

Communicative Intentions and Language: Evidence from Right-Hemisphere Damage and Autism

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In this review article, it is argued that the wide range of communicative deficits that have been noted in both individuals with damage to the right cerebral hemisphere (RHD) and high-functioning individuals with autism may stem from difficulties appreciating the importance of their interlocutor's communicative intentions (CIs). It is also argued that the abnormal semantic development noted in infants with RHD and autism may be related to difficulties in appreciating CIs as well. Finally, it is suggested that the CIs hypothesis may provide an avenue for integrating a number of theoretical suggestions that have been made regarding the right hemisphere's contributions to communicative competence. © 1999 Academic Press

1. INTRODUCTION

A considerable body of research on individuals with acquired damage to the right cerebral hemisphere (RHD) and individuals with autism has revealed that these individuals display a wide range of communicative abnormalities that are often thought of as “extra-linguistic;” these abnormalities lie outside the domains of syntax, semantics, phonology, etc. In adults, these abnormalities include difficulties with understanding prosody, making appropriate conversational contributions, understanding nonliteral speech (such as metaphor or indirect requests), and identifying a main theme in discourse (Brownell, Gardiner, Prather, & Martino, 1995). In infants and children with RHD and autism, these deficits have a more linguistic character, as they include noted delays in vocabulary development (Thal, Marchman, Stiles, & Aram, 1991). Efforts to provide a more precise characterization of one or more of these communicative abnormalities have tended to appeal to these individuals' inability to integrate language into the contexts within which

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it is used (Rehak, Kaplan, & Gardner, 1992). One problem with this characterization lies in the fact that there is little consensus on how the term “context” should be defined. Often, what is considered context simply includes aspects of the environment that are not being studied. Because individuals with RHD and autism do not tend to have profound difficulties with articulation, grammatical construction, or primary semantic relations—all skills typically considered to be special to language—their difficulties are related to “context.” In other words, they point to the fact that there is “something else” involved in becoming an expert communicator.

In this article, I argue that the “something else” that makes everyday communication flow so smoothly is an ability to make appropriate inferences about one’s conversational partner’s *communicative intentions* (CIs) in any given situation. In support of this point, I will attempt to briefly outline a model describing the dynamic influence of CIs on everyday discourse and then suggest that the communicative deficits demonstrated by individuals with RHD and autism might best be viewed as related to an inability to integrate CIs with language comprehension and production. Furthermore, I will argue that the CI hypothesis might provide a new perspective on the delays in vocabulary acquisition noted in infants with RHD. Finally, I suggest that the CI hypothesis may provide an avenue for integrating a number of theoretical suggestions that have been made regarding the right hemisphere’s contributions to communication. I conclude by noting that, on the basis of the neuropsychological data, a complete model of the neurophysiology of language processing should include a role for the processes associated with making appropriate inferences about a speaker’s CIs.

2. COMMUNICATIVE INTENTIONS AND DISCOURSE: A DYNAMIC SYSTEM

The importance of making appropriate inferences about CIs was first explicitly considered by Grice. Noting that people do not always mean precisely what they say, Grice (1968/1991) proposed a distinction between two kinds of meaning present in any given utterance: “sentence-meaning” and “speaker-meaning.” Sentence-meaning is the interpretation that can easily be derived from the words themselves as specified by the grammar and primary semantic relations of the utterance (Searle, 1969). In contrast, speaker-meaning is the meaning that is derived through an understanding of what the speaker *intended* to communicate via his or her utterance. Of course, it may be that in certain cases, sentence-meaning and speaker-meaning are identical; sometimes people do say precisely what they mean. However, it is often the case that speakers rely on more than their words to communicate important information. This is particularly clear in instances when the sentence-meaning of a particular utterance does not serve any logical communicative purpose by virtue of its seeming redundant, untruthful, or uninforma-

tive given the preceding utterance. In these circumstances, an awareness of speaker meaning and CIs provides two related benefits. First, it allows one to “go beyond” what is said and make an appropriate interpretation of the conversational utterance. Second, the CIs provide a framework for resolving the potential incongruity between successive utterances by highlighting appropriate and relevant relationships.

As an example of the benefits of CIs on discourse processing, consider the following exchange:

Marianne: Would you like some coffee?

Chester: Coffee will keep me awake.

Here, Marianne poses a question which, on some level, requires a simple yes/no answer. However, instead of providing a yes/no answer, Chester provides information which, on the sentence-meaning level, was not requested. Despite the potential irrelevance of Chester’s utterance, Marianne will probably be able to decide whether she should pour Chester some coffee. How might Marianne do this? While it is clear that the primary semantic and syntactic relations of the words in the utterance will provide a good deal of information, Marianne’s ultimate understanding of Chester’s utterance will be based on inferences she makes about Chester’s CIs. That is, she will interpret Chester’s utterance in terms of her inferences about what Chester might have meant.

The question of what needs to be considered in order to make correct inferences about an interlocutor’s CIs is not trivial. Many researchers have theorized that correct inferences about CIs are predicated on an assessment of what aspects of each partners’ mental lives (e.g., desires and beliefs) are likely *mutually* known (Gibbs, 1994; Green, 1989). Some theorists have characterized these inferences as an appreciation of “common ground” (Clark, 1996). In the above example, Marianne’s precise understanding of Chester’s communicative intentions must be derived from her understanding of what she knew to be Chester’s desires in the situation. On the one hand, if Marianne knows that Chester is hoping to go to bed early, she is likely to take the utterance as a polite refusal. On the other hand, if she knows that Chester wants to stay awake watching a Star Trek marathon on television, the utterance is taken as an eager acceptance. By the same token, in order for Chester himself to be sure that his utterance is going to be interpreted appropriately, he needs to know that his desires in the situation have been clearly communicated prior to making the utterance. That is, if Marianne did not know anything about Chester’s plans for retiring, the response would have been uninformative. Thus, the shared awareness of one another’s mental states provide the basis for making correct inferences about CIs.

It is important to point out that inferences about CIs are not simply made once at the outset of the conversation and then forgotten. Instead, one’s un-

derstanding of an interlocutor's CIs is necessarily updated and modified over the course of the conversation. Often this updating occurs as a direct result of the conversation itself as new information is presented and the shared knowledge upon which inferences about CIs are made becomes increasingly elaborated. Consider, for example, situations in which very little is known about an interlocutor's communicative intentions to begin with. Over the course of the conversation, one uses what little one knows about the CIs of the speaker to aid in understanding the speaker's utterances. The emergent understanding of what is being said, then, feeds back into the database of shared knowledge between the interlocutors which, in turn, serves as the basis for drawing more refined inferences about a speaker's CIs. With these more refined inferences about CIs, one has an improved framework for understanding future utterances in this context.

For an illustration of the dynamic influence of CIs, see Fig. 1. In this diagram, two parties are seen as having their own set of mental states, including their CIs. Independently, each have to assess their common ground, that is, what aspects of their experiences are shared and can provide the background knowledge for interpreting their utterances. Based on this background knowledge, each party makes inferences about CIs. The utterances that make up the conversation are based on what each party knows will be understandable, or hopes will be understandable if the initial basis for making inferences about CIs is poor. The resulting utterances are then interpreted, for better or worse, in terms of the CIs. From the conversation, new information may come to light for each party, which then feeds back into their initial database. From this point, the process begins again, with new inferences about what is shared resulting in new inferences about CIs, which contribute to a new framework for understanding and producing conversational contributions.

Recent theory and research in psycholinguistics have identified a multitude of specific conversational abilities that are necessarily impacted by an appreciation of CIs. Among these are *discourse tailoring*, or the understanding that utterances are produced in a manner that is sensitive to the needs of the listener; *discourse inferences*, which encompasses the abilities to appreciate and produce discourse that coheres on the basis of the speakers' CIs; *non-canonical language understanding*, such as sarcasm, metaphor, and indirect requests and humor; and *vocabulary development*. In this article, I will describe in a more precise manner just how these areas are related to an appreciation of CIs and review research suggesting that individuals with RHD and autism have deficits that can be related to some aspect of appreciating CIs.

3. DISCOURSE TAILORING

There is no doubt that language itself plays an important role in our communicative endeavors. However, there is also no doubt that the ways we use

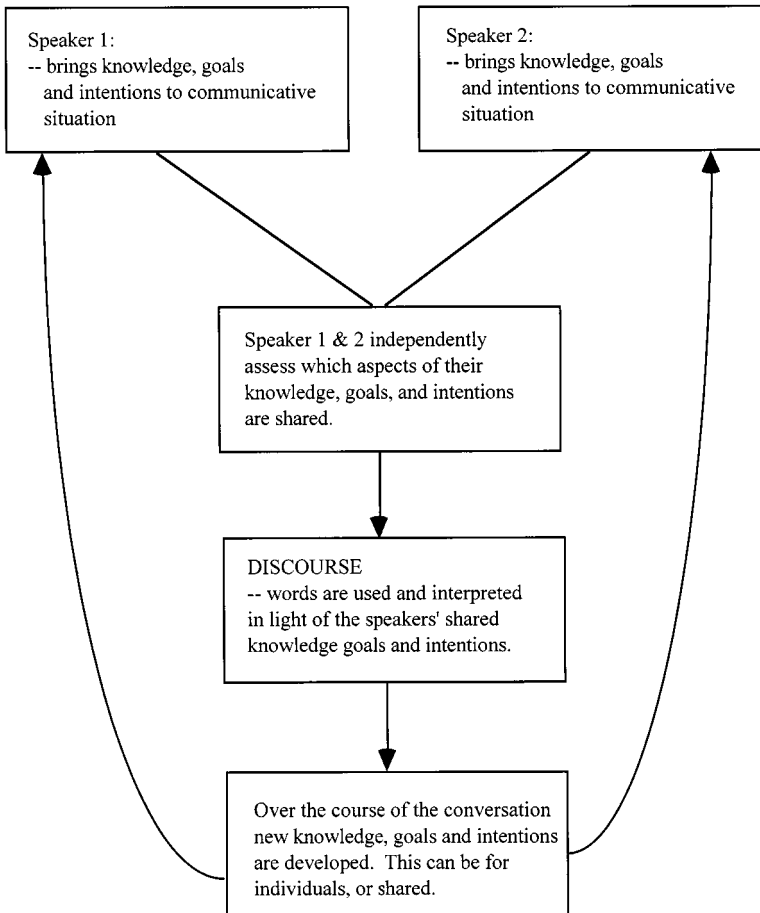


FIG. 1. Schematic of the dynamic influence of communicative intentions on conversation.

the language—the words we choose, the way we say the words, and so on—are also very important to communication. The way we use language and the way we understand others’ uses of language are guided by our inferences about CIs. Essentially, one “tailors” a conversational contribution to ensure that it will be easily and readily appreciated by one’s conversational partner. For instance, if one knows that a close friend has recently been through a bad breakup with a romantic partner, one may want to either avoid related topics, or be sure that one contributes relevant utterances in a manner that is sensitive to the friend’s needs. Additionally, a knowledge of the relationship between discourse tailoring and CIs provides interlocutors with a basis for drawing more refined inferences about the CIs of one another as the conversation develops. For instance, if the topic of the nasty breakup is sensitively

broached, one may be able to determine on the basis of the friend's subsequent conversational contribution whether she feels comfortable discussing the matter. In a dynamic manner, then, this new information influences one's own tailoring behavior. In this section, I review evidence suggesting that people with RHD and autism have difficulty both with tailoring their own discourse and with recognizing the tailoring efforts of others.

3.1. Tailoring One's Own Conversational Contribution

Grice noted that conversations are the result of a rather great cooperative effort between interlocutors that is focused, to some extent, on the achievement of a common purpose. This purpose can be stated from the outset, or the purpose can evolve with the conversation itself. In either case, it is an appreciation of the purpose that allows speakers to tailor their utterances to fit the specific needs of the situation. Grice (1968/1991) referred to the act of tailoring as abiding by the Cooperative Principle: "Make your conversational contribution such as is required, at the stage at which it occurs, by the accepted purpose or direction of the talk exchange in which you are engaged" (p. 307). Grice suggested that interlocutors are able to adhere to the Cooperative Principle by guiding their conversational contributions in accordance with four maxims: (1) quantity—say no more or less than is required; (2) quality—tell the truth; (3) relation—be appropriate to the immediate needs of the conversation; and (4) manner—avoid ambiguity and obscurity. By upholding these maxims, and by assuming that others are abiding by them, participants are able to successfully engage in conversations and other communicative exchanges.

Before one can tailor one's utterances to the needs of the conversation, one has to be able to identify what the needs of the conversation are. Grice noted that a prerequisite for identifying the needs of the conversation is the consideration of an interlocutor's CIs. The interlocutor's specific CIs provide the basis for establishing the topic and thus provide the foundation for the specific application of the conversational maxims. For instance, the maxim of relation requires that one first be able to appreciate what the interlocutor believes to be relevant to the topic at hand.

Grice's maxims serve to highlight the subtle ways in which conversational contributions are tailored with respect to CIs. There are other more obvious ways in which utterances have to be tailored in order to be easily understood by a listener. For example, when using pronouns to refer to objects, one has to make sure that the referent of the pronoun is understood by the listener. This is particularly important when considering the personal pronouns "I" and "you," as one person can be called by either one, depending on who is speaking. In what follows, I suggest that Grice's maxims and these more obvious situations can serve as standards for identifying discourse tailoring problems in individuals with RHD and autism.

3.1.1. Discourse tailoring by RHD patients. Gardner (1975) first noted that while patients with RHD seemed to have normal command of the grammar of language, they seemed to be impaired in their abilities to engage in normal discourse. More detailed observations along these lines were made by Myers (1978, 1979). Specifically, Myers (1979) characterized RHD patients' productive speech as "copious and inappropriate, confabulatory, irrelevant, literal, and occasionally bizarre." Interestingly, this list seems to relate directly to an inability to abide by the communicative maxims that were described above concerning making one's conversational contributions relevant, brief, and truthful.

One particularly important point to note is that not all of the conversational contributions made by RHD patients were necessarily characterized as untailored. Specifically, Myers (1978) found that RHD patients responded quite appropriately to questions that were clearly structured and required specific answers (e.g., "Where do you live?"). However, productive abnormalities were most prevalent when patients were engaged in free-flowing discourse involving more open-ended questions (e.g., "What did you do yesterday?"). This difference is important in that it highlights the degree to which RHD patients' deficits are related specifically to deficits in making appropriate inferences about their interlocutors' CIs. In the case of structured questions, the sentence meaning is unambiguous and requires no additional inferences regarding CIs in order to fully understand what is required. By contrast, well-formed responses to open-ended questions require inferences regarding the asker's CIs (what they might find relevant, interesting, etc.) Thus, these observations suggest that RHD patients do not suffer global impairments in making conversational contributions; instead, their deficits are limited to situations where structure requires discourse tailoring in line with inferences about CIs.

These clinical observations have been replicated and extended in more controlled observations of the productive discourse abilities of RHD patients. For example, Gardner, Brownell, Wapner, and Michelow (1983) found that when RHD patients were asked to recall the major events of a fable, these patients were more likely than age-matched controls to make unnecessary comments, digressions, and confabulations. In addition, Joannette, Goulet, Ska, and Nespoulous (1986) noted similar abnormalities in RHD patients' descriptions of pictures. Specifically, when RHD patients' discourse was analyzed with respect to conversational principles very similar to Grice's conversational maxims, RHD patients demonstrated a tendency to make irrelevant, repetitive, and contradictory remarks that did not cohere in a normal manner relative to age-matched controls. Like the observations made by Myers (1979), RHD patients' productive abnormalities seem to fit nicely with an explanation in terms of their impaired abilities to make appropriate inferences about an interlocutor's CIs, as measured by their inability to adhere to Gricean maxims concerning relevance, quantity, and truthfulness.

3.1.2. Discourse tailoring in autism. While they have not been measured in exactly the same tasks, high-functioning individuals with autism seem to demonstrate tailoring deficits that are very similar to those noted in RHD patients, with the possible exception that the deficits appear more extreme. For example, Baltaxe and Simmons (1977) analyzed the bedtime monologues of a girl with autism and found that in contrast to normal children's bedtime monologues which typically imitate a dialogue between two people, the girl with autism referred only to one perspective: her own. Additional abnormalities which seem to be related to an inability to consider a conversational partner's needs include the absence of reference to time and place when describing an event that the listener has not experienced (Bruner & Feldman, 1993), and the frequent misuse of I/you pronouns. In addition to these striking inability to consider the speaker's communicative needs, people with autism also show tailoring deficits similar to those of RHD patients including difficulties making relevant contributions to conversation. This has been noted in clinical observations noting a regular use of bizarre and irrelevant speech combined with uninformative gestures (Baltaxe, 1977; Loveland, McEvoy, Kelley, & Tunali, 1990). As was mentioned above, each of these deficits can be seen as related to the inability to make appropriate inferences about the interlocutor's CIs.

Like RHD patients, it appears that individuals with autism show some variability in their abilities to tailor conversational contributions that relates directly to the extent to which an interlocutor's CIs need to be considered. Loveland and Tunali (1993) identify five different types of narrative discourse, ranging from recitations and performances which require little tailoring to original story narratives which require a maximum amount of tailoring with respect to the hearer. The authors note that while types of narrative discourse which require little tailoring seem to be prevalent among individuals with autism and constitute the greater percentage of their conversational contributions, there are no known examples of truly original story telling by individuals with autism. Indeed, even narratives which Loveland and Tunali (1993) identify as requiring minimal tailoring efforts, such as providing information or teaching the rules of a game, seem to break down as a result of an inability to consider CIs. For example, when asked to explain a simple board game, a high-functioning 27-year-old male with autism explains (from Loveland & Tunali, 1993, p. 255):

You have these animals. If you get these and then you can get on this one [points]. Then you can keep this animal here [points]. If you get on this one [points], the animal, you get to keep the animal. You do here or here [points], you have to go back. And here you get a short cut. . . How old are you?

(Interviewer: Tell me more about this game)

You just. . . whenever you land right here [points] you get it.

This example highlights difficulties in abiding by the Gricean maxim of quantity as the speaker does not provide nearly enough information to either specify the referents of his pronouns, or communicate the instructions of the game. There is some indication that similar difficulties in upholding Gricean maxims are characteristic of the discourse narratives of very high-functioning individuals with autism [e.g., Temple Grandin (Happé, 1991)]. Together, the evidence suggests that even high-functioning autistic people, who clearly have a strong grasp of the formal aspects of language, have considerable difficulty tailoring their conversational contributions according to their interlocutor's CIs.

3.2. Recognizing the Tailoring Efforts of Others

As was mentioned above, the ability to recognize and appreciate the tailoring efforts of others provides one with information that can guide more refined inferences about a speaker's CIs in a particular situation. Often, the tailoring process seems transparent; utterances are interpreted in line with conversational maxims. For example, if someone says something that seems relevant to the topic at hand, we interpret it as being relevant. However, there are also times when conversational contributions appear to violate conversational maxims. That is, the contribution does not make sense given an initial interpretation of a speaker's CIs. In these situations, a listener may need to use the utterance to update or revise the initial interpretation of the speaker's CIs to make sense of the apparently aberrant utterance. For example, when one detects a violation of the maxim of relevance, one does not immediately assume that the speaker has lost his or her mind. Rather, one assumes, perhaps, that they would prefer to talk about something else. Such discourse tailoring efforts are regularly made in the flow of conversation. The detection of a speaker's violations and abidances to conversational maxims in order to update inferences about a speaker's CIs is critical to tracking the dynamic flow of discourse in a conversational context.

3.2.1. RHD patients' recognition of tailoring efforts. Rehak et al. (1992) investigated RHD patients' abilities to appreciate the conversational tailoring efforts of others by measuring their sensitivity to Grice's maxim of relevance—conversational contributions address the topic being jointly discussed. Relevance is an interesting maxim because, as with all of the Gricean maxims, it can be strategically violated in order to fulfill a particular communicative need. For instance, as I have just described, the maxim of relevance might be violated by a speaker who wishes to politely change the subject of conversation. Rehak et al. (1992) tested RHD patients' abilities to identify tangential conversational remarks as abnormal, and make inferences about the communicative intentions of the speaker who provided the tangential remark. Results indicated that normal controls had no difficulty identifying the tangential remark as abnormal and suggesting that the speaker made the

remark because she wished to change the subject of conversation. By contrast, RHD patients were more likely to interpret the tangential remark as a relevant to the original topic of conversation. Thus, it would seem that not only are RHD patients' unskilled at tailoring conversational contributions, it would seem that they are also unskilled at recognizing the tailoring efforts of others.

While the data provided by Rehak et al. (1992) are quite convincing with respect to the conversational maxim of relevance, it leaves questions regarding the abilities of RHD patients to detect violations of other maxims. This is an important point in that it is possible that violations of the maxim of relevance are in some ways more difficult to detect than violations of other maxims that are used when tailoring conversational contributions, such as the maxim of quality. For instance, when asked "How would you like your tea?" the response "On the moon" may seem more abnormal than the response "In a cup" although, broadly construed, both are violations of Gricean maxims—"On the moon" is a violation of quality, while "In a cup" is a violation of relevance. One possible reason for this difference might lie in the fact that detecting a violation of relevance requires making inferences about what the speaker finds relevant, while detecting a violation of quality may just involve judgments about a largely objective state of affairs (e.g., the fact that one cannot have tea on the moon). More research is required before we can be certain that RHD patients lack the ability to detect any instance where discourse has been tailored to serve a particular communicative need.

3.2.2. *Recognition of tailoring efforts by autistic people.* Researchers have looked at autistic people's appreciation of discourse tailoring efforts in an approach similar to that looking at the same abilities in RHD patients. Specifically, Surian, Baron-Cohen, and Van der Lely (1996) investigated autistic individuals' sensitivity to violations of various Gricean maxims of communication including maxims of truthfulness, quantity, relevance, and politeness. Subjects were presented with 27 short conversational exchanges consisting of one speaker asking a question and two additional speakers each providing a reply to the question. Of the two replies, one constituted a maxim violation while the other was conventional. For example, if the asker asked "Where do you live?" subjects would hear "I live in London" from one speaker and "I live on the moon" from another. Subjects were asked to identify the reply that sounded "funny or silly." Relative to IQ-matched groups of children with specific language impairments (SLI) and normal children, autistic children performed more poorly overall in this task. Of particular note was the chance performance of autistic individuals on detecting violations of the maxims of truthfulness and relation (e.g., Q: What's your favorite program on telly?; A: My favorite is sandwiches). These findings provide some evidence suggesting that autistic individuals have considerable difficulty recognizing the discourse tailoring efforts of others.

3.3. *Additional Tailoring Behaviors: Prosody?*

Prosody is the quality of speech that imparts meaning through changes in intonation, pitch, and stress (Trauner, Ballantyne, Friedland, & Chase, 1996). Often, prosody is used by speakers to attach emotional significance to language. Indeed, many researchers have suggested that the presence or absence of linguistic prosody indexes the extent to which an individual experiences emotions (e.g., Ross, 1993). However, prosody can be used to communicate information other than emotional states. Monrad-Krohn (1947) identified four different types of prosody: (1) intrinsic prosody—which distinguishes interrogative and declarative sentences; (2) intellectual prosody—whereby different words are stressed within a sentence; (3) emotional prosody—which clarifies the emotional content of utterances; and (4) inarticulate prosody—whereby grunts, sighs, and other nonlinguistic speech sounds convey communicative messages.

Interestingly, all of the different types of prosody can be used in order to clarify or add communicative value to language. Given these varied functions, it is possible to conceive of the use of prosody as part of the way in which communicative contributions are tailored to reflect an appreciation of the CIs being negotiated in the communicative situation. For example, one might use emotional prosody to tailor one's communication if one senses that an interlocutor is upset by the topic of conversation. Specifically, one may want to provide one's conversational contribution in low soothing tones which suggest support and empathy. By contrast, intellectual prosody might be used when a speaker feels that a listener is not understanding a specific aspect of what the speaker is saying. Here, the speaker might add additional stress to key elements that may aid the listener's comprehension of the speaker's main ideas. Note that in both of these situations, the use of prosody hinges on the speaker's ability to appreciate the CIs of their interlocutor. Thus, the use and understanding of prosody are likely to be profoundly impacted by the ability to make appropriate inferences about CIs.

3.3.1. RHD patients' use and understanding of prosody. The difficulties experienced by RHD patients in both using and understanding emotional prosody were first noted by Ross and Mesulam (1979), who reported that a group of RHD patients all displayed speech patterns that were characterized by a lack of prosodic content which resulted in flat, monotonic speech. Similar observations have been made by researchers who investigate language in RHD patients (e.g., Gardner et al., 1983). In addition to these clinical findings, more controlled experimental studies have found that when RHD patients were instructed to read sentences with varying emotional prosody (e.g., happy, sad, angry), normal raters were not able to accurately distinguish the different prosodic patterns from one another (Tucker, Watson, & Heilman, 1977). Thus, RHD patients seem to have clear deficits in adding prosodic contours to speech.

In addition, RHD patients also demonstrate reliable deficits in interpreting the emotional and linguistic prosody of others (Heilman, Bowers, Speedie, & Coslett, 1984). Numerous experimental studies have found that RHD patients are unable to distinguish the emotional content of sentences when this content is conveyed by prosody alone (e.g., Heilman, Scholes, & Watson, 1975; Tucker et al., 1977). Other studies have found that RHD patients are unable to detect different forms of linguistic prosody (Weintraub, Mesulam, & Kramer, 1981). To control for the possibility that deficits in linguistic prosody and emotional prosody result from different kinds of injuries, Heilman et al. (1984) compared the same group of patients on both varieties of prosodic information. In their study, RHD patients' were presented with filtered speech whereby the prosodic content was retained while the propositional content was unintelligible. Results indicated that RHD patients were significantly poorer at making appropriate interpretations of *both* linguistic and emotional prosodic patterns relative to other neurological patients and normal controls.

Brownell et al. (1995) note that the inability of RHD patients to discriminate both emotional and linguistic prosody suggests that the deficit does not stem from difficulties in understanding or expressing emotions. Research has shown that while RHD patients have difficulty using and understanding emotional prosody, they do not necessarily have difficulties correctly identifying emotional facial expressions (Cancelliere & Kertesz, 1990). Further, in many cases, RHD patients report the ability to feel emotions normally even though they fail to express their emotions through prosodic modulations of speech (see Ross & Mesulam, 1979). Thus, the deficit seems to encompass particular problem with analyzing prosody in general. The presence of an analyzing deficit is underscored by Tucker et al. (1977), who found that not only did RHD patients fail to correctly identify the emotional content of prosodic patterns presented with semantically neutral sentences, but they also failed to accurately make simple same/different judgments regarding prosodic contours.

Some researchers have argued that these findings support a specific perceptual deficit account for RHD patients' difficulties with prosody (Brownell et al., 1995). It is possible, however, that these difficulties stem from difficulties in interpreting the communicative needs and intentions of speakers. Everyday processing of spoken language requires that listeners filter out numerous aspects of acoustic speech that vary between speakers but are largely meaningless with respect to understanding discourse (e.g., fundamental frequency, accent). Without an understanding of the ways in which discourse is tailored in accordance with CIs, the acoustic variation normally associated with prosody might be ignored as irrelevant. This inattention to the prosodic characteristics of language could potentially account for RHD patients' processing deficiencies in this area.

3.3.2. *Understanding and use of prosody by autistic individuals.* While prosodic abnormalities in the speech of autistic individuals have long been considered an important aspect of the speech and language disorders associated with autism (Kanner, 1946; Baltaxe & Simmons, 1985; Frith, 1989), very few studies have experimentally addressed autistic individuals' abilities in this area (Tager-Flusberg, 1993). Von Benda (1983) asked speech therapists to rate the prosodic characteristics of speech recordings made by autistic or language-impaired children. The recordings of the autistic speech were judged to be more erratic and careless with respect to prosodic contours. Indeed, many of the raters noted that the prosodic patterns of autistic people sometimes conflicted with the sentence-meanings of utterances. For example, a tragic event might be described with the prosodic characteristics usually associated with joy. Additional studies have provided evidence for autistic individuals' deficits in the use of linguistic prosody (Baltaxe, 1984), thereby suggesting that, as in RHD patients, both linguistic and emotional prosody are impaired in autism.

Interestingly, these results contrast in certain respects with the findings from RHD. Instead of not using prosody at all, autistic patients seem to use prosody in a random manner. However, it is possible that these two symptom profiles could reflect a similar deficit. One way of characterizing the prosodic abnormalities of individuals with autism is that they add prosodic variation to their speech in ways that seem to serve no communicative purposes. Thus, these deficits could have at their roots an inappreciation of the manner in which discourse is tailored and understood with respect to the CIs of each interlocutor.

Unfortunately, very few studies have looked at autistic individuals' abilities to understand linguistic or emotional prosody. One study using a similar task to those used to investigate prosody reception in RHD patients indicated that autistic individuals have difficulties accurately identifying emotional prosodic patterns in spoken sentences (Van Lancker, Cornelius, & Kreiman, 1989). These findings are commensurate with those reported for RHD patients.

3.4. *Summary of Discourse Tailoring Deficits*

In order for discourse to proceed smoothly, speakers must both tailor their conversational contributions to the communicative needs of others and appreciate the efforts that are made by others to do the same. This tailoring process impacts the way we make our contributions on the level of what, when, and how we say what we do. Central to the use and appreciation of discourse tailoring is the notion of CIs. Specifically, we base our efforts to tailor discourse on what we know will be understandable by our interlocutors, and we update our notions about our interlocutors' CIs based on how

their own discourse has been tailored. Using Grice's conversational maxims as a metric for evaluating discourse tailoring efforts I noted that autistics and RHD patients have difficulty both making and appreciating the discourse tailoring process. Further, I suggested that the difficulties that both groups demonstrate in the realm of producing and appreciating prosody may also be linked to general deficits with discourse tailoring.

4. IDENTIFYING MAIN THEMES IN DISCOURSE: PRODUCTION AND COMPREHENSION

Above, I have been discussing the role that CIs play in making and understanding specific conversational contributions. I would like to shift the focus now on how an understanding of CIs also assists in organizing and understanding discourse on a more global level. Discourse production and comprehension are complex activities; they involve creating, maintaining, and updating links between sentences and ideas over time (Bloom, Borod, Obler, & Gerstman, 1993). Multiplying the complexity is the fact that language is often polysemous—there are multiple ways in which given words and sentences can be related in a discourse setting. One can imagine that if this polysemy were left unconstrained and each of these multiple links was consciously entertained, both production and comprehension would be impacted severely. In the production domain, a speaker who cannot constrain polysemy might be particularly susceptible to frequent digressions on aspects of the discourse that are either tangential or irrelevant. In comprehension, trouble with polysemy would make it quite difficult to get the main point of a speaker's discussion. Thus, for discourse production and comprehension to work as smoothly as it does in normal situations, listeners must develop a strategy for constraining the possible relationships between words to arrive at a single interpretation of the speaker's theme.

It is possible that CIs may provide such a constraining tool. Specifically, an understanding of the speaker's CIs could provide a framework for highlighting the semantic relationships that are most relevant, while downplaying the ones that are not. Another way of thinking about the role of communicative intentions is that they provide a topic around which discourse can be organized. Research has shown that for normal subjects, memory for discourse is much stronger when the topic of discourse is evidently established (Bransford & Johnson, 1972). When a topic is provided, the relationships between sentences seem more clear. It is possible that by going into a conversation with a starting notion about CIs, one has a tool which acts as an organizing topic. Individuals lacking the ability to make appropriate inferences about a speaker's CIs, or the ability to relate what is said to those CIs, individuals may have difficulty establishing a topic when presented with discourse.

In addition to providing a basis for constraining polysemy, an appreciation of CIs is also important in that it allows for a certain amount of flexibility

in discourse interpretation. That is, if a listener developing one interpretation of discourse subsequently encounters information which runs counter to that interpretation, the listener can reinterpret the communicative intentions of the speaker. This reinterpretation of the speaker's CIs then provides the basis for reconsidering the preceding discourse while also providing a framework for constraining interpretation of future utterances. If one lacked this ability to reframe discourse in light of new information about the speaker's CIs, discourse interpretation would be impaired. This illustrates, again, the dynamic influence that CIs have on language and communication.

4.1. RHD Patients' Difficulties with Discourse Production and Comprehension

RHD patients' abilities to extract a main theme from discourse and to organize discourse have been studied extensively (see Brownell et al., 1995, for a review). Gardner et al. (1983) found that when RHD patients were instructed to recall the major events of a fable, their narratives tended to focus excessively on detail, recall events out of temporal order, digress on tangential information, and lack a coherent overall structure. In addition, about half of these patients were unable to articulate the moral of the story. The authors interpreted these findings in terms of RHD patients' inability to organize the production of discourse around a central theme and an inability to extract a main theme from the story. Myers and Brookshire (1996) report similar findings from RHD patients' descriptions of illustrations by Norman Rockwell. For example, when asked to describe an illustration of a waiting room in a doctor's office, RHD patients tended to focus excessively on specific details (e.g., the bandage on a boy's head) while omitting the larger details related to the main theme (e.g., the waiting room itself). Together, these clinical observations suggest that individuals with RHD have considerable difficulty establishing a topic around which to organize discourse into a coherent structure.

These clinical observations have been supported in more controlled observational settings. In terms of discourse production, a number of studies have shown that RHD patients have difficulty organizing the events of a story (e.g., Joannette & Goulet, 1990; Joannette et al., 1986). For example, in a study carried out by Delis, Wapner, Gardner, and Moses (1983), RHD patients were presented with five randomly ordered sentences and instructed to elaborate a story on the basis of a topic. There were three different kinds of stories, stories describing spatial sequences (e.g., the path of a cat), temporal sequences (e.g., a doctor's day), and categorical sequences (e.g., stages in training a dog). Interestingly, patients with RHD had difficulty organizing the randomly ordered sentences into a coherent discourse structure relative to age- and IQ-matched controls in all three topics. The authors relate these deficits to an inability to correctly organize the discourse structure which stems from a failure to appreciate the implicit relationships between sentences.

In addition to these difficulties in extracting themes to guide discourse production, RHD patients also show considerable difficulty in using discourse to update their appreciation of speakers' CIs. This is demonstrated by an apparent inability to update their interpretation of a given sentence in light of following information. In a study carried out by Brownell, Potter, Bihle, and Gardner (1986), RHD patients and normal age- and IQ-matched controls were presented with two sentences which presented related facts about a character. The twist was that the first sentence was constructed to be somewhat ambiguous; its meaning only made sense within the framework provided by the second sentence (e.g., "Barbara became too bored to finish the history book. She had already spent five years writing it.'). After these sentences, RHD patients had to make true-false judgments regarding both simple facts about the two sentences (e.g., Barbara had been writing for five years), and inferences that were based on the relationship between the two sentences (e.g., Barbara became bored writing). Results indicated that while RHD patients performed as well as normal controls on the fact questions, they were poorer than normals on the questions which required an inference based on the relationship between the two sentences. These findings suggest that, even in this pared down experimental paradigm, RHD patients have difficulty making use of information which occurs later in the discourse in order to update their understanding of a word's meaning. This is consistent with an inability to extract themes and use them to update original notions of a speaker's CIs.

There is some evidence to suggest that RHD speakers' difficulties with CIs are not necessarily global. That is, RHD patients can organize discourse comprehension around CIs when the discourse is structured such that the topic, or CI, is explicitly stated and presented at the outset of the discourse. This phenomenon is nicely illustrated in a study by Hough (1990), who presented RHD patients, LHD patients, and normal controls with short stories in which a statement including the main theme was presented explicitly at the beginning or toward the end of the story. After reading the story, subjects were asked a number of comprehension questions and requested to select from a variety of options a main theme for the story. Results indicated that when the main theme was provided early in the story, RHD patients were able to correctly identify this theme later. By contrast, when the main theme was delayed until the end of the story, RHD patients had considerable difficulty identifying the theme relative to the LHD patients and normal controls. These findings again highlight the difficulties that RHD individuals have in using relatively late-occurring information in order to update their notion of a speaker's CIs.

4.2. Autistic Individuals' Discourse Comprehension and Production

As with many of the communicative abnormalities present in individuals with autism, autistic individuals' difficulties with organizing discourse and

distilling main themes are well-documented as clinical observations (e.g., Loveland & Tunali, 1993) although little experimental work has explored these deficits. One notable exception to this is a study carried out by Ozonoff and Miller (1996) using tasks identical to those carried out with RHD patients. Specifically, autistic individuals were presented with a somewhat ambiguous sentence followed by a second sentence that clarified the significance of the first. For example, subjects were presented with sentences like "Jane hurried into the dentist's office. She saw her purse on the table in the waiting room." Subjects then were asked questions that tapped their ability to both make correct judgments about the topic of the paragraph (e.g., She had forgotten her purse when she left the office), and their abilities to remember the story (e.g., Jane's purse was in the waiting room). Results showed that, like the RHD patients in the previous studies, autistic individuals had little difficulty remembering facts but failed to correctly identify the main theme of the paragraph.

4.3. Summary of Discourse Comprehension and Production Deficits

Correct inferences about CIs can play an important role in discourse comprehension and production as it provides a tool for constraining the polysemy inherent in language and highlighting the most relevant relationships between sentences. I suggested, more specifically, that CIs' constraining forces might keep discourse producers from following irrelevant tangents, and allow discourse comprehenders to entertain only the most relevant links between sentences. Further, I suggested that an ability to use discourse to update CIs may lead to a deeper appreciation of discourse dynamics. Extensive clinical observations and some experimental research has indicated that RHD patients demonstrate clear abnormalities in discourse production and have difficulties with using relatively late-occurring information in order to update their comprehension of main themes in discourse. While relatively little experimental work has investigated similar deficits in autism, preliminary studies have found results that are largely commensurate with those demonstrated in studies of RHD patients. These patterns of findings are consistent with the possibility that both RHD patients and autistic individuals have difficulties organizing discourse in relation to CIs.

5. NONCANONICAL LANGUAGE PROCESSING

Above, we have discussed the ways in which an appreciation of CIs plays a role in the maintenance of everyday discourse and conversation. In all of the situations above, it was argued that CIs provide individuals with a basis for constraining polysemy in order to reliably arrive at an appropriate meaning of an utterance. The ability to arrive at an appropriate meaning for a sentence is particularly critical when listeners are faced with noncanonical, figurative, or "nonliteral" language. Examples of this type of language in-

clude sarcasm, metaphor, indirect requests, and humor. In all of these cases, the sentence-meaning of the utterance does not provide adequate information regarding how the utterance should be interpreted. Instead, a correct interpretation is critically dependent upon an appreciation of the speaker's CIs (see Clark, 1996; Gibbs, 1994, for a review). In this section, I review evidence clearly suggesting that both RHD patients and autistic individuals have deficits in the processing of noncanonical language.

5.1. Sarcasm

Sarcasm is a very interesting case of noncanonical language use, because the speaker's CIs are exactly opposite to the sentence-meaning of the utterance. To illustrate this phenomenon, consider the utterance, "That sure was great coffee." If this utterance is delivered by an antagonistic coffee enthusiast who believes that the coffee in question is of poor quality, the utterance will most often be understood as intended sarcastically, and thus considered a cutting criticism. By contrast, if the same utterance were to be made by the proud owner of the coffee shop, the utterance would be taken as congratulations. Thus, arriving at an appropriate interpretation of a sarcastic utterance requires an appreciation of the CIs of the speaker, which in turn requires understanding of additional mental states (e.g., beliefs) held by the speaker.

5.1.1. RHD patients' difficulties with sarcasm. Several studies have been carried out considering RHD patients' interpretations of sarcastic utterances. For example, Kaplan, Brownell, Jacobs, & Gardner (1990) investigated RHD patients' abilities to distinguish sarcasm from white lies. Patients were presented with vignettes involving two characters engaging in an everyday activity. The relationship between the two was described as being either friendly or antagonistic. Within this context, a poor performance on some aspect of the activity by one character was followed by a statement from the other character which was positive with regard to the performance. Patients were asked to interpret the meaning of this "literally" positive comment. For skilled users of language, it is most commonly assumed that criticism is a prevalent mode within antagonistic relationships. Thus, when the relationship is described as antagonistic, the comment that is literally positive should be interpreted as a cutting use of sarcasm. Results indicated that, indeed, normal controls tended to interpret the positive utterance as intended sarcastically when the relationship was antagonistic, and as intended literally (i.e., as a lie) when the relationship was friendly. In contrast, RHD patients tended to always interpret the statement literally—that is, as a lie—thereby failing to appreciate that the utterance could be taken as a sarcastic criticism.

5.1.2. Autistic individuals' difficulties with sarcasm. Often included in the long list of communicative abnormalities associated with autism is a failure to appreciate sarcasm and irony (Frith, 1989). However, only a few studies

have looked at this ability directly (Happé, 1991; Tantam, 1991). One study carried out by Happé (1993) investigated autistic individuals' understanding of irony in a story reading task. Subjects were read a story about a boy who, in the course of preparing a cake batter, put whole eggs into the mixture without cracking them. The story ends with the boy's father entering the room and saying "What a clever boy you are!" Subjects are asked whether the boy's father meant that the boy was clever (literal) or silly (sarcastic). Relative to mental age-matched children with mild learning difficulties, autistic individuals were less likely to appreciate that the boy's father was being sarcastic by his utterance.

In support of the notion that autistic individuals' failures to provide nonliteral interpretations is related to an inability to appreciate the communicative intentions of others, Happé (1993) classified autistic individuals on the basis of whether they could pass standard tasks which assess mental understanding. She found that of the autistic individuals who could pass second-order false belief tasks (e.g., "Know what she knows about what I know") were quite adept at distinguishing sarcastic comments from literal ones in the task described above. This strongly suggests that interpreting discourse in context is related to an appreciation of the mental perspective and communicative intentions of the speaker.

5.2. *Indirect Requests*

Indirect commands are considered to be examples of nonliteral speech because they require a response that does not directly address the literal meaning of the question. For example, when sitting at the dinner table, we might ask a fellow diner, "Could you pass me the salt?" If this question were to be taken literally, we would expect an answer of "yes" or "no," relative to the diner's ability to pass the salt. However, the CIs of the speaker do not generally reflect this literal interpretation. Instead, the utterance is often intended as a polite way of phrasing a command (e.g., "Pass me the salt"). Here, again, a consideration of a speaker's CIs are critical to making an appropriate interpretation of an utterance.

5.2.1. *RHD patients' difficulties with indirect requests.* Difficulties similar to those noted with sarcasm have been shown in RHD patients' processing of indirect commands. For example, Foldi (1987) presented subjects with line drawings in which one character delivered an indirect command to a second character. Subsequent line drawings depicted the second character responding to the indirect command in an appropriate nonliteral manner, or in an inappropriate literal manner. Subjects were asked to judge whether the response of the second character reflected what the character was supposed to do in that situation. Results indicated that patients with RHD made far more inappropriate literal interpretations relative to nonliteral interpretations than did normal controls and LHD patients. An additional control was added

whereby subjects were asked to judge actors' responses to direct commands. Here, RHD and LHD patients were not different from one another, although both showed reduced performance relative to normal controls. These findings have been replicated and extended using variant methodologies in different laboratories (e.g., Stemmer, Giroux, & Joannette, 1994; Weylman, Brownell, Roman, & Gardner, 1989). All of these studies converge on the finding that RHD patients have particular difficulty making appropriate nonliteral interpretations of verbal expressions.

5.2.2. *Autistic individuals' difficulties with indirect requests.* In Baltaxe's (1977) analysis of the spontaneous conversation of very high-functioning autistic individuals, it was suggested that the tendency to make overly literal interpretations of conversational remarks extended to indirect requests. However, the only experimental study to date looking at autistic individuals' responses to indirect requests was carried out by Paul and Cohen (1985), who used a procedure that had been used previously to study indirect request comprehension in adults (Clark & Lucy, 1975) and children (Carrell, 1981). In their study, Paul and Cohen presented autistic individuals with red and blue crayons and asked them to color in circles in accordance with a number of different kinds of indirect requests that were interspersed throughout a conversation (e.g., "Can you color the circle blue?", "Must you color the circle blue," "The circle really needs to be colored blue"). Results indicated that autistic individuals were significantly less likely to respond appropriately to the indirect request relative to IQ-matched mentally handicapped individuals.

5.3. *Metaphor*

Perhaps the most canonical form of nonliteral language is verbal metaphor. Taken literally, metaphors read like false class-inclusion statements (e.g., "Some jobs are jails"). When taken nonliterally, however, metaphors often provide illuminating insights into the relationships between two domains, or give us a way of concretely understanding an abstract domain (Lakoff, 1987). As many researchers and theorists in psycholinguistics have noted (e.g., Clark, 1996; Gibbs, 1994), an important aspect of metaphor interpretation is a consideration of a speaker's CIs. When interpreting a "class-inclusion" metaphor, one is faced with ambiguity similar to the ambiguity that is faced in discourse theme extraction. That is, there are a potentially unlimited number of similarities that could be drawn between the two concepts which are being compared. In the metaphor, "Some jobs are jails," the target similarity is that both jobs and jails have a "confining" or "inescapable" quality. However, they could also be similar in that you might have to eat bad food, or one might have to wear the same clothes as those around them. Indeed, given appropriate contextual support, it is likely any of these alternative similarities could be entertained as a viable interpretation of the metaphor. In

these situations, an appreciation of CIs could be critical as it provides the basis for determining how the two domains being considered (e.g., jobs and jails) might be comparable.

5.3.1. RHD patients' difficulties with metaphor. As with their processing of other forms of non-literal language, RHD patients seem to have considerable difficulty processing metaphor. Winner and Gardner (1977) investigated RHD patients' processing of metaphor by presenting them with a metaphorical expression and asking them to select a picture that best captured the meaning of the expression. For example, patients were presented with the expression, "He had a heavy heart," and shown an array of pictures. A picture of a person crying represented the metaphorical meaning while a picture of a person stumbling under the burden of a heart tied to his back represented the literal meaning. Results indicated that RHD patients picked the picture representing the inappropriate literal meaning much more often than did normal controls or individuals with LHD. These findings are consistent with the findings presented above and further suggest that RHD patients have particular difficulty appropriately interpreting nonliteral speech.

While the findings indicate that RHD patients have deficits in interpreting nonliteral speech relative to normal controls, it is unclear what these findings imply regarding the specific nature of the deficit. One possibility is that RHD patients simply have a specific deficit in generating a nonliteral interpretation of a given expression. Indeed, work carried out by Brownell and colleagues seems to suggest that patients with RHD have difficulty identifying words which are metaphorically associated relative to those that are literally associated (Brownell, Simpson, Bihrlé, & Potter, 1990). An alternative interpretation of RHD patients' apparent deficits in nonliteral speech processing is that this deficit stems from a difficulty integrating linguistic expressions with the conversational context within which the expression is made. In accordance with this interpretation, it may not be that RHD patients are incapable of understanding metaphor, but rather are unable to reliably determine when metaphor should be used. Interestingly, each of these potential sources of the deficit can be related to a deficit in making appropriate inferences about CIs. As mentioned above, an understanding of a metaphorical utterance requires an appreciation of the similarities between two seemingly disparate domains. Understanding a speaker's CIs could be critical in highlighting those similarities and arriving at an appropriate metaphorical interpretation. Similarly, an appreciation of how metaphor fits into context would also require an appreciation of communicative intentions, as one would want to be sure that there is sufficient common ground to sustain an appropriate interpretation. Thus, at all levels of metaphor usage and interpretation in context, communicative intentions are likely to play a critical role.

5.3.2. Autistic individuals' difficulties with metaphor. Like RHD patients, the communicative efforts of autistic individuals are often characterized as overly literal. Along these lines, recent research has suggested that autistic

children have particular deficits understanding metaphor. Happé (1993) tested autistic individuals' abilities to choose from a jumbled list the appropriate completion of a sentence in three conditions: (1) *synonym* [e.g., Sarah was so beautiful, she really was . . . (lovely)]; (2) *simile* [e.g., The night sky was so clear, the stars were like . . . (diamonds)]; and (3) *metaphor* [e.g., The dancer was so graceful, she really was . . . (a swan)]. Results indicated that although they had little difficulty in the simile and synonym conditions, autistic individuals had considerable difficulty choosing appropriate completions of the metaphor sentences. These findings are particularly interesting given that the only distinction between the simile and the metaphor conditions is the presence of the word "like" which literally specifies a comparison in the simile condition. This pattern of results shows that although autistic individuals are able to make appropriate comparisons across domains, they have difficulty when these comparisons require metaphorical thinking.

5.4. *Humor*

Although quite different from metaphor, humor often embodies a form of noncanonical speech. Bihrlé, Brownell, and Powelson (1986) proposed that the detection of humor arises as part of a two-stage model whereby first, an incongruity is noted between what someone has said and the context within which it is said. Following this incongruity detection, Bihrlé, Brownell, and Powelson (1986) suggested that the listener solves the incongruity by reinterpreting the information that preceded the incongruity. Building on this model, Bihrlé, Brownell, and Powelson (1986) suggest that the pleasure that one has upon hearing a joke depends on their ability to reinterpret the previous information. When cast in this way, the appreciation of humor is seen as critically dependent on the ability to make flexible interpretations of discourse on the basis of a speaker's CIs.

5.4.1. RHD patients' difficulty with humor. Considerable anecdotal evidence (e.g., Gardner, Ling, Flamm, & Silverman, 1975) and experimental evidence (Birhle et al., 1986) have suggested that RHD patients are extremely limited in their appreciation of utterances that normal controls find humorous. For example, Brownell, Michel, Powelson, & Gardner (1983) presented subjects with a brief conversational exchange and asked subjects to select from a sample of four endings the one that would be most humorous. As many researchers have noted, expressions that are at once incongruous with a given conversational context, but can be resolved after a reinterpretation of the context is made, are typically found to be humorous. Of the four sentences provided, two were incongruous, but only one was resolvable within the context. The other two were congruent. Results found that both RHD and normal controls tended to identify incongruent sentences as humorous, but only normal controls reliably selected ones which were resolvable within the context. RHD patients, by contrast, selected from among the in-

congruent sentences randomly. The authors interpreted this pattern of results as suggesting that while RHD patients seemed aware that humorous expressions are ones that are incongruous with a conversational context, they did not appreciate that the context could be reinterpreted to accommodate a humorous interpretation.

5.4.2. *Autistic individuals' difficulties with humor.* In an observational study, St. James and Tager-Flusberg (1994) investigated autistic children interacting with their mothers for evidence of spontaneous engagement in humor. Their study found that autistic children produced significantly less humor relative to age- and language-matched Down syndrome controls. In addition, these authors found that autistic children told no jokes at all, and very rarely initiated humor based on verbal incongruity. In addition to these naturalistic findings, Ozonoff and Miller (1996) experimentally tested autistic individuals' understanding of jokes and humor in a task very similar to that of Bihrlé et al. (1986). In this study autistic individuals showed a pattern of responding that was commensurate with that of RHD patients. Specifically, while autistic individuals seemed to understand the notion that joke endings, or punchlines, were supposed to be surprising, they consistently failed to choose endings that were both surprising but resolvable within the context of the story.

5.5. *Summary of Noncanonical Language Processing Deficits*

In this section I have described the difficulties that both RHD patients and autistic individuals have with the appreciation of noncanonical language. I have suggested that in the cases of sarcasm, indirect request, metaphor, and humor interpretation, these deficits are exactly those that we would expect if the ability to appreciate communicative intentions were somehow impaired. What is particularly compelling in these cases is that the surface or sentence meaning of these noncanonical utterances is at best misleading or nonsensical and thus an appreciation of communicative intentions is required to arrive at appropriate interpretations.

6. LANGUAGE DEVELOPMENT: VOCABULARY ACQUISITION

In addition to being important to adult language, an appreciation of speakers' communicative intentions has been considered to play an important role in language development, particularly in the domain of vocabulary acquisition. The problem of vocabulary acquisition is one that has traditionally puzzled researchers in language development. Starting at around 17–20 months, young children are very good word learners; they develop from having a productive vocabulary of about 50 words to one of as many as 500 or 600 words by the age of 24 months. By the time they are about 4 years old, children have developed a lexicon of up to 10,000 words (Clark, 1993). What is puzzling is that children's strong performance at this task seems to be

despite the fact that philosophers of language have identified the problem of word learning as an extremely difficult one. For example, Quine (1960) noted that word learning poses a serious problem of induction, whereby young word learners are required to select from an infinite number of possibilities the appropriate meaning of a novel label.

Recent research has suggested that infants' hypotheses of word meaning might be guided by an understanding of speakers' communicative intentions (e.g., Akhtar, Dunham, & Dunham, 1991; Baldwin, 1993; Tomasello, 1995). Tomasello (1995) argued that an understanding of pragmatics clues young word learners in to the most likely hypotheses of word meaning by directing word learners' attention to what was intended by the speaker. In his research, Tomasello and his colleagues have shown that by using communicative intentions, children can learn words in a variety of circumstances. In one striking study, it was demonstrated that children could use pragmatic cues to learn verbs, even when the referent action was not explicitly demonstrated at the time the new verb was introduced (Akhtar & Tomasello, 1996). In this study, 24-month-old children were presented with a prop that performed a novel activity, such as a catapult. In a pretraining task, children were familiarized with this activity, along with several other activities, through the use of label-neutral language (e.g., "watch what I can do.'). In the experimental training phase, the catapult was brought out, and the experimenter said "Now let's *meek* Big Bird! Let's *meek* him, okay? Let's *meek* him." The experimenter then searched in a bag for Big Bird but failed to find him. At this point the experimenter put away the target prop and proceeded to demonstrate the other activities. Note that in this training phase, children were never presented with the novel label in conjunction with the novel activity. Thus, children had to make complex inferences about the experimenter's intentions in using the word *meek* in order to arrive at the correct meaning. Results indicated that children performed as well under these complex labeling situations as they did when the referent activity was demonstrated in conjunction with the novel verb. The authors interpret these findings as indicating that children rely heavily on a pragmatic understanding of language which directs their attention to the intentions of speakers when formulating probable meanings of words.

In addition to guiding children's hypotheses about verb meaning, an appreciation of communicative intentions has also been found to play an important role in guiding children's hypotheses about object names (Tomasello & Barton, 1994). Children can also use information about communicative intentions to guide grammatical form-class judgments (Tomasello & Akhtar, 1994). Work carried out by Baldwin (1991, 1993) has demonstrated that children also seem to use inferences about communicative intentions to guide their formation of word-referent links. For example, in one study (Baldwin, 1991), 18-month-old children were presented with two objects. After children were familiarized with these objects, one was taken away and placed

into an opaque bucket. The experimenter then presented an object label in two different conditions. In one condition, she looked at the toy that the child was playing with when she presented the label. In the second condition, she peered into her bucket while presenting the label. If it were the case that children were simply attaching novel words to novel objects that they themselves were attending to, we would expect that children would always assume that the novel word being used by the experimenter referred to the object they were attending to, regardless of the speaker's attention. In this experiment, of course, this egocentric associative strategy would lead children in half of the cases to error. However, results indicated that children 16 months and older reliably avoided these errors and by 18–19 months they consistently associated the word that was used by the experimenter with the object that the experimenter was attending to when the label was used. These findings again suggest that children make inferences about what speakers intend to communicate by their use of language. Together, the studies carried out by Baldwin (1991, 1993) and Tomasello and colleagues (e.g., Akhtar & Tomasello, 1996) suggest that an appreciation of communicative intentions plays an important role in early language development.

If an appreciation of communicative intentions is crucial to vocabulary development, we might expect that a disruption in the ability to make inferences about communicative intentions should lead to delays or difficulties in vocabulary development. As a first step, we might hypothesize that the neurological disorders associated with deficits in making inferences about communicative intentions in adults, such as RHD and autism, would lead to delays in vocabulary development.

6.1. *Infant RHD and Vocabulary Development*

In a groundbreaking study carried out by Thal et al. (1991), children with unilateral left- and right-hemisphere lesions were assessed for language abilities at three different time periods between 12 and 20 months. The findings of the study were surprising with respect to what might have been expected from the adult aphasia literature. The most important finding relevant to the present discussion was that delays in language *comprehension* (reception) were most prevalent in infants with *right-hemisphere* damage. Additionally, Vargha-Khadem, O'Gorman, and Watters (1985) found that individuals who had sustained lesions to their right hemisphere early in life performed worse on object naming tests relative to normal controls. Together, these findings from studies on infants with right-hemisphere lesions converge on the notion that the right hemisphere plays a critical role in semantic development and vocabulary acquisition. This pattern of results is predicted given the role of the right hemisphere in appreciating communicative intentions.

Additional evidence implicating right-hemisphere involvement in language development comes from a series of studies using the event-related

potential (ERP) technique for indexing cortical responses to linguistic stimuli. In these studies, Mills, Coffey-Corina, & Neville (1993a, b) investigated the organization of brain activity of infants as they passively listened to three types of linguistic stimuli: comprehended words, novel words, and backward words. Two different age groups were tested, infants ages 13–17 months and infants age 20 months. Results indicated that for all age groups there was a differentiation in the ERP response for comprehended relative to novel words. Specifically, comprehended words were associated with stronger negativities peaking about 200 and 350 ms after the stimulus was presented (N200 & N350). Interestingly, however, the distribution of these effects over the scalp was different for the different age groups. For the younger age group, the N200 and N350 effects were bilaterally distributed and present at all electrode sites anterior to occipital regions. By contrast, for the 20-month-olds, the N200 and N350 effects were much more localized, occurring only at the left temporoparietal electrode sites. The authors take these findings as suggesting that the brain systems that are active during language comprehension become increasingly left-lateralized and localized to temporoparietal regions with age.

However, as was noted above, learning a given word requires making inferences about the meaning of a *novel* word. That is, children must coordinate an association between the novel word and some aspect of the environment. Given the nature of word learning, then, it is more likely that the ERP data relevant to language acquisition and the vocabulary burst are the findings concerning infants' brain activity while listening to noncomprehended words. Interestingly, Mills et al. (1993a, b) also report a shift in young infants' processing of novel words with age. At all ages, children show a late and broad anterior negativity in response to noncomprehended words. While for all ages the grand average ERPs showed a stronger negativity for comprehended relative to noncomprehended words, there were interesting differences in the amplitudes and distribution of the negativity associated with noncomprehended words between age groups. Specifically, the negativity associated with noncomprehended words was generally stronger in amplitude for the older group relative to the younger group. Most importantly, the effect for noncomprehended words was stronger over the right hemisphere than over the left in 20-month-olds. This right-greater-than-left effect for novel words was not found in the younger age group. The authors suggested that this finding might reflect a right-hemisphere contribution to the processing of novel but potentially meaningful stimuli. It is possible that this response is related to infants' attempts to make appropriate inferences about the communicative intentions of the speaker using the novel word.

6.2. *Vocabulary Development in Autistic Children*

There is no question that in autistic children vocabulary development is severely delayed (Frith, 1989). Indeed, a delay in vocabulary development

is one aspect of the diagnostic criteria for assessing autism in young children (DSM-IV). While some autistic individuals seem to be able to develop rather extensive vocabularies, the way in which words are used tends to be abnormal and bizarre (Happé, 1991). What is particularly interesting is that the impairments associated with vocabulary development do not seem to be related to more general language development. For example, it seems that autistic children eventually acquire a mastery of syntax and are able to regularly produce complex syntactic structures (Tager-Flusberg et al., 1990).

Frith and Happé (1994) note that the problem associated with the abnormal semantic development may very well be due to difficulties in appreciating the importance of communicative intentions of speakers. As was noted above, an appreciation of communicative intentions is critical to understanding what a speaker is talking about when he or she provides a label for a referent (Baldwin, 1993). Without an appreciation of communicative intentions, one might be prone to simply match any word sound with the particular thing that one is focused on. Frith and Happé (1994) note that autistic children do tend to make these errors. That is, autistic children tend to attach any word, or word phrase, with a salient novel referent (see Kanner, 1946, for great examples). The tendency for autistic children to make these “egocentric” mapping errors has been shown recently in an experimental situation. Indeed, Baron-Cohen, Baldwin, and Crowson (1997) have shown that autistic children are more susceptible to mistakenly associating a novel word with the object of their own focus than are normals or children with Down syndrome. These findings strongly suggest that autistic children do not appreciate the importance of communicative intentions in establishing word–referent relationships.

6.3. *Summary*

Above I described evidence suggesting that (1) normal vocabulary acquisition critically depends on the ability to assess a speaker’s communicative intentions, and (2) children with RHD and autism have abnormal vocabulary development. For autistic children, recent research has suggested that the underlying cause of abnormal vocabulary development may be the inability to appreciate communicative intentions. Direct research linking these two abilities has not been performed on children with RHD. However, given that the language functions in adults that are related to an appreciation of communicative intentions are impaired in RHD patients, it seems reasonable to hypothesize that the abnormal vocabulary development shown in infants with RHD may be related to an inability to appreciate communicative intentions.

7. COMMUNICATIVE INTENTIONS: AN INTEGRATIVE APPROACH

I have proposed that one approach to accounting for the communicative deficits associated with RHD and autism relates them to difficulties with

appreciating the importance of CIs. Within this approach, there are two ways of considering the cognitive processes associated with appreciating CIs. One possibility is both syndromes involve the disruption of a distinct cognitive module responsible for making inferences about CIs, or mental states in general (e.g., Baron-Cohen, 1995). This speculation was first made on the basis of research with autistic individuals who seemed to lack the ability to think about mental representations, but are quite skilled at thinking about nonmental representations (Leslie & Thaiss, 1992; Charman & Baron-Cohen, 1995). Similarly, more recent research on individuals with brain damage suggested that RHD patients have difficulties making inferences about the mental states of others (e.g., Stone, Baron-Cohen, & Knight, 1998). Thus, it is possible that the communicative deficits associated with RHD and autism could be related to a fundamental deficit in the ability to think about mental states.

A second possibility within the CIs framework is that the ability to make appropriate inferences about the mental states of others is an emergent cognitive skill resulting from a number of so-called "lower-level" operations that have been associated with right-hemisphere functioning. In what follows, I explore this possibility by looking at three mechanisms which have been proposed to account for the right-hemisphere's contribution to language: novelty processing (Goldberg & Costa, 1981), coarse coding (Beeman et al., 1995), and executive functioning (Ozonoff & Miller, 1996). For each of these mechanisms I first briefly describe and evaluate them with respect to how well they account for the wide range of clinical and experimental data I have described. Second, I suggest that instead of viewing each of these as sufficient on their own, it may be more fruitful to think of each of these mechanisms in terms of how they impact language via their relationship to making inferences about CIs.

7.1. Processing Novelty

One account of the communicative deficits associated with RHD and autism is that they are related to a very general disruption in the processing of novelty. In their thought-provoking paper, Goldberg and Costa (1981) speculate that the right hemisphere is more anatomically suited to processing novel stimuli while the left hemisphere is stronger at accessing well-routinized codes. On some level, this proposal seems quite intuitive with respect to the communicative deficits associated with RHD and autism. One common thread running through the various communicative deficits described above is that they all seem to have a strong flavor of novelty (e.g., metaphor seems to require a "novel" interpretation of a particular utterance). Goldberg and Costa also argue that the right hemisphere plays a critical role in the initial stages of development of any cognitive system, including language development. With development, language processing is characterized by a right-to-left shift in hemispheric specialization. This proposal offers some account

of why infants with RHD would experience more severe delays in language development relative to infants with LHD. The novelty-processing deficit account has also been explored in the study of autism. In a series of studies using the ERP methodology, Courchesne and colleagues have found that autistic individuals show abnormal cortical responses when presented with novel stimuli in the visual modality (Courchesne, Yeung-Courchesne, Press, Hesselink, & Jernigan, 1988). Thus, it does seem that novelty processing deficits may play a role in the understanding of the communicative deficits associated with RHD and autism.

While there are clear strengths of the novelty processing deficit hypothesis, there are some questions about whether this hypothesis is alone sufficient to account for the wide variety of communicative deficits apparent in RHD patients and autistic individuals. One concern stems from the fact that it is unclear what kind of language is appropriately considered to be novel. If we take the concept of novelty to apply broadly, it would seem that there are many occasions of novelty in everyday language. As Pinker (1994) suggests, the "generative" nature of language allows for the fact that much of what is said in a particular conversation has not (at least not precisely) been said before. If these everyday utterances are considered to be novel, then we might expect the deficits associated with an inability to process novelty to include a wider range of communicative abilities. The fact that high-functioning autistic individuals and RHD patients only have deficits in certain communicative abilities suggests that the novelty processing hypothesis alone does not accurately describe these two syndromes.

A novelty processing deficit account would be more viable given a view of novelty in language that is limited to speech that expresses thoughts in an uncommon or unfamiliar way relative to the context. As mentioned above, it is under this definition that certain things one does with language (e.g., metaphor) seem more novel, and indeed, it is just these aspects of language that pose the most difficulty for individuals with RHD and autism. Even so, the novelty processing deficit still seems to leave some issues unresolved. For example, indirect requests such as "Can you pass the butter?" are arguably more common than their corresponding direct requests in some settings. Yet, research has suggested that even when the context supports a nonliteral interpretation of an indirect request, both RHD patients and autistic individuals are impaired in their apprehension of the nonliteral interpretation. That autistic individuals and RHD patients have difficulty with indirect requests as well as with other forms of noncanonical speech suggests that the underlying impairment is not only related to the fact that the speech is novel.

Another question worth considering regarding the novelty processing deficit hypothesis is how such a deficit should relate to the processing and production of prosody. As many prosody researchers have shown with their taxonomies, prosody is used in certain canonical ways to communicate specific notions. For example, in the case of linguistic prosody, rising intonation

at the end of a sentence is used canonically to signify the fact that a question is being asked, or that what is being said might be questionable. Similarly, in the case of emotional prosody, both sadness and happiness are communicated via canonical prosodic contours in speech that are identifiable even when linguistic information has been filtered out of the speech signal. Given that prosody is used in canonical ways, it would seem that individuals with difficulties in processing novelty would not necessarily be impaired in the processing of prosody. Instead, simple detection of the covariation between types of content and prosodic contours should be sufficient. The fact that both RHD patients and autistic individuals show difficulty in understanding and using prosody suggests that there may be something other than, or in addition to, novelty processing deficits contributing to the difficulties that RHD patients experience with discourse processing.

It is interesting to note, however, that there may be an important relationship between an ability to appreciate CIs and the ease with which one can process novelty in discourse. Many researchers and theorists have claimed that the true power of having a coherent understanding of the internal mental states of another is that it provides for the prediction and explanation of the actions of others (cf. Wellman, 1990). To take an example from the language domain, if one has some starting assumption about speakers' CIs in a particular context, one might be better able to fit a novel use of a familiar term into a coherent framework of interpretation. A very different story is likely to be true for individuals who, for some reason, might lack a conception of internal mental states (such as CIs). For these individuals, prediction of human action is just as likely to be important, but without a conception of mental states, prediction would require different metrics. Perhaps the extreme sensitivity to covariation that is characteristic of high-functioning autistic individuals reflects a developed strategy for gaining predictability of action. A similar proposal might be offered to explain the development and adherence to rigid routines. Of course, these alternative prediction-supporting devices are not without their costs. One clear cost could be that these inflexible systems may be resistant to the incorporation of novelty. In this light, deficits in appreciating novel linguistic stimuli could be the result of strategies that have evolved for coping with the prediction of human behavior without access to internal mental states.

7.2. Coarse Coding

Recently, Mark Beeman and colleagues (Beeman et al., 1994) have proposed that the communicative deficits associated with RHD patients are related to a dysregulation in the way the right hemisphere normally codes language. This suggestion is grounded in recent research findings indicating that semantic priming in the right hemisphere is distinct from semantic priming in the left hemisphere. Making use of the split-visual field methodology, this

research converges on the finding that primes presented to the right visual field/left hemisphere strongly facilitate recognition of closely related words for a short period of time, while primes presented to the left visual field/right hemisphere weakly facilitate words that are both closely and distally related over a longer period (Chiarello, 1988; Chiarello, Burgess, Richards, & Pollock, 1990; Chiarello & Richards, 1992). Beeman et al. (1994) characterize this difference in terms of the right hemisphere's ability to perform "coarse coding" on linguistic stimuli, while the left hemisphere reacts quickly to select the most appropriate of the meanings activated given the conversational context.

In short, Beeman et al. (1994) argue that the communicative deficits demonstrated by RHD patients are related to deficits in the coarse coding of linguistic stimuli. Specifically, they suggest that the distal semantic information that is activated in the right hemisphere is critical to drawing inferences, comprehending jokes or metaphors, and recognizing the themes of discourse. In an elegant demonstration, Beeman et al. (1994) provide evidence that "summation priming"—using *foot*, *cry*, and *glass* as a prime for CUT—is somewhat stronger in the right hemisphere than in the left hemisphere. Interestingly, it would seem that summation priming does a very nice job of capturing the types of processes involved in theme extraction; the three primes converge on a limited number of semantic nodes that can be used to characterize the relationship between them. It is also very likely that the understanding of jokes and metaphors relies on the ability to consider not the primary semantic relations of words but rather the more uncommon or distal relations. Thus, the notion of coarse coding seems to do an excellent job of characterizing the communicative deficits associated with RHD and autism. Given the similarities that were noted between RHD and autism, it would be interesting to investigate autistic individuals' performance on summation priming tasks such as those outlined by Beeman et al. (1994).

One source of concern with respect to the coarse coding hypothesis comes from the data concerning vocabulary acquisition in infants with RHD. In vocabulary acquisition, the main task of the child is to arrive quickly at the most appropriate meaning of a novel word. If, as some researchers have suggested may be the case, children entertain multiple possible meanings for a given word, one might expect that the right hemisphere would be responsible for maintaining those multiple meanings over time. The critical factor for language learning, then, would be the maturation of the left hemisphere which would constrain the indeterminacy associated with the right hemisphere (see Tucker, 1992, for a very similar proposal). As was noted above, however, this account is at odds with the findings from children who have suffered brain damage in infancy. Specifically, vocabulary development is most severely delayed following injury to the *right* hemisphere and not the left. Thus, one possible challenge to the coarse coding model is to construct a

developmental account of how the hemispheric contributions to linguistic processing might change over time.

A related concern is that the coarse coding model does not accurately capture the experience of aphasic individuals who have acquired damage to the left hemisphere. Beeman et al. (1994) characterized language processing as an interaction between the activation of distal associates in the right hemisphere and the constraining functions of the left hemisphere. Accordingly, Beeman et al. (1994) have spelled out some rather grave consequences for individuals who have a well-functioning right hemisphere combined with a poorly functioning left hemisphere. Specifically, Beeman et al. have suggested that these individuals should be "mired in a sea of indeterminacy" due to the unconstrained distal activations associated with the right hemisphere (p. 28). This, characterization, however, does not square with what we know about aphasic individuals. Clinical observations and anecdotes seem to suggest that even densely aphasic individuals with damage to the perisylvian regions of the left hemisphere retain some communicative abilities such as interpreting the main theme of what someone has said and interpreting prosody. It is likely that these aspects of language also require some abilities to constrain meanings; it seems that even an independent right hemisphere has some mechanism which supports contextually appropriate interpretations of linguistic utterances. Thus, while coarse coding is certainly an important component of language processing in context, there is some question whether it alone can account for the wide range of communicative difficulties observed.

It is possible, however, that some of these concerns could be answered by considering how coarse coding might be related to inferences about CIs and how an appreciation of CIs might help to constrain the coarse coding process. As was noted above, activation and maintenance of the distal meanings of words may help to extract CIs from the discourse situation. In other words, we might see the summation priming paradigm as a test of abilities to make inferences about CIs in a very pared down experimental situation. The question, of course, is why we need to posit a role for CIs when summation priming might be enough. The answer is that an appreciation of CIs may guide the coarse coding process to avoid the problems that were mentioned above. That is, while coarse coding could be important for generating various interpretations about meaning, choosing the most relevant one is likely to require some notion of CIs. For instance, in the case of language development, instead of considering all of the weakly activated possible interpretations of a novel word, one can use an appreciation of CIs to settle on one which is most appropriate or relevant (see Baldwin & Tomasello, 1998, for a similar argument).

Similarly, an appreciation of CIs could provide a necessary constraint on the coarse coding process in adults as well. If one had a starting notion about a speaker's CIs, the relevant distal semantic links might be more highlighted

relative to the more irrelevant ones. This is best illustrated in the case of metaphor processing. In the metaphor, "Some jobs are jails," there are potentially many links between jobs and jails. While coarse coding may play a fundamental role in activating these different connections, the nature of the connections is likely to be constrained by an appreciation of CIs. If one knows that a person is dissatisfied with his or her job, one is likely to activate the notions of how both can be "confining." In the end, starting notions about a speaker's CIs provide a framework for constraining the coarse coding associated with the right hemisphere. While Beeman et al. (1994) acknowledge a role for this constraining function, they place it within the left hemisphere, which, as I argued above, does not accurately characterize the deficits associated with RHD and language, or the case of language development.

7.3. *Executive Functioning deficit Hypothesis*

It has recently been proposed that at the heart of the deficits present in autism is the dysfunction of the executive functioning system (Ozonoff, 1995; Ozonoff, Pennington, & Rogers, 1991). The central argument is that dysfunction of the executive system results in difficulties inhibiting prepotent or overlearned behaviors, even when the prepotent behavior is not contextually appropriate. In the language domain, the inability to flexibly interpret words could be related to an executive deficit (see Ozonoff & Miller, 1996). For example, in the case of metaphor, it is possible that canonical interpretations of words are "prepotent" and difficult to inhibit when the circumstances call for an alternative one. Similarly, in the case of discourse inferences, once one interpretation of a particular utterance is made, it may be difficult to inhibit that initial interpretation.

While the executive function deficit hypothesis is one that deserves a considerable amount of attention, it may be that the assumption that canonical meanings are prepotent does not accurately capture the nature of metaphor processing. This assumption is called into question by research on noncanonical speech processing in normal individuals. Gibbs (1986) asked subjects to make sense/nonsense judgments to sentences that could be read either metaphorically or literally (e.g., "He let the cat out of the bag") and were preceded by a paragraph which supported either a literal or a nonliteral interpretation of the target sentence. If the canonical meanings of utterances are "prepotent," then we might expect that developing noncanonical meanings would result in a cost in reaction time performance on the task due to the extra cognitive activity associated with inhibition. Results indicated that there was no such reaction time difference, thereby suggesting that both canonical and noncanonical meanings are equally available, or prepotent, if they are supported by the context. If natural language is sufficient for creating a context that would, in normal individuals, turn a noncanonical interpretation into a one that was prepotent, then we might expect that autistic individu-

als and RHD patients would not have much difficulty making these contextually appropriate interpretations. The clinical data, and some of the experimental data, suggest that both autistic individuals and RHD patients fail to make a noncanonical interpretation even when it is clearly supported by the context (see Happé, 1993; Ozonoff & Miller, 1996). It should be noted, however, that studies of metaphor which provide a rich contextual basis for making a noncanonical interpretation are rather sparse in the literature of autism and RHD. Clearly, more research is needed to investigate the abilities of these two groups to make noncanonical interpretations of utterances in context before we can better assess their deficits and the possible sources.

Ozonoff and Miller (1996) noted a second difficulty with the executive functioning deficit hypothesis in that some predictions it makes are not borne out. They argued that while some forms of noncanonical language processing might require large demands on executive functioning capacities, and so should be very difficult to process, other forms do not. For instance, understanding humor and making discourse inferences require a considerable amount of flexibility in discourse processing; initial interpretations of sentences need to be inhibited in order to develop new, contextually appropriate interpretations. By contrast, indirect request processing does not require as substantial a level of inhibition, as the only aspect that needs to be inhibited is a potentially prepotent literal interpretation. Accordingly, one might predict that high-functioning autistic individuals and RHD patients might perform better in situations which require minimal amounts of executive functioning, relative to those which require more. Contrary to this hypothesis, Ozonoff and Miller (1996) found that high-functioning autistic individuals performed just as poorly on the low executive functioning demand tasks as they did on the tasks which required high levels of executive functioning. This finding suggests that at the core of autistic individuals' communicative difficulties is a conceptual deficit. Although it has not been tested directly, it would be interesting to determine whether RHD patients show a similar pattern of performance.

Interestingly, the role of executive functioning in developing notions about others' mental states has recently been a topic of considerable debate in the developmental literature (see Carlson, Moses, & Hix, 1998; Russell, 1996). Indeed, there may be many aspects of the ability to make appropriate inferences about CIs that require some level of executive functioning. For instance, the fundamental ability to adopt the perspective of another individual may first require the inhibition of one's own very salient perspective. In addition, mental states are abstract entities and thus may be much less salient relative to the concrete reality of things. This salience imbalance is perhaps even more pronounced when having to consider the mental states of others. For these reasons, executive processes are likely to play a role in allowing one to focus on mental states at all. Strong evidence in support of a relation-

ship between executive processes and the ability to consider the mental states of others comes from Carlson (1997), who found that in 3- and 4-year-olds, performance on executive functioning tasks (e.g., the Wisconsin Card Sort) is very highly correlated with the ability to correctly solve tasks which require thinking about the mental states of others (e.g., the "false-belief" task). Thus, executive function processes could lead to the language deficits noted above by making it difficult to consider another's CIs.

7.4. *Summary*

I have described three accounts for the communicative deficits associated with RHD and autism that have been advanced previously in the literature: novelty processing, course coding, and executive functioning. I argued that while each hypothesis captures some aspects of the communicative deficits in question, a potentially more fruitful way to consider these hypotheses is with reference to how they relate to the abilities important to making appropriate inferences about CIs. This approach is best viewed as "integrative," as it sees the different mechanisms that have been proposed as all working together to achieve the same goal.

8. CONCLUSION

I have advanced the hypothesis that the communicative deficits associated with RHD and autism can be related to a failure to appreciate the role of CIs in everyday conversation. On the basis of these neurobiological data, I suggest that this hypothesis has important implications for developing a model of the neural systems implicated in communicative functioning in everyday situations. However, there are many research challenges facing such a proposal. I outline these challenges and point to a couple of potentially promising directions for future research.

While the evidence from the autistic and RHD syndromes provides us with an initial picture of how certain abilities that are important to communicative function might be represented in the brain, this picture is still quite fuzzy. Very little is known about the exact nature of the neurobiological abnormalities associated with either syndrome. The neurobiological profiles of individuals with autism tend to differ radically on the structural and neurochemical level (see Bailey, 1993, for a review). Thus, it is a mistake to consider as homogenous a group that is in fact heterogeneous in important ways. A similar scenario is true for RHD patients. While clinicians can often ascertain the cause of damage in RHD patients, for research purposes, individuals who vary widely with respect to the location and size of their injuries are often grouped together. In short, the wide variation in neurobiological abnormalities associated with both groups makes it difficult to say anything specific about the brain systems responsible for the communicative deficits discussed above.

Interestingly, complementing the neurobiological variation is the fact that both autistic individuals and RHD patients show considerable variability on the behavioral measures that were reviewed here. Indeed, most researchers working within the field are impressed by the variability in performance they observe within each population. One possible topic for future investigation is the possibility that the variation that we see in performance on the different measures could potentially be systematically related to specific neurobiological abnormalities. One promising approach to this topic in RHD patients might be a lesion overlap methodology to determine whether there is a significant correlation between common lesions and specific communicative abnormalities.

Unfortunately, methodologies which rely on lesion data and developmental neurobiological disorders are limited in important ways. In addition to the specificity problems that were noted above, there are important questions regarding how well these clinical findings might generalize to the processing of everyday language by normal individuals. All of the limitations of the clinical data militate for functional neuroimaging studies on normal individuals. To date, no work has been done explicitly considering the neurophysiology of appreciating CIs despite their importance to language reception and production. Studies employing a range of neuroimaging techniques, including dense array ERP and functional imaging studies, will be critical to the development of a better understanding of the neural systems subserving the appreciation of CIs in normal individuals. Careful research studies along these lines would be an important step in developing a better understanding of the neurological foundations of communication.

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