakes rather than less. Our original analysis showed the reason was that participants who thought their responses would be known had more difficulty controlling their responses, akin to a distraction effect. Based on a reanalysis using the Quad Model, it was argued that making responses public both reduced the controlled ability to discriminate items and increased the ability to overcome bias. Was this effect "obscured" by the dual-process model but revealed by the more "accurate" Quad Model? The problem is that there is no independent criterion for "accuracy" when comparing the two models in this study. Without some independent standard, there is no way to tell whether the additional parameters provide more information or only capitalize on chance.

Bishara and Payne (2005) reexamined the comparisons of two-process and four-process models across several experiments using the weapons task. One way to evaluate alternative models is to compare statistical fit tests, which estimate how closely a model fits the data. In the public scrutiny study previously described, Sherman and colleagues reported that the two models fit the data about equally well. However, those comparisons failed to take into account that the models differed in complexity. As more parameters are added, the probability that a model will statistically fit increases, independent of the accuracy of a model (Pitt, Myung, & Zhang, 2002). This "overfitting" results because as a model becomes more complex there is a greater tendency to "fit" error variance and hence capitalize on chance. Comparing models with different levels of complexity requires appropriate fit tests that adjust for complexity. A reanalysis of the public scrutiny study showed that when methods are used that equate for complexity, the simpler model provided a better fit than the more complex model. The same outcome was found for each study examined (Bishara & Payne, 2005).

The more general point of these fit tests is that more parameters do not necessarily mean more accuracy. Although good statistical fit is necessary, it is not sufficient as a guide to accuracy. To gauge accuracy, an independent standard of comparison is needed, such as the ability to predict behavior. As an example, Bishara and Payne (2005) compared the simple and complex models in their ability to predict discrimination in a separate im-

pression formation task. In a study reported in Payne (2005), participants performed both the weapon identification task and formed an impression of a new Black person based on an ambiguous written description. The two tasks were correlated such that participants who showed greater race bias in their false weapon claims also disliked the Black character. Because the race bias detected on the weapons task predicted impressions that were formed, those impressions can serve as an independent standard for accuracy.

The two-process and four-process models were compared by estimating multinomial models for each, producing individual scores for each participant on each process estimate. Then the estimates were compared in their ability to predict impression judgments. When the two-process model was used, both process estimates were related to impressions. Greater automatic race bias and poorer cognitive control were associated with greater dislike of the character. When the four-process model was used, the additional process estimates did not explain additional variance in impressions, but less. No significant relationship was found between impressions and process estimates generate by this model. This analysis suggests that more process estimates do not necessarily mean more accuracy.

We began this comment by asking "What should a process model deliver?" and using instances of conflict to illustrate differences between the approaches in this symposium. Such conflicts illustrate the value of dual-process models because, as shown by Deutsch and Strack (this issue), the conflicting tendencies can be understood within separate processes or systems. Occasional conflicts are a natural outcome of independent processes. The process dissociation model that has guided our research illustrates how quantifying those processes sheds new light on automatic and controlled aspects of behavior. That goal is shared by Sherman's (this issue) multinomial model approach. We share his enthusiasm for the potential of such models to illuminate simple processes underlying complex behavior. But we end with a note of caution about the tendency for models to grow complex themselves. When it comes to process models, sometimes less delivers more.

Note

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Problems With Dividing the Realm of Processes

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Multimode models with two, three, or four modes of processing have been proposed in domains as diverse as reasoning (e.g., Sloman, 1996), categorization (e.g., Rouder & Ratcliff, 2004), learning (e.g., Shanks & St. John, 1994), social judgment (e.g., Strack & Deutsch, 2004), and emotion (e.g., Leventhal & Scherer, 1987). Multimode models have proposed several criteria (e.g., operating conditions, formal properties of the process, content, and format of the representations on which the process operates) to divide the realm of processes. As Sherman (this issue) notes, one can make as many categories as one deems useful in a certain context. Like all forms of categorization in daily life and science, making categories of cognitive processes is context dependent. However, there are at least two potential problems with dividing processes into several categories. First, most multimode models make a priori assumptions of overlap among the categories obtained by two or more criteria for division. We argue that there are many ways to cut the cake but that the different slicing methods do not necessarily result in the same slices (see also Sherman, this issue). A second problem has to do with some of the proposed criteria for division. Some criteria are not discrete but dimensional, and they do not allow for the creation of clear-cut, all-or-none categories. Other criteria are discrete but have poor explanatory value (at least according to some authors). We discuss these problems in more detail next.

Mapping Categories Obtained With Different Criteria

The realm of processes can be split up according to several criteria. To gain a better understanding of these criteria, we find it useful to start from a levels-of-analysis approach. Following Marr (1982), we distinguish three levels of process understanding. At the first level, a process is described as a *functional relation* between an input and an output. This level includes the *content* of *input* and *output*, and the *conditions* under which the process operates. The second level articulates the *formal properties* of the process (the primitive *mechanisms) involved in transforming input into output and the format of the representations* in which *input* and *output* are coded. This level addresses what is in the black box.[1] The third level is concerned with the *physical realization* of processes in the brain. The three levels are related, but only loosely. For example, the choice of a formal process is influenced by the functional process it must account for, but one functional process can be implemented by different formal processes. Other theorists (e.g., Anderson, 1987; Clark, 1990; Pylyshyn, 1980) have proposed a different number of levels and have placed the boundaries between the levels at somewhat different heights, but they share the idea that processes can be considered at qualitatively different levels of analysis and that lower levels are implementations of higher levels.

The criteria for categorization used by multimode models can be situated within this framework.

1. The characterization of a process as automatic or nonautomatic tells something about the *conditions* under which the process operates (e.g., Bargh, 1992). A process is automatic when it operates under suboptimal conditions, such as when there is minimal time, minimal attentional capacity, a subliminal stimulus input, no intention to engage in the process (or the intention is not achieved), and/or when there are attempts to stop or avoid the process. A process is nonautomatic when it operates under optimal conditions.
2. Some models distinguish processes on the basis of the *functional process* (or the *content of input* and *output*) involved in the processes. An example are the models that distinguish between the processing of heuristic information (e.g., source attractiveness, the majority's opinion, message length) and the processing of systematic information (i.e., message's persuasive arguments; e.g., Chaiken, Liberman, & Eagly, 1989).
3. The distinction between rule-based and associative processes (Sloman, 1996) refers to the *formal properties* of the process or the primitive *mechanisms*.
4. Some models use as a criterion the *format of the representations* that serve as the *input* of a process, also termed mental *codes*. For example, multimode models in the domain of emotion distinguish between processes operating on sensory codes, those operating on perceptual/analog codes, and those operating on conceptual/semantic codes (e.g., Leventhal & Scherer, 1987; Power & Dalgleish, 1997).
5. Neurophysiological models distinguish processes according to their underlying neurophysiologi-

[1]One might argue that the formal level is by definition impenetrable and that it therefore only makes sense to consider the functional level. The functional level can itself be subdivided into different sublevels. These sublevels are not qualitatively different but can be placed on a continuum ranging from the most concrete to more abstract descriptions.

cal structures or circuits (e.g., neocortical vs. subcortical pathways to the amygdala; LeDoux, 1986).

The majority of multimode models map the categories obtained with two or more criteria. We discuss and evaluate five examples of such a confounding of criteria. First, some models impose a priori constraints on the *conditions* under which certain *functional processes* can take place. For example, in Sherman's (this issue) Quad Model, stimulus detection and guessing are automatic, whereas response selection and inhibition are nonautomatic.[2] For another example, the processing of heuristic information is usually thought to be automatic, whereas the processing of systematic information is thought to be nonautomatic (e.g., Chaiken, 1980). It is not difficult to find exceptions to this or alternative explanations (Kruglanski, Erb, Pierro, Mannetti, & Chun, this issue; Pierro, Mannetti, Erb, Spiegel, & Kruglanski, 2005; Sherman, this issue). Pierro et al. (2005) showed that in prior studies, observed dissociations in automaticity between processes involving different types of information (heuristic vs. systematic) were partly due to a confounding of quantitative parameters (e.g., complexity, length, presentation order) that are not meaningfully related to information type. In these studies, heuristic information was typically less complex, was shorter, and presented earlier than systematic information, thus enabling heuristic but not systematic information to exert an automatic influence on judgment.

Second, several models impose a priori constraints on the *conditions* under which certain *formal processes* can take place. The dominant view is that associative processes operate under suboptimal conditions, whereas rule-based processes can operate only under optimal conditions (cf. Logan, 1988). Opponents of this dominant view have suggested the possibility of automatic rule-based processing (e.g., in skill-development, Anderson, 1992; Tzelgov, Yehene, Kotler, & Alon, 2000; implicit grammar learning, Reber, 1989). Instead of denying automaticity to rule-based processes on an a priori basis, opponents of the dominant view argue that it should be empirically assessed which type of process can or cannot operate under suboptimal conditions. Admittedly, research aimed at establishing automatic rule-based processing is confronted with many hurdles, such as how to assess automaticity and how to assess the involvement of rule-based processes separate from, or in addition to, associative processes (see further).

Third, some models impose a priori constraints on the *format* of the *representations* or *codes* that can be acted on by each *formal process*. For example, rule-based processes are often said to operate on symbolic codes, whereas associative processes operate on perceptual or analog codes (Deutsch & Strack, this issue; Leventhal & Scherer, 1987) or on subsymbolic codes (in connectionist or hybrid models). However, other theorists have suggested that associative processes can also deal with abstract concepts (Bartlett, 1932; Hahn & Chater, 1998; James, 1890; Sloman, 1996; C. A. Smith & Kirby, 2001). Conversely, we see no principled reason to assume that rule-based processes cannot operate on perceptual codes.

Fourth, some models map different *neurophysiological routes* onto different operating *conditions*. In multimode models of emotion elicitation, for example, the subcortical pathway to the amygdala is linked to automatic and the cortical pathway to nonautomatic emotion elicitation (LeDoux, 1986). It is often recognized, however, that automaticity is not unique to the subcortical circuits of the brain and that we are only beginning to understand the subtleties of the interactions among cortical and subcortical brain structures (cf. Phelps, 2004).

Finally, so-called dual-system models (Deutsch & Strack, this issue) postulate links between the categories formed by almost all of the criteria discussed: *functional processes*, *conditions*, *formal processes*, *representations*, and *neurophysiological structures*. Each of the previous comments applies to these models.

To summarize, multimode models tend to forge links among the categories obtained by different criteria. Often these links have not been explicitly investigated (in a manner that permits falsification), and counterexamples or alternative explanations are available (see Kruglanski et al., this issue). Instead of taking as a default assumption that there is perfect overlap among the categories obtained with different criteria, we propose to take independence of categories as the starting point and to progressively investigate possible degrees of overlap. In our view, there are no compelling reasons to assume principled overlap among the categories discussed. It should be a matter of empirical research to determine whether there is some degree of actual overlap.

Value of Individual Criteria

Now that we have discussed the problem of assumptions of overlap among various ways of categorizing processes, we turn to the second problem, whether the criteria proposed are suited to divide the realm of processes in a clear-cut manner.

Automatic Versus Nonautomatic

In the introduction, we suggested that some criteria do not allow for the creation of all-or-none categories.

[2]Although Sherman (this issue) recognizes this problem, we wonder why he goes to the trouble of explaining in great detail a model whose central assumptions he eventually comes to reject.

One such criterion is automaticity. According to a feature-based approach, automaticity is an umbrella term for a number of individual features such as fast, efficient, unintentional, uncontrolled, and unconscious. The definitions of these features can be reformulated in terms of operating conditions. For example, an efficient process is one that makes minimal use of attentional capacity, which means that it can operate when a minimal amount of attentional capacity is available. A fast process is one that can operate when there is not much time. An unintentional process is one that is not caused by an intention (i.e., the goal to engage in the process), which means that it operates when there is no causally efficacious intention. More generally, an uncontrolled process is one that is not influenced ([a] in the sense of caused, or [b] in the sense of stopped/avoided) by the goal to do so ([a] engage in the process, or [b] stop/avoid the process). This means that it operates (a) in the absence of a (causally efficacious) goal to engage in it or (b) despite the presence of a goal to stop/avoid it.[3] To say that a process is unconscious means that the process occurs when the person is not conscious of it (or of its input or output; cf. Moors & De Houwer, in 2006).

These features, it has been argued, do not hang together in an all-or-none fashion (Bargh, 1992). For example, it seems that certain processes are fast and efficient but not uncontrollable (in the sense of stop/avoid; cf. Uleman & Moskowitz, 1994). We have even raised the possibility of interdependence between some automatic and some nonautomatic features (Moors & De Houwer, in press). For example, in threshold determination studies for subliminal perception, it seems that short presentation times of the stimulus can be compensated by increased focusing of attention to the stimulus or by increased salience of the stimulus. In cases like this, there seems to be a trade-off rather than a cooccurrence among the features fast and efficient. Because of the lack of coherence among automaticity features, we favor a decompositional approach to the study of automaticity. Such an approach proposes to investigate the presence of indivual features separately (Bargh, 1992; Moors & De Houwer, 2006).

It has further been argued that each automaticity feature can be regarded as a continuum (Logan, 1985; Moors & De Houwer, 2006). For example, a process can be more or less fast, more or less efficient, more or less controlled (i.e., [a] more or less conform to one's intentions, or [b] more or less successfully stopped/avoided), and more or less unconscious. It is often not possible to conclude for the complete presence or absence of a feature. In sum, the lack of coocurrence among automaticity features as well as their gradual nature complicate the task to create separate bins of automatic and nonautomatic processes. Processes are automatic with regard to some features and to some degree, but not with regard to others. Moreover, processes may be automatic (with regard to some features and to some degree) on some occasions, but not on others, depending on conditions that are unrelated to automaticity (such as salience, complexity, length, and presentation order of the stimulus input; see Kruglanksi et al., this issue). We can thus conclude that the criterion automatic–nonautomatic is not suited for a clear-cut division of processes.

[3]Note that according to our definitions, unintentional processes are a subclass of uncontrolled processes. Unintentional processes are uncontrolled in sense (a).

Rule-Based Versus Associative

Another distinction that has been under fire is between rule-based processes and associative ones. In a rule-based process, a mental rule is applied to an input (or a representation thereof), and computation of the rule produces an output. In an associative process, an input activates stored representations of similar past inputs. This activation, in turn, spreads to associated stored representations, which determine the output. Kruglanski et al. (this issue) argue that both mechanisms have the same formal properties in that they can both be expressed in an if–then format. Given the authors' claim that an if–then format is the hallmark of rules, they argue that associations are, in fact, rules and that the activation of stored associations is a rule-based process. There are, however, reasons to challenge this definition. Rule-based processes and associative ones may have things in common (they are both processes after all), but there may still be formal distinctions left to make between them. We discuss three of these distinctions next.

First, some authors have argued that rule-based processes are governed by *abstract* rules (e.g., Sloman, 1996). Abstract rules not only fit the if–then format, they also require that the premise contains variables. Variables are abstract representations that can be instantiated in more than one way (i.e., with more than one constant). Consider the abstract rule that could underlie the elicitation of positive emotions such as happiness: "if X = Y then q" in which X stands for an actual situation, Y stands for a desired situation, and q = happiness. The rule applies to an infinite set of actual and desired situations (e.g., if you desire chocolate cake [y1] and you are offered chocolate cake [x1], happiness occurs; if you desire success at work [y2] and success is what you achieve [x2], happiness occurs). Associations, on the other hand, can be said to fit the format of nonabstract rules in which the premise merely consists of constants. Constants are representations of concrete or even unique instances. For example, "if p then q," with p = chocolate cake and q = happiness. For a more complex example, "if (p and r) then q," with p = chocolate cake, r = desire for chocolate

cake, and q = happiness. Because p and r are constants, the rule cannot be applied to new input (e.g., s = new car or t = success at work) unless there is some resemblance with p (e.g., u = strawberry cake). Nonabstract rules can thus be applied to new input but only by virtue of similarity among the input and the constants specified in the premise.

This brings us to the second distinction between rule-based processes and associative ones. In the case of a rule-based process, the premise of the rule must be strictly matched, whereas in the case of an associative process, the premise may be partially matched (Hahn & Chater, 1998[4]). Rule-based processes and associative ones can both account for generalization, due to the complementary forces of abstraction and partial matching. In the case of rule-based processes, generalization is obtained by virtue of abstract variables. In the case of associative processes, generalization is obtained by virtue of partial matching (partial matching compensates for the lack of variables). Also note that abstraction is a relative notion (Hahn & Chater, 1998). Abstraction has to do with a loss of information: abstract representations contain less unique features than concrete ones. The variables figuring in abstract rules and the constants figuring in nonabstract rules thus occupy two points on a continuum. Variables can be substituted by a larger class of instances than constants can, but the variables that figure in abstract rules can often not be substituted by just any constant (e.g., in the previous example of an abstract rule, X must be an actual state and Y must be a desired state). At the very extreme are logical rules in which the variables can be sustituted by any constant (e.g., if [X and Y] then X). Conversely, concrete representations often contain some level of abstraction (e.g., in the previous example of a nonabstract rule, the representation of chocolate cake can itself be instantiated by more than one unique chocolate cake). At the very extreme are constants that represent a unique instance.

A third, often mentioned distinction between rule-based and associative processes is that rule-based processes must *follow* rules, whereas associations—at most—*conform* to rules. Rule *following* requires that a mental rule sits between the input and the output of a process and *causally affects* the output; rule *conforming* merely requires that the relation between input and output can be described or summarized according to a rule (Hahn & Chater, 1998; Pylyshyn, 1980; Searle, 1980; Sloman, 1996; E. E. Smith, Langston, & Nisbett, 1992). If this constraint of rule-based processing would be relaxed, anything that can be described by rules, such as the swimming pattern of a school of fish or planetary motions, would have to be categorized as rule-based. Although associations (or patterns of associations) also mediate between input and output, some do not consider them to be mental rules in that they are not symbolic representations of a rule; they do not have a rule as their content (e.g., Hahn & Chater, 1998). According to others (Clark, 1990; Fodor & Pylyshyn, 1988) the rules in rule-based processes must not be symbolically represented. They may also be wired in the system from birth or through learning. Associations can be seen as rules on the latter view.

Although these three criteria provide formal distinctions between rule-based and associative processes, one can argue that these distinctions remain meaningless at the functional level because they do not seem to lead to different testable predictions. The two mechanisms seem able to account for much the same functional observations. First, as previously explained, both mechanisms are able to account for generalization toward new stimuli (abstract rules by virtue of variables, associations by virtue of partial matching). Second, given the relative nature of abstraction, no objective line can be drawn between variables and constants. This is reflected in the idea that activation of stored stimuli can be based on concrete as well as abstract similarities (e.g., similar function). Similarity may even pertain to abstract relations among variables (cf. Redington & Chater, 1996). Thus, evidence for generalization toward stimuli that share abstract (but not concrete) features with previously acquired ones (Marcus, Vijayan, Bandi Rao, & Vishton, 1999; Reber, 1989) is equally compatible with rule-based as with activation-based accounts (Redington & Chater, 1996; but see Sloman & Rips, 1998; E. E. Smith et al., 1992). Third, even if an arbitrary line would be drawn between abstract and concrete features in a way that everybody would agree with, there still is the problem that every abstract rule can be translated in a set of nonabstract rules (one for each combination of values that can be entered in the variable slots of the abstract rule) and vice versa. Both can thus account for the same input–output relations. Fourth, to empirically assess whether the output of a process is causally determined by a symbolically represented rule is not an easy task. Some authors have proposed to use verbal protocols to investigate the content of representations. If people's performance is mediated by mental rules, it is possible that they can verbally report these rules. There are two problems with this proposal. For one thing, the inability to report a rule cannot be taken as proof for its absence, because a rule may affect performance without being consciously accessible. The criterion of ver-

[4]Actually, Hahn and Chater (1998) distinguished between rule-based processes and similarity-based ones, linking strict matching to rule-based processes and partial matching to similarity-based ones. They distinguished both types of processes from purely associative ones such as those described in connectionist models, in which no actual computation of a match takes place but which are nevertheless sensitive to similarity. We use the term *associative* in the broad sense, including all processes that are in some sense dependent on similarity between features of the input and features of a stored (symbolic or subsymbolic) representation.

bal reportability is thus useless for research concerned with automatic (in the sense of unconscious) rule-based processing. In addition, the ability to report a rule cannot always be taken as proof for its causal role, because people may report rules that they did not actually use (Nisbett & Wilson, 1977). Recall, moreover, that some authors do not think that the rules governing rule-based processes should be symbolically represented but may also be built-in (Clark, 1990). Built-in rules are not likely to be available for introspection. The literature contains several other proposals for how to empirically assess whether performance is rule based or associative (cf. reviews by Hahn & Chater, 1998; Sloman, 1996; E. E. Smith et al., 1992). However, there does not seem to be general consensus about what constitutes evidence for each process. A further problem noted by many authors (Jacoby, Toth, & Yonelinas, 1993; Reingold & Merikle, 1993; Sherman, this issue) is that no task is process pure. Task performance may be determined simultaneously by rule-based and associative processes. Evidence for one type of process thereby does not exclude presence of the other.

We have thus seen that, in contrast to Kruglanksi et al. (this issue), one can make formal distinctions between rule-based processes and associative ones. These distinctions do not seem to lead to decisive distinctions at the functional level. Despite the controversial status of many empirical results, we prefer to leave open the issue of whether rule-based processes and associative ones can be distinguished empirically. It is up to proponents of dual-mode models that rely on this distinction to investigate the issue further. If no functional difference can be found between the two processes, or if no agreement can be obtained about what this difference should be, rule-based, associative, and hybrid models remain empirically indistinguishable theories (Marcus, Berent, Seidenberg, MacDonald, & Saffran, 2003).

Is There a Future for Multimode Models?

We have seen that several of the criteria for the categorization of processes are problematic and that there is a lack of overlap among the categories obtained with different criteria. Because of these problems, certain proponents of multimode models have toned down some of their initial claims. Some models now grant exceptions, or they abandon some of their initial criteria. For example, some dual-mode models that were originally based on the criterion of type of information processed (e.g., heuristic vs. systematic) have now abandoned that criterion (cf. Sherman, this issue). Others grant that the automaticity criterion is not able to create separate bins of processes (Deutsch & Strack, this issue). We agree with Sherman (this issue) that when the original criteria for categorization are given up, the models risk losing their ground for being a dual-mode model. Multimode models should be able to keep at least one criterion to which they attach their categories.

It seems that the safest criterion to choose is the type of functions that can be performed by each system (e.g., evaluation, counting, detection, guessing, metacognition). So rather than dividing processes at the formal level (mechanisms), one could divide processes at the functional level. Sherman (this issue) seems to have reached the same conclusion near the end of his target article. This criterion also seems to be the key criterion in the Deutsch and Strack (this issue) model: The reflective system can perform functions that the impulsive system cannot, such as metacognition and generating new action plans. Even if metacognition would turn out to rely on associative mechanisms (Theofilou & Cleeremans, 2005) or be able to operate under suboptimal conditions (Reder & Schunn, 1996), the functional distinction between cognition and metacognition remains valid and useful.

Conclusion

Categorization has been marked as a normal aspect of information processing. It serves to reduce information in a way that enables people to focus on the relevant aspects in some context and to facilitate communication. There is nothing fallacious to dividing a group of people according to age, gender, skin color, or shoe size. The fallacy is in attributing to the resulting categories features that have not been verified but that are consistent with our implicit theories. Similarly, talking about processes using contrasting categories permits focusing on key features in some context and may facilitate communication. We should be cautious, however, not to let our implicit theories dictate overlap among categories obtained with different criteria. The tenacious link between the categories of associative and automatic perhaps stems from an implicit metaphor of associative processing as a kind of electrical signal that effortlessly and uncontrollably flows through a copper wire. Conversely, the link between the categories of rule based and nonautomatic perhaps originates from an implicit metaphor of rule application as an active manipulation performed by some homunculus. Such metaphors have considerable intuitive appeal, but so do our implicit theories and prejudices about people in daily life. This should not be an excuse for not making "the hard choice" (Fiske, 1989), which consists in postponing conclusions until sufficient converging evidence supports them. Until that happens, it is best to make as few presuppositions as possible to leave open the debate and the opportunity for careful empirical research.

Notes

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Reading the Tea Leaves in Models That Seek to Integrate Implicit and Explicit Measures and Cognitions: Is This the Future of Social Psychology?

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The evidentiary rules that we all learned to use when judging the relative goodness or badness of theories are consensual and well internalized. To displace an established model, the upstart must account for the elder's prior predictive successes; show how it handles results that the established theory either cannot anticipate or misanticipates; and, ideally, demonstrate added value by fostering predictions that substantially enlarge the scope of the phenomena that fall into its predictive world and clarify and identify the underlying psychological processes responsible for observed outcomes (Crano & Brewer, 2002). Campbell's (1963) wonderful discussion of pattern matching and his later differentiation of definitional and multiple operationism (Campbell, 1966) provide clear guidelines for judging the usefulness of new theories vis-à-vis established models. The mental picture that Campbell's description conjured (for me, at least) was that the successful theory would overlay the lumpy topography of empirically derived observations to create a coherent epistemological picture, much as Christo's constructions seem to wrap the world in a common cloth, creating a picture that in the best of circumstances is at once beautiful and instructive.

To these desiderata I would add two other useful features in judging the goodness of a theory. These correspond roughly to the mundane realism constraint that Aronson, Wilson, and Brewer (1998) discussed in their treatment of experimentation in social psychology and to considerations of psychological realism (Aronson, Wilson, & Akert, 1994), which is concerned with the "extent to which the psychological processes that occur in the experiment are the same as the psychological processes that occur in everyday life" (Aronson et al., 1998, p. 132). Mundane realism principally is concerned with the research context and operations used to capture the phenomena of interest. These operations, and the circumstances under which they are administered, should be at least minimally congruous with the lifespace of the people who serve as research participants in our tests of theory. Identifying the primacy of one cognitive process over another via minute differences in reaction time may clarify our understanding of the ways in which judgments are made, or attitudes formed or changed. However, it remains to be seen whether the information gathered through esoteric measurement processes will prove useful in the study of real persuasion or judgment processes undertaken by motivated individuals in their natural habitat, who probably would not sit still long enough for electrodes to be attached to their bodies, or allow us to gauge their reaction times to stimuli judged under response demands for rapid decision making.

On the other hand, the psychological realism of at least two of the models, as they have been described, probably is quite high, insofar as the operations used to capture the processes underlying critical judgments are largely outside the conscious control of the participants. In research involving measures of implicit associations, we may be fairly confident that the processes uncovered by our research operations are not contaminated by response biases. Both Sherman's Quad Model and the Reflective-Impulsive Model (RIM) of Deutsch and Strack can or have made use of implicit measures, and so, on this score their psychological realism may be judged relatively positively. Kruglanski, Erb, Pierro, Mannetti, and Chun (this issue) have not made use of such measurement techniques in tests of the unimodel, but this is not to say that they could not do so in future research.

Judging via the Standard Criteria

The models presented in this symposium do not fare well on the standard criteria typically used in judging the utility of a theoretical position. These criteria are concerned with the models' capacity to anticipate earlier results and to demonstrate their capacity to predict the unpredictable from the standpoints of the established models. This is not a fault of the models themselves, but of their comparative youth. Sufficient time has not passed since their invention to allow us to determine confidently whether the three contenders for our attention, and perhaps admiration, deserve a careful second or third look. To do so, each model's predictions must be pit in extended and meticulous research programs against the more established dual-process approaches, the touchstone against which they have chosen to be compared. Their acceptance will depend on their greater efficiency and sufficiency in explicating resultant research outcomes. That these tests have not yet taken place is a temporal issue that has nothing to do with the quality of the proposed theoretical conceptualizations or the inventiveness of the methodologies that have been suggested, at least at the theoretical

level, in the various tests of concept described in these three intelligent and thought-provoking presentations. However, the admonition implicit in this prescription for the future should be clear, insofar as it suggests, indeed requires, further and more intensive research into the critical social psychological processes that are the focus of all three of these novel predictive devices. You're only young once.

This is not to say that the models do not differ in the extent to which they have been subject to examination. Of the three alternatives considered in this symposium, the unimodel has received the greatest theoretical and empirical attention (e.g., Erb et al., 2003). Seven years ago, an entire issue of *Psychological Inquiry* was devoted to the unimodel (see Kruglanski & Thompson, 1999, and responses to their ideas by 15 sets of critics). Much of this attention was directed toward the unimodel's reconsideration and reinterpretation of the findings generated in research on the Elaboration Likelihood and Heuristic-Systematic dual-process models of attitude formation or change (Chaiken, 1980; Chaiken, Liberman, & Eagly, 1989; Crano & Prislin, 2006; Petty & Cacioppo, 1986; Petty & Wegener, 1999). In these studies, Kruglanski and Thompson suggested that past research on the established models typically had confounded the types of information presented targets. Peripheral (or heuristic) cues were viewed as being confounded with message arguments. Peripheral cues always were terser (and thus potentially less informative) than message arguments, and they almost always preceded message presentation. When this confounding was undone in subsequent unimodel research, the standard results were eliminated, as predicted by the model, and findings consistent with the unimodel's expectations were discovered (e.g., Kruglanski et al., 2003; Pierro, Mannetti, Erb, Spiegel, & Kruglanski, 2005; but see Chaiken, Duckworth, & Darke, 1999; Petty, Wheeler, & Bizer, 1999; Wegener & Claypool, 1999).

It is more difficult to use the first set of criteria to judge the utility of Deutsch and Strack's (this issue) RIM or Sherman's (this issue) Quad Model. Neither has had time to attract sufficient research that would allow a reasoned assessment of utility relative to competing models (see Conrey, Sherman, Gawronski, Hugenberg, & Groom, in press; Strack & Deutsch, 2004). From this perspective, then, the game is still on, with no clear favorite.

The contending models as described here clearly differ in terms of their values on mundane and psychological realism, and these differences *may* have implications for their respective futures. In research to date, the unimodel has been tested by "standard" research operations, that is, in contexts using familiar and common treatments and measures that have been commonplace in social psychology for at least the past half century in research on attitudes. This is not a bad thing. People are accustomed to being exposed to persuasive messages—persuasion is ubiquitous—and answering survey questions is far from an unusual event, especially for the college students who typically serve as participants in unimodel research. Both (a) the use of standard factorial designs that systematically cross the timing of cues and messages and (b) measures of attitudes and thoughts tapped via standard and psychometrically sound instruments represent strengths of the approach. These standard methods have been, and continue to be, a part of our common scientific language, and they work. On the other hand, some may fault the approach taken thus far in the study of the unimodel precisely because of its resolute adherence to the methodological tactics of the mid-to-late 20th century. At a minimum, one might argue, in a process model may we not expect more empirically based insights into the underlying processes of change and resistance than those afforded by a thought listing task, which to date is the most advanced peek into the cognitive dynamics of targets afforded in research on the unimodel? I hope that the use of more advanced methods of ascertaining the cognitive dynamics involved in judgment is in the offing. In short, although the research that has characterized study of the unimodel may be judged acceptable in terms of mundane realism, there is room for improvement on the psychological realism dimension.

The Quad Model flips this evaluation on its head. As presented, this model is focused precisely on the underlying controlled and automatic process dynamics of decision making. To realize its central function, research on the model makes use of somewhat esoteric research operations that promise much in terms of psychological realism but seem deficient in realism of the mundane variety. It is not usual that the time it takes for us to make decisions is measured in milliseconds. In normal circumstances, it is not critical if a decision to, say, go to the movies or stay home and read a book takes more (or less) than a few milliseconds. The usual experimental arrangements used to ensure and measure rapid responding would seem to divorce such studies from usual experience. As such, except under unusual conditions (see Bassili, 1996, 2003), standard research on the Quad Model will lack mundane realism to the extent that it is dependent on variations in reaction time to infer possible conflicts between automatic and controlled processes. This is not necessarily a bad thing. The gains realized in terms of psychological realism may be well worth the cost, which is measured in mundane realism units, but this evaluation awaits future research. The model promises to provide a defensible picture of interacting processes that may add appreciably to our understanding of fundamental decision making, whether these decisions involve attitudes, impressions of others, or causal attribu-

tions. The Quad Model seems to have been built to study processes in conflict and, as such, may contribute substantially to our understanding of vexing social problems—stereotyping, modern racism, minority influence, discrimination, and so on. Thus, paradoxically, a model based on research operations that must be considered suspect in terms of mundane realism may come to make significant contributions to our understanding and solution of important practical problems.

The RIM of Strack and Deutsch (2004, 2005) seems amenable to the standard research operations that have had a long and distinguished history in our field as well as the newer investigative approaches popularized in the Implicit Association Test (Greenwald et al., 2002; Greenwald, McGhee, & Schwartz, 1998) and the Evaluative Priming Task of Fazio and associates (Fazio & Olson, 2003; Fazio, Sanbonmatsu, Powell, & Kardes, 1986), among others (e.g., Maass, Castelli, & Arcuri, 2000). It is not difficult to see how the implicit and the more direct models of measurement could be applied to the RIM, but to date the literature offers no examples of such applications. As such, it is not possible to know how the model will fare when these approaches are employed. The focus of the RIM's development to this point has been theoretical. The authors of the model have provided an elegant vision of a model of decision making that is, on its face, quite persuasive. The step beyond face validity, however, often is daunting; I hope that researchers will take this model beyond logic and theory and begin the exciting if arduous task of empirical validation.

Some (More) Random Thoughts About These Models

Unimodel

The unimodel of Kruglanski and colleagues (this issue) presents an intriguing epistemological conundrum to existing dual-process theories. On one hand, it poses a serious alternative to the idea that persuasive information is digested via a two-process system. It is interesting that the unimodel has been tested in the same methodological arena, with the same methodological tools, as the standard dual-process models of Chaiken (1980) and Petty and Cacioppo (1986). This tack probably was not whimsical; engaging the competing approaches in their own backyard is a well worn and well-respected strategy in science. The pitfall of the strategy in the case presented here has been pointed out, namely, that it tends to suppress use of more advanced measurement approaches that might help establish the plausibility of the processes the new model hypothesizes to underlie the outcomes it predicts. There is no easy fix to this, but the solution is obvious; use both standard and more novel measurement approaches, explicit and implicit methods, to test the competing formulations. If this approach is followed, the next stage of the unimodel's progression will be the specification, identification, and exposition of implicit processes that are hypothesized to operate in the formation of judgments.

A strength of the unimodel is its insistence that judgments are rule based. This insistence at a minimum delineates the proper sphere for social psychology. As Sherif (1936) insisted so long ago, social psychology is, or should be, concerned with rational processes, with rule-based behavior. Recent research on cognitive shortcomings might have suggested otherwise, but this would be a misreading of the literature. Even cognitive failures, we have found, are based on social-cognitive regularities. It matters not that the rule makes sense but that it exists and is followed. We have come to learn that even chaos follows lawful patterns (Robertson & Combs, 1995).

A final observation that might be made concerns the relative complexity of the unimodel and its hypothesized processes and the lack of a clear roadmap to follow when testing its goodness. The dual-process approaches the unimodel hopes to supplant were models of clarity. They took the established theories, added a variable or two, and clearly showed how the addition produced order from the rather chaotic literature that had been produced in the attempted validation of the older approaches. The addition of the concept of message strength, for example, and the renewed emphasis on motivation to process allowed Petty and Cacioppo to produce a predictive model that moved well beyond that of Hovland, and that has served us well for more than 30 years (Hovland, Janis, & Kelley, 1953). This is a long lifespan in the world of social science theories. The methods needed to test the then-new dual-process models were straightforward, and the success or failure of the outcome of these tests generally was not disputed.

But how is one to take the unimodel and determine whether the underlying (hypothesized) processes have been supported, even if the overall outcome of the study appears to favor its predictions over those of the more established models? The theoretical complexity of the model allows for a comparison with the competing theories at the level of outcome but renders difficult a clear determination of whether the underlying mechanisms operated as proposed. What is needed here is a clear specification of operations that facilitate the unambiguous test of competing theories while allowing inspection of the processes that are thought to operate in producing the sought-for outcomes. Failing to do this will produce a literature in which defenders of the status quo argue that support for the interloper is based on development of "special case" scenarios that admittedly confound the established model but that do not

particularly add much to understanding. Recall the ancient duel between Osgood's congruity theory and Rokeach's belief congruence model (Osgood & Tannenbaum, 1955; Rokeach & Rothman, 1965). Rokeach was devilishly adept at creating stimulus sets that produced problems for the more established congruity model of Osgood, but the failure of both models to develop a persuasive explication of underlying psychological processes responsible for change, and the even more fatal lack of specification and measurement of these processes, doomed both models to the musty textbooks of the 1960s or the blurry memories of old professors. Let us hope that the unimodel avoids a similar fate. The prescriptions for avoidance have been spelled out here; all that is needed is some research.

Quad Model

The Quad Model shares a set of strengths and weaknesses distinct from that of either of the other approaches reviewed here. The model's strength is its capacity to make predictions that are clearly consistent with past findings and that extend via the application of innovative methods the predictive range of current judgment models. A possible complaint that may be laid against the Quad Model is that, by layering on enough predictors, anyone can create a model that faithfully reproduces any data set. Such an approach may produce strong predictions, but it surely is not parsimonious. This would be an unfair charge to level at the Quad Model, however. The model's (automatic and controlled) parameters are well considered theoretically. They make sense, they are consistent with earlier theory and empirical research, and in combination they form a coherent and persuasive judgment model. The parameters are reasonable, and they have not been dredged up to account for variations in an observed data pattern (in some ways this is easy, as there is no published data pattern that needs to be modeled; Conrey et al., in press, promise to remedy this situation).

The second reason to believe that the predictive parameters of the Quad Model are well chosen has to do with the fact that they are consistent with the emerging body of social psychophysiological research that has evolved in the study of judgment processes. Of the three models discussed in this symposium, the Quad Model is the most tightly linked with developments in implicit measurement methodology and neuroanatomy. Whether the model provides all that is claimed for it remains to be seen—the proof of the pudding is in the eating, after all—but there is little in Sherman's presentation that raises a red flag, other than its implicit disagreement with Spinoza, who surely would have given primacy to automatic processing (followed by controlled). Disagreeing with Spinoza has always seemed a bit risky (see Gilbert, Tafarodi, & Malone, 1993). In any event, the Quad Model is a serious contender for serious consideration, and its investigation promises to provide social psychology with considerable grist for its theoretical mill. Of course, to take maximal advantage of the ideas inherent in this theory will require sophisticated laboratory models that probably will prove considerably deficient in mundane realism. This is a problem, especially in today's market, but the development of a broad model that promises better and more precise insights into human judgment may prove suitably intriguing to garner the kinds of support that will be necessary to put these ideas to a fair test.

The RIM

The RIM represents an interesting attempt to integrate conflicting forces of impulse and considered thought. The model seems to me to have a flavor of the deliberative/implemental mindset approach of Heckhausen, Gollwitzer, and colleagues (e.g., Gollwitzer, Heckhausen, & Ratajczak, 1990; Gollwitzer, Heckhausen, & Steller, 1990; Heckhausen & Beckmann, 1990), but it is broader and considerably more formalized. Even so, it might profit from some of the insights developed in tests of that earlier model. An intriguing feature of the RIM, as with the Quad Model, is its capacity to deal with seemingly impulsive or mindless activities brought about by passion or mere habit. Also like the Quad Model, the RIM acknowledges earlier work in cognitive neuroscience in building its predictions. An impressive feature of the RIM is its capacity to predict when implicit methods will be more faithful predictors of thought and behavior and when more explicit measures will prevail.

The model is in agreement with the unimodel's rule-based orientation by locating judgment formation exclusively in the reflective system. Unlike the unimodel, however, it focuses more on the interaction of reflective thought with impulsive and other nonjudgmental cognitions (e.g., affect, habit, etc.). This expansion is interesting and useful, and it sets the RIM, a dual-systems model, apart from the usual dual-process models.

A potential problem with the RIM as it is presently constituted is its relatively high level of abstraction. It is not completely evident how the model can be actualized in authentic research. The theoretical discussion provided by Deutsch and Strack is exceptionally interesting but also exceptionally abstract. If the devil is in the details, there is precious little sin in the RIM. Development of useful tests of the multitude of interesting ideas laid out in this commentary should be the next step in the development of a predictive device that will prove a worthy competitor in the present theoretical sweepstakes.

In Conclusion

The importance of these models from both a theoretical and historical perspective should be recognized. This symposium is devoted to a consideration of the processes that guide how we think about, handle, elaborate, and combine information in coming to a judgment, decision, intention, or action. This issue represents a central focus of much of contemporary psychology, human and otherwise, and certainly is the central epistemological pillar of the edifice we call social psychology. These models of human thought and behavior represent a clear challenge to the quasi-semiparadigmatic state that social psychology has attained. This is a good thing. But the old order is far from overcome. There is considerable life still in the standard dual-process models of attitude, impression formation, judgment under uncertainty, causal attribution, and the like. These established models will not go gentle into that good night, nor should they. The models of Petty and Cacioppo (1986), Chaiken (1980), Brewer and Feinstein (1999), and Kahneman and Tversky (1973), among others, will not be displaced easily. The research needed to advance beyond these models has yet to be undertaken, but the important point is that the theoretical groundwork—and the methodological advances—are in place to allow this research to be done. Time will tell if the models discussed here succeed in moving the field beyond its current situation. If and when the time to decide on that movement comes, it would be wise to remember some important lessons from the past. The person who invented the bathtub probably was smart enough to know when emptying the thing not to throw the baby out with the bathwater. We should follow this lead when thinking about the process models proposed here in contradistinction to those that have served the field so well over the years.

Note

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Duality Models in Social Psychology: Different Languages or Interacting Systems?

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We appreciate and welcome all three attempts at process models in social psychology. All of them try to find a solution to the problem that lies at the heart of psychology: to fill the gap between the description of human beings as individuals who intentionally act (and judge) according to their beliefs and goals, and the description of human beings as biological systems that behave according to inbuilt or acquired regularities. We appreciate the fundamental discussion in these contributions, because most of the time we psychologists suppress, circumvent, or ignore this gap by focusing solely on one or the other side of the gap.

Our contribution to the debate is not meant to add any further arguments for or against a uni- versus multimodal perspective. Instead, we want to make *explicit* a problem that implicitly lies behind the discussion of a uni- or dual-model approach. To elaborate on this point, we must focus on the aspect of theoretical languages that govern psychological theorizing.

Theoretical Languages in Psychology

In a rough picture, the decline of behaviorism swept away two "do not!"s of empirical psychology at that time: First, thoughts on the inner structure of the "black box" were no longer forbidden. Second, folk psychology (or ordinary language psychology), that is, the use of a mentalistic idiom, was no longer abandoned in the scientific community. The break of the first "do not" led to the development of cognitive psychology. In a nutshell, behavior is seen as the result of causal processes that operate within and between some functional modules. Here, (traditional) cognitive psychology does not bother too much about a concrete physical realization of a module (e.g., "working memory") or process (e.g., "spread of activation"). These scientists argue—more or less convincingly—that a certain module together with its associated processes can be implemented (at least in the long run) in rather different ways, including,

say, a computer program. (We can add as an aside: It is the endeavor of cognitive neuroscience to bother about the concrete physical realization of those modules and processes. But that is a different story.)

The disappearance of the second "do not" has reintroduced mentalistic concepts (e.g., to act, to intend, to believe, to feel, etc.) as indispensable concepts in psychology. In the end, we are very often interested in explaining phenomena that are established in a mentalistic language. Why does Judge A impose a drastically more severe sentence compared to Judge B in largely comparable cases? It is not the utterances of different strings of phonemes that are essential in marking the difference. It is the result of the *act of judging and sentencing* that matters.

Both of these approaches are intimately but not simply related. Whenever one tries to theorize about so-called higher order cognition (i.e., to theorize about mentalistic concepts like judging, intending) in a way that is inspired by the cognitive endeavor (i.e., to theorize in a functionalistic way, postulating modules and processes, etc.), the problems of this relationship become evident. In a nutshell: The mentalistic idiom is about individuals who act meaningfully. The mentalistic idiom is about the semantic and emotional meaning that something has for someone. In short: mentalistic language is a "personal" language. In contrast, cognitive psychology is inherently "subpersonal." Its theories describe syntactic regularities that have no personlike semantic qualities. A cognitive system does not judge, intend, or act but only transforms inputs, which can be discriminated by formal features, into outputs according to some built-in or acquired regularities.

We want to proceed in the following way. First, we want to give some arguments about the indispensability of a personal psychology and try to figure out what can be considered its main characteristics and/or problems. Second, we spell out how (social-)cognitive psychology tries to handle the gap between a personal and a subpersonal psychology by giving a taxonomy of solutions. Finally, we discuss the three target theories of this issue with regard to that background.

Mental Events and Human Behavior: Bridging Invisible Gaps

Why do we investigate judgments? We are convinced that judgments are a necessary component of any valid explanation of human action. If any human behavior is more than a mere automatic reaction (e.g., a reflex), it is necessarily based on an intention, which in turn is based on beliefs and evaluations and, in the end, on a personal judgment about how to weight these different aspects that have come to the actors' mind. Psychologists want to explain why human beings *decide* and *act* the way they do.

However, despite impressive progress in terms of both theoretical differentiation and empirical refinement (e.g., Gollwitzer & Bargh, 1996), fundamental theoretical problems of the explanation of (human) action still remain overlooked or ignored (see also Brandtstädter, 1998). In particular, three problems are of primary importance here. First, it is often overlooked that the concepts of personal psychology are semantically (thus not *causally*) related. Second, the connection between mental states (intentions, judgments) on one hand and physical events (visible behavior) on the other is still conceptually unclear. Third, personal psychology is not self-contained. For example, we do not learn from this type of psychology which causal processes change personal belief and value systems.

Semantic Connectedness of Mental Terms

When we perceive a human action (i.e., if we see a certain behavior as human action), the presence of specific "intentional" processes (such as beliefs, aims, judgments) cannot be doubted: If the observed behavior is in fact the expression of an intentional action, then a corresponding constellation of these mental states is *necessarily* implied. This point is often overlooked. Take for example the "theory of planned behavior" (Ajzen, 1996), which remains within the parlance of personal psychology by predicting actions from intentions and, in turn, intentions from attitudes, subjective norms, and perceived control. The theory runs into logical difficulties by trying to establish *causal* relationships between mental states and intentional actions, which are in fact logical relationships (Greve, 2001). Thus, a personal psychology is about conceptual relationships between beliefs, values, emotions, and actions. The misinterpretation of these conceptual relations between personal concepts can easily lead to pseudoempirical research (Brandtstädter, 1982; Smedslund, 1978; see also Brandtstädter, 1998). Dennett (1987) compared the intentional stance (i.e., the personal psychology stance) with a calculus, in particular the calculus of forces in the parallelogram of forces: It is an idealized level of abstraction, but not, for instance, a real mechanical linkage of rods and pivots.

The Connection Between Mental States and Physical Events

Subpersonal cognitive psychology, however, is—to stay with the metaphor—about mechanical linkages of rods and pivots. Therefore, there are attempts to reconstruct action theory within a subpersonal theoretical language (e.g., see the "Rubicon model" of volitional action; Gollwitzer, 1990, 1999) with the goal to predict behavior.

Such approaches often ignore the problem that judgments (as part of the idealized personal psychology parlance) are not identical to specific cognitive processes (even if these processes can be reconstructed as necessary parts of a personal judgment). The crucial question is whether both parts of an explanation (*explanans,* i.e., some specific behavior*,* and *explanandum*, e.g., intentions) are commensurable, that is, whether they can be integrated in one theoretical explanation within one language layer.

One way to illustrate this point is to take a closer look at the hierarchical structure of actions (see also Carver & Scheier, 1998): I prepare a journey *by* packing my bag *by* filling in my shirts *by* folding my best white shirt *by* stretching it with my hands *by* moving my left hand in an angle of x° *by* a contraction of the x-muscle in my left forearm *by* a chemical reaction in the fibres of this muscle (etc.). At a first glance, these "by"-relations look like adequate empirical explanations ("what *really* happens is … ") in a progressive (reductive) direction of a cumulatively increasing insight (into microprocesses). A closer look reveals, however, that while moving through this explanatory sequence we have crossed the conceptual border between intentional, controllable actions (such as preparing, packing, folding) on one hand and physical processes (such as chemical reactions in some muscles) on the other, which we cannot intend or plan and usually are not even aware of. Somewhere in between, an invisible "semantical switch" alters the object of explanation, as it were: The action itself remains "relatively irreducible" (De Sousa, 1987).

Note that jumping over the gap marked by the lowest level of mental events is not at all senseless or useless. In certain respects, it is both the privilege and the duty of empirical psychology to boldly go beyond the limits of ordinary language and folk psychology. However, leaving the categories of our common language aside in that particular case means losing sight of the object of investigation (i.e., the intentional action). Every approach that attempts to integrate the explanations of complex human behavior into one theoretical model is in danger to do so.

Personal Psychology Is not Self-Contained

We do not learn from personal psychology which forces change personal beliefs and values. Actually, we are even unable to describe these forces properly. For example, whereas the inevitable logic of a convincing argument is describable within a personal psychology, cognitive processes of persuasion (i.e., why a certain person actually feels forced to agree with an argument whereas another person does not) are already outside this logic. The individual increase or decrease of personal values, to give a second example, cannot be understood within a personal psychology: We are not able to cancel a wish of ours intentionally, just because we realize that it cannot be fulfilled (see, e.g., Brandtstädter, 2000). Especially in the domain of judgments, a lot of evidence shows that there are several factors influencing judgments in a way that cannot be described within a rational calculus.

To summarize so far, there is a need for a description of higher cognition (e.g., judgments) in the language of personal psychology. This language, however, provides more of a description than an explanation (the connectedness problem), it is not self-contained, but the link between this level of description and the mechanics of a causal system is not a simple one. How do psychologists in general and social-cognitive judgment researchers in particular account for this duality?

Bridging Invisible Gaps: (Social-)Cognitive Solutions

(Social-)Cognitive theories on judgment and intending proceed from two starting points: First, it is clearly seen that judgments or intentions are phenomena within personal psychology: A person judges or intends on the basis of evidence, beliefs, and goals, according to the rules of a psychological calculus. Second, dual-process theories emerged as response to the permanently growing evidence that the causal factors fueling these processes, which are outside of personal psychology or—to put it the other way around—which can only be described within a subpersonal psychology, do in fact moderate or shape (personal) judgments (our third problem given previously). How should we reconcile these two perspectives? Actually, we see three attempts.

The Hybrid Approach

In a rough picture, dual-*process* theories tend to explain behavior by reference to a hybrid creature: Given some specified circumstances or predictors, behavior is seen as the result of rather automatic processes and can purely be explained within a subpersonal framework. When unobtrusive priming with the age stereotype modifies the speed of walking (Bargh, Chen, & Burrows, 1996), we are confronted with the challenging task to explain this perception–behavior link, but we can do so without reference to the mysteries of the "person." The same rationale applies if we observe that consumers tend to pick a product that is placed on the right hand side (Nisbett & Wilson, 1977). We have to build a story about why it is the right-hand side, but there is no need to refer to the person. By way of contrast, given other circumstances, a judgment or an action is described as a full-blown rational act of a per-

son. From the hybrid approach, we can even put the two components in opposition. The punch line of the Nisbett and Wilson story was that the *individuals* claimed to have *chosen* a product because of some plausible *reasons*, whereas Nisbett and Wilson could claim (in our terms) that a *biological system* has *picked* the right-most of almost identical items because of some *built-in or learned mechanism.* It should be obvious that the hybrid approach does not contribute much to uncover the mysteries of the personal–subpersonal *gap*.

The Interface Approach

Individuals act or judge *not* on the basis of all beliefs that are in principle available to them. It is a subset of those beliefs accessible at the moment that will enter into considerations. In addition, individuals act according to personal values and evaluations. We can add, to values and evaluations as they are at the moment of deciding, judging, or intending. There is a lot of room to specify within a subpersonal psychology what determines accessibility (e.g., recent presentation) or variations in evaluation (e.g., evaluative conditioning). Thus, this approach describes an interface between a personal and a subpersonal perspective by reference to a representational system with parameters of, for instance, accessibility and valence, which in some sense have a double character: *Accessibility* can be clearly defined as a parameter within subpersonal psychology (e.g., via activation in a network representation) *and* it has a clearly defined role in personal psychology ("Oh, you bought a new iron today! Why didn't you take into account that the store has announced a 20% discount on all products for tomorrow?" "My god, I did know that, but it was completely lost to me!"). In a similar sense, within subpersonal psychology *valence* can be defined as a feature of object representations that might have some special process qualities (e.g., Fazio, 1990) and it has a clearly defined role in personal psychology.

The interface approach is best suited to account for those phenomena doubtlessly outside the explanatory range of personal psychology (automatisms, "cognitive reflexes," etc.), that, however, contribute to our understanding of phenomena described in terms of personal psychology (see also Wentura, 2005). Let us illustrate this by an example inspired by Englich and Mussweiler (2001; see also Strack & Mussweiler, 1997). We can describe, for example, the behavior of judges completely in personal terms: They base their verdicts[1] on a weighting of all evidence they know of (i.e., all evidence that they remember at the moment they judge). They consider arguments, they ask other individuals (witnesses, lawyers, experts, etc.), and they deliberately decide in the end. However, the why-&-when of remembering facts, of weighting arguments, and so on is outside the range of explanation of a "personal" psychology. For the subpersonal part of the story, we have to assume that the beliefs about the case are represented in memory. Representations are characterized (among other aspects) by the parameter of accessibility, which can be understood as the probability that the given representation will enter into the current information processing (if it is in principle applicable). The parameter of accessibility can be manipulated by processes that can be completely understood without reference to such a mysterious thing like a person, for example, by flashing belief-associated symbols onto a screen the person is looking on.

The interface works in both directions. Let us explain by continuing the example (see Englich & Mussweiler, 2001): Assume that our judge hears the final speech of the public prosecutor who demands a sentence of 2 years. Probably, the judge will spontaneously react with some thoughts about whether the claim is appropriate. Knowing that individuals tend to follow a positive test strategy (Klayman & Ha, 1987), the judge will retrieve facts about the case that speak for this claim. This is completely a personal psychology story. However, "retrieving a fact from memory" is an interface concept. For example, in a subpersonal theory of memory the process of retrieving a representation might have the aside that the accessibility of this representation is temporarily increased, with the consequence that the corresponding fact will determine the subsequent verdict of the judge with high probability.

The "As If" Approach

The most demanding approach tries to build a complete cognitive system around phenomena of judging, intending, and acting. It goes like this: Saying that a *person* has made a judgment according to some *beliefs* of his or hers—which is clearly personal psychology talk with all its intricacies—has a correspondence at the level of subpersonal psychology. Because personal psychology descriptions and explanations are inherently concerned with meaning and semantics, but the cognitive apparatus is inherently a machine driven by the syntax of its components (see Dennett, 1987), it is the task of (cognitive) psychology to find out how a system must be designed such that its syntax-driven behavior mimics behavior that can be plausibly *interpreted* as intentional acts of a personal agent. The system behaves "as if" it is a person. That is a very demanding task (actually, the time-honored mind–body problem is hidden within it). For example, it is not self-evident that concepts which play a role in the personal psychological description of a given event (e.g., a certain *belief* that we ascribe to a person to understand his or her behav-

[1]The example is based on German law. Verdicts are given by the judges and not by a jury.

ior) have a structural representation (e.g., symbols in a proposition-like format, the *belief') within our cognitive apparatus. Of course, that is a good starting point if we remain aware that the semantics of a belief cannot be identical to the syntactical properties of the representation of that belief (the belief').*

The natural theoretical enemy (a built-in temptation, as it were) of the "as if"-approach is the homunculus—this little creature that acts, intends, chooses, or judges within the system. Finally, any component of the "as if" system has to be homunculus free. But up to this end, a divide-&-conquer strategy might be successful. Actually, this is an ubiquitous strategy in cognitive psychology: Take for example Baddeley's well-known working memory model (e.g., Baddeley, 2002) with its components *phonological loop* and *visual scratch pad*—which are fairly well understood at a subpersonal level—on one hand and the *central executive* on the other hand—an entity that is suspected to have homunculus qualities. The strategy can be successful as long as it is acknowledged that some components are yet not fully understood and there is no danger of an infinite regress (which would be the case if the *central executive* would need a *working memory* to fulfill its duties).

How can we categorize the approaches of Deutsch and Strack (this issue); Kruglanski, Erb, Pierro, Mannetti, and Chun (this issue); and Sherman (this issue) with regard to this taxonomy?

The Dual-System Approach by Deutsch and Strack

Deutsch and Strack's (this issue) approach is clearly driven by the goal to reconcile the personal psychology of judgments with the automatic processes that moderate judgments. Certainly, with their dual-*systems* approach they want to go beyond the hybrid theories that are known as dual-*process* approaches. There are two readings of their approach.

One reading is that the theory comprises the dual languages of personal and subpersonal psychology (while ignoring the conceptual duality). Seen from this angle, the approach is in fact an interface approach and the reflective system (RS), which then reflects the qualities of a person, is not commensurable with the impulsive system, which explains the automatisms that moderate judgments. Some sentences support this perspective (e.g., "[The RS] generates judgments, decisions, and intentions," (Deutsch & Strack, this issue); "The RS is endowed with a process of *intending,*" (Deutsch & Strack, this issue). The second reading is that their dual-systems approach is an "as if" approach, that is, it can be seen as the attempt to construct a complete cognitive system in the subpersonal language, which finally behaves in a way that makes a description of the behavior in terms of personal psychology seem plausible. Seen from this perspective, the RS in particular is yet underspecified. But, as we have argued here, this might be acceptable given a divide-&-conquer strategy: Then, the IS encompasses the mechanisms that are fairly well understood within subpersonal cognitive psychology, whereas the more complicated and less well understood processes are located in the RS.

The Unimodal Approach by Kruglanski and Colleagues

Do Kruglanski and colleagues (this issue) want to entirely discard the dual character of human beings as individuals and biological systems? Possibly not. Given our taxonomy, Kruglanski and colleagues rather attempt to paint an "as if" picture. They draw heavily on the idea of production system architectures in computer science. A production system is one (of many) conceptualization of a universal machine (the famous Turing machine is another). That is, a machine that consists of a list of if–then rules and an interpreter that processes the "then" part if the "if"-part of a rule is true can calculate anything. For a long time, cognitive psychologists have seen production systems as a possible candidate for a general cognitive architecture, with Anderson's ACT-R model as its most famous instantiation (see Anderson, 2005; Anderson et al., 2004, for the most recent descriptions).

The approach is especially appealing because the authors correctly claim that if one goes beyond personal psychology, into the subpersonal sphere, there is no principle need for a qualitative shift between the theoretical description of phenomena that are outside the range of a personal psychology (i.e., automatic behavior, "cognitive reflexes," etc.) and the "as if" description of phenomena that are established within personal psychology (e.g., an elaborated, reflective judgment). It follows from the arguments just presented, however, that there is the danger of confusing theoretical languages: A person follows a rule while judging. A system instantiates a rule.

The Quad Model by Sherman

Recent years have seen a growing body of research on so-called indirect (or implicit) measures of the constructs central to subpersonal social-cognitive psychology. This was an indispensable step, because first and foremost we have nothing but those measures related to that level of theorizing (see also Wentura & Rothermund, in press): If a given theory

includes assumptions about accessibility and its role in judgment, it is necessary to have an independent measure of accessibility (see, e.g., Strack & Mussweiler, 1997, who used the lexical decision task in the context of their model of anchor-moderated judgments, which was hidden in our judge example given previously). If a theory includes assumptions about the automatic activation of evaluation upon presentation of attitude-related symbols, it is necessary to have an independent measure of automatic evaluation (see, e.g., Fazio, Sanbonmatsu, Powell, & Kardes, 1986, who invented the affective priming task for this purpose). Verbal data, which are the most natural measure for a personal psychology, are far too distant from the (subpersonal) process under consideration to be satisfying: It takes a long story to predict a verbal utterance solely in terms of subpersonal cognitive psychology! Without a doubt, a very elaborated "as if" theory is needed to do that job! To the contrary, a paradigm like the affective priming task can be easily linked to the concept of automatic evaluation by a simple small-scale theory of the underlying processes (see, e.g., Klauer & Musch, 2003; Wentura & Rothermund, 2003).

Given the necessity of indirect measures, it is of course a valuable task on its own to establish valid small-scale theories of those measures. For example, Rothermund and Wentura (2001, 2004; see also Wentura & Rothermund, in press) opened up a discussion about the valid small-scale theory of the Implicit Association Test. We do not want to recapitulate this discussion here. But we can discuss Sherman's (this issue) contribution in the same spirit. He refers to the well-known assumption that measures can often be traced back to processes that are not under the control of the participant (automatic components) as well as to processes that are (controlled components). Again painting a very rough picture, we can claim that only the automatic components are of interest, because they are the only ones that can be easily understood within a subpersonal cognitive psychology. (What corresponds to the personal "control" in a cognitive system?) For some paradigms, we know that the choice of simple parameters of the task makes all the difference: For example, by presenting a related prime, Neely (1977) found that semantic priming effects with short stimulus onset asynchronies result from automatic processes that increase the accessibility of the target concept, whereas priming with longer stimulus onset asynchronies can be suspected to have a component based on participants' expectancies. For the Implicit Association Test, there is no such parameter. Sherman (this issue) tries to solve this problem by multinomial modeling. If he succeeds, this kind of modeling will certainly by a valid tool in social-cognitive research.

Conclusions

Psychological theorizing inherently has a dual character that is given by the two perspectives on human beings as individuals and human beings as biological automata. Many psychological phenomena are given or established by the perspective of human beings as individuals, including phenomena that are of special interest in social cognition research (e.g., judgments). From that point of view, a personal psychology perspective is indispensable at least to describe the phenomena of interest. However, psychologists are interested in the "mechanics" that are behind a complex behavior described as an act of, for example, judging. Therefore the leading theories are phrased in the language of subpersonal cognitive psychology.

The dual-system approach of Deutsch and Strack (this issue) mirrors the dual character of psychology. However, the approach appears somewhat undecided: Some aspects of the reflective system seem to have person-like qualities, which would make it incommensurable with the mechanics of the Impulsive system. If, however, the reflective system is meant as a subpersonal cognitive system (and we think the authors had this in mind), the authors must be aware of the traps that are inherent in any attempt to "translate" personal psychology in the most straightforward way into the cognitive language (e.g., a "belief" translated into a "string of symbols"). The same applies to the approach of Kruglanski and colleagues (this issue) who correctly claim that if one goes beyond personal psychology into the subpersonal sphere, there need not be a qualitative shift. Thus, in conclusion, what is contrasted (uni- vs. dual-approaches) seems at the end to be of a similar character. It is interesting to note that although we are not very much concerned with the developments of Anderson's ACT-R approach (see Anderson, 2005; Anderson et al., 2004), both the dual-process as well as the unimodal approach reminded us of that general cognitive architecture. This should be evident for the model of Kruglanski and colleagues (this issue), who apply the same basic mechanism and who explicitly refer to Anderson's work. But it appears to us that the dual-system approach can benefit from this analogy as well. As we have argued, the RS is somewhat ambiguous. The success as an "as if" system depends on its power to simulate higher cognition with all the moderations that stem from lower processes. As far as we can see, the Anderson group has comparable goals (albeit in somewhat different domains of content), and it has powerful tools for simulation.

In our view, the Quad Model of Sherman (this issue) focuses on a somewhat different spot in the research process. With the multinomial model, Sherman tries to separate automatic and controlled components of measurement tools. This is highly valuable, because we

need variables that can be plausibly interpreted within subpersonal theorizing. As the name suggests, *controlled processes* are processes that carry with them the burden that we partially attribute them to a person who intentionally controls the behavior.

Note

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Understanding Social Judgment: Multiple Systems *And* Processes

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The venerable dual and multiprocess models that have guided work on attitudes and social cognition for the past few decades (see Chaiken & Trope, 1999) have been challenged recently on one hand by those who claim that there is really only one fundamental process of judgment (e.g., Fishbein & Middlestadt, 1995; Kruglanski, Erb, Pierro, Mannetti, & Chun, this issue; Kruglanski & Thompson, 1999) and on the other hand by advocates of newer systems approaches (e.g., Kahneman, 2003; Lieberman, 2003) that try to subsume the earlier frameworks. Indeed, the claim of some systems theorists is that "the most important strength of dual-system models is their ability to integrate theory and research in the realm of existing dual-process models" (Deutsch & Strack, this issue, p. 168). In this commentary we argue that there is room for both multiprocess and multisystem approaches, because processes and systems are somewhat distinct beasts (although some have used these terms interchangeably; e.g., Kokis, McPherson, Toplak, Stanovich, & West, 2002). If systems and processes are distinct, then it is not clear that systems perspectives make process approaches unnecessary.

In this commentary we first reinforce our belief that a single-process framework is not the most fruitful way to account for social judgment (see also Petty, Wheeler, & Bizer, 1999). Next, we examine the evidence for multisystem frameworks and conclude that although it is quite plausible that there are multiple systems that contribute to social judgment, the purported criteria for establishing different systems are not entirely convincing. Nevertheless, in accord with Sherman (this issue), we conclude that a consideration of both multiple systems and processes is the way to make the most progress in understanding the judgmental and behavioral phenomena of interest to social psychologists.

Single Versus Multiprocess Models of Judgment

We begin our discussion with Kruglanski and colleagues' (this issue) unimodel. Perhaps the key difference between the unimodel and multiprocess models such as the Elaboration Likelihood Model (ELM; Petty & Cacioppo, 1986; Petty & Wegener, 1999) is in how one thinks about psychological processes. Social psychologists are enamored with theories and with process considerations. Recent issues of major social psychology journals have taken on the topics of what makes for a good theory (see *Personality and Social Psychology Bulletin,* February 2004) and what are the best ways to go about establishing a postulated process (e.g., moderational vs. mediational tests; see Muller, Judd, & Yzerbyt, 2005; Spencer, Zanna, & Fong, 2005). Theories and processes are inextricably linked in social psychology in that our theories specify the processes by which variables have their effects. But what is a process? Simply put, a process is a means of bringing something about (turning straw into gold; turning a negative attitude into a positive one). *Webster's Unabridged Dictionary* (J. L. McKechnie, 1976) defines *process* as "a method of doing something generally involving a number of steps or operations" (p. 1434). For example, one might have discovered that putting people in a positive mood or exposing them to an attractive source can make attitudes more favorable than when in a negative mood or with an unattractive spokesperson, but why does this occur? Table 1 outlines some causal sequences that are possible according to the ELM.

As Table 1 makes clear, Kruglanski and colleagues (this issue) make an error when they characterize the ELM as asking, "when do message arguments, versus *peripheral* or *heuristic* cues, impact opinions" (p. 153), as if the ELM suggests that some variables invariably serve as arguments whereas *other* variables invariably serve as cues. Rather, as explained in some detail in a previous exchange (see Petty et al., 1999), and illustrated in Table 1, the ELM holds that any *one* variable (e.g., mood, source attractiveness) can serve as an argument or a cue and serve in several other roles as well, depending on the situation. However, assessing the processes by which variables can affect attitudes often involves measuring some content rather than the process directly. For example, if an attractive source is postulated to motivate people to generate positive thoughts, and integration of these positive thoughts into an overall evaluation produces the favorable attitude (Process 4 in Table 1), we do not measure the generation process or the integration process per se (i.e., without more advanced techniques, we cannot see the thoughts coming to mind or being integrated). Rather, we assess the content of what is generated and integrated—the positive thoughts. It is indeed difficult to find pure measures of the cognitive processes themselves (Jacoby, 1991).

Table 1. *Possible Processes by Which a Visually Attractive Source Can Lead to More Favorable Attitudes in a Shampoo Ad Presenting Five Cogent Reasons to Buy the Product*[a] *Compared to an Unattractive Source*

1. ATTRACTIVENESS PROCESSED AS A CUE (Peripheral process)
   Attractive source → positive affect associated with product → If I feel good, then I like it (if-then).
2. ATTRACTIVENESS PROCESSED AS ARGUMENT (Evidence)
   Attractive source → infer that the shampoo makes your hair very clean → if it gets my hair clean, I like it (if-then).
3. ATTRACTIVENESS MOTIVATES MORE THINKING (Extent of thinking—Objective Processing)
   Attractive source → instills curiosity about message → increased thinking → more positive thoughts to the strong arguments → if many positive thoughts, then I like it (if-then).
4. ATTRACTIVENESS MOTIVATES POSITIVE THINKING (Direction of thinking -Biased Processing)
   Attractive source → motivated to like the recommendation → generation of positive thoughts → if many positive thoughts, then I like it (if-then).
5. ATTRACTIVENESS VALIDATES THOUGHTS (Self-validation process)
   Attractive source → enhances confidence in thoughts → if thoughts positive and confident in them, then adopt favorable attitude (if-then).

[a]For example, arguments included: "has a top conditioner," "vitamin enriched," and so forth.

Notably, the ELM does not dispute that rule-based reasoning can be involved in lots of judgments (and lots of judgmental processes can be described within a rule-based framework). For example consider the possible processes outlined in Table 1. In this table we outline some ways in which an attractive source featured in a shampoo advertisement might make attitudes more favorable toward the shampoo. In this example, the variable of interest is always the same attractive source who presents some information about the shampoo. Thus, there are no confounds across the postulated conditions in complexity, order of presentation, and so forth, with respect to the key variable of interest.[1]

In each of the processes we have inserted an if–then reasoning step. Does this render the mechanisms by which an attractive source produces persuasion the *same* for each of the possibilities outlined in Table 1? We think not, but why should we consider the processes as fundamentally different? First, there are different discrete steps involved in the five postulated processes. For example, in Processes 1 and 2, people are not postulated to think about the verbal arguments presented. Processing of the attractive source, either as an argument or a cue, is sufficient to produce the attitudinal judgment. When two postulated processes involve qualitatively different events, we think it makes sense to view them as different. To take a well-worn example, the fact that dissonance processes (Festinger, 1957) involve a step in which people experience unpleasant arousal whereas self-perception processes (Bem, 1972) do not is sufficient to regard dissonance and self-perception processes as qualitatively different mechanisms of attitude change (see also Petty & Cacioppo, 1986; Spencer et al., 2005; Wegener & Carlston, 2005).

A second reason to see the processes as different is that separating the processes allows us to make unique predictions (e.g., about moderating conditions). Consider the cue versus argument process alternatives (1 vs. 2). If attractiveness is processed as a cue, then it will have a positive effect on attitudes regardless of the product under consideration, because the cue effect is unidirectional (i.e., attractiveness is always good as a cue). However, if attractiveness is processed as an argument, then it will have a positive effect for some products but not for others (e.g., an attractive source provides persuasive visual evidence for the merits of a beauty product but not for an air conditioner). So, it is important to know by which process attractiveness is working. Focusing on the if–then commonality does not allow for this differentiation. The ELM predicts that the cue process should operate when motivation or ability to think are low and thus, in a highly distracting environment, attractiveness would work just as well for shampoo as for an air conditioner or a car. However, in a high-thinking environment, attractiveness would work for the shampoo (and other beauty products) but not for beauty-irrelevant products.

Note that in each of the causal chains in Table 1, the final step can be described as involving if–then reasoning. Because of this, Kruglanski and colleagues (this issue) hold that there are no qualitative differences in the processes. However, seeing them as the same process ignores what comes *before* the final if–then syllogism. In our view, focusing only on the if–then aspect of the steps above does not help us much in understanding the mechanisms of persuasion. Readers might test themselves to see where they stand on the classic issue just mentioned. Specifically, if you believe that it is more fruitful to see dissonance and self-perception

[1]Kruglanski et al. (this issue) note that in some prior research on the ELM (and the Heuristic-Systematic Model [HSM]; see Chaiken, Liberman, & Eagly, 1989), the information processed as a "cue" versus as an "argument" differed in several ways. For example, the variable processed as a cue (e.g., an expert source) was shorter, less complex, presented first, and so forth, compared to the variable processed as an argument (e.g., a list of eight verbal reasons to favor the product). In the example presented in Table 1, as in some prior research (e.g., Petty & Cacioppo, 1984a, 1984b), these confounds are not present. That is, the same information (i.e., an attractive source), presented at the same point in time is processed as a cue, an argument, or serves in other roles allowed by the ELM (see also Wegener, Clark, & Petty, 2006).

as fundamentally the *same* process (differing only in degree) because both involve some if–then reasoning, then you are a unimodel fan. If you think that it is more fruitful to see these as qualitatively different processes that work in different situations with differing outcomes (e.g., Fazio, Zanna, & Cooper, 1977), then you are not a unimodel fan.

But how does the unimodel account for data generated by multiprocess frameworks with just one process? It may seem that by proposing five distinct roles that variables can play in persuasion situations, the ELM is less parsimonious than the unimodel. However, to deal with the complexities involved in persuasion, the unimodel introduces multiple "parameters," five of which were identified as relevance of information, task demands, cognitive resources, nondirectional motivation, and directional motivation. It is interesting that each of these parameters was highlighted earlier in the ELM and is, in fact, a core part of the theory. The subjective relevance of the information is what the ELM refers to as whether the evidentiary value of a variable processed as an argument leads it to be seen as strong or weak. Task demands and cognitive resources are what the ELM refers to as one's ability to process. The unimodel subdivides motivation into nondirectional and directional categories, which the ELM refers to as relatively objective versus biased processing. Furthermore, ability and motivation together determine the extent of thinking in the unimodel just as it determines the extent of elaboration in the ELM (elaboration likelihood). Finally, all of the persuasion predictions of the unimodel (e.g., the impact of relevant information increases with greater processing resources; the impact of simple to process information increases with reductions in resources, etc.) are totally compatible with (and have been made previously by) the ELM.

As desirable as a true unimodel might be, and as much as we truly admire Kruglanski and colleagues' (this issue) attempts to formulate one, we think that ultimately this effort is not likely to foster enhanced understanding of the phenomena of interest to social psychologist beyond that already provided by the existing models—at least in the domain with which we are most familiar, persuasion.

Single Versus Multiple Systems of Judgment

Although dual-process models have been popular for decades, over the past several years there has been a growing shift in terminology from *dual-process* to *dual-system* approaches. Whereas theories popularized largely in the 1980s such as the ELM, HSM, the dual-process model of impression formation, and so forth initially attempted to outline the fundamental mechanisms that contributed to judgments in particular judgmental domains, the more recent dual-system models are cast more broadly. Sherman (this issue) therefore refers to the dual-system models as "generalized dual-process models" (p. 177). However, because the earlier dual-process models could be and have been applied beyond their original domains, we do not see generality across domains as a sufficient reason to differentiate system from process approaches. Another difference is that whereas the first wave of dual-process theories focused largely on predicting new effects, the current dual-system models have a mountain of effects that they can try to explain. But the earlier models also attempted to explain prior data, and the newer models also make new predictions, so this too is not a reason to distinguish them. One of the most striking differences between the older process models and the more recent system models is that the newer models focus not on individual processes but on "regularly interacting groups of processes" (Deutsch & Strack, this issue). Second, the system models typically relate these groups of processes to some underlying mental architecture (e.g., memory systems, Smith & DeCoster, 2000) and/or specific brain structures (e.g., Lieberman, 2003).

Perhaps of greatest interest to the current issue, recent system articles have attempted to subsume the prior process models. We believe that although it makes sense to relate systems to processes, it is useful to keep some conceptual distinctions. Indeed, there are many kinds of systems that have been postulated to be involved in human judgment: affective versus cognitive systems (Zajonc, 1980), perceptual versus knowledge systems (Sloman, 1996), approach versus avoidance systems (Cacioppo, Gardner, & Berntsen, 1999), along with the automatic/impulsive and controlled/reflective systems that are at the center of this issue (see also Carver, 2005).

Deutsch and Strack (this issue) nicely outline the arguments for a dual-systems approach, and we comment on each of their points next. They first argue that dual-systems approaches, such as their own Reflective-Impulsive Model (RIM) subsume dual-process models such as the ELM and HSM. However, they argue that just one of their systems—the Reflective system—"generates both heuristic and systematic judgments, and the intensity of thinking is a function of people's motivation and capacity" (p. 168). Indeed all models, including the unimodel proponents, would likely agree with this statement with respect to explicit judgments. To complete an explicit judgmental scale requires some degree of reflection. In terms of understanding how variables affect attitudes and other judgments, however, locating the process within one system, though potentially correct, doesn't get us far enough. That is, to assert that all of the mechanisms identified in Table 1 end up with an if–then inference

generated by the reflective system is not completely satisfying if one's goal is to understand the more precise steps in going from some variable of interest (attractive source, mood) to an evaluative judgment. Thus, the systems framework needs to be supplemented by multiprocess frameworks pitched at a more microlevel of analysis.

Second, Deutsch and Strack (this issue) note that their systems framework can be related to "distinct brain structures." Even if this is true, it is not clear that distinct brain structures necessarily imply that different processes are going on in the structures (Cacioppo et al., 2003; Dunn & Kirsner, 2003). For example, some larger houses have separate heating systems for different zones, such as one system for the right side of the house and one for the left. Nevertheless, the existence of two separate systems that can operate independently in one house does not mean that they operate via different mechanisms or processes (much as the processes of motor control of the right and left brain in one body are the same, though the two sides of the body are capable of independent movement).

Third, the systems framework is argued to provide an account of why controlled (explicit) and automatic (implicit) measures of social judgment predict different kinds of behaviors (spontaneous vs. deliberative, respectively). That is, the dissociation "reflect[s] the differential input from the two processing systems" (p. 169). Although this account is a reasonable one, it is important to note that the fact that explicit and implicit measures predict different things does not necessarily indicate that different systems are involved. Rather, there is matching of the measurement conditions to the behavioral situation (i.e., spontaneous measurement predicts spontaneous behavior and controlled measurement predicts controlled behavior; Vargas, 2004). This matching result also holds true *within* the category of explicit measures. Thus, measures of affective evaluation (pleasant–unpleasant) versus cognitive evaluation (useful–useless) predict behavior better in affective (consumatory) than in instrumental (cognitive) situations (and vice versa; see Millar & Tesser, 1992). Of course, one could take this as evidence that affect and cognition represent separate systems themselves—even though both are assessed with reflective measures. But then, solely within the cognitive domain, measures focused on "price " would presumably predict more variance in behavioral situations where price was salient, whereas measures focused on "image " would predict better in behavioral situations where image was salient. Again, one could take this as an indication of the existence of price versus image systems, or simply of the importance of matching the judgment assessment conditions to the behavioral assessment conditions so that similar inputs come to mind and drive each outcome.

Fourth, Deutsch and Strack (this issue) argue that perhaps the most compelling evidence for dual-system theories comes from the domain of self-regulation, which often entails conflicts between systems. Other systems theorists have also emphasized conflict as providing evidence for the dual-system approach. Sloman (1996), for example, noted that optical illusions can suggest that the perceptual and knowledge systems tell you different things. Logically, one can understand that two lines are the same length (knowledge system), even if they do not look that way (perceptual system). Sloman also gave an example of contradictory responses to an advertisement based on affective associations versus more cognitive considerations like price. He explained, "the fact that people are pulled in two directions at once suggests two forces pulling " (p. 19). Does the presence of conflict necessarily indicate the operation of two separate systems? Consider that emotion researchers have argued that one can have conflict not only between the emotional and cognitive systems but also *within* the emotional system (e.g., feeling "bittersweet"; see Larsen, McGraw, & Cacioppo, 2001). Likewise, conflicting cognitive associations can come to mind quickly and cause conflict even though the cognitions (e.g., the car is prestigious but expensive) each presumably reside within the same system (e.g., Priester & Petty, 1996; see also, Newby-Clark, McGregor, & Zanna, 2002).[2]

Finally, Deutsch and Strack (this issue) note that automatic inputs from one system (Impulsive system) can come to mind and interfere with the judgmental processes of the other (Reflective system) system. Like the aforementioned conflict notion, this phenomena too seems to suggest different inputs from different systems. However, such interference effects can also occur within one system, such as when learning an initial list of words (but not to the point of automaticity) interferes with learning a later list of words even though both learning processes took place by the same mechanisms within the same system. (i.e., proactive interference). If so, the interference criterion does not provide unique evidence for the dual-systems approach.

In sum, Deutsch and Strack highlight a number of sensible predictions that one might make from a dual-systems approach, such as (a) if dual systems exist, different measures should predict different behaviors; or (b) if dual systems are in operation, one can see different areas of the brain activated; or (c) if dual systems exist, there will sometimes be conflict between the outputs of the systems; or (d) if dual systems exist,

[2]Of course one can maintain a systems approach by arguing that the conflict in these cases stem from the collision of the positive versus negative or approach versus avoidance systems rather than the affective/cognitive or rational/intuitive systems (e.g., Cacioppo et al., 1999).

they can interfere with each other. However, just because these consequences would be expected if dual systems exist does not mean that if these consequences exist, we can infer the presence of dual systems. This is the logical error of affirming the consequent.

The Quad Model: Multiple Systems and Processes

Sherman, in the third target article in this issue, postulates both systems and processes. Although Sherman makes some of the same unfortunate mischaracterizations of the ELM, as does Kruglanski (e.g., the ELM was never a content dissociation theory; see Petty & Cacioppo, 1986), and presents some new misunderstandings (e.g., assuming that the dual routes to persuasion map onto automatic and controlled processes that cannot co-occur), we agree with the overall conceptual position about psychological processes that is at the heart of his framework—especially the caveats with which he opens the target article. That is, we agree with Sherman's suggestion that there are multiple systems and multiple processes within each system (and perhaps processes that cut across systems).

In addition, Sherman challenges the view that two is a magic number when it comes to either systems or processes, and we agree because the number of processes or systems that make sense will depend on one's purpose. What are you trying to explain, and what are the best criteria by which to lump and to split when distinguishing processes and systems (Petty et al., 1999)? For example, in the ELM, various cue processes (e.g., mere association, reliance on heuristics) are lumped together, not because there are not some meaningful distinctions that might be made among them but rather because the antecedent conditions that foster use of these processes (low motivation or ability to think), the impact the process has on judgment (main effect unmediated by issue-relevant thoughts), and the consequences they have (e.g., producing relatively weak attitudes that are not very resistant to change) are similar.

We also agree with Sherman (this issue) that it is important to distinguish processes not only when the two processes lead to different outcomes (as when their outputs collide) but also when different processes produce the *same* outcome. Sherman notes, for example, that if two people appear to be unprejudiced on an implicit measure, it is important to know if they are activating equally positive associations to the ingroup and outgroup, or if it is just the case that they are very good at inhibiting negative reactions to the outgroup. Just as cue processes and elaboration processes in the ELM can produce the same positive judgment (see Table 1), so too, in the Quad Model, can different processes produce the same judgment.

Although we agree with the overall conceptual position articulated by Sherman, his use of the term *process* does not appear to map directly onto our own. For example, in our framework "detection" or "correction of bias" are not in and of themselves processes. In some sense, each is more akin to a goal (e.g., I aim to detect the correct answer, or I am trying to avoid bias). The particular way in which one goes about implementing these goals can vary. Consider self-regulation or correction of bias. Correction can occur in a variety of ways. Effortful recomputing of one's judgment can be a debiasing strategy (Strack & Mussweiler, 2001) as can subtracting out the contaminating thoughts (Martin, Seta, & Crelia, 1990). Relying on a naïve theory of the magnitude and direction of the bias to make an adjustment is a third approach (Petty & Wegener, 1993). These bias correction strategies involve different steps and can lead to different predictions (see Wegener & Petty, 1997, for a review). When bias correction is viewed as a goal, it becomes more clear that it can be carried out in different ways (i.e., refers to a family of processes). Most notably, perhaps, Sherman acknowledges that bias correction (self-regulation) processes can be controlled or, with practice, become automatic. Thus, bias correction is independent of, or cuts across, the automatic/controlled distinction. Similar points might be made about the other processes Sherman identifies.

Conclusions

Each of the target articles in this issue has made valuable contributions to understanding social judgment and each has enriched our own thinking. The articles share various ideas as well as conflict in certain ways. Deutsch and Strack *partially agree* with Kruglanski's unimodel in that they locate judgment formation as syllogistic reasoning exclusively taking place in the reflective system. Thus, from their point of view, theories of judgment all are incorporated within the reflective system. However, to argue that there is one system largely responsible for the formation of explicit judgments does not mean that this system relies on just one meaningful psychological process. Again, from our point of view we can agree with Deutsch and Strack and Kruglanski that some form of syllogistic (or reflective) reasoning is likely involved at some point in the formation of explicit judgments. Nevertheless, we believe that it is useful to distinguish the qualitatively different steps that can be involved in producing a judgment under different conditions (see Table 1) and the qualitatively different inputs from multiple systems (affective/cognitive; approach/avoidance; perceptual/knowledge; impulsive/reflective) that can be involved.

In accord with Sherman (this issue), we believe that various systems models entail "multiple processes" (p. 173). Because of this, the systems perspective *cannot* replace the processes perspective, because one can still enumerate processes within and across systems. To the extent that the enumerated processes are still useful in explaining phenomena of interest, the processes should be retained. The systems approach can be valuable to be sure. Our point is that the new systems perspectives, valuable though they may be, do not imply the replacement of the earlier process perspectives. We can have both systems *and* processes.

Note

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One, Two, Three, What Are We Fighting, Four?

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Way back in the 1960s when it was fashionable to protest seemingly unjustifiable wars, the musical group Country Joe and the Fish posed the rhetorical (musical) question, "And it's one, two, three, what are we fighting for?"[1] It was rhetorical in the sense that Country Joe let us know in the next line that he did not want an answer because he *did not give a damn* (maybe he just needed a rhyme for *Vietnam,* but what he probably meant was, "Why answer, because if its unjustifiable there is no answer"). In this issue we find ourselves ensconced in a much different type of battle (given merely careers, not lives, are at stake) between wholly justifiable process models of human cognition (okay, careers are not at stake, only theoretical ideas). Here we ask a similar question: "Is it one, two (does someone have a three) what are we fighting, four?" The battle rages between whether four processes, two processes, or one process can best explain social cognition. Like Country Joe, we respond with an enthusiastic, "Don't ask us, we don't give a damn."

Yet the editors did ask us, and we agreed to write this, so obviously we give a damn about something. It just does not happen to be how many processes can best describe social cognition. It smacks a little too much of the old TV show *Name That Tune*: "I can explain social cognition in one process (the übermodel)." No, we agree with Jeff Sherman (and not because he is the only one among the authors of the target articles still with editorial responsibilities at a major U.S. social psychological journal) that "the question of How Many is a tricky one. The fundamental problem is that the designation of any particular number of processes as the real or important ones is bound to be somewhat arbitrary" (Sherman, this issue). As the very attractive Sherman points out, such a goal is futile. The only real point for establishing such a number would be for metaphorical purposes, to help us illustrate basic processes in some manner that easily describes how the system operates. Any real answer would ultimately take us down to the level of the neuron and could involve any imaginable number of processes. And even then we may debate whether any real answers lie at that level of analysis. For us, the interesting questions are not whether there is one process, or four. The interesting questions are in the details—where the various approaches make similar predictions; where among them there is disagreement; and, most important, how well each accounts for existing data and makes predictions for future research regarding human judgment and action. Each does the incredibly important job of theory building and data integration after an enormously ambitious period of data generation in our field.

Just as the 1950s and 1960s generated tremendous amounts of data that yielded cognitive consistency theories, and the 1970s and 1980s generated tremendous amounts of data that yielded models of social cognition (such as the person memory model and the dual-process model, e.g., Hastie & Carlston, 1980; Hastie & Kumar, 1979; Petty & Cacioppo, 1986), the 1990s and 2000s have seen an enormous amount of research on implicit stereotyping (for reviews see Bargh, 1999; Dovidio, Kawakami, Johnson, Johnson, & Howard, 1997), goals (for reviews see Bargh & Gollwitzer, 1994; Dijksterhuis & Bargh, 2001), and attitudes (spurred by the theory building of the last period, e.g., Brewer, 1988; Chaiken, Liberman, & Eagly, 1989; Devine, 1989; Fazio, 1990; Gilbert, 1989) that needs integrating and consolidation into a coherent frame-

[1]"I Feel Like I'm Fixin' to Die Rag", words and music by Joe McDonald. Copyright @1965 renewed 1993 by Alkatraz Corner Music Co. All rights reserved. Used by permission.

work. If these frameworks turn out to be metaphors, that sits well with us (we expect a little less from models than theories), so long as they help to generate important new predictions that will yield data we will need to integrate into new models in the 2010s (which is why we attempted to do this with our own implicit volition model: Moskowitz, Li, & Kirk, 2004). In the end what is important is not the number of processes the current models offer up but the sense making the models provide. In this regard there really is no battle at all, as each of the three models provides a useful framework (not without omissions and flaws) for cataloging the data and generating new predictions. Kruglanski, Erb, Pierro, Mannetti, and Chun (this issue) are correct in asserting that at times rule-based cognition drives judgment and action, and in such cases there are differences not in kind but quantity (regarding cognitive process). However, although a one-process account may explain much, does it explain all? And is it necessary to void altogether the distinction between automatic and controlled processes based on the assumption they do not differ in kind? What is to be gained, and when is it to be gained, by considering these distinctions by posing a reflective system and an impulsive system? And should we, as the Quad Model suggests, make even finer grained distinctions between these processes? The issue is not really the number of processes but what can be explained by each approach—the utility each yields for sense making, and what sense is left unmade by each. It is to these issues we turn.

If It Looks Like a Rule Then It Must Be a Rule?

Fifteen years ago a prominent social psychologist set out to illustrate that goals operate automatically in guiding behavior. The idea was that subliminally priming a goal would trigger the goal, and the goal's activation would lead the individual to engage in relevant behaviors. A funny thing happened along the way: Our psychologist discovered that the goals that were the driving force behind the research in the first place were not found to be necessary in producing behavior. It was, instead, what James (1890/1950) called "ideomotor" behavior. Indeed, behavior that looked goal directed, and that could easily be described as goal directed, was unmediated in any way other than through the activation of concepts that included the behavior as part of the mental representation (see Dijksterhuis & Bargh, 2001). Consider another case where looks may be deceiving. Another prominent social psychologist set out to illustrate how stereotypes held toward a group by others could serve as an anxiety-evoking form of threat (Steele, 1997). Individuals otherwise skilled in a stereotype-relevant domain would underperform in that domain, supposedly due to the threat of fulfilling the stereotype that arises from the stereotype having been made accessible in some fashion. But, again, underlying process is not always as our theories dictate, even if overt responses look exactly like that predicted by the theory and the process it purports. Thus, in some cases we find that underperforming in a stereotype relevant domain is not due to threat, but to ideomotor behavior (once again)—the person simply acts in a fashion consistent with the stereotype, even if not threatened by it (see Wheeler & Petty, 2001). These are cautionary tales in considering the unimodel's contention that associations are rules: Just because something looks like it is rule based does not make it so. Several more such tales are provided by Sherman's (this issue) discussion of the fact that responses on implicit measures cannot separate the strength of automatic activation from the ability to overcome that activation. The young child who cannot yet read may produce the same overt response as the literate adult on a Stroop task, but for strikingly different reasons. Just as two people can have similar moderate responses of bias on an Implicit Association Test task, one because bias is moderate and the other because a substantial bias has been controlled. Identical responses may be driven by very different processes (Sherman, this issue).

In the unimodel's main premise, there is but one path to human judgment, one that is rule driven and based on conditional if–then statements. Even conditioned responses, those that come to occur automatically through practice and repetition (Bargh, 1990, 1994), are in the end described as routinized if–then rules. However, although it is certainly true that if–then rules were necessary before the procedure in question became routinized and are central to the process of routinization, once associations exist and may be automatically triggered, what utility remains for asserting that in an automatic response a rule is still being applied as opposed to mere spreading activation? The resulting response will certainly appear rule based and map onto the theoretical notion that judgment and action is rule based. But our cautionary tales remind us that appearances do not tell the processing story. It is more plausible that conditioning and automaticity remove if–then rules from the equation altogether, despite their necessity during routinization. Why believe that associations are more plausibly free of syllogisms despite overt appearances?

Logical rules require unambiguous input and give absolute answers (e.g., Medin, 1989; Medin & Coley, 1998). They cannot handle fuzzy input and do not give ambiguous output. To follow the rule "If a professor, then absent minded," one must know whether the target is a professor. If the input is ambiguous, the propositional system gives no answer. Social inputs are seldom unambiguous, yet people do have at least tentative

answers to most issues. The association-based processes solve this problem by varying the degree of activation as a function of input salience or ambiguity. The perceived salience of those features of the stimulus associated with the concept determines the level of activation of this concept and its associated responses. Increasing the amount of concept-related features being detected in the target increases the concept's activation level or accessibility (Higgins, 1996). This mechanism that makes the increase of accessibility incremental, rather than all or none, is lost in the reduction to rule-following processes.

A cognitive routine that follows a rule "If a professor, then absent minded" yields the absolute conclusion that a target is absent minded every time it receives the input that the target is a professor, with the same level of confidence (e.g., Medin, 1989; Medin & Coley, 1998). To accommodate the subtlety and flexibility in human judgment, Kruglanski et al. (this issue) introduced another parameter to the rule-based process: the strength in which the person believes in the rule. If the strength of belief is strong (e.g., from over learning or trust in authoritative sources), the rule-following processes are more likely to be implemented upon appropriate input. However, when one thinks about how this parameter is represented in the cognitive system, one realizes that it is suspiciously similar to the notion of association strength, which the authors are trying to move away from. Is the strength of belief used to replace association strength? Does this replacement have any benefits?

Conceding that associations, conditioning, and other implicit operations may not be rule based would by definition limit the unimodel's applicability to what Deutsch and Strack (this issue) call the *reflective system* (RS) and to what Sherman (this issue) calls *controlled processing*. Such a concession is not damning by any means. In the end, this model does an excellent job of describing the process of forming a judgment. It also provides an immensely valuable window as to how differences between research materials and procedures may have contributed at times to a belief that judgments and attitudes were being produced through two wholly different processing routes, a conclusion that in some cases may not have been accurate. Differences once thought to be of kind may merely be differences of quantity. However, this does not mean that differences in kind do not exist even within the reflective system. And indeed, as Deutsch and Strack assert, "judgment formation touches only the tip of the iceberg of social cognition, which does not occur in mental isolation, but in close interaction with memory, affect, habits, and other nonjudgmental factors" (p. 169). The unimodel acknowledges this fact by detailing a host of parameters that serve to impact the subjective judgment of relevance, parameters that include affect, goals, accessibility, resource limitations, and context. One process can at times do the work of two if we accept the parameters.

But such parameters, from our perspective, represent entire processing systems that do not necessarily operate on the single mechanism dictated by the unimodel. Indeed, as we describe next, just the one parameter of resource limitations cannot be described well by one system. The same is true of implicit processes such as ideomotor action, accessibility of concepts and goals, habits, affect activation, and self-regulation, none of which need be rule based and all of which may be qualitatively different from syllogistic reasoning. By lumping all such processes into a group called "parameters that influence the 'then'" we neatly skirt the issue of whether multiple processes exist. We believe they do and that the number runs higher than two or four.

The Impulsive System Is Unlimited?

A commonly accepted notion in social cognition, one explicitly endorsed by the Reflective-Impulsive Model is that automatic processes have no processing capacity restrictions (e.g., Bargh, 1990, 1994; Gilbert, 1989). They are boundless and without limits. In contrast stand processes that reside in the reflective system that require levels of effort that are susceptible to resource drains. Effortful processes can be short-circuited by cognitive load. Indeed, one diagnosis used in many research programs is whether load can disrupt a process; if not, one has diagnosed that process to be automatic (see Andersen, Moskowitz, Blair, & Nosek, in press). One consequence of such logic was the development of two stage models where an automatic first stage must occur (such as stereotype activation) and only controlled through subsequent action (Devine, 1989). None of the three models reviewed in the target articles discusses the important possibility that even implicit processing is subject to capacity limits, resource constraints, and cognitive load.

During day-to-day social interactions, one could be cognitively busy with various types of resources-contending tasks. For instance one may be intensively processing a focal target to the exclusion of surrounding objects (e.g., looking at a particularly interesting scene in a crowded railway station). Alternatively, one may be preoccupied with internal thoughts so deeply that one is "looking blankly" at the outside world. Do these instances of load disrupt all cognitive processes through the same mechanism? These questions have been seldom asked, because social cognitive research in mental resources often fails to specify the particular type of resources a process is supposed to depend on, as pointed out by Macrae, Bodenhausen, Schloerscheidt, and Milne (1999). The implicit assumption that a unitary pool of resources

underpins all aspects of a cognitive process has left some "caveats" in explaining certain research findings. Gilbert and Hixon (1991) noted that although their participants in the cognitive load group had to rehearse digits, their memory of features of the experiment setting, such as the stimulus person's physical characteristics (e.g., gender and race) and the font color of the word fragments, was as good as the participants in the control group. Gilbert and Hixon found this result surprising and felt the need to convince readers that the load really had worked despite the unusually good memory.

To achieve a better understanding of the resource-dependent characteristics of cognitive processes, Sherman, Lee, Bessenoff, and Frost (1998) made a distinction between perceptual and conceptual encoding of behavioral information. *Perceptual encoding* refers to the extraction of physical characteristics of the target person's behavior. *Conceptual encoding* refers to extraction of the behavior's gist and meaning. They found that cognitive load affects perceptual and conceptual encoding differently with respect to stereotype-consistent and inconsistent behavioral information. We have similarly made a distinction between perceptual resources, which are involved in encoding perceptual features of objects currently present in the environment, and resources for symbolic representation, which are specialized in representing absent or abstract objects, using internal codes as "stand-ins" (Li, 2004; Li & Moskowitz, 2006b; see Luck & Vecera, 2002; Pashler, 1995, 1998). We believe that processing stereotype-relevant stimuli (e.g., group labels or images) consumes perceptual resources, whereas the increase in stereotype concepts' accessibility following encoding of the sensory input consumes resources for symbolic representation (Li & Moskowitz, 2006b). This would explain why Gilbert and Hixon's (1991) participants could be under load for symbolic representation due to digit rehearsal yet still have excellent memory for perceptual features of the experimental context.

All three target articles talk about availability and allocation of cognitive resources, with the implicit assumption that cognitive resources are a fixed pool of energy that can be measured and incrementally depleted. However, years of research has shown that the fixed-capacity model of cognitive resources is untenable (Logan, 1990). It proves difficult to establish the maximum capacity for any type of resources; flexibility in capacity is prevalent. Recent conceptualization of cognitive resources hinges on specific cognitive structures, processes, and operations (Allport, 1989). A particular resource is limited not because it has a fixed capacity but because the cognitive processes associated with it can be applied to one task at a time to prevent mutual interference. One cannot chew gum and sing at the same time, not because of the use of certain resources hits the ceiling but because the two tasks uses the same set of structures. The same results have been found in social-cognition research. For instance, some research has shown that stereotype activation depended on cognitive resources (Gilbert & Hixon, 1991) and gets disrupted under cognitive load. Other research has shown that even under cognitive load, stereotype can be activated if the goal to repair damaged self-esteem is activated (Spencer, Fein, Wolfe, Fong, & Dunn, 1998). These contradictory data are difficult to reconcile under the assumption of a fixed capacity. Should we conclude the same process (activating a stereotype) requires different amounts of cognitive resources under different goal conditions? Or should we conclude that cognitive resources have a malleable, not fixed, capacity? Either answer would render the notions of supply and depletion of cognitive resources impossible to measure and investigate. Goal regulation can help resolve such contradictions. In the situation where the participants have the goal to repair damaged self-esteem, processes that facilitate the achievement of this goal (activating derogatory stereotype that provide opportunities for downward comparison) may enjoy higher priority among all the goals that need to be coordinated (reciting digits). In the absence of a goal facilitated by stereotype activation, it fails to activate in the presence a load task because of its low priority.

Goals and Self-Regulation

The issue of self-regulation (Carver & Scheier, 1998) appeared in both the Sherman (this issue) and Deutsch and Strack (this issue) models. In the dual-system model, the authors justify their binary division with the benefit of extending the applicability of the models beyond the realm of judgment and impression formation, to self-regulatory processes (among others), such as suppressing unwanted thoughts and stopping unwanted behavior. This argument implies that judgments and impression formation are not part of the self-regulation system. In the Quad Model, self-regulatory processes such as overcoming bias are differentiated from discriminability as two distinct "controlled" systems. We believe this conception of self-regulation is too narrow (Carver & Scheier, 1998). Self-regulation include all goal-directed activities, be they cognitive, emotional, or behavioral in nature. Moreover, self-regulatory processes can be both automatic and controlled (Moskowitz, et al., 2004). All psychological processes are goal directed and therefore relevant to self-regulation. Perception, judgment, impression formation, stereotype activation, and conflict resolution among incompatible operations should all be viewed within the framework of goal-directed self-regulation. These processes gather feedback for the purpose of

achieving particular goals and are directed by these goals, on one hand, and trigger changes in these goals, (e.g., disengaging from the current goal or adopting new goals) on the other (Carver & Scheier, 1998; Moskowitz, et al., 2004).

Even in those aspects of information processing traditionally dubbed "automatic," participants' responses are often regulated by goals (Moskowitz, et al., 2004). Although Sherman provides the caveat that settling on the number two for describing automatic processes was somewhat arbitrary, after the description of the two automatic processes our mutual yet independent reactions was one of "don't stop yet." A whole host of goal-relevant automatic processes are just as central to describing a functioning cognitive system as the two processes detailed by the Quad Model (ranging from searching the environment for goal-relevant stimuli and opportunities to act, to inhibition of competing constructs, to setting thresholds for determining construct activation, to goal-monitoring processes, e.g., Aarts & Dijksterhuis, 2000, 2003; Moors, Houwer, & Eelen, 2004). Whether the officer in Sherman's example shoots or not will surely depend on the automatic goals the officer is regulating at the time the stimulus is encountered (some of which are triggered by that stimulus).

In procedures showing automatic processes, such as implicit attitudes (Fazio, Sanbonmatsu, Powell, & Kardes, 1986), and stereotype activation (e.g., Blair & Banaji, 1996), participants' responses are directed at least by the goal to complete the task according to the experimenter's instructions. In these procedures, the experimental condition has a relatively simple goal structure, without distracting goals and associated actions to interfere with the primary goal. These implicit associations facilitate participants' responses in so far as they activate response plans compatible with the appropriate responses on the task such as pressing a the correct key to indicate whether a letter string is a word. Sherman's example of the discriminability process in which an illiterate child performs the Stroop color-naming task also constitutes such a case. When there is no conflict between cognitive processes, it does not mean that there is no self-regulation. Allowing a cue to trigger activation of associated concepts and behavior patterns without intervention is a state of control (Aarts & Dijksterhuis, 2000, 2003) as much as an attempt to disrupt an unwanted process (such as a literate adult performing the Stroop test).

Thus we find it an omission that in the dual-systems and Quad Model goals are not explicitly given a role in the automatic or association-based processes. In these models the environmental input (e.g., members of minority groups) trigger associated affect (negative feelings), concepts (stereotypes), and behavior patterns (shooting) directly. Goals (embodied in intentions) are supposed to kick in only when there are conflicts among them, or when existing associations are inappropriate or inadequate for coping with the situation. Leaving out the role of goals also creates problems with the unimodel, particularly on the definition of the critical parameter "relevance." We address this point later in this commentary.

Specifying the Mechanisms for Coordination Among Different Processes

An indispensable task for both the dual-system model and Quad Model is to specify the mechanisms that regulate and coordinate between different mechanisms. When does each process get initiated, terminated, and switch to another process? Deutsch and Strack (this issue) suggest that the impulsive system and the reflective system work in a sequence, starting with triggering of the former by cues in the environment. They also believe that the impulsive and reflective systems work in interaction. The mechanism of interaction is by mutually triggering each other through activation of associations. However, a particular environmental cue can be associated with multiple concepts, beliefs, and behavior tendencies. For example, the image of an Asian woman is associated with both the concept of women and the concept of Asians with equal strength (Macrae, Bodenhausen, & Milne,1995). An image of a Black male may be associated with stereotypes or the goal to maintain one's self concept of being egalitarian (Moskowitz, Salomon, & Taylor, 2000). Which associated concepts get activated upon exposure to a cue is not determined merely by strength of association.

Stereotypes can be activated or disrupted under cognitive load, depending on whether the participants have the goal to repair their damaged self-esteem (e.g., Gilbert & Hixon, 1991; Spencer et al., 1998). The goals currently activated by the cue need to be considered to have a more complete understanding of which one gets triggered. From the starting point of a perceptual cue, a variety of reflective processes can be triggered. For instance, upon encountering a member of a minority group, one can engage in either a process of debasing against socially shared prejudices for the purpose of affirming one's egalitarian beliefs (Devine, 1989) or a process of derogating the target for the purpose of improving self-esteem (Fein & Spencer, 1997). Again the goal activation and regulation are critical for understanding the selection between not only automatic versus controlled processes but also particular processes within each type.

In the Quad Model, regulation and coordination between different types of processes also present unre-

solved issues. According to Sherman (this issue), the initiation of the processes is conditional upon each other. For instance, overcoming bias is conditional upon association activation and discriminability. Guessing is conditional upon absence of association activation and discriminability. The exact meaning of *conditional* and the mechanisms of "conditional control" need to be spelled out. Does *conditional* mean "necessary and sufficient"? Does association activation and discrimination always initiate debiasing? Or does conditional mean "necessary but not sufficient"? If so, what are the sufficient conditions for triggering overcoming of bias to occur? Or does *conditional* mean "probabilistic"? If so, how are the conditional probabilities determined in each case? Again, the introduction of goal activation and regulation sheds light on these ambiguities. Without goals, one has to assume an "executive function" that monitors and coordinates these processes.

The issue of process regulation and coordination is also prominent in the unimodel, which attempts to eliminate the boundary between rule-based and association-based processes, reducing the latter to a subtype of the former. Such regulation and coordination are determined by the interplay among multiple parameters, such as relevance, task difficulty, and cognitive resources. When the input information is judged as low in relevance, one relies on those items of input that are easy to process and presented earlier in the encounter. In persuasion studies, these "superficial" cues are found to impact on the attitudes of the participants who followed the heuristic route (Chaiken et al., 1989). When relevance is high, the individual allocates more cognitive resources to process the items of input that are more difficult to encode and presented later, such as the quality of the persuasive message (Kruglanski et al., this issue). Who decides whether relevance is high or low? What is the criterion for making such a decision? What kind of mechanisms decide that the task is too difficult and resources too low for encoding the systematic information? Again, a mysterious executive function is assumed to keep these processes in operation.

Relevance can be conceptualized as strength of association with certain goals. If in one's mind, features of African Americans have a strong association with the goal to be egalitarian, then the presence of these features has high relevance, drawing attention toward them (Moskowitz, Gollwitzer, Wasel, & Schaal, 1999). On the other hand, if the presence of African Americans has strong associations with guns, violence, and personal danger, the presence of these features also has high relevance, but of a different kind (Correll, Park, Judd, & Wittenbrink, 2002). A stimulus that does not trigger any goals (e.g., most of the strangers we pass in the street) is low in relevance. The more important the goal associated with a stimulus, the higher the stimulus's relevance. The specificity of the associated goal determines the specific type of relevance of the stimulus. The association with goals also relates to the distinction between potential relevance versus perceived relevance discussed by Kruglanski et al. (this issue, p. 160). Given the same conditions of observation (e.g., with the same noise-to-signal ratio, information amount, and complexity), one is more likely to successfully perceive a stimulus's relevance if it is strongly associated with an important goal (Correll, Park, Judd, & Whittenbank, 2002). Research shows that once a goal is activated, it facilitates the perception of features of the environment related to its accomplishment (Moskowitz, 2002). Evidence comes not only from social cognition but also from clinical research. Researchers have shown with a Stroop-like task that phobia patients are highly vigilant to information relevant to their particular phobia object, even when they are instructed to direct attention away from it (Amir, Freshman, & Foa, 2002; Mattia, Heimberg, & Hope, 1993). The goal of self-protection against threatening stimuli draws their attention to these stimuli.

It is only recently that cognitive theories started to recognize the dilemma posed by the issue of control, as reflected in the discussions on the "executive function" (Logan, 2003). In traditional cognitive models, the executive system monitors all cognitive processes and determines which process to initiate and terminate and when. It is a stand-alone system that is omniscient and omnipotent; it has knowledge about and power over all processes (and sometimes it is known as the "chief executive"). Dennett (1991) dubbed such an executive as a homunculus sitting in a "Cartesian theatre" watching events unfold in the mind and in the world and pulling control levers. The difficulties with this stand-alone conception of the executive function are well documented. It constitutes a homunculus in the head, the operations of which are hard to explain in scientific terms. If the executive perceives all the information and processes going on in the mind, there must be another homunculus perceiving what it perceives, and the regression is infinite. Have the mystery of control and coordination over different processes been solved in the three models as presented in the target articles? Based on the aforementioned analyses, we believe the answer is "not quite," and introducing goal regulation into the model can help solve this issue.

Goal Regulation and Information-Processing Models

Recent social-cognition research has found that goals are cognitive, at least in some aspects (Bargh, 1990; Kruglanski, 1996). Bargh (e.g., 1990) conceptualized goals as knowledge structures stored in

long-term memory, which can be activated or retrieved by cues in the environment, just like other knowledge structures such as concepts. Human responding (both external and internal) is intrinsically goal directed. Through practice, a goal becomes associated with certain environmental features (e.g., the goal to study becomes associated with features of a library). The activated goal itself triggers the retrieval of concepts and action routines related to it, through pre-existing associations.

Our interaction with an environment invariably involves certain goals. In the shooting paradigm (Correll et al., 2002), the images of African Americans trigger the goal to protect one's life and avoid harm in the police officer, which in turn triggers the response of shooting and the biased judgment of viewing African Americans as more likely to be armed, in concert with stereotypic associations. The goal to be accurate, to be nonprejudiced in perception, and not to harm unarmed suspects may become activated at the same time or slightly following, depending the strength of the goal. The process governing an actor's cognitive and behavioral processes under these circumstances is one of goal prioritizing. The goals compete to be implemented in a race. Whichever goal first reaches its associated cognitive processes or actions gets them executed. The goals triggered earlier and/or more strongly are less subject to interference from other incompatible goals; they enjoy a head start. Moskowitz et al. (1999) provided evidence that a chronically accessible goal (egalitarianism) can overturn responses associated with an incompatible goal (stereotype activation).

The Impulsive System Lacks Metacognition About Its Responses?

A short note before leaving revolves around a commonly accepted axiom of social cognition: Because implicit responses occur without awareness, they cannot be reflected upon. This position is explicitly stated by the Reflective-Impulsive Model. This may be true if we defined metacognition as conscious thinking about conscious thought. But is it not possible to have implicit cognitions about implicit cognition? For example, what processes are responsible for the phenomenon known as the "illusion of truth," where participants are shown to label familiar information as true? Or similarly, what process yields the false fame effect? We have argued (Li & Moskowitz, 2006a; Skurnik, Moskowitz, & Johnson, 2006) that these are metacognitive in that implicit beliefs are used to reflect on implicit feelings of fluency. A feeling of familiarity, not consciously detected, is reflected on outside of awareness, and an implicit theory associated with the feeling is then applied. In some sense then, metacognition is not limited to the reflexive system.

Conclusion

Back at a time when both of us were young, and a man named George Bush was president of the United States, one of us can recall sitting at his first conference surprised to hear the remarkable Elliot Aronson assail social cognition research as boring and many of its prominent theories simply rehashing cognitive dissonance theory. Aronson (1990) argued, in effect, "how many dissonance theories do we need?" After listing about eight theories that he assumed nobody would want to keep straight or recall (self-discrepancy, control theory, self-verification, etc.), he called once again for consolidation (at which point Erik P. Thompson, a fellow graduate student at the time, turned to one of us and recalled all eight theories with great ease and interest). There was much wisdom to Aronson's call for larger theory building, but more was learned that day from Erik P.'s response. A variety of exciting, slightly overlapping theories was not at all bad for the field and was instead an amazing way to provoke growth and lead us into the future. Without self-discrepancy theory there would be no regulatory focus theory (and of course without regulatory focus theory there would be no B school jobs for any of our graduate students!). Without control theory, symbolic self-completion theory, and the theory of action identification, much of the modern work on automaticity in self-regulation would not have occurred (and Ap Dijksterhuis would probably be off winning a Nobel Prize in physics). No, competition is healthy and necessary, and the more models (from amazing scholars like the one's responsible for our target articles) the better. Erik Thompson, whose sister is the most decorated American Olympic athlete, earned a gold medal himself that day.

Of course, George Bush is no longer president of the United States. Another man named George Bush is. And social cognition researchers are no longer fighting over whose tension reduction models are the best. Another fight over whose processing model best captures the data predominates. But one thing is clear—such fights are healthy and necessary, and not at all a waste of energy. They pave the path to the future. When dual-process models were first proposed, the field knew very little about self-regulation relative to today. We had books warning us that we need to reacquaint ourselves with motives and create synergistic models that consider goals and cognition. Today we have books (e.g., Baumeister & Vohs, 2004; Moskowitz & Grant, in press; Shah & Gardner, 2006) dedicated to summarizing the voluminous empirical work on goals and self regulation that those prior models helped create. Thus, Sherman's point that there is much to be

gained from distinguishing between various types of control and various types of automatic processing is not to be taken lightly. The same weight is afforded Deutsch and Strack's point that numerous processes reside within the reflective system and impulsive system and that these two systems represent a bare minimum of processes needed to explain social cognition. Indeed, the value of these models lies not in identifying whether there are one, two, three, or four basic processes, the value lies in their ability to point out what we should be looking for and considering in our research. The three models provide for us a map of where the field is today, and many more maps would be welcomed. We must keep in mind that we will be in a wholly renovated city (metaphorically of course) a decade from now and may at that time need to use these maps only to help us construct the new ones.

Notes

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A Critique of Three Dueling Models of Dual Processes

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I can't work without a model.
—Vincent Van Gogh

Dual-process models abound in social and cognitive psychology (cf. Chaiken & Trope, 1999). Advocates of the unimodel suggest that we do not need them—a single unitary psychological process underlies all human judgment (Kruglanski, Erb, Pierro, Mannetti, & Chun, this issue). Advocates of the dual-systems approach suggest that a more general and integrated approach be taken to dual-process models. Specifically, Deutsch and Strack (this issue) theorize that there are commonalities across the findings accrued from many domain-specific dual-process models that might be better understood in an integrated systems model. Finally, a newcomer, the Quad Model, suggests that a more refined analysis of the subprocesses in a dual-process framework may provide a more thorough account of the thought processes important in some popular social cognitive tasks (Sherman, this issue). Herein we offer critiques of each of these alternatives.

Critique of the Unimodel

… much virtue in 'if.'
—William Shakespeare

The unimodel assumes that all human judgment is rule based. This boils down to a series of if–then propositions. This basic premise extends to all conscious and nonconscious information processing. Included in this sweeping assumption are associations and pattern recognition. Although dual-process models contend that associations and pattern recognition function as automatic processes, in the unimodel these are merely examples of the functioning of if–then rules. One process fits all. The unimodel does specify several parameters of the judgment processes:

1. *Subjective relevance*: Some antecedent conditions ("ifs") are perceived as more likely to produce the consequent conditions than others.
2. *Gleaning difficulty*: Some if–then rules require more effort to discern than others.
3. *External task demands*: Some contexts affect the gleaning difficulty.
4. *Cognitive resources*: Due to the recency and frequency of activation, some rules are more or less cognitively accessible; also, cognitive capacity affects rule use.
5. *Motivation*: People may be more or less motivated to process information, or they may be more or less vested in some conclusion.

Armed with these fundamental assumptions, the unimodel then proceeds to subsume the proposed evidence for all dual-process models into the operation of one or more of these parameters upon if–then rules. Depending on your perspective, this model looks like a feat of either elegant parsimony or grand reductionism.

A basic problem with the unimodel is that it overextends the concept of if–then judgment rules to include all regularity in psychological processes. Any deterministic quality in human behavior, therefore, would follow an "if the" rule and would imply a rule-based process. For example, in social cognition, the unimodel analysis of if–then rules is applied to priming phenomena whereby primed stereotypes influence social judgments. Even under circumstances where the experience of priming is nonconscious and even when the individual does not endorse the stereotype (e.g., Devine, 1989), the unimodel depicts the psychological process as following an if–then rule. All that seems required for the unimodel to be satisfied is that there must be some rulelike regularity in psychological functioning. By this same logic, reflex reactions such as the patellar reflex (controlled by the lumbar region of the spinal cord) or the pupillary light reflex (used to assess brain stem functioning) could be considered examples of rule-based processes. At some point, the unimodel's quest for reductionism seems to obscure some important distinctions in psychological processes.

In contrast, most dual-process models distinguish between intentionally controlled and unintentional aspects of behavior (e.g., Payne, 2005). Control involves planning and monitoring thought processes and behaviors to achieve goal-relevant ends. Rule-based processes in this light are not just regularities in human behaviors and judgments, they are the conscious strivings of the individual to satisfy goals. This is not to say that all psychological processes involved in rule-based processes are conscious or that nonconscious processes do not influence rule-based processes. Complex control processes are thought to orchestrate a variety of "slave systems" that operate automatically once activated (Baddeley, 1986). Also, goals themselves may be primed through nonconscious means (Bargh, Gollwitzer, Lee-Chai, Barndollar, & Trötschel, 2001). Thus, the unimodel glosses over an important distinction between mostly conscious, intentional behavior and mostly automatic, unintentional behavior.

Several lines of research concerning the activation of different brain structures during social cognition appear to support dual-process models. Such findings seem difficult to incorporate into the unimodel. For instance, when Black and White faces were flashed very rapidly on a computer screen to participants, at a speed too fast to be consciously detected, White participants showed stronger amygdala responses to Black faces than to White faces. The amygdala is a brain region associated with emotion. However, when the faces were presented at a much slower rate, Black faces evoked stronger activation in areas of the prefrontal cortex and the anterior cingulate cortex, brain structures thought to be involved in executive control functions (Cunningham et al., 2004). Although it is beyond the scope of this commentary to review other research connecting brain structures to automatic and controlled processes (cf. Leiberman, Gaunt, Gilbert, & Trope, 2002), we simply note that the unimodel, as it is currently presented, offers little guidance in understanding why different tasks activate different parts of the brain. Such differential activation of brain structures seems more consistent with a dual- or multiple-process model.

Critique of the Dual-Systems Model

The dual-systems model described by Deutsch and Strack (this issue) postulates a variety of automatic or *impulsive processes* "linking perceptual stimulation to behavioral schemata through previously learned associations" (Deutsch & Strack, this issue). These behavioral schemata possess an implied ap-

proach/avoidance motivational orientation. Likewise, this model postulates a variety of control or *reflective processes* that are activated when habits need to be overcome or when new plans are needed to meet new situations. This dual-systems approach is similar in many ways to other models found in the social cognition literature (e.g., Lieberman et al., 2002; Smith & DeCoster, 2000). A systems model's primary advantage is its capacity to integrate findings from across a variety of domain-specific dual-process models (Chaiken & Trope, 1999). Many of the critiques offered by the unimodel appear aimed at particular interpretations of domain-specific dual-process models (e.g., the unimodel's analysis of the role of source effects in the Elaboration Likelihood Model—see Wegener & Claypool, 1999). Thus, although the unimodel might seem parsimonious on the surface, the dual-systems approach may ultimately rely on fewer assumptions.

Dual-systems models owe an intellectual debt to the classic work of Schneider and Shiffrin (1977) on automatic and controlled information processing. Like Schneider and Shiffrin, Deutsch and Strack conceptualize automatic processes as the workings of an associative network housed in long-term memory. The primary process is one of spreading activation. Long-term memory is essentially the store of an individual's learning experiences. Control processes involve symbol manipulation in a finite-capacity working memory and require attentional focus.

One element that may be missing from the Deutsch and Strack analysis is the recognition of impulsive processes that do not require learning. Evolutionary psychologists suggest that contemporary humans may have evolved certain preferences and aversions that are essentially "hard-wired," that is, they require no experiential learning. For example, judgments of sexual attractiveness for both men and women are related to body fat distribution (Singh, 1993, 1995, 2004). The waist/hip ratio of fat distribution (WHR) is sexually dimorphic in *Homo sapiens* and related to sex-linked hormonal patterns. Higher ratings of the physical attractiveness of women who fit a *gynoid* and men who fit an *android* fat distribution pattern have been found across many cultures with both younger and older men and women. WHR connections to perceived physical attractiveness are independent of overall body weight in men and women and women's breast size (Singh & Young, 1995). To some extent, evolutionary psychologists suggest judgments of physical attractiveness based on WHP are neither learned nor represent conscious decisions about what qualities we might or should find attractive. Rather, we know what we like instinctively, effortlessly. This inherent sense of attraction is thought to activate approach/avoidance tendencies. It therefore seems similar to what Deutsch and Strack describe as an *impulsive process*.

Similarly, we may often know what we don't like instinctively, effortlessly. Kurzban and Leary (2001) argued that certain "marks" are stigmatizing in virtually all cultures. Specifically, most people react negatively to those who are health risks (particularly highly disfigured individuals), those who cheat in social exchange relationships, and outgroup members. Evolutionary psychologists theorize that the psychological systems underpinning stigmatization are domain specific and evolved to solve particular adaptive problems. Pryor, Reeder, Yeadon, and Hesson-McInnis (2004) suggested that psychological reactions to stigma could also reflect automatic associations to stigma labels (similar to stereotypes) as well as instinctive aversions and that control processes are also important in how people respond to someone who is stigmatized.

Critique of the Quad Model

Like the dual-systems model, the Quad Model postulates that there are two general classes of psychological processes: control processes and automatic processes. The Quad Model further differentiates two basic control processes and two basic automatic processes that are most commonly found in other dual-process models and that may be evident in many social cognitive tasks. The two control processes are essentially concerned with the goals of *discrimination* (i.e., being accurate) and *overcoming biases* (i.e., self-regulation). The two automatic processes involve response biases triggered by specific associations to features in the environment (e.g., associations to group labels or stereotypes) and response biases that are related to the specific task at hand but are more or less content free. Although Sherman (this issue) acknowledges that there may be many other control and automatic processes, he argues that these four processes achieve a balance between breadth and specificity in describing findings using two currently popular social cognition tasks: the Implicit Associations Test (IAT; Greenwald, McGhee, & Schwartz, 1998) and the Weapons Identification Task (WIT; Payne; 2001). Although the evidence that Sherman musters for the Quad Model seems compelling, two theoretical criticisms come to mind. The first concerns the generality of the Quad Model. The second concerns the model's assumptions about the time course of automatic and controlled processes.

The Generality of the Four Processes

Is the Quad Model a model that aspires to describe some general social cognitive processes or is it a model of the psychological processes involved in how research participants perform some very specific laboratory tasks? In other words, do the four processes identified in the Quad Model represent four "basic-level " processes

found in social cognition or might these processes only be important when specific tasks are required of research participants? We argue that two of the Quad Model 's subprocesses may reflect specific task demands inherent in the IAT and the WIT. Furthermore, other social cognitive tasks may not impose such task demands and therefore may not reflect these subprocesses.

Evidence for the Quad Model comes from studies in which participants are asked to perform tasks where accuracy is an inherent concern. For example, in the IAT, participants are asked to make a series of speeded categorization judgments. Participants press buttons to indicate whether a word or a picture is correctly categorized one way or another. In each experimental trial, there is a correct and an incorrect response. Similarly, in the WIT, participants are asked to make rapid binary choices of whether a picture represents a tool or a weapon. Two of the processes described in the Quad Model deal with accuracy issues: discriminability (the control goal of trying to determine a correct response) and guessing (an automatic default behavior when the participant does not know the correct response). The key data relevant for the Quad Model analyses are error rates. There seems little doubt that participants who follow the instructions in performing the IAT or the WIT have a goal to be accurate. So, a mandatory control process for cooperative participants would be to monitor and constrain thought processes and behavior to achieve some level of accuracy. Still, one might question whether the empirical evidence cited by Sherman for a discriminability process reflects participants' "attempts to provide an accurate representation of the environment" (p. 174) or just their responses to task demands for accuracy.

Some recent attempts to measure automatic and control processes within the same laboratory task do not require participants to pursue an accuracy goal. For example, Pryor et al. (2004) asked participants to move a cursor on a computer screen toward or away from a picture of a person to indicate how they felt about interacting with that person. Participants were given 10 sec to adjust the cursor position to reflect their feelings. Pryor and his colleagues theorized that early movements of the cursor should be more affected by automatic associations triggered by features of the stimulus persons and that later movements should be more be affected by control processes in which the participants try to make the distance of the cursor to the picture conform to personal goals, such as the desire to be nonprejudiced. A number of stigmatizing characteristics (e.g., AIDS, mental illness, obesity, etc.) were used to describe the stimulus persons across a pair of studies. Consistent with predictions, early cursor movements were correlated with specific associations to the stigmas and tendencies for emotional reactivity. Later movements were more correlated with motivations to control prejudice toward the stigmas. Note that the cursor movement task used in these studies involves no obvious accuracy standards imposed on participants' responses. Certainly, none were emphasized in the instructions to participants. So, although the approach/avoidance behaviors reflected in cursor movements would seem consistent with the Quad Model's automatic process of association activation and the model's control process of overcoming bias, it is difficult to see where a control process concerned with being accurate or an automatic guessing bias would enter into such behavior. This contrast seems to transcend a comparison of this cursor movement task to the IAT and the WIT. For many naturalistic social behaviors as well as other laboratory social cognitive tasks (e.g., the Affect Misattribution Task; Payne, Cheng, Govorun, & Stewart, 2005), there would seem to be no clear-cut standards for accuracy. In such situations, control processes aimed at achieving an accurate representation of the environment might be largely irrelevant and therefore infrequently a part of the course of social cognition.

Time Course

As a second theoretical criticism, there seems to be some confusion about what the Quad Model postulates with regard to the temporal relationships between automatic and controlled processes. On one hand, Sherman (this issue) argues against other dual-process models that assume sequential processing, whereby automatic processes come first, followed by control processes. In contrast, the Quad Model assumes that automatic and controlled processes operate simultaneously and independently from the onset. Yet, in logic, measurement, and graphic model depiction, some parameters of the Quad Model seem to be conditionally related to others. For example, a bias related to an association must be first activated before the bias can be monitored and overcome. If there is no initial bias, what is there to control? The notion that a process is automatically triggered by features of a stimulus by definition implies that it is fast and relatively effortless (Smith & DeCoster, 2000). Hence terms like *impulsive* (Strack & Deutsch, 2004) and *reflexive* (Lieberman et al., 2002, Pryor et al., 2004) have been coined to describe these processes. Likewise, control processes are generally conceived as effortful, time-consuming, deliberative, and reflective (Sloman, 1996). If pitted against one another in a "horse race," automatic processes would appear to be first off the mark. This is not to say that both types of processes may not act simultaneously or even interact dynamically at some point in time. Also, as pointed out before, some automatic processes may represent slave systems invoked by control processes to achieve certain goals. Perhaps guessing as an automatic process represents such a system. Guessing is evoked if discrimination fails. With regard to "first impressions," automatic pro-

cesses would seem to be immediately triggered and to dominate until controlled processes have had a chance to engage and establish control. Empirical evidence for this time course comes from studies of approach/avoidance behavior in response to stigmas where initial reactions are strongly related automatic processes, whereas subsequent reactions are more related to control processes (Pryor et al., 2004).

Summary

To summarize, in our view the unimodel employs an overinflated sense of if–then rule-based processing. The logic of the unimodel would lump together practically every psychological process that can be described as having some regularity. We suspect that this model obscures important distinctions between qualitatively different types of psychological processes. On the other hand, the dual-systems model provides a useful integration of the common features of many domain-specific models. What remains to be seen is whether the dual-systems model represents just a useful summary of past research or whether it will be a tool to generate future research. Therein lies the potential theoretical contribution. We have pointed to one way in which the dual-systems approach might be expanded to include impulsive processes involving evolved predilections (Kurzban & Leary, 2001). The point is that some impulsive reactions may not reflect just learned associations. Further research is needed to ascertain whether and how these impulsive processes differ from those based on learning.

Finally, the Quad Model offers a sophisticated account of the subprocesses involved in two popular social cognitive tasks: the IAT and the WIT. The Quad Model could be viewed as a refined version of the dual-systems model because it also postulates two basic types of information processing: automatic and controlled. The essential question we posed for the Quad Model is whether these four subprocesses are task specific or they represent common psychological processes found across social cognition. We suspect that the degree to which people pursue goals of accuracy vary widely in social thought processes. In any case, the Quad Model's analytic and quantitative decomposition of the different types of automatic and control processes involved in the IAT (as well as the WIT) represents an impressive achievement.

Although the IAT was only introduced in 1998 (Greenwald et al., 1998), a recent meta-analysis found 126 studies using the IAT (Hofmann, Gawronski, Gschwendner, Le, & Schmitt, 2005). One of the controversies surrounding the IAT concerns the nature of its connection to explicit measures of attitudes like self-report scales (Fazio & Olson, 2003; Olson & Fazio, 2004). The Quad Model's decomposition of different controlled and automatic processes involved in IAT responding may shed some light on what component processes are related to more conventional self-report measures of attitudes. Also, indexes of self-regulation processes specified in the Quad Model should relate to other self-report measures of the motivation to control prejudice (Devine, Plant, Amodio, Harmon-Jones, & Vance, 2002). In some ways, such future investigation might be viewed as construct validity explorations of the processes described by the Quad Model. The Quad Model is poised to generate an exciting new wave of social cognitive research.

Note

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Joyce's *Ulysses* and Woolf's *Jacob's Room* as the Phenomenology of Reasoning: Intentions and Control as Emergent of Language and Social Interaction

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Three groups of researchers propose three respective models of cognitive processes. The first group (Kruglanski, Erb, Pierro, Mannetti, & Chun, this issue) argues that a single inferential type of processing encompasses all possible judgments. The second group (Deutsch & Strack, this issue) divides processes into rational and impulsive. Presumably, qualitative differences between a reasoning, impulse control system and an impulsive system require this separation. The third author (Sherman, this issue) recognizes that attempts to count processing modes are not likely to succeed. However, these scholars see advantages in separating four types of processes that explain decisions. These four processes account for responses in certain sensitive domains. For example, a police officer who needs to decide whether to shoot a person of color may confront racial stereotypes, the need to reduce stereotyping, and the need to self-defend.

Commentary authors in this issue of *Psychological Inquiry* face several challenges. One is to contribute to the debate that motivates this issue. We first review the scope, precision, and heuristic value of the models. We then discuss the models' assumption about reflection and control. We identify a need to investigate the ecological validity of the presence of intention and control in two types of data. Comparing the use of intentionality and control words in literary texts with intention reports in psychological studies suggests dramatic differences in the frequency of intention references. We propose that intentionality requires a translation from random, sequential contents in the stream of consciousness into a more coherent narrative in the first person. The mechanism for the translation is probably syntactic parsing. Some preliminary data and potential directions of this view are discussed.

Scope and Precision of the Models

Our colleagues' contributions have much to offer to the field of social psychology. The unimodel relies on a simple implicational molecule that underlies all human judgments. Thus, in principle, this simple-process model may have the broadest applicability (persuasion, stereotyping, attributions). However, to predict specific

outcomes, the unimodel relies on five parameters. For example, the application of stereotypes should depend on the ease or difficulty of extracting the stereotypical information (task characteristics). It may also depend on whether the person sees the stereotype as relevant or irrelevant (subjective relevance), has high or low cognitive ability to process information (cognitive resources), has high or low motivation to think about the information (nondirectional motivation), and is motivated to avoid stereotypic judgments (directional motivation). Clearly the simplicity of the single-process model decreases with these five parameters. Nonetheless, using those parameters in combination with one process is still simpler than using the same parameters in combination with two qualitatively different processes (see, e.g., Petty & Cacioppo, 1986).

In contrast to the unimodel, the Reflective-Impulsive Model links different outcomes to different processes. This conceptualization describes a system of reflection, intention, and propositional thought that is governed by logic and verification of truth (see also Freud's, 1923/1961, reality principle). Further, this model assumes a separate though interacting system governed by reward and approach/avoidance tendencies. This system is guided by what Freud termed *pleasure principle* and lacks either logic or ability to assess the truth value of an object or situation.

The Reflective-Impulsive Model incorporates the unimodel's if–then molecules under the reflective system. In doing this, Deustch and Strack's (this issue) model is not concerned with the detailed predictions made by the unimodel. However, like Freud's (1923/1961) Ego and Id, the reflective and the impulsive systems have the potential to explain conflicts between "desire " and "reason." Desires emerge when reasoning stops. As a result, people succumb to temptations and are unable to fully control their impulses.

Finally, the Quad Model applies to the Implicit Association Test (IAT) and attempts to control one's responses. In the stereotyping example, Sherman's (this issue) model assumes two automatic processes, namely, association activation (e.g., of an automatic stereotype) and guessing. It also assumes two controlled processes, namely, discriminability (e.g., ability to discriminate types of stimuli) and bias control (e.g., control of the influence of the stereotype). The model further assumes six possible sequences resulting from the combination of these four processes (see Figure 1 in Sherman, this issue). Thus, when a person sees a Black face, six outcomes are possible. For instance, a person may show a stereotypical response because of the activation of the stereotype, discrimination of Black and White faces, and failure to overcome the bias. As shown by this example, the model offers great precision in this area. Its scope is presently limited to the use of the IAT and related measurement procedures. Nonetheless, it could easily be extended as further research develops.

Heuristic Value of the Models

The three models in this issue clarify prior findings and predict new ones. Thus, they have high heuristic value. Kruglanski and his colleagues (this issue), for example, state that both automatic and controlled processes obey if –then rules. Further, they argue, previously reported qualitative differences between processes fade when one equalizes task demands. For example, in dual-processing persuasion research, the message arguments are typically lengthier and more complex than a cue such as the identity of the communicator. However, keeping the complexity of both types of information constant eliminates the differential influence of ability and motivation to think about the information. Both short arguments and short source cues have more impact when ability and motivation are low. Correspondingly, both long arguments and long source descriptions have more impact when ability and motivation are high. In this sense, the unimodel reinterprets prior findings and opens the door to important new observations.

The Reflective-Impulsive Model has the advantage of using cognitive and neuroscience concepts to integrate prior findings in the areas of implicit measures, automaticity, and self-regulation. More important, this model specifies interactions between impulsive and reflective systems and makes unique predictions for these interactions. A good example comes from self-regulation. According to Deutsch and Strack (this issue), feelings are related to the impulsive system, whereas knowledge is related to the reflective system. When a person is tempted to eat high-fat foods, feelings create the urge to eat. In contrast, knowing that these foods are unhealthy may yield inhibited eating. That is, incompatible behavioral schemata will be activated in the situations that require self-regulation. Resolving the conflict in favor of the reflective system requires cognitive resources.

In a related vein, the Quad Model explains the results of compatible and incompatible trials of IAT (see Sherman, this issue) and makes new predictions for data previously obtained by Lambert et al. (2003). In a race IAT, for example, a compatible response (Black/bad and White/good) depends on automatic association (retrieving racial stereotypes) and discriminability (distinguishing Black and White faces). In contrast, incompatible responses (Black/good and White/bad) reflect the ability to overcome the bias created by the automatic associations. Using these principles, Sherman reanalyzed data reported by Lambert et al. In these data, public situations were shown to increase rather than reduce stereotyping. Using the Quad Model, Sherman attributes this effect to decreases in the ability to discriminate group cues. However, he also shows that the public setting had produced parallel attempts to overcome the stereotype bias. In fact, considering both antagonistic effects explained the experimental outcomes better than includ-

ing only discriminability. These examples were used to demonstrate the heuristic value of the model.

The Hidden Assumptions of the Models: Division Between Desire and Reasoning and the Concepts of Intentionality and Control

Social psychological models have often partitioned processes into (a) desire, impulse, or irrationality and (b) reasoning, inferences, or rationality. This dualism may underlie all existing dual models. In addition, the distinction remains in the recently proposed Quad Model because half of the Quad's processes fall on the more reflective side and the other half on the impulsive side.

If one recognizes two systems—one reflective and the other impulsive—then the unimodel would be part of the reflective system. It describes all processes as the application of if–then inferences that consume cognitive resources (for similar arguments, see Fishbein & Middlestadt, 1997). However, the model does not take a clear stand on this issue. One could argue that an attractive stimulus is the premise for an immediate approach tendency even when no inference is involved.

In any case, a commonly held social psychological assumption is that people engage in highly controlled reasoning that is governed by formal logic and verbal propositions. For instance, people may spontaneously discriminate against members of minority groups. However, they manage to control these tendencies when they set their mind to it. Similarly, the emphasis on automatic processes has researchers perplexed at the fact that previously known reasoned processes can be accomplished automatically. In other words, this surprise may be due to the premise that reasoning and intentionality were default. Therefore, it is surprising that lack of reasoning and intentionality are also common.

In this commentary, we argue that the frequency of algorithmic, controlled reasoning and first-person intention are empirical questions. In agreement with all models presented here, people may be unable to exert any control over their cognitive processes whatsoever. Or they may be able to do so only when certain conditions are met. Thus the ecological validity of intentional and controlled cognitive processes is an issue. We analyze some relevant data from both literary and real-life sources as a preliminary approach to this problem. Then we propose some preliminary hypotheses about how reasoning unfolds.

Speculating About the Ecological Validity of Reasoning as It Is Often Characterized (Controlled, Intentional, Propositional, Organized)

The division between associative and propositional processes (see Deustch & Strack, this issue) raises interesting questions about the phenomenology of reasoning and intention. Does reasoning have the characteristics we often ascribe to it? Is it controlled and intentional?

Stream of consciousness. If certain processes are performed in a conscious, intentional fashion, an analysis of spontaneous conscious thoughts should reveal traces of controlled, reasoned processes. For example, if intentionality and controllability are properties of conscious processes, one should find that these contents include references to "goals," "trying," and "intention." Whether these contents are part of spontaneous thought, however, is not clear. On one hand, the spontaneous stream of thought may include images, random recollections in verbal forms, assessments of the future, and feelings. Moreover, it may not contain any references to intentionality, effort, or even the first person. On the other hand, spontaneous mental contents may be frequently tidy and propositional. If so, these contents should have the coherence, logic, and syntactic structure that are supposed to characterize intentional and controllable thought processes (see Bargh, 1994; Deustch & Strack, this issue). They may also include actual references to intentionality and processing effort.

To test these possibilities, we analyzed literary stream of consciousness data. First, we took Joyce's (1922) *Ulysses.* In this novel, Joyce achieved one of the most extreme usages of the stream of consciousness technique. This method, first used by Édouard Dujardin (1888), consists of presenting the thoughts and feelings of a character as they occur, without editing. Like automatic writing, it produces a continuous, flowing series of images and ideas running through the mind of the character without the writer making a translation of these contents into propositional form. (The technique likely inspired the term *stream of consciousness,* introduced by William James in 1890. Nonetheless, his introspection method was different.)

We believe that the stream of consciousness technique may be useful to verify the subjective experience of controlled processing. Granted, one cannot introspect and correctly determine the source of an idea (Nisbett & Wilson, 1977). However, one can certainly enumerate the images and thoughts present at a particular time as they occur. Consider the following section from *Ulysses* (Joyce, 1922):

> that was a relief wherever you be let your wind go free who knows if that pork chop I took with my cup of tea after was quite good with the heat I couldnt smell anything off it Im sure that queerlooking man in the porkbutchers is a great rogue I hope that lamp is not smoking fill my nose up with smuts better than having him leaving the gas on all night I couldnt rest easy in my bed in Gibraltar even getting up to see why am I so damned nervous about that though I like it in the winter its more company O Lord it was rotten

> cold too that winter when I was only about ten was I yes I had the big doll with all the funny clothes dressing her up and undressing that icy wind skeeting across from those mountains the something Nevada sierra nevada standing at the fire with the little bit of a short shift I had up to heat myself I loved dancing about in it then make a race back into bed Im sure that fellow opposite used to be there the whole time watching with the lights out in the summer and I in my skin hopping around I used to love myself then stripped at the washstand dabbing and creaming only when it came to the chamber performance I put out the light too so then there were 2 of us goodbye to my sleep for this night anyhow I hope hes not going to get in with those medicals leading him astray to imagine hes young again coming in at 4 in the morning it must be if not more still he had the manners not to wake me what do they find to gabber about all night squandering money and getting drunker and drunker couldnt they drink water then he starts giving us his orders for eggs and tea and Findon haddy and hot buttered toast I suppose well have him sitting up like the king of the country pumping the wrong end of the spoon up and down in his egg wherever he learned that from. (pp. 660–661).

One way of determining how much thought is experienced as controlled is to count the number of instances in which words like *try, tried, intend,* or *goal* appear in *Ulysses*. We performed these calculations with 267,198 words of Joyce's text. The results were astounding. *Try/tried* appeared only four times, half the times figuratively and always in reference to another person or as a statement from another person (as shown in italics here). For example, Joyce wrote

> I am *trying* to work up influence with the department. Now I'm going to *try* publicity. I am surrounded by difficulties, by … intrigues by … backstairs influence by … . (statement made by character to the protagonist; p. 32)

> History, Stephen said, is a nightmare from which I am *trying* to awake. (figurative sense; p. 34)

> Couldn't sink if you *tried*: so thick with salt. (figurative sense; p. 66)

> He *tried* his hardest to recollect for the moment whether he had lost as well he might have or left because in that contingency it was not a pleasant lookout, very much the reverse in fact. He was altogether too fagged out to institute a thorough search though he tried to recollect. About biscuits he dimly remembered. Who now exactly gave them he wondered or where was or did he buy. However in another pocket he came across what he surmised in the dark were pennies, erroneously however, as it turned out. (description of the behavior of another character; p. 529)

A similar conclusion arises from quantifying the use of the words *intend/t* and *attempt,* which appeared two times each. Joyce never used either of these terms to describe the conscious experience of the first person. Instead, the terms appeared as follows:

> He looked down *intently* into a stone crypt. Some animal. Wait.

> There he goes. (description of the behavior of another character; p. 108)

> Do you intend to pay it back? (question posed by another character; p. 183)

> He will see in them grotesque *attempts* of nature to foretell or to repeat himself. (figurative sense; p. 190)

> All a kind of *attempt* to talk. Unpleasant when it stops because you never know exac. Organ in Gardiner street. Old Glynn fifty quid a year. Queer up there in the cockloft, alone, with stops and locks and keys. (figurative sense; p. 283)

Last, the word *goal* appeared seven times in *Ulysses*. In four of these seven times, the term referred to the "goal of a ball game." The other three instances were as follows:

> H. E. L. Y.'S filed before him, tallwhitehatted, past Tangier lane, plodding towards their *goal*. (descriptions of movement by others; p. 219)

> The door! It is open? Ha! They are out, tumultuously, off for a minute's race, all bravely legging it, Burke's of Denzille and Holles their ulterior *goal*. Dixon follows giving them sharp language but raps out an oath, he too, and on. (descriptions of movement by others; p. 409)

> Ceylon (with spicegardens supplying tea to Thomas Kernan, agent for Pulbrook, Robertson and Co, 2 Mincing Lane, London, E. C., 5 Dame street, Dublin), Jerusalem, the holy city (with mosque of Omar and gate of Damascus, *goal* of aspiration) (figurative sense; p. 628)

Briefly, these analyses show absence of words associated with intentionality and control in the thought of the protagonist of *Ulysses.* Given a sample size of one, however, we decided to extend our analysis to another writer who was also skilled at representing the stream of consciousness: Virginia Woolf. It is interesting that, out of 55,094 words in *Jacob's Room* (Woolf, 1922/2004), only 8 had the root *inten**. These analyses confirmed the conclusion from *Ulysses.* Of these 8 occasions, 4 were used to describe another person, 3 were actual statements from a third person, and 1 was figurative. None of these instances was part of a stream of

consciousness. Instead, the streams of consciousness would read as follows:

> True, there's no harm in crying for one's husband, and the tombstone, though plain, was a solid piece of work, and on summer's days when the widow brought her boys to stand there one felt kindly towards her. Hats were raised higher than usual; wives tugged their husbands' arms. Seabrook lay six foot beneath, dead these many years; enclosed in three shells; the crevices sealed with lead, so that, had earth and wood been glass, doubtless his very face lay visible beneath, the face of a young man whiskered, shapely, who had gone out duck-shooting and refused to change his boots. (p. 7)

> "Merchant of this city," the tombstone said; though why Betty Flanders had chosen so to call him when, as many still remembered, he had only sat behind an office window for three months, and before that had broken horses, ridden to hounds, farmed a few fields, and run a little wild— well, she had to call him something. An example for the boys. (p. 7)

> Had he, then, been nothing? An unanswerable question, since even if it weren't the habit of the undertaker to close the eyes, the light so soon goes out of them. At first, part of herself; now one of a company, he had merged in the grass, the sloping hillside, the thousand white stones, some slanting, others upright, the decayed wreaths, the crosses of green tin, the narrow yellow paths, and the lilacs that drooped in April, with a scent like that of an invalid's bedroom, over the churchyard wall. Seabrook was now all that; and when, with her skirt hitched up, feeding the chickens, she heard the bell for service or funeral, that was Seabrook's voice—the voice of the dead. (p. 7)

Of course, this coding is preliminary and does not exhaust linguistic references to intentionality. Therefore, future analyses should consider other words with similar connotations (e.g., *vow, will,* etc.). If replicated with finer methods, these findings may illuminate the subjective experience of thought.

Data from intention scales. Contrary to an analysis of literary streams of consciousness, survey and experimental data contain abundant evidence of intentionality and control. For example, researchers can reliably assess people's intentions about a variety of topics and irrespective of educational level. For example, Patry and Pelletier (2001) asked a group of Canadian college students about their intentions to report an alien abduction. Reporting an alien abduction was a rather new behavior, because only 2% of the sample reported being abducted by aliens in the past. Moreover, the behavior was so specific that participants were unlikely to have thought about it in the past. It is interesting, however, that 49% of the sample intended to report an abduction to the authorities should it occur.

In a different domain, Durantini, Glasman, Albarracín, Earl, and Gunnoe (2006) asked a sample of community participants from Florida to report their intentions to use condoms in different situations. In this sample of participants, 76% was female, 66% was African American, 71% of the same had completed high school, and 53% had annual incomes of less than $10,000. Among other things, these participants answered the following questions:

1. How likely is it that you and your main (occasional) partner will use a condom the next time you have vaginal sex?
2. How likely is it that, for the next 6 months, you and your main partner will use a condom every time you have vaginal sex?
3. How strong are your intentions to use condoms with your main partner in the next 6 months?
4. How motivated are you to use condoms with your main partner in the next 6 months?

It is interesting that, for condom use with the main partner, these items correlated between .71 and .91 (Cronbach's α = .94). Similarly, for condom use with occasional partners, these items correlated .64 to .93 (Cronbach's α = .93). This highly consistent report also revealed a high frequency of intentions. Thirty-three percent of the sample intended to use condoms the next time they had sex with main partners. Moreover, 84% of the sample intended to use condoms the next time they had sex with occasional partners.

Differences between stream of consciousness and intention-scale data. Clearly there are differences in the frequency of "intentions" in stream of consciousness data relative to the use of intention scales. These differences are graphically depicted in Figure 1. As seen, the word *intention* appeared less than 0.001% of the times in the literary stream of consciousness data. In contrast, people can easily report their intentions in response to intention scales. In addition, these scales reveal high frequency of intentions to perform different behaviors in the future.

One potential conclusion of the stark contrast in Figure 1 might be that intentionality is illusory (see Dennett, 1991, 1996; Kant, 1781/1990; Skinner, 1948, 1953; Wegner, 2005). However, intentions are very good predictors of future behavior. For example, meta-analyses of condom use prediction have revealed average intention–behavior correlations ranging from .44 to .56 (Albarracín, Johnson, Fishbein, & Muellerleile, 2001; Sheeran & Orbell, 1998). These strong correlations suggest that intentions have very real effects on people's behaviors and their environment.

The next potential conclusion is that intentions are crystallized when we communicate with other people.

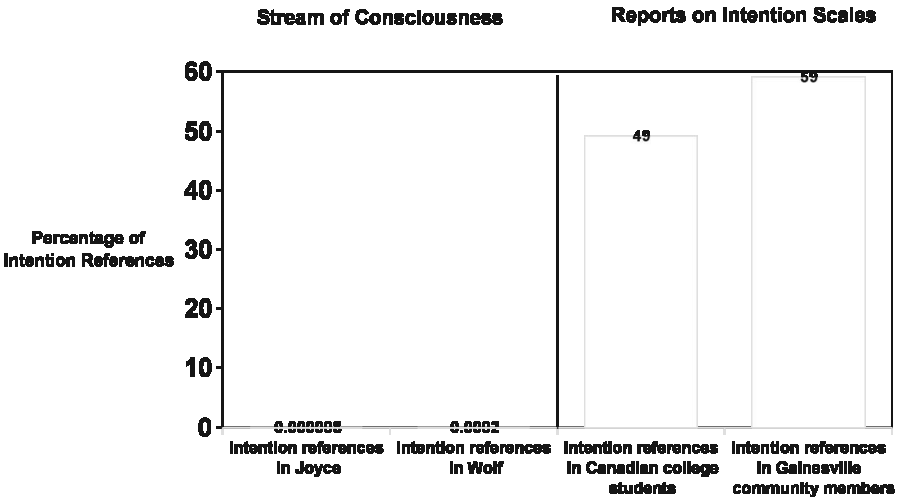

Figure 1. Literary and questionnaire references to intentionality.

Thus, both explicit and implicit social communication can prompt the formation of intentions based on cultural theories about how people operate (see also Malle, 2004). At a more basic level, intentionality may be a translation. That is, the deep structure of language may spontaneously derive a narrative based on the random sequential contents of the stream of consciousness. We elaborate on some of these aspects next.

If the Stream of Consciousness Is Not "Reasoned," How Do We Reason? Intentions and Control as Emergent of Social Communication

An interesting question is what triggers the translation of events in one's stream of consciousness into first-person intentions and reasoning. Responses to this question are probably multifaceted. In this commentary, however, we focus on the role of communicating with other people.

Social communication. The effects of communicating with other people can be seen through an example. Figure 2 has the stream of consciousness of one of these authors while writing this commentary. The top part of the figure presents the sequence of ideas, percepts, and images flowing over a period of a few seconds. To best represent the nature of this stream of consciousness, we use words and icons, including a sound icon to represent auditory perceptions.

The bottom part of the figure contains the thinker's account of the stream of consciousness for readers. As seen from that account, the material now adopts a first-person perspective, and there is a reference to intentionality ("trying"). The differences suggest that the communication attempt yields propositional structures in the first person as well as references to intentionality.

Of course, as a one-person experiment with a nonnaïve participant, the results in Figure 2 may be unimpressive. Nonetheless, future work with similar methodologies may be useful to capture the subjective experience of cognitive processes. It may be possible to compare the outcomes of those methods with actual reports to others. Alternatively, one may compare the raw description of these experiences with a description when one simply thinks of reporting one's thought. Moreover, one could vary the person with which participants communicate or simply remind participants of different characters in their life (e.g., thought priming). Based on our conceptualization, the characteristics of the audience should be important in the propositional structure of these thoughts. In Western cultures, audiences may heighten first-person, intentional language. As a result, the audience may facilitate carrying out personal intentions and acquiring control over personal future events.

Linguistic aspects. Thought may become truly verbal and propositional when we communicate to others. Undoubtedly, then, people possess a capacity to translate sequentially flowing material into linguistic propositions. These propositions may facilitate self-talk as well as communication with others. The way in which this happens, however, is worth investigating empirically.

One possible hypothesis is that linguistic propositions emerge when relatively random material in the stream of consciousness is ordered in a way syntactically compatible with a given proposition. To test this possibility, Noguchi, Albarracín, and Fischler (2005) performed a preliminary experiment investigating the formation of implicit intentions. They reasoned that people could form intentions on the basis of the mere succession of certain words and context. In this study,

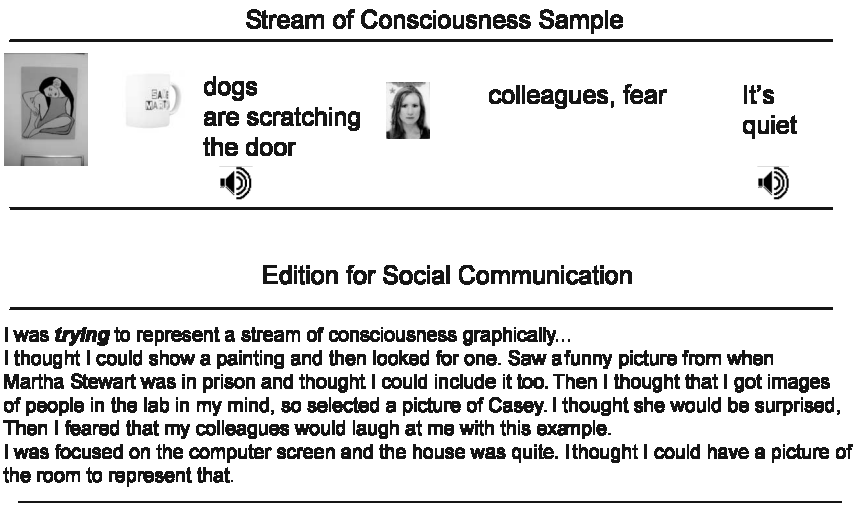

Figure 2. Sample of free association and social account of the thoughts.

participants engaged in a word-detection task after participating in a prisoner's dilemma game. The word-detection task was introduced as an unrelated task while participants waited for the scores of the game. In this task, participants were instructed to press a key when words began with certain letters (e.g., *A* or *N*). In a series of trials, two words composed the experimental manipulation. The manipulated words were five synonyms of *act* or five synonyms of *nice.* In one condition, participants were exposed to the words *act* (or, e.g., *play*) and *nice* (or, e.g., *fair*) in this sequence. In the other condition, participants were exposed to the same words, but *nice* preceded *act.*

After the word-detection manipulation, participants played another prisoner's dilemma game. The prediction was that the implicit proposition *act–nice* might motivate participants to cooperate because the order suggests an instruction. In contrast, the implicit proposition *nice–act* could be perceived as a compliment. As a result, *nice–act* may suggest that participants had already been nice. In turn, this assessment may reduce the perceived need to be nicer on a future game. Supporting these expectations, the *act–nice* sequence increased cooperativeness from the first to the second game. Correspondingly, the *nice–act* sequence decreased cooperativeness from the first to the second game.

Briefly, then, reasoning may be governed by similar mechanisms. People may possess a deep syntactic structure (Chomsky, 1959) with which to process random material. As a result, when the order of verbal and nonverbal stimuli matches a meaningful syntactic proposition, they can easily translate those stimuli into a linguistically meaningful unit.

Language, meta-cognition, and reasoning. According to Vygotsky's (1975) theory of cognitive development, a linguistic system is at the root of all higher cognitive functions. First, language frees the child to rearrange outside stimuli in various ways and to delay the solution of a problem. Problem solving is first possible through "egocentric speech" (the child talks to himself or herself). Later, around the age of 5, egocentric speech is replaced by inner speech (reflections). Once egocentric speech has become internalized, the child is able to focus consciously on cognitive processes such as memory. As a result, the child can exercise greater conscious control over cognitive processes (Vygotsky, 1986).

Reasoning and metacognition are both equally linked to language. For instance, archeological evidence confirms that hominids had to the ability to use environmental materials as tools as early as 5 million years ago (Jurmain, Nelson, Kilgore, & Trevathan, 2000). Nonetheless, the *creation* of tools was possible after the development of language in Homo sapiens, which took place approximately 2½ million years ago (Jurmain et al., 2000). This tool development has long been considered the first evidence of reasoning in human history (Jurmain et al., 2000).

Relevant to the hypothesis in this commentary, among nonhuman primates, those species that live in groups (e.g., chimpanzees and gorillas) are both faster and better to learn vocabulary than those that generally live in isolation (e.g., orangutans; Jurmain et al., 2000). This evidence supports a relation between social interaction and linguistic capability. Even in humans, there is evidence that social interaction promotes linguistic capability, reasoning, and metacognition. For instance, if one does not interact with other humans early in one's childhood, then one may never be able to convert ideas into linguistic propositions or engage in metacognition.

Important evidence about the relation between language and metacognition comes from observations of foundlings or feral children. These children, by definition, have limited or no social interaction through at least

early and middle childhood (Curtiss, 1977; Shattuck, 1980; Singh & Zingg, 1942). Reports of interactions with these children indicate that they are never able to learn more than a few words, let alone a grammatical or syntactic structure (Curtiss, 1977; Shattuck, 1980; Singh & Zingg, 1942). In addition, there are no reported cases in which feral children were capable of learning even simple arithmetic, let alone complex metacognitive processes or first-person intentional thought (see, e.g., Curtiss, 1977; Shattuck, 1980; Singh & Zingg, 1942)

Applied Implications of Intentionality's Dependence on Social Communication

Catalysts of first-person, intentional thought compose the presence of other people and a familiar language. To be important for social psychologists, however, these ideas should have implications for socially relevant phenomena. We speculate on three possible phenomena that may be understood with this framework.

Journaling as a Way of Achieving Control

Mental health professionals have long recognized the benefits of writing about one's problems (see, e.g., Progoff, 1975). Putting one's problems in perspective allows one to rationally examine the problem and come to a viable solution. Without this essential process, one may experience subsequently negative cognitive, affective, and behavioral outcomes. Indeed, empirical tests of this hypothesis suggest that journaling can have positive mental (Greenberg & Stone, 1992; Murray & Segal, 1994; Rimé, 1995), physiological (Dominguez et al., 1995; Hughes, Uhlmann, & Pennebaker, 1994; Pennebaker, Keicolt-Glaser, & Glaser, 1988), and behavioral (Cameron & Nicholls, 1998; Francis & Pennebaker, 1992; Spera, Buhrfeind, & Pennebaker, 1994) effects.

It is interesting that the processes underlying the efficacy of journaling have been elusive (Pennebaker, 1997; Pennebaker & Francis, 1996; Pennebaker, Mayne, & Francis, 1997). Three linguistic factors appear to predict improved health outcomes. They entail the use of positive emotion words, the use of negative emotion words, and increased usage of both causal and insight words (Pennebaker et al., 1997). In addition, greater cognitive processing during journal writing facilitates awareness of positive outcomes. Focusing on positive outcomes may in turn decrease the severity of mental health symptoms (Ullrich & Lutgendorf, 2002). In terms of our previous observations, translating one's experiences into meaningful syntax via journaling assumes the explicit use of the first person and greater attributions of intention and control. These processes may then improve actual control over one's life and subsequently facilitate positive mental health outcomes.

Bilingualism

If propositional, intentional thought depends on social communication, migration to places with a different language may provoke negative consequences. For example, the incorporation of a new language may lead to perceived and actual loss of control over one's behavior, because one is partially prevented from using one's previous code. This observation implies that migrants who learn the language of the new area may experience more difficulties than migrants who do not.

Incidental evidence supporting the effects of a new language on mental functioning comes from a study conducted in Canada. Ali (2002) compared immigrants who learned to speak either French or English or both with those who learned neither. Findings indicated that those who learned either or both English or French suffered negative health outcomes, including alcohol dependence and depression (Ali, 2002). In addition, being surrounded by ethnically and linguistically similar groups promoted mental health among the new immigrants (Ali, 2002; Beiser & Edwards, 1994; Burnam, Hough, Karno, Escobar, & Telles, 1987).

The finding that giving up one's syntactic code can lead to negative consequences is not limited to Canadian immigrants. Indeed, these findings are replicated across populations of Mexican immigrants moving to the United States. For example, immigrants with higher levels of acculturation (i.e., speaking both English and Spanish, living outside immigrant communities) experience more negative mental health outcomes, including phobia, alcohol abuse or dependence, drug use or dependence, and antisocial personality (Burnam et al., 1987). Recently, Guilamo-Ramos, Jaccard, Pena, and Goldberg (2005) found that among recent immigrants, youths from English-speaking homes were more likely than those from Spanish-speaking homes to engage in sexual-risk behavior. Again, these types of data are likely to reflect many factors. Among other things, however, youths who communicate using one linguistic system at home and another outside of the home may be more likely to engage in risky behavior because of the linguistic effects on reasoning and control. Thus, although acculturation may facilitate career and educational achievement (Ali, 2002), losing one's native linguistic community may have detrimental effects on well-being.

Of course, these negative effects should last only as long as migrants are unused to or uncomfortable with the new syntax. Once the new language is mastered, the detrimental effects of code switching should de-

cline. Indeed, research with fluent bilinguals indicates that relative to monolinguals, bilinguals have greater mental flexibility (Cook, 1997), higher metalinguistic skills (Ben-Zeev, 1977; Cook, 1997), better selective attention (Bialystok, 1993), greater creativity (Cook, 1997), improved analogical reasoning (Cook, 1997), and a more diversified set of mental abilities (Cook, 1997). These studies are intriguing for analyzing the relation between propositional thought and social communication.

Effects of Isolation on Cognitive Tasks

If social interaction facilitates linguistic translations into intentional, first-person language, then a dearth of interpersonal relationships should impede these processes. Indeed, a search of the relevant literature indicates that isolation has a number of deleterious health outcomes, including appetite and sleep disturbances, anxiety, panic, rage, loss of control, paranoia, hallucinations, and self-mutilation (Haney, 2003; Jackson, 1983; Porporino, 1986; Rundle, 1973; Scott, 1969; Slater, 1986). These problems exist in different contexts and across a variety of populations including prisoners (Haney, 2003), the mentally ill (Fisher, 1994), the elderly (Chappell & Badger, 1989), and those in isolated environments such as Antarctica or space (Harrison, Clearwater, & McKay, 1989). Moreover, some of these effects can be induced in the lab in otherwise healthy college students by simply signaling that one is socially rejected (Twenge, Catanese, & Baumeister, 2003).

Related to the hypotheses in this commentary, isolation has especially negative consequences for complex cognitive and linguistic ability. For instance, people who are not selected as members of a group have been shown to write fewer words during a thought-listing task (Twenge et al., 2003). Also, rejected individuals are slower to detect words in a word recognition task (Twenge et al., 2003). Indeed, even the belief that one may be alone later in life can decrease performance on intelligence measures (Baumeister, Twenge, & Nuss, 2002). Of these measures, effortful logic and reasoning are impaired the most. Simple cognitive tasks like encoding of information, however, do not seem to suffer (Baumeister et al., 2002).

The effects of social rejection are likely complex. However, these findings support the hypothesis that a social group serves as an explicit and implicit listener to otherwise relatively haphazard, nebulous thoughts. Some of these effects may be automatically facilitated by the presence of others. Consequently, the lack of a group may decrease the ability to translate the contents of one's stream of consciousness into intentional, first-person language. The language and translation involved in social reasoning are worth studying in the future.

Note

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Modeling the Architecture of Linguistic Behavior: Linguistic Compositionality, Automaticity, and Control

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The three processing models advanced in this issue build on the legacy of 20 years of work on dual-processing models (for an overview, see Chaiken & Trope, 1999). These models of how social information is processed rest on an analytic rationale that is rule based or representational, namely, slow, effortful, and rule based *versus* one that is fast, associative, and relying on heuristic cues. The contributions to this issue move beyond these generic assumptions. Kruglanski, Erb, Pierro, Mannetti, and Chun (this issue; Erb et al., 2003) advance an alternative view on dual-process models. They argue that the distinction between two modes of processing (associative vs. rule-based effects) is superfluous and can best be understood in terms of a single rule-driven model. According to their view, rule-driven processes may be deliberative, conscious or explicit, or associative and mechanistic, thus escaping conscious access. Moreover, they identify a set of parameters (e.g., relevance of information, motivation, cognitive capacity, etc.) that jointly may shape the contribution of information upon judgments. In the case of Deutsch and Strack (this issue; Strack & Deutsch, 2004; see also Smith & de Coster, 2000), this advance is achieved by anchoring processing modes in two mental faculties or systems, along with suggestions about how these systems may be neuroscientifically grounded. They argue that these systems operate in accordance with different principles that are assumed to interactively determine social judgment and behavior.

Sherman (this issue; Conrey, Sherman, Gawronski, Hugenberg, & Groom, 2005) elaborates on the notions of control and automaticity, raising the stakes on these processes from two to four, with an option on more. He does so by suggesting that control and automaticity assume different guises. In his view, control can be conceptualized either in terms of achieving accuracy or as implementing suppression of, for instance, prejudice. Similarly, Sherman distinguishes automaticity resulting from sheer association or habitual response from automaticity that is recruited when control fails.

There is much to be recommended by these alternative developments, which provide different integrations of the empirical literature as well as provocative theoretical approaches to how incoming information is "processed." There are numerous ways in which it is possible to comment on each of these alternatives. Here I single out a feature common to all three approaches on which I build my comment.

All three models focus on information processing and rely on a set of *amodal* computational rules. Consequently, they are independent of any specific meaning or content (e.g., the different processes are assumed to be generic) and are *not dependent* on the particular meanings of incoming information (e.g., attitudes toward a detergent, the U.S. budget deficit, or the new Bugatti Veyron 16.4), the medium that carries such information (language), and the socially situated context within which such information is exchanged. This is a consequence of a specifically computational and *intraindividual focus*. What are the implications that arise from considering cognition as social rather than an intraindividual "phenomenon "? Such an individual-centered focus does not need concern itself with the social and adaptive functions of cognition.

The adaptive function of cognition means that mental processes are action oriented and that cognition is for the regulation of action (cf. Smith & Semin, 2004, for detail). Consequently, cognition is not locked into individual brains (Hutchins, 1996). Thus, if cognition is for action, then one has to ask the question, How is cognition implemented in social interaction? The answer to this is to be found in language and communication. Language is one of the chief tools by which cognition is extended and implemented in social interaction (Semin, 2000a). For cognition to "happen," it has to be "coupled " with an external entity in a two-way interaction, and this happens chiefly with linguistic behavior.

> Without language we might be much more akin to discrete Cartesian "inner minds", in which high-level cognition, at least, relies largely on internal resources. … Language thus construed, is not a mirror of our inner states but a complement to them. It serves as a tool whose role is to extend cognition in ways that on-board devices cannot. (Clark & Chalmers, 1997, p. 14)

Language is the means by which action is brought about, the medium for practical activity (Chiu, Krauss, & Lau, 1998; Higgins, 1981; Krauss & Fussell, 1996), and a tool to implement cognition in communication. The phenomena addressed by the diverse processing models occur in a linguistic ecology and find their expression in linguistic behavior. This is a feature of social reality in which cognition "occurs." Considering this ecological niche and linguistic behavior introduces a social link missing in the three models.

To complement this missing link, I advance an analysis of how linguistic behavior is structurally assembled. This analysis furnishes a preliminary model of

the architecture of linguistic *behavior*, with specific psychological implications about the interface between automatic and controlled processes. Thus my comment consists in advancing a novel model of linguistic behavior that is intended to draw attention to an aspect of *social* cognition that needs to be considered when modeling the processing of social information.

Notably, this analysis treats process and function as inseparably related. In the first brief section to follow, I argue for the significance of linguistic behavior. In particular, I draw attention to the recursive nature of language. Recursiveness of language and its implications is the subject of the second section. Based on this feature, I advance a blueprint for the architecture of how linguistic behavior is assembled and its implications for automatic and explicitly controlled aspects of language use.

The penultimate section provides an overview of experimental evidence that provides some empirical support and elucidates some aspects of the interplay between the automatic and controlled in terms of the architecture model advanced here. In conclusion, the implications of the model are drawn for the status of automatic and controlled processes, how they interface, and their meaning for implicit measures of preferences and prejudices.

Why Linguistic Behavior?

There are at least three reasons why an examination of linguistic behavior may provide insights that could further our understanding of the different processing models advanced in this issue. The first has to do with the general significance of linguistic behavior for social cognitive processes. The second has to do with the recursiveness of linguistic behavior. The final reason has to do with the temporal characteristics of linguistic behavior.

The first reason is based on the self-evident observation that social behavior happens chiefly, albeit not only (cf. Semin in press) by means of linguistic behavior. It is predominantly by means of linguistic behavior that cognition is extended and implemented in action (Semin, 2000a). Linguistic behavior is a pervasive aspect of our waking life. Human beings spend a considerable proportion of their time firmly engaged in preparing, generating, and making sense of verbal messages. In generating and making sense of verbal messages, people utilize language as a tool to give public shape to their goals, motives, and intentions, thereby directing the attention of a listener to specific aspects of reality, an idea or state, and to shape the social cognitive processes of a listener.

The second reason revolves around a distinctive feature of language that makes it a biologically unique phenomenon. Communication itself is not biologically unique. It is an endowment that a great number of species have, and in each case it has its unique specialization (cf. Seyfarth & Cheney, 2003). Among nonhuman species, communication takes place via *signals*. However, such signals are not combined to convey new meanings. Typically, nonhuman communication systems are *closed*. In contrast, human verbal communication displays a unique property. It relies chiefly on the use of *symbols* that are part of a hierarchically organized combinatorial system (cf. Jackendoff, 1999, 2002). In contrast to communication among other species, human communication is capable of unbounded diversity building upon a very limited set of discrete elements. This second reason is elaborated on in the next section of this commentary and constitutes the focal point of this contribution. In this section, I advance a novel model of linguistic behavior based on the recursiveness of language. This model is intended to draw attention to language driven sources of automatic and controlled behavior and provide a complement to the three models presented in this issue.

The final point about why linguistic behavior presents fertile ground for an investigation of automatic and controlled processes has to do with the speed at which linguistic communication takes place (Semin, 2000a, in press). The average speaking rate for English is 180 to 200 words per minute (approximately 333 msec per word); the upper range can go from fast (300 words per minute) to very fast (500 words per minute). The demands that this speed makes on speaker and listener are remarkable. It simply takes the brain a few seconds to put speech rate, accent, and message together for communication to occur. We do so by accessing a lexicon with a volume between 20,000 and 60,000 (or more) words. Moreover, talk does not involve merely producing words. It requires choosing words from a lexicon to create sentences that are also linguistically structured. Doing these things consciously and trying to control each and every step of linguistic behavior would present an insurmountable capacity problem. Thus the architecture of linguistic behavior must have a high-speed feature complimenting its recursiveness. This simply means that substantial portions of linguistic behavior must escape conscious access and be "driven automatically" in the sense that the individual is not aware of them, that these behaviors are highly efficient, not controllable, and not necessarily voluntarily instigated (cf. Bargh, 1994).

An additional advantage of casting the issue of automatic and controlled processes into a linguistic behavior framework is to be found in the fact that such a model does not dissociate process from function. Focusing on linguistic behavior and its recursive structure furnishes an integrated and heliocentric view (Hanson, 1958) on the compositionality of automatic and con-

trolled processes. This, as I argue in the concluding section of this commentary, gives a different complexion to prominent analyses of automatic and controlled processes that have relied on methodology dissociating process from function.

The Architecture of Linguistic Behavior: The Particulate Principle and Linguistic Compositionality

Although the distinctively recursive propensity of linguistic communication may be unique to the human species, the principle by which infinite diversity is generated is not unique to language. Abler (1989) derived the central tenet of his thesis from von Humboldt's (1836/1999) observation that language "makes infinite use of finite media" (p. 70) whose "synthesis creates something that is not present *per se* in any of the associated constituents" (p. 67). This is a point that has been reiterated by Chomsky (2000): "Human language is based on an elementary property that also seems to be biologically isolated: the property of *discrete infinity* [italics added]" (p. 3).

Abler's (1989) special contribution is to show that this observation is not specific to language but that it applies to all self-diversifying systems, including physics, chemistry, genetics, and language. He termed this thesis as the "*particulate principle of self-diversifying systems*" (p.1).

There are a number of features of this principle. First, self-diversifying systems rely on a discrete set of basic units, elements, or particles (e.g., language: phonemes; atomic system: neutrons, protons, electrons; genetics: four chemical units called A, G, C, and T). The second feature is *compositionality.* The elements of this finite set are repeatedly combined into larger units (e.g., phonemes to words; protons, electrons, etc., to atoms, etc.). The third feature is *emergence*. The larger units have an *emergent quality.* The different combinations of the particles create something that is *not present* in its constituents. The permutation and combination of these larger units (e.g., atoms to molecules; words to sentences) lead to even larger units in a hierarchy of compositionality that yields an unbounded diversity of form and function. Moreover, each level of organization displays a new emergent quality. The different combinations at different levels of organization display qualities and properties, which are absent in their constituent elements. The fourth feature is *preservation of identity.* Although compositionality at different levels displays emergent qualities, the constituents do not lose their original identities. The final feature is *concealment*. The emergent quality of the higher level of organization means that the qualities of the constituent particles are concealed or masked. Thus there are five distinct features of self-diversifying systems: (a) discrete set of foundational units, (b) compositionality of these units, (c) emergence, (d) preservation of the identity of constituent units, and (e) concealment of lower levels of organization.

The particulate principle and its features are best illustrated with simple chemical compounds such as *sand* or *water*, namely, combinations of distinct elements such as hydrogen, oxygen, and silicon, which in turn consist of specific combinations of neurons, protons, electrons, and so on. Specific combinations of the discrete set of units (neutrons, electrons, etc.) give rise to elements (H, O, Si). The elements reveal different emergent qualities as a function of the distinctive combinations of basic units that are absent in their constituents. Combinations at the element level give rise to new compounds (water, sand). At this higher level of organization the compounds (SiO_2, H_2O) reveal qualities that are distinctively different from their constituent elements. For instance, take the case of water. It has fire-extinguishing characteristics, whereas one element (hydrogen) burns, and the other (oxygen) sustains burning. The particular syntheses of elements (e.g., H_2O vs. SiO_2) produce compounds with emergent properties that are distinct and unique. It is important to note that the constituent elements do not change their character in compound form but retain their identities. The elements preserve their distinctive and invariant qualities and are "categorical." Finally, it is impossible to identify the elements of the compound from the appearance of the compound (e.g., oxygen in sand and water). Compounds conceal the characteristics of their constituents. However, this does not mean that the constituent elements cannot be retrieved and that their characteristics are retained.

The situation is no different with language. In the case of language, creative synthesis or infinite diversity relies on a discrete set of basic units, namely *phonemes*, as constituents at the primary level of organization, with *morphemes* at the second, *phrase structure* at the third, and *utterance* at the fourth levels. The fourth level is where the situated meaning is brought to expression with *utterances* (see Figure 1).

Different compositions within the discrete set of phonemes give rise to a variety of morphemes, distinct compositions thereof to phrase structure, and so on. Each composition yields a "higher" unit with an emergent quality. The higher level of organization has something that is not present in its constituents. Nevertheless, it is possible to decompose the higher unit to its lower constituents. Most important, in the context of our focus here, *lower level constituents* (e.g., phonemes and phoneme composition) tend to be obscured or concealed by the organization at *higher levels* (e.g., phrase structure, thematic structure). This is very much like chemical compounds and their constituent atoms. Higher levels of organization have a propensity to act

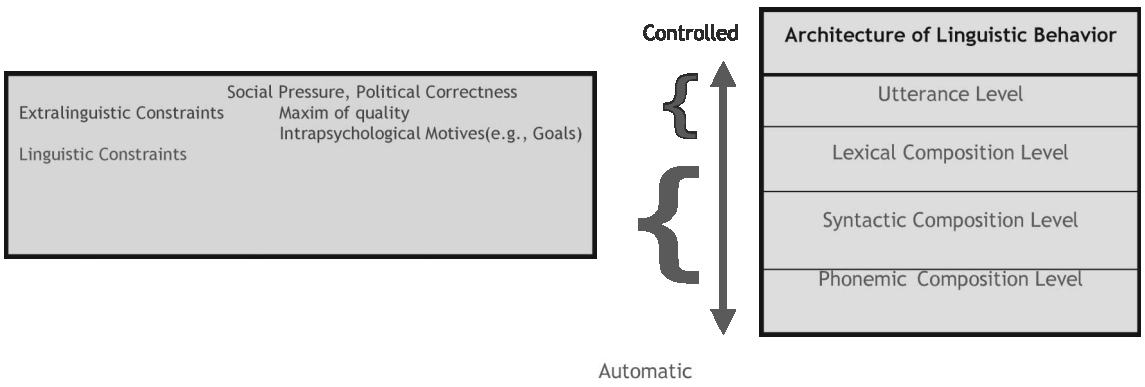

Figure 1. **A model of the architecture of linguistic behavior.**

as shells, which enclose or hide their constituents—a consequence of the fact that the compositions are emergent and display unique and novel qualities. This does not mean that the constituents (e.g., phonemes, morphemes) loose their identity or are not retrievable—on the contrary. However, the fact that the higher order compound conceals the characteristic properties of its constituents also means that these are not necessarily accessible and are very likely to escape conscious access. These different organizational levels provide human language with its distinctive characteristic: *unbounded diversity* or *discrete infinity,* a characteristic feature of self-diversifying systems in general. In the following section I detail the psychological implications of this particular architecture of linguistic behavior.

The Architecture of Linguistic Behavior: Psychological Implications

Linguistic behavior is about choices between alternatives, but at which level of organization are decisions made and which levels are automatically driven? Linguistic behavior consists of intentionally produced acts in relation to a goal (see however Moskowitz, Li, & Kirk, 2004). At the utterance level, thematic or topical choices are made consciously and explicitly,[1] which are driven by explicit goals and their situated relevancies (Sperber & Wilson, 1995).[2] Goals determine where attention is directed (e.g., Shallice, 1978), and the focus and direction of attention determines the content of consciousness. Moreover, the proposed architecture of linguistic behavior suggests that the highest level of organization of linguistic behavior (utterance) conceals the characteristics of its subordinate-level constituents. According to the model advanced here, processes that are entailed at the phonemic, lexical, and phrase structure levels should be inaccessible.

The function of language, as I noted earlier, is to give public shape to particular goals by realizing them in speech acts (Searle, 1969), thereby directing the attention of a recipient to specific aspects of reality, an idea, or state. This could be about a secret passion or a personal problem, yesterday's soccer match, a dream car, or the latest Supreme Court nomination. At the utterance level the speaker is *aware* of what she is saying and therefore doing so *intentionally* to realize a goal; the behavior requires the allocation of *attention* and is demanding on *cognitive resources*. Finally, behavior at this level is *controlled*—the speaker can decide to change the topic or stop talking (Bargh, 1994).

If the *emergence* and *concealment* features of the proposed architecture are correct and a thematic or topical decision is made, then all other levels (phrase structure, lexical, and phonetic level) should be driven automatically, but not necessarily autonomously, as a decision to stop or change thematic course at the utterance level means that all automatic processes that provide scaffolds to this level will also cease. However, this does not mean that the "subordinate" or scaffold processes (lexical, phonetic, etc.) are consciously monitored. What are the supportive and nonsupportive arguments for this general conclusion? The process of selecting phonemes and syllables for words is predominantly automatic albeit not autonomous. Thus, although no one single level of the architecture, including the phonological, is independent of the other, the entire process of linguistic behavior is driven top down, with decisions at the utterance level shaping how subordinate levels are *composed*.

Are lexical decisions made under explicit control? Some appear to argue that they are (e.g., Garrod & Pickering, 2006). One can regard lexical decisions as decisions about levels of semantic specification appropriate to the conversational context. On the face of it, one

[1]There are limiting conditions to this observation as is the case of brief and highly ritualized exchanges such as fleeting exchanges (e.g., Langer, 1989, 1992).

[2]See, however, speech accommodation theory (communication accommodation theory; e.g., Giles & Coupland, 1991), where global decisions can affect accent, and so on.

might argue that decisions regarding the appropriate level of description are likely to be explicitly driven and controlled. Should an object be referred to as a car, a fast vehicle, or the new Bugatti Veyron 16.4? Some authors (e.g., Garrod & Pickering, 2006) have suggested that these choices are highly controlled, intentionally driven, and demanding on central attentional resources. Notably, they do not generalize this to all word choices. For instance, people are unlikely to be aware of their selection of function words (e.g., *the, of, to*).

There are two general arguments against this position, which in my view suggest that a controlled lexical decision may be the exception rather than the rule. The first one relies on the speech rate argument. It would be hardly possible to maintain an average speech rate of a 333 msec per word if lexical decisions were made in a controlled manner—which would impose considerable demands on attentional resources that are already stretched by the task of monitoring the utterance level. The second argument is derived from the emergent feature of the higher level organizations. If the type of architecture outlined earlier is valid, then the utterance level should conceal lexical choices.[3] Thus both speed of speech rate and the emergent feature of the high-level organization should deny intentional control of lexical choices, which would require the coactivation of a goal subordinate to the conversational one. What then shapes the relationship between the utterance and how particular lexical selections come about?

There are two complementary sets of constraints that contribute to lexical selections. The first set is driven by *extralinguistic* considerations, and the second set has to do with the type of match between the type of reality and the type of linguistic tools (words) that are available to represent it.

Three general extralinguistic constraints contribute to the shape that the representation of a social event takes in linguistic behavior. The first is conversational conventions (Grice, 1975). I am unlikely to describe somebody who is cheating as honest. A contributory factor to this is the maxim of quality—do not say what you believe to be false—one of Grice's (1975) four conversational maxims. These are shared assumptions followed in conversations. Thus, I am unlikely to describe Ajax winning by four goals against Intermilan if they have lost the game, although it may be more prudent to do so under some circumstances that have little to do with Grice's maxims. This may happen due to the second type of constraint that is impressed by social norms—political correctness, or social pressure. The third constraint is intrapsychological, namely, the person's motives and motivations (e.g., is he an Ajax fan or not?). These three constraints will interactively prime the type of semantic fields that will be recruited to represent the social event and its actors.

The second set of constraints has to do with the type of reality that is to be represented in linguistic behavior and the nature of the types of lexical units available. Visualize an instance where you have to describe a person who is phoning. The choice of word, given only this information, to describe the action is probably *consensually*: "She is phoning." Alternatively, one can say, "She is on the phone"or "She is talking on the phone." The verb *to phone* or noun (*phone*) captures a perceptually invariant feature of the event and preserves it. Indeed, it is unlikely that there is a good alternative to it, Consider now a somewhat more complex social event where a soccer hooligan helps an old lady negotiate a very busy crossroad. Thus, simple situations (e.g., phoning) where there is a one-to-one correspondence between a feature of an event and a word may erroneously lead to the conclusion that lexical selections follow an intentionally controlled path, but this would appear to be misleading for the two central reasons I just mentioned— the speech rate argument and the emergent feature of the architecture.

For the same two reasons, I argue that *phrase structure* is largely automatic. Although it may be the case that on the odd occasion some speakers may attend to a choice between active or passive form, the speech rate argument and the emergent feature apply at this level as well. To repeat: The constituents escaping conscious attention are not merely a consequence of exceeding attentional capacity, they are also a consequence of the fact that the end products (syntheses) have a quality that is entirely different from the constituent parts. Thus it is inherent to the architecture of linguistic compositionality that constituent levels of organization are outside of conscious access.

The model about the architecture of linguistic behavior and its psychological implications provide an analytic framework (see Figure 1). Is there any empirical evidence in support of this model? Next I review research that was not designed to investigate the proposed model but yet has a bearing on it.

Evidence at the Level of Lexical Decisions That Escape Conscious Access

A number of studies in the field of how stereotypes are transmitted and maintained have revealed a Linguistic Intergroup Bias (LIB; Maass & Arcuri, 1992; Maass, Milesi, Zabbini, & Stahlberg, 1995; Maass, Salvi, Arcuri, & Semin, 1989). This research shows that people use a biased selection of predicates (verbs and adjectives) when they are describing positive and negative behaviors of in- and outgroup members. Moreover, this research shows that this selection bias is

[3]Indeed, those instances when people display attention and care with a word choice are generally accompanied with speech pauses and hesitations, dysfluencies, and so on.

an automatic process. The voluminous work in this field provides evidence for the automaticity of lexical decisions (see Maass, 1999, for a review), with comparable findings from the field of interpersonal relationships (e.g., Fiedler, Semin, & Finkenauer, 1993; Fiedler, Semin, Finkenauer, & Berkel, 1995; Fiedler, Semin, & Koppetsch, 1991).

The LIB involves a tendency for individuals to describe positive ingroup and negative outgroup behaviors in relatively abstract terms (adjectives, or abstract verbs), implying that the behavior is attributable to an actor's stable or enduring characteristics. In contrast, negative ingroup and positive outgroup behaviors are described in relatively concrete terms (prominent use of concrete verbs), implying situational specificity and that the behavior is due to external or situational factors. There is both a motivational and a cognitive account for this bias (cf. Maass, 1999), neither of which is central to the current focus. What is important is that the linguistic biases convey differential information as a function of word choices. The relatively abstract description of positive ingroup behaviors and negative outgroup behaviors represents the ingroup in a positive light and the outgroup in a negative one by implying that the behaviors of the group members concerned are due to enduring characteristics. The more concrete representation of negative ingroup behavior and positive outgroup behavior minimizes the significance of these behaviors as evidence for the respective groups' identities. Concrete language use implies that situational forces drive the behaviors and thus reduce the significance of these behaviors as diagnostic evidence (negative outgroup and positive outgroup behaviors).

A number of studies have used these systematic differences in predicate selection that have been observed in the LIB as an implicit indicator of attitude and compared it to explicit indicators of preferences and prejudices. The logic of these studies is based on a comparison of measures that use statements with measures deriving from analyses of predicate selection. According to the architecture of linguistic behavior model, predicate selection should be masked or concealed at the utterance level, thus escaping conscious access and control. Thus, although some of the extralinguistic factors are likely to drive situated meaning (e.g., political correctness, social pressure) others (personal goals and motivations) should seep through influencing predicate selection (see Figure 1).

For instance, Franco and Maass (1999) examined the relationship between the LIB as an implicit measure of prejudice (LIB) and explicit measures (reward allocation, liking ratings). They used two target groups, one that at the time was not protected against explicit prejudice (Islamic Fundamentalists) and the other, which was (the Jewish). Although they were able to show systematic prejudice for both groups by means of the LIB, it was only in the case of the Islamic Fundamentalists that there was a significant correlation between LIB and the explicit measures but not in the "protected" outgroup. In an earlier study, the same authors (Franco & Maass, 1996) argued that although explicit measures such as reward allocation and trait attributions are amenable to intentional control, the LIB is not necessarily so. They investigated two basketball teams, one of which was known for its uninhibited expression of intergroup hostility. The other group was known for considering aggressive behaviors unacceptable. The pattern of results they obtained repeats the one just reported. Although both groups showed a similar LIB pattern for positive and negative behaviors of in and outgroup members, the group that did not inhibit expression of hostility also displayed prejudice on explicit indices, namely, reward allocation and trait attributions. Similarly, Von Hippel, Sekaquaptewa, and Vargas (1997) compared the LIB with a self-report measure and an implicit prejudice measure (pairing stereotype-congruent articles with photographs of a Black vs. a White target). Their studies showed that the LIB-based measure was correlated with the implicit measure (assessment of biased attributional responding) but not an explicit measure, which measures bias in terms of situated surface meanings.

More recently, Douglas and Sutton (2006) reported a series of experiments that are explicitly designed to examine whether communicators are able to inhibit linguistic bias. Their findings show that even when participants were explicitly instructed to inhibit gender stereotypes or expectancies (create the opposite impression in their descriptions of expected or unexpected behaviors), they were unable to suppress the biased pattern of predicate selection in the free descriptions they provided (Experiment 3). Expected behaviors displayed a more abstract pattern of predicate selection compared to unexpected behaviors. In a further study (Experiment 5), participants were asked to suppress gender stereotypes in a design where expectancy (expected vs. unexpected) was a within-subjects variable and the participant's task was to describe a gender stereotype congruent versus incongruent behavior. They were explicitly instructed to suppress gender stereotypes in their descriptions of these behaviors. Despite that, participants displayed the typically biased pattern of predicate selection in their descriptions. Stereotype congruent behaviors were described with significantly more abstract predicates than stereotype incongruent ones.

A further source of evidence suggesting that people are unable to access lexical choices and their implications comes from how language can be strategically used in the context of question answer situations (cf. Semin, 2000b, for a review). This research, which also relies on the same model of interpersonal language (Semin & Fiedler, 1988, 1991; Semin & Greenslade, 1985) as the LIB research, indicates that

the abstractness level of questions influences the locus of causal origin for answers (e.g., Semin, Rubini, & Fiedler, 1995). If questions are formulated with action verbs (i.e. concrete verbs such as *to help, to phone*), then they cue the logical *subject* of a question as the causal origin of answers. Questions formulated with state verbs (i.e., abstract verbs such as *to love* or *to like*) cue the logical *object* of a question as the causal origin for answers. Consequently, when a simple question such as "Why did you buy a dog?" is posed, the answer that people provide refers to themselves (the subject of the question) as the causal agent in the answer—for instance, by stating "Because I enjoy dogs." However, the question "Why do you like dogs?" prompts responses in which the object is more prominent, e.g., "Because dogs are good companions." The research shows that participants are not aware of the steering power that such predicates have on their answers and cannot infer the inferences about causal origin that their answer may prompt in a listener. The research evidence (e.g., Semin & De Poot, 1997) suggests that predicate choices (abstract vs. concrete) in question formulation systematically influences the shape of answers. These in turn give rise to systematic differences in the inferences that listeners form. Moreover, these systematic biases escape both the producers' and the audiences' conscious access (cf. Semin, 2000b, for a review).

Although the studies just reviewed were not designed with a view to test the model advanced here, they provide convergent evidence that although the situated meaning of utterances may be monitored, the choice of words (predicates) may be concealed by the highest level of organization in linguistic behavior and thus escape intentional monitoring even under conditions where there is an explicit request to do so instructionally. This inability may be due to the emergent quality of the utterance that conceals access to the unique elements from which it is composed.

Conclusions, Implications, and Possible Directions

In concluding, I should start by noting what the proposed model is not. The architecture of linguistic behavior model advanced here is not about speech production. It does not address the processes involved in the conversion of a nonlinguistic representation about what to talk about (conceptualization) to the construction of linguistic representation and articulation, or for that matter the intermediary stages in this process from conceptualization to sound (cf. Levelt, 1989). The proposed model is about the structural architecture that provides the scaffold for linguistic behavior. An examination of this architecture reveals how linguistic behavior is composed. The general principle from which the current model has been derived is not specific to linguistic behavior alone although it is derived from von Humboldt's (1836/1999) observations about language. Indeed, Abler (1989) referred to the two distinctive features of making infinite use of finite media and the "creative synthesis" as "Humboldt's criteria" (p. 1). Notably, the particulate principle is applicable, as Abler (1989) pointed out to self-diversifying systems in general and may also have applications in other fields, such as cognitive neuroscience and the compositionality of neural processes.

What is the main difference between the structural architecture model advanced here and the different information processing modes or systems? The exclusive focus on amodal process is partly a legacy of modeling social cognitive processes on cognitive psychological models that dissociate process from function and therefore neglect the situated context in which behavior occurs. Oftentimes, the treatment of whether a behavior, judgment, impression, or expression is driven by controlled or automatic processes addresses the issue both experimentally and conceptually by dissociating the process from its function. Most of the standard process paradigms such as Stroop effects (e.g., McLeod, 1991), lexical decision tasks (Neely, 1976), affective (e.g., Fazio, 2001; Klauer & Musch, 2003) and semantic (e.g., Neely, 1991) priming, inter alia are creative methods designed to document and authenticate diverse automatic process. Although highly informative about the fine minutia of automatic processing, an exclusive focus on process paradigms introduces a dissociation of process from function. This is akin to the parable of the two Martians visiting Earth for the first time and encountering a car. One of the Martians has a geocentric approach, whereas the other has a heliocentric perspective (Hanson, 1958). They examine this alien object in different ways. The geocentric one opens the hood, discovers the engine, begins to examine its works, and proceeds with modeling the processes, trying to put together a general picture of the engine's possible workings. The heliocentric Martian gets to the driving seat; eventually finds the engine key; and figures out the roles that steering wheel, accelerator, clutch, gear, and brakes play, thus discovering the function of this alien object, only to conclude that it is a very primitive and environmentally unfriendly means of transportation.

The structural architecture approach presents a *preliminary* analytic step in modeling how integrated behavior is assembled at different but simultaneously produced and interwoven levels of organization and does not pit automatic and controlled processes against each other. The production of linguistic behavior that draws on cognitive resources is intended, goal driven, and subject to interference. However, linguistic behavior is impossible without the scaffolding of remarkably complex automatic processes at the

phonemic, morphemic, phrase structure, and utterance levels, all of which operate at remarkably high speed. Thus the production of controlled linguistic behavior, which is what we consciously perceive and which drives our attention to specific features of reality, is inconceivable without the highly automated scaffolds that need to be cooperating at the lower levels of organization of linguistic compositionality. Indeed, once the controlled, intended, and monitored process of expressing unique situated meaning is interrupted, all behavior ceases to be performed. The automatic processes in such a model are not autonomous. The entire scaffold of the architecture ceases. Thus there are no automatic processes without controlled ones, and vice versa. Such a structural perspective does not divorce process and function in the analysis of linguistic behavior in particular and behavior in general.[4] These considerations suggest that there are substantial domains of behavior in which an analytic separation of automatic versus controlled processes—as in the case of the Quad Model or for that matter dual-systems models—may not appropriate. In fact, this analysis suggests that the performance of one of the chief carriers of social behavior cannot be conceived unless automatic and controlled processes operate in an integrated manner. A further feature of the proposed model is that although it is specific to language, it integrates process and function in a way in which content is largely irrelevant.

Let me in closing present one of the possible implications of this preliminary structural architecture model. One of the daunting problems in social psychology has been developing true indicators of people's preferences and prejudices. What do people really feel, think, and believe about little men from Mars, candy bars and apples, the Tasmanian Devil, the European Constitution, soccer hooligans, blondes, Blacks, immigrants, and guest workers? How are they likely to act when they encounter a situation involving any one of these? A perennial problem that has occupied social psychology, very much from its early days, has been to find methods that will provide a handle on people's true orientation toward different groups, objects, or issues and how they act toward them. Although there may be no need to conceal one's orientation toward the Tasmanian Devil or men from Mars, the situation becomes increasingly complicated when one moves from candy bars and apples (e.g., Karpinski & Hilton, 2001) to blondes, and even more so once people enter the arena of the politically sensitive and socially problematic. Such indicators have been repeatedly shown to be prone to what I referred to earlier on as extralinguistic constraints.

Not surprisingly, there is a venerable history of the substantial amount of thought that has gone into developing instruments that may provide us with an incisive entry and may furnish an insight into people's "true" orientations (cf. Brauer, Wasel, & Niedenthal, 2000). These have progressed from measurement techniques (e.g., Bogardus, 1931; Likert, 1932; Thurstone, 1928) that were transparent to the respondent and therefore easy prey for bias to instruments that have attempted to tap concealed aspects of orientations assumed to be less reactive, such as the modern racism scale (McConahay, Hardee, & Batts, 1981). However, subsequent inquires have proven that such scales are also subject to situated biases (e.g., Fazio, Jackson, Dunton, & Williams, 1995). All these earlier measures have relied on instruments that rely on situated meanings—namely, statements that are easily monitored in terms of their implications and indications.

The current stage of this quest has found solace in the development of a rich repertoire of measures that seek to reveal true orientations without using direct questions, namely, methods that are assumed to activate a construct that is related to a particular group (e.g., blondes) or the consequences of such activation (see Fazio & Olson, 2003, for a review). The critical feature of these implicit measures is their attempt to rid the assessment process of possible biasing effects, such as giving politically correct, or socially desirable responses by adopting procedures that are assumed to escape the participants' awareness of the construct under consideration. One of the daunting problems confronting these implicit measures has been the theoretical underpinning of such measures. As Fazio and Olson noted, "Despite incredible activity, research concerning implicit measures has been surprisingly atheoretical. It has been a methodological, empirically driven enterprise" (p. 301).

The current structural model provides a possible way of theoretically underpinning those aspects of linguistic behavior that are easily subject to monitoring, namely, the situated meaning level. However, the architecture also points to specific aspects of linguistic behavior at a lower level of organization, such as the brief review of the research on predicate compositionality, which suggests that the emergent properties of the situated meaning level conceal lower levels such as predicate selection and thus escape conscious access and monitoring. Thus it is possible to reveal preferences and prejudices, although research in this area is only in its early stages. The structural architecture model advanced here is a preliminary step toward sketching the integrated relationship between function and process, which will hopefully provide a fertile pathway toward our understanding of social behavior.

[4]The lower levels of linguistic organization are obviously not the only scaffolds of communicative acts. Aside from vocal gestures that make up speech, bodily movements, gestures, facial expressions, and their corresponding neural substrates constitute crucial scaffolds, all of which are integrally matched to each other in communicative acts.

Notes

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