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Autism, Social Comprehension, and Cognitive Impenetrability

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by

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Under the Direction of George Graham

ABSTRACT

Autism is a neurodevelopmental disorder featuring severe social and communicative deficits. Cognitive impenetrability is the inability of systems to be affected by an individual's beliefs and desires. Individuals with autism have delayed performance on "mindreading" tasks. Mindreading is the interpretation of others which enables successful social interactions. This task performance is not correlated with "everyday" social function in autism. These deficits are in contrast with general intelligence and reasoning abilities within the normal range, resistant to cognitive behavioral training, and partially attributable to atypical social predispositions. This suggests individuals with autism perform social tasks differently than typicals. I argue that this mindreading deficit is cognitively impenetrable, then position this deficit within a theoretical framework, enactivism, emphasizing cognitive embodiment and inseparability of social comprehension and action. This framework helps explain the cognitive impenetrability of these social deficits by "locating" failure to penetrate in individuals' failure to properly interact with the environment.

INDEX WORDS: Autism, Cognitive penetrability, Cognitive deficit, Enaction, Mindreading, Klin

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Here is my secret. It is very simple. It is only with the heart that one can see rightly; What is essential is invisible to the eye.

–Antoine de Saint Exupéry, *The Little Prince*

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1 Introduction

Victims of autism suffer from a variety of cognitive, social, and sensory deficits. One of the core deficit areas is social communication, in which individuals with autism seem to exhibit an absence of basic comprehension of other people. Individuals with autism appear to be disconnected from the social world such that, often, we do not understand their behavior and they do not understand ours. The disconnect goes further than this misunderstanding, however. Autism researchers and advocates often have a difficult time working with their students and/or patients with autism, saying, for example, "They just don't see me." One researcher tells a (not unfamiliar) story of a young girl with autism climbing up his body, no different than she would a bookshelf, to reach something too high for her (Bloom, 2004). It is in this sense that individuals with autism are sometimes said to be "mindblind," exhibiting a failure in the typical capacity for "mindreading". Intervention programs, and studies of them, indicate that it is very difficult to develop social skills in individuals with autism. This is true despite these individuals showing proficiency in non-social tasks and skills that are seemingly quite similar. Even for those individuals who can complete specific social tasks, e.g. interpreting the intentions of others or labeling facial emotions, it is not clear that they are doing the task in the same way. Perhaps autism deficits in the capacity for mindreading are not "cognitively penetrable," in that they appear to be unresponsive to the thoughts and beliefs of the individuals plagued by these deficits.

In this thesis, I will look at deficits in social understanding in autism. For much of what follows, I will focus on problems related specifically to deficits in mindreading, the interpretation of the thoughts and behavior of others. Mindreading, in some variation or another, has been a dominant theme in autism research over the past twenty-five years, resulting in

thousands of books and articles in such diverse fields as developmental, cognitive, and social psychology, philosophy, both basic and applied neuroscience, artificial intelligence and robotics, game theory, and beyond. Mindreading,[1] as it has traditionally been defined, is the capacity to attribute mental states to oneself and others and to understand that others have mental states that are not the same as one's own. The traditional view says, roughly, that we describe people by reference to their beliefs, desires, and intentions and that the primary purpose of this rests in the attempt to explain and predict their actions. This view, painted for now in *very* broad strokes, will be kept in the background for the first part of this thesis. The view should not be allowed to completely fade away, however, as much will be done in reference to it in the end.

For now, I mean to use the term 'mindreading' in a very broad sense, as whatever it is that we are doing when we "read the minds" of others, the general types of capacities discussed by theorists of various persuasions. Most of the time, people know and understand what those around them are doing. If I were to walk into a classroom, for example, and one of my students was upset, I would likely not have to ask her *whether* she was upset. I can figure that out on my own. With minimal probing, I could, at the least, learn whether she was upset *with me* or *with something else*; and if she was upset with me, then I would likely be able to quickly decipher, based on our shared experiences, the reason for her distress and be able to predict, with some level of accuracy, her future behaviors (e.g. whether she will politely approach me after class, or if the situation warrants, at least *in her mind*, a heated discussion involving her classmates). Likely, the student would also "read my mind", herself knowing that I would know roughly what she was thinking. All this before a single word is spoken. Köhler has a particularly illustrative example about following other's gaze:

[1] This has often been called Theory of Mind (ToM) in the philosophical and psychological literature. I take the more theory-neutral (no pun intended) term 'mindreading' from Nichols and Stich (2003).

> If my attention is attracted by a strange object, a snake for instance, I feel directed toward it and at the same time a feeling of tension is experienced. A friend, even if he has not recognized the snake, will see me and especially my face and eyes directed toward it; in the tension of my face he will have a visual picture of my inner tension, as in its direction he has a direct picture of the direction which I experience. (Köhler, 1929, p. 250f)

These examples are meant to illustrate the special sense in which the term 'mindreading' will be used. It is the ability to interpret (or understand or grasp) other people in such a manner that facilitates successful social interactions with them. Individuals with autism have problems with this. The mindreading deficits in individuals with autism represent a significant breakdown in social comprehension. Through the study of these deficits, the understanding of autism is increased and would ideally provide a path to treatment. Certainly, many a scientific talk begins with a defense of seemingly abstract research by explaining the implications for treatment. In addition, the study of these deficits can contribute to an understanding of social interactions more generally. Discovering exactly what it is that individuals with autism cannot do aids in understanding just what it is that typically developing individuals are doing, which, in turn, can contribute back to a better understanding of autism.

I will use a particular model of social understanding to help explain the sort of failure in mindreading exhibited in autism. Roughly, it could be said that our dealings with the social world has two parts. The first part involves interpretation of the actions and behavior of others, i.e. knowing what it is that other people are thinking, doing, or feeling. The second part is about what role this interpretation plays, or should play, in appropriate social actions. The model considered below, enactivism, emphasizes the inseparability of these two aspects of our dealings with others and the world. On this view, the very idea of comprehension is action-oriented. Likewise, social comprehension is (social) action-oriented, interaction-oriented. I hope to show that this intimate relationship between thought and action helps us to better understand the social

deficits in autism. Many aspects of autism are brought together, and made sense of, through conceiving of proper social comprehension as action oriented. If proper mindreading capacities entail, in some sense, proper action, then a wide variety of the characteristics of autism are explained. If social cognition is essentially action-oriented, then this provides insight into the cognitive impenetrability of mindreading deficits in autism.

In sum, I will argue for three main claims in this thesis. I look at a variety of data in autism to argue that (1) the mindreading deficit cannot be properly understood outside of the entire array of social deficits in autism. It is often said that individuals with autism live "in their own world." I argue that this metaphor is quite literal. Individuals with autism do not search out the same objects in the environment, so, as infants, they do not attend to the same things. For example, they do not look at faces as much as typical developing infants. They do not orient to the motion or sounds of other humans. By not attending to social cues, these infants are not exposed to the relevant social information. They are, in a sense, *not exposed* to the social world. The result is a cascading effect, in which their brains don't develop typical methods of processing social stimuli. Mindreading is just one of a *wide range* of social deficits to be explained these early processing problems. I use claim (1) to support two points: (2) The mindreading deficit in autism is not cognitively penetrable. Here, the basic idea is that there is massive developmental damage done so that the deficit becomes cognitively impenetrable before the subject is able to penetrate it cognitively. I will also argue that (3) positioning the deficit within an enactivist framework helps explain the cognitive impenetrability of these social deficits by "locating" the failure to penetrate in a failure to properly interact with the environment.[2]

[2] When citing this thesis, please note that the pagination is different between print and electronic versions.

2 Cognitive (Im)Penetrability

Ever since Fodor popularized the use of the term *module* in cognitive science (1983), much philosophical discussion has taken place on whether, and to what extent, processes of the human brain may be *cognitively impenetrable* (see e.g. Prinz, 2006; Pylyshyn, 1984). Cognitive impenetrability is a special case, a subtype, of what Fodor calls *informational encapsulation*, where encapsulation is a restriction on the type of input available to a system. A system is informationally encapsulated when it only has access to a specific subset of the information potentially relevant to the task at hand; the system is unable to reference information stored outside of itself (2009).[3] For example, consider the following:

> A parser for [a language] *L* contains a grammar of *L*. What it does when it does its thing is: it infers from certain acoustic properties of a token to a characterization of certain of the distal causes of the token (e.g., to the speaker's intention that the utterance should be a token of a certain linguistic type). Premises of this inference can include whatever information about the acoustics of the token the mechanisms of sensory transduction provide, whatever information about the linguistic types in *L* the internally represented grammar provides, *and nothing else*. (Fodor, 1990, pp. 245-246)

In other words, a language parser may only have access to the language lexicon but not to expectations about topics of conversation. In this case, words would be distinguished from non-words and ambiguities settled based on the meanings of individual words and their relations to one another. The parser may not be as helpful, however, in making sense of metaphorical language or stream of consciousness writing (e.g. Morrison, 1987). In this sense, cognitive impenetrability is the encapsulation of a cognitive faculty "relative to information stored in central memory, paradigmatically in the form of beliefs and utilities" (Robbins, 2009). Fodor

[3] Cognitive penetrability, flow of information into a system, should be understood as distinct from either accessibility to central monitoring, which is the flow of intermediate computational representations out of a system, often referred to more generally as metacognition,

says that a system is cognitively penetrable if it is "importantly affected by the subject's belief about context, or his background information, or his utilities" (Fodor, 1983, p. 73).[4] He also says that "[t]he penetrability of a system is, by definition, its susceptibility to top-down effects at stages *prior* to its production of output" (Fodor, 1983, p. 74).

So, a cognitive system or faculty is cognitively impenetrable when the faculty cannot be importantly affected by the subject's attitudes: beliefs, background knowledge, or utilities. If a particular system is cognitively impenetrable, then the information available to that system may be, as Fodor says: "considerably less than the organism may know" (Fodor, 1983, p. 69). To be clear, attitudes pene*trate* faculties. Cognitive faculties are (potentially) penetrat*ed* by attitudes. It is the faculties, capacities, or deficits that are cognitively (im)penetrable with respect to attitudes. The examples most effective at illustrating the concept of cognitive impenetrability are likely visual illusions. In these cases, an illusion persists despite viewers' knowledge regarding the nature of the image. In the Müller-Lyer illusion, e.g., the two horizontal lines appear to be of unequal length (see Figure 2.1, below).

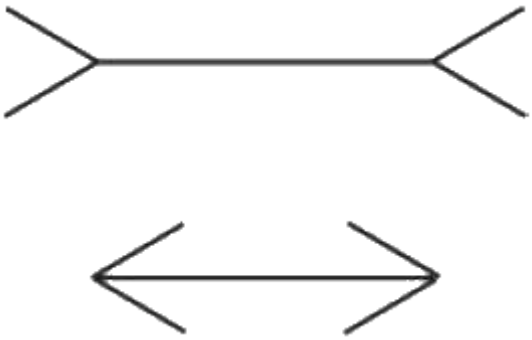

Figure 2.1: The Müller-Lyer Illusion (image from Robins, 2009)

[4] Here, the usage of 'or' is taken from the philosophical practice (i.e. 'or' is always inclusive, not exclusive). That practice is continued throughout this thesis, unless otherwise specified.

The illusions persists even after viewers have been told, or even measures for themselves, that the two lines are equally long. Although it may affect the way one thinks about the image, knowing that what is seen is, in some sense, "not real", does not affect the way that it is seen. In other words, being aware of a conflict between the subjective experience of the image and objective facts about it does not change the subjective experience.[5]

It was said above that cognitive faculties, capacities, or, importantly, *deficits* are cognitively (im)penetrable with respect to attitudes. Although the cognitive (im)penetrability of deficits has not been discussed, this would function in an analogous way. A deficit could be understood as cognitively penetrable if the mechanism(s) contributing to the deficit are not cognitively penetrable such that the deficit can be affected. So, to say that a deficit is cognitively impenetrable is to say it is not importantly affected by the person's beliefs, background knowledge, or utilities.[6] For example, suppose I visit the home of a friend. Suppose further that this friend, who is significantly taller than I, has furnished his home relative to his stature, such that I cannot reach items on the top shelf of a bookcase. It might be said that I have a deficit with respect to reaching items on the top shelf. Seemingly, there is nothing that I could think or believe that would affect this deficit, i.e. make me taller. Knowledge about the deficit could assist me, e.g. if I know the problem is that I am not tall enough, then I might use a stepladder. It should be noted that this does not affect *the deficit itself*, but only the effects of the deficit. This is the same as in the Müller-Lyer illusion. Knowledge of the illusion could be useful (e.g.

[5] Other illustrative examples include the McGurk effect, in which auditory speech processing appears to be encapsulated relative to beliefs but not encapsulated relative to visual processing, (McGurk & MacDonald, 1976) or Shepard's "Turning the Tables", a visual illusion in which two figures of the same shape and size appear to be *very* different in both shape and size (Shepard, 1981). Turning the Tables is a particularly striking illusion, which, unfortunately for present purposes, requires movement to be most effective.

[6] The exact meaning of the phrase 'importantly affected' is likely to be particularly important in the case of deficits, cognitive or otherwise. For current purposes, a system is 'importantly affected' when its output is changed either in a manner, or to an extent, which is relevant to the organism in which the system resides. This is meant as a "rough and ready" definition, rather than an analysis.

knowing the nature of the illusion, one would be more inclined to use a ruler); but that knowledge does not remove the illusion.

The cognitive penetrability of attitudes has important potential implications for individuals with cognitive deficits. An understanding of the deficit, combined with research on the (im)penetrability of the deficit, often reveals much about individuals both with the deficit and without. The first half of this paper explores the (im)penetrability of the mindreading deficit present in individuals with autism. What does it mean to ask whether this deficit in autism is cognitively penetrable? It might mean that this particular deficit in autism can be affected simply by the way in which individuals with autism think about their deficit. Can a reframing of these individuals' understanding of their deficits cause a change in their cognitive deficits? There are three basic possible answers to the question of whether any given cognitive deficit is penetrable. It could be that, in all cases, the given deficit is cognitively penetrable. This seems unlikely for most, if not all, interesting deficits. It could be that the deficit is not cognitively penetrable in any case. In other words, there is nothing that the individual can think, believe, or feel that will affect the deficit in any important way. In this case, the nature of the deficit is such that it is not the *kind of thing* capable of reacting to a change in belief structure.

The third possibility is that the deficit is cognitively penetrable in some cases, but not others. The potential situations in which this is the case seem innumerable; but for example, the cognitive penetrability of the deficit might be relative to the severity of the deficit. So, the more severe the case, the less cognitively penetrable the deficit is in that individual. On the other hand, the cognitive penetrability might depend on other factors, such as an individual's stage of development. The deficit might be penetrable at some point along the developmental trajectory, but then become impenetrable, or vice versa. The existence of deficits which might lose

cognitive penetrability makes sense with reference to the well-known developmental "critical periods," sometimes called "sensitive periods," in which an organism has a time window, relative to e.g. a particular information processing system, during which certain types of learning can occur. After a particular critical period has come to a close, learning, with respect to that domain, is much slower or sometimes even impossible. For example, in a classic series of studies, Hubel and Wiesel demonstrated that proper maturation of the developing visual cortex is dependent on visual experience within a certain developmental timeframe (Hubel & Wiesel, 1963, 1965; Wiesel & Hubel, 1963, 1965a, 1965b). Deprived of visual input in one eye, cortical areas typically devoted to binocular vision failed to develop and the cortical space normally used by the blind eye was taken over by the seeing eye. After a certain point, removing the eye covers made no difference. The animals would be blind for life.[7] For present purposes, one of the most important aspects of this research is that this cortical reorganization could be reversed, provided that the closed eye was opened, and allowed input, within a specific time window (Wiesel & Hubel, 1965a).

It might also be possible for a deficit to be penetrable for a certain amount of developmental time, after which it is *relatively* impenetrable. In other words, after the critical period in development, the deficit remains penetrable but the penetrability is lessened in some way. Consider an analogy. Children typically learn to walk very quickly. Within a matter of weeks (and after a significant number of cute, then loud, falls), this skill is mastered and the child goes on to learning other things. If, however, a child were to be immobilized, e.g. due to broken bones, such that the learning of this skill is delayed, then the time it takes for the child to acquire the skill, the learning curve, can be increased significantly (Sparks, Ortman, & Aubuchon, 2005).

[7] Interestingly, Ostrovsky, Andalman, & Sinha (2006) provide evidence that children with either monocular or binocular congenital cataracts are not in a position comparable to that of the subjects of Hubel and Wiesel's studies. Patients, some as old as 15 years, are showing recovery of sight after the removal of the cataracts.

For instance, a child immobilized in a body cast until the age of 4 years can learn to walk, but likely will never walk smoothly. This is, of course, similar to the developmental trajectory of language learning. Children acquire languages in a seemingly effortless fashion. After the age of 9-12 years, the ability of children to learn languages through passive experience is significantly lessened and the learning of languages becomes increasingly difficult.[8]

[8] The range of this critical period and its importance are, of course, controversial. The outcome of this debate, however, does not affect the usefulness of this illustrative example. For a fascinating new direction in this research, and potentially a matter of great social import, see the work of Kilgard and Merzinick (1998).

3 Autism

Autism is a neurodevelopmental disorder in which the brain function of individuals with the disorder, especially children, is often markedly different than those of typically developing individuals. Although the existence of structural atypicalities in the brain development of individuals with autism, specifically increased early brain growth and decreased later brain growth, is supported by much evidence (Schumann & Amaral, 2006), data must usually be averaged over dozens of patients before these differences can be found reliably (e.g., Corbett et al., 2009). It is also notable that the atypicality in brain structure associated with autism is significantly less than that of other neurodevelopmental disorders and that these differences, with respect to typically developing individuals, often disappear when data analysis includes statistically controlling for intelligence (Belmonte et al., 2008).

Genetics has considerable influence on an individual's susceptibility to autism, with autism being one of the most, if not *the* most, heritable psychiatric disorders. Ironically, the nature of the genetic basis of autism seriously impedes autism research. The etiology, as well as symptoms and behavior, of the disorder are heterogeneous across individuals. No specific biological markers have been identified for autism, meaning that there are no known biological indicators or characteristic traits that appear reliably enough to allow for diagnosis of autism. The symptoms and behavior can even vary widely in one individual over time. Individuals with autism have a high rate of co-morbidity, commonly exhibiting other psychiatric symptoms, such as anxiety and depression, as well as genetic disorders, such as fragile X syndrome.[9] The criteria currently used both to characterize and diagnose autism are strictly behavioral, and, because of

[9] For an alternative perspective on disorders associated with high rates of co-morbidity, see Horwitz (2002).

the features stated above, these criteria are quite varied (American Psychiatric Association, 2000). Even so, there seem to be certain core features that tie together individuals with autism, including deficits in social communication and reciprocal social interaction, as well as repetitive activities and narrow interests (Frith, 2008).

These features are present to varying degrees across individuals and may not all be present in any one individual. Although the complete absence of any of these features is rare in individuals diagnosed with autism, autistic symptoms not sufficient for a diagnosis are common in family members of those diagnosed (Frith & Hill, 2003). For example, Baron-Cohen has hypothesized two distinct types of cognitive activity displayed by normal humans, systemizing and empathizing (2002, 2003; Baron-Cohen & Hammer, 1997). He has shown that individuals with autism are extreme systemizers. Engineers and scientists, also predominantly systemizers, are over-represented in the families of individuals with autism (Baron-Cohen, Wheelwright, Stott, Bolton, & Goodyer, 1997).[10] It has even been speculated that autism forms such a continuum with the general population that without autism genes there would be no scientists or engineers (Grandin, 2008).

The characterization of autism as a disorder itself serves as a major obstacle for studies on the prevalence, as well as the cognitive, neurological, or genetic phenotype of autism. As Frith and Hill explain: "In line with the clinical recognition of the variability, there is now general agreement that there is a spectrum of autistic disorders, which includes individuals at all levels of intelligence and language ability and spanning all degrees of severity" (2003, 1-2). "Classic" autism, Asperger syndrome, and PDD-NOS (pervasive developmental disorder – not

[10] On a side note, Baron-Cohen also found that males score significantly higher on the systemizing side of the scale. One interesting phrase that Baron-Cohen has used to describe autism is "extreme male brain." Although this view has been criticized for being a description of autism, rather than an explanation, Baron-Cohen's research group has recently found preliminary evidence of abnormal levels of fetal testosterone being associated with autism, providing support for an "extreme male brain" *explanation* of autism (Auyeung et al., 2009).

otherwise specified) constitute the autism spectrum (American Psychiatric Association, 2000).[11] There is some disagreement among both clinicians and theorists as to exactly how these disorders should be classified. For example, current criteria require that individuals diagnosed with Asperger syndrome not exhibit any delay in language or cognitive development, differentiating it from high functioning autism. However, as Frith and Hill state: "This requirement seems somewhat arbitrary, as it is not clear that there are significant differences in the core features of autism between such cases and those who showed significant language delay early on, but later acquired fluent language and a social interest (Prior et al., 1998; Gilchrist et al., 2001)" (Frith & Hill, 2003).[12]

It would be difficult to overstate how central the words 'heterogeneous' and 'heterogeneity' are to the autism literature. Tager-Flusberg and Joseph explain this: "Autism is a complex disorder that is heterogeneous both in its phenotypic expression and its etiology. The search for genes associated with autism and the neurobiological mechanisms that underlie its behavioural symptoms has been hampered by this heterogeneity" (2003). Genetics plays a large role in an individual's susceptibility to autism. Autism, broadly defined, affects roughly 1% of the general population (Frith, 2008). The rate of shared affectedness of autism is 2-6% among singleton siblings, 10% for dizygotic (fraternal) twins, and 90% for monozygotic (identical) twins (Bailey et al., 1995). Frith points out that: "Hardly any other mental disorder is so highly genetic" (2008). However, the severity of symptoms can vary *widely* even between twins. Evidence suggests that 2 to 10 genes, possibly interacting, are involved in autism (Pickles et al., 1995; Santangelo & Folstein, 1999), with locations on several chromosomes (International

[11] The exact diagnostic criteria distinguishing these are not important for the purposes of this paper.
[12] By current criteria, Asperger syndrome and high-functioning autism are separate disorders (American Psychiatric Association, 2000). The possibility of merging Asperger syndrome and high-functioning autism was considered for the DSM-IV-TR. The assimilation of both Asperger syndrome and PDD-NOS (pervasive developmental disorder – not otherwise specified) is being considered for DSM-V (Swedo, 2009).

Molecular Genetic Study of Autism Consortium, 1998). Individuals with autism exhibit both genetic and phenotypic heterogeneity, whether the term 'autism' is used strictly or loosely. Tager-Flusberg and Joseph explain: "The current view is that each locus identified in these studies [on autism susceptibility genes] contains genes with only small or moderate effects on the etiology of autism. These small effect sizes make the identification of specific genes significantly more difficult" (2003, 44). Various classifications of subgroups have been proposed on the basis of covariance in behavior, genetics, and neuroanatomy (e.g., Tager-Flusberg & Joseph, 2003).

3.1 Mindreading and Deficits in Autism

"Humans are exceptionally social primates, and increasing evidence suggests that human social cognition is not simply the application of general cognitive abilities to social perception and behavior, but may reflect the operation of distinct specialized processes (Adolphs, 2006; Saxe, Moran, Scholz, & Gabrieli, 2006)" (New et al., 2009). Typically developing children exhibit a wide variety of social predispositions which have been found to be deficient or absent in children with autism, including preferential orienting of attention to social stimuli (Klin, Lin, Gorrindo, Ramsay, & Jones, 2009). For example, although human voices are one of the earliest and most effective stimuli involved in the social engagement of typically developing individuals (Eimas, Siqueland, Jusczyk, & Vigorito, 1971; Mills & Melhuish, 1974), this is not found in individuals with autism (Klin, 1991, 1992). For two year olds, lack of spontaneous orientation to human sounds (e.g. voices) is one of the best known predictors of a later diagnosis of ASD (Lord, 1995). From the first hours of life, typically developing humans preferentially attend to social stimuli (Gallagher & Meltzoff, 1996), preferring the sound of a person's voice over silence and the sound of their mother's voice over that of unknown woman (DeCasper & Fifer, 2004). Human infants preferentially look at their mother, rather than an unknown woman, at 2 days of

age (Bushnell et al. 1989). Infants typically begin to preferentially attend to biological motion within 2 days of birth (Simion, Regolin, & Bulf, 2008), distinguish between faces directed at them and faces directed away by four days old (Farroni, Csibra, Simion, & Johnson, 2002), and, by 3 months, look more at emotionally relevant areas, i.e. eyes more than other parts of faces and faces more than other body parts (Haith, Bergman, & Moore, 1977).

Very young infants have the ability to distinguish a human from surrounding objects with enough detail to imitate gestures and facial expressions. The findings of these studies include the imitation of mouth-opening and tongue protrusion gestures in newborns less than an hour to 71 hours old (Meltzoff & Moore, 1983) and imitation of smiling, frowning, or surprised expressions (Field, Woodson, Greenberg, & Cohen, 1982). Even the youngest infant in Meltzoff and Moore's (1983) study, only 42 minutes old, showed a statistically significant level of imitative behavior.

Although 2-3 weeks old infants imitate facial gestures and certain hand gestures (Meltzoff & Moore, 1983), they do not imitate similar movements by mechanical devices (Meltzoff, 1995). There is evidence to suggest that the imitation in newborns is interactive, using facial expression and gesture to provoke a response from others (Nagy & Molnar, 2004). Infants learn to detect a correspondence between visual and auditory information indicating the expression of emotion at 5-7 months (Hobson, 1993, 2004; Walker-Andrews, 1986) and develop social evaluation processes as early as 6 months (Hamlin, Wynn, & Bloom, 2007).

Typically developing children gain various aspects of mindreading between the ages of 3-5 years (Wimmer & Perner, 1983). There is reason to believe that two particular capacities, joint attention and language, are particularly important in the development of mindreading (Murray et al., 2008). Joint attention is a triadic attention relationship between two individuals and an object. For example, mommy sees baby Tim looking at a teddy bear. Tim notices mommy looking at

him and then looks at her. After a few glances back and forth between the bear and the other person, both individuals are paying attention both to each other and to the bear. Children and adults with autism do not engage in joint attention, often showing an aversion to looking at faces, especially eyes (Klin et al., 2007). In addition, they are often late to develop language (Frith, 2008).

Typically developing children pass first-order false belief tasks,[13] on average, at a mental age of 4 years (Wimmer & Perner, 1983). Although there is a large variability across studies in the number of children with autism who pass these tests (Happé, 1995 reports that this ranges from 15-60% respectively; Reed & Paterson, 1990; Prior, Dahlstrom, & Squires, 1990), individuals with autism do not pass first-order false-belief tasks until average mental age of 9 years (Happé et al., 1996). There is a discrepancy between the social and non-social reasoning skills in individuals with autism. Although 75% of individuals with autism have IQ scores below 70, those with higher IQ scores (labeled 'high-functioning') exhibit performance within the normal range on reasoning tasks that do not involve the mental tasks of others. For example, children with autism do not have difficulty representing counterfactuals *per se*, but do have a problem with counterfactuals *as beliefs*. This can be seen through experiments such as that by Zaitchik (1990): Suppose a researcher and a child are sitting are sitting at a table. The researcher takes a Polaroid picture of a pencil on the table, and then places the picture face down on the table to develop. While it develops, the researcher moves the pencil away from the table then asks the child: "In the picture, where is the pencil?" Age-matched children with or without autism answer this question equally well (Peterson & Siegal, 1998). However, if the situation is slightly altered (such that it involves mental, rather than physical, representations) and the child is asked: "Where does Timmy [present only when the pencil was on the table] think the pencil

[13] False-belief tasks vary in complexity. See Perner, Leekam, and Wimmer (1987) for a review.

is?" or "Where will Timmy look for the pencil?" then children with autism will fail this task far beyond the age at which typically developing children pass it (Peterson & Siegal, 1998). There is something special about *social* information to which individuals with autism do not, in some sense, have access.

There is also a discrepancy in high-functioning individuals with autism between "what they can do on explicit tasks of social reasoning (when all of the elements of a problem are verbally given to them), and what they fail to do in more naturalistic situations (when they need to spontaneously apply their social reasoning abilities to meet the moment-to-moment demands of their daily social life) (Klin et al., 2000)" (Klin, Jones, Schultz, & Volkmar, 2003, p. 345). This extends to their level of social responsiveness, i.e. their ability to cope with typical social situations (Klin et al., 2003; 2007).

Although some individuals with autism do exhibit proficient, though developmentally delayed, performance on "theory of mind" tasks, there is evidence that, once individuals with autism can perform mental state reasoning tasks, they are doing so in a way that is functionally and neurologically different from typicals (Happé et al., 1996). They can solve these tasks, but reports from researchers and individuals with autism indicate that they solve mental state tasks in an explicit manner, not automatically as typicals do it. Although some researchers have suggested that individuals with autism who show proficient performance on various mentalistic tasks may be using cognitive processes which differ from that of typically developing individuals (e.g. Frith & Happé, 1999), throughout much of the literature these distinctions are still very unclear. Individuals with autism are still sometimes said to develop mindreading capacities late. Their development in this area is said to be "delayed," not "deviant." Persons with autism said to develop these capacities, however, actually do not develop mindreading capacities analogous to

typically developing individuals *at all*, in that they do not ever develop the capacity to mindread in the same way that typicals do it.

Individuals with autism are performing this explicit task in a way that seems even more explicit than typicals. Stop. Reread the first sentence of this paragraph. It equivocates over the word 'explicit.' This is representative of equivocations *between* researchers in much of the literature on social cognition, with autism research included. With regard to the first sentence of this paragraph, the task is explicit in that all the elements of the task are explicitly given to the participant (Bloom & German, 2000). The manner in which the task is completed is explicit in that explicit calculations are performed in the solving of the problem. In contrast, typically developing individuals solve these explicit mindreading tasks *implicitly*. Victoria McGeer points out an implication of this:

> Indeed, the most striking fact about these autistic subjects is that their way of knowing others seems *more* theory-like than does our method of normal psychological knowing. That is, they seem to explain and predict others' behaviour in much the same way they would explain and predict the behaviour of other complex things in their environment, slowly and with effortful calculation based on a vast repertoire of (third-person) observations. Consequently, from the autistic point of view, there is a sense in which other people do not become easier to understand at all: they do not become 'familiar'. Rather, the strange behaviour of so-called 'normals' simply becomes easier to negotiate as a consequence of acquiring better tools for seeing predictable patterns in it. (McGeer, 2001, p. 115)

In context, this quotation is being used as part of an argument against a particular model of understanding mindreading capacities. Aside from that, it is useful in considering the phenomenology of mindreading experiences. From self-reports, among other things, it would appear that the process of "reading someone else's mind" is phenomenologically different between typicals and individuals with autism. To solve mentalistic reasoning tasks, e.g., individuals with autism must consciously entertain hypotheses regarding the sources of the behavior of others. They must *solve*, in a phenomenologically literal way, the problem of other

minds. In contrast, typically developing individuals seem to *just know* the solution to these problems. The deficit in the capacity for mindreading is not properly understood outside of the entire array of social deficits present in autism. In what follows, I will consider new social cognition research in autism. These data indicate that the social and communicative deficits observed in the behavior of individuals with autism are a result of a deficit in perceptual processing, in which social stimuli are neither given preference over other types of stimuli nor even recognized as a distinct type of stimuli at all.

3.2 Topologies of Salience: What Are We Looking For?

Recent work has attempted to access the magnitude of the discrepancy between performances on structured versus more naturalistic tasks in individuals with autism. In one series of experiments (Klin, Jones, Schultz, Volkmar, & Cohen, 2002a, 2002b), eye-tracking techniques allow researchers to record what participants are looking at when viewing various complex social scenes. As Klin and colleagues write: "This paradigm allows for an appreciation of a person's spontaneous reactions to naturalistic demands inherent in seeking meaning in what is viewed. In real-life social situations, many crucial social cues may lead to a general failure in assessing the meaning of entire situations, thus precluding adaptive reactions to them" (2003). These studies found that individuals with autism, as compared to typical controls, viewing social situations spent twice as much time looking at the mouth regions and 2.5 times less looking at the eye regions (Klin et al., 2002b). This lack of preferentially attending to eyes has been replicated in studies by Jones, Carr, and Klin (2008). It was also found that individuals with autism did not spontaneously respond to social gestures, such as pointing (Klin et al., 2002a).

It has also been found, with patients as young as 2 years, that individuals with autism fail to orient to biological motion (Klin & Jones, 2008; Klin et al., 2009). This attention bias is "a

fundamental mechanism facilitating adaptive interaction with other living beings" (Klin et al. 2009, p. 257). Preferential attention to biological motion is found in a wide range of species (e.g. in humans, Fox & McDaniel, 1982; Johansson, 1973; in monkeys, Oram & Perrett, 1996; and in birds, Omori & Watanabe, 1996). It appears very early in development, within 2 days of birth in humans, as mentioned above, and in newly hatched chicks (Vallortigara, Regolin, & Marconato, 2005). The detection and recognition of biological motion remains intact despite altering the amount of information available, e.g. through occlusion or the use of point-light displays (Neri, Morrone, & Burr, 1988; Thompson, Clarke, Stewart, & Puce, 2005), as well as in individuals with other motion perception problems, such as individuals with Williams syndrome (Jordan, Reiss, Hoffman, & Landau, 2002) or with circumscribed brain lesions (Jokisch, Troje, Koch, Schwarz, & Daum, 2005). "Furthermore," as Klin and colleagues remark, "biological motion perceived through other sensory modalities – such as when listening to sounds of human motion (Bidet-Caulet, Voisin, Bertrand, & Folumpt, 2005) – evokes activity in the same areas of the brain that are typically responsive to visual presentations" (Klin et al., 2009). Importantly, preferential attention to biological motion has been considered to be a precursor to attributing intentions to others (Frith & Frith, 1999).

These results suggest that individuals with autism have an atypical topology of salience. A person's topology of salience represents the relative import given to the variety of stimuli experienced in one's environment. Typically developing individuals process social stimuli with a high level of salience. For example, if a typically developing child sees a face and a hammer, greater emphasis is put on the face. Typically developing children automatically fixate on the eyes, whereas children with autism spend much more time looking at the mouth. Individuals with autism have impaired perceptual processing with respect to social stimuli. Children with autism

are drawn to fixate on the mouth because they are drawn to audio-visual synchrony (AVS) (Klin et al., 2009). AVS is the synchronization of auditory and visual stimuli. Typically developing children completely ignore AVS and are drawn to social cues. This means that, while typically developing individuals preferentially attend to social stimuli, for individuals with autism, social stimuli are neither given preference over other types of stimuli nor even recognized as a distinct *kind* of stimuli at all. For typically developing infants, "the social dimension is behaviorally salient and appears to command the greatest portion of the typically developing child's attention" (Jones et al., 2008).

3.3 Topologies of Salience: What Are We Looking *At*?

It might be thought that if individuals with autism were only taught to look at eyes, then they might internalize more of the social information available. It seems unlikely that the solution will be this simple, however. Many individuals with autism actually are taught to look at eyes. They can hold perfect (inappropriate/awkward and often timed) eye contact while they're talking to you. Piggot and colleagues conducted a study in which they had individuals with autism and typically developing controls fixate on a particular point on a blank screen (Piggot et al., 2004). An angry face then appeared on the fixation point and was replaced by an emotionally neutral face before the participant has any conscious awareness of the angry face. Brain activity, measured using fMRI, showed significant differences in multiple areas between individuals with autism and typicals. Typicals show significant spontaneous amygdala activity, reacting to the angry face. Individuals with autism show little to none. Subjects are then asked whether the face is angry (i.e. asked to explicitly process the emotion). Typicals identify the correct emotion, while amygdala activity dies down and frontal cortical activity appears. Generally, this cortical region is thought to modulate amygdala activity in the case of false positives. When individuals

with autism are explicitly asked to identify the emotion, they correctly identify it, but show brain activity similar to typicals in the first case. They show increased amygdala activity, although the absolute amount of activity is much smaller, and do not show the cortical activity that typicals show in the explicit labeling of emotional expressions.

In a "Directed v. Averted Gaze" paradigm, Bookheimer compares data within the autism group (Feusner, Townsend, Bystritsky, & Bookheimer, 2007): their responsiveness to emotional faces (as indicated on fMRI) to their scores on the Social Responsiveness Scale. Better social responsiveness correlated with increased activity in the medial prefrontal cortex, the inferior frontal gyrus, and some temporal and cerebellar regions. This means that these regions are not only different between typically developing controls and individuals with autism. They are also associated with the magnitude of the social deficits between individuals with autism. Children with autism attend to or process gaze-directed information differently. Children with autism perceive the faces, see the emotions and can label them, and see the eye direction. The *meaning* or *significance* of the emotion or gaze within a social context is not properly processed in the brain. Individuals with autism do not exhibit a spontaneous response to emotions. Once their attention is explicitly brought to the stimulus, however, they do show behavior and neural processes that are closer to that of typically developing individuals.

Adults with autism learn the meaning of various social cues, although they do not use them in ways that are seemingly obvious. They learn these skills cognitively, but do not internalize them. Adolescents with autism are better at facial processing than younger children with autism. They are processing the face cognitively, unlike typicals. Their brains do not differentiate social stimuli as a distinct *kind* of stimuli. Faces are processed just like any other object. This is not the case with typically developing children. Their brain specializes for facial

processing. They become experts in "faces." They automatically differentiate social stimuli as a distinct *kind* of stimuli, a kind given a very high level of salience.

Adults with autism (at least) learn the meaning of various social cues, although they do not use them in ways that are seemingly obvious. For example, adults with autism often understand the meaning of a social gesture, say pointing at an object. When this gesture is made in their presence, however, these adults often do not use the information encoded in this gesture. So, when someone points across the room, typically developing individuals fixate on the object indicated in the gesture. Individuals with autism, however, do not follow the gesture, and so, do not look at the object. This is despite the fact that they can explain what the gesture means.

3.3.1 "Seeing" Versus "Recognizing"

Fred Dretske makes a distinction that will be useful here (1993). He distinguishes between what he calls "seeing a state of affairs" and "seeing a fact". For instance, there is a difference between seeing a mouth and seeing it *as* a source of communication, seeing a rectangular object on the wall and seeing it as a painting. There is a difference between "seeing a state of affairs" – e.g. see that someone is smiling at you – and "seeing a fact" – seeing the fact that they are happy with you. This, of course, comes in degrees or levels. For example, one could see a painting, see a painting of Winston Churchill, see a painting of Winston Churchill at Buckingham Palace, see a painting of Winston Churchill at Buckingham Palace in the midst of a WWII bombing raid, etc.

To apply this distinction to the problem of autistic deficits: Individuals with autism see social stimuli, but that there is something that they cannot understand about them. There is some sense in which they cannot access the meaning. This is not straightforwardly analogous to the way in which Dretske uses the distinction, but with a bit of clarification, it can serve present

purposes as well. Individuals with autism do seem to see, e.g. gestures *as* a form of social communication with a particular meaning. They see the gesture, e.g. my pointing at a painting, and, if asked, can explain what the gesture is and what was meant by it, me attempting to direct the attention of another person to the painting. Although they seem to have a firm cognitive grasp of the requisite concepts for social interactions, individuals with autism do not act on them spontaneously. They do not spontaneously process the emotional or social significance of these interactions.

Consider the following, there is a difference between "seeing a Rembrandt" and "seeing a Rembrandt plus *experiencing* a Rembrandt." A person doing the former may be able to, e.g., explain many things about the Rembrandt such that that person seems to have a cognitive understanding of the work of art. This person is, however, missing something important, essential even, about the Rembrandt. If they do not experience the Rembrandt in the right way, e.g. if it does not evoke in them the typical emotional states, we might be inclined to as that there is a sense in which they do not *see* the Rembrandt at all. This is analogous to what is happening with the individuals with autism. They can see gestures and can identify the associated social meanings. They do not, however, *experience* the gestures in the right kind of way. Similarly, individuals with autism can see and identify faces, but do not see them "as" emotional faces until explicitly asked to evaluate them (until their attention is explicitly directed). Implicitly, they do not process faces "as" emotional.

For individuals with autism, cognitive level social concepts do not seem to connect to the same inner states as those of typically developing individuals. There are (at least) two possible explanations for this state of affairs. First, it could be the case that individuals with autism have

the same concepts,[14] but not have them "hooked up" in the right way. On the other hand, individuals with autism could have different, "substitute concepts" that only appear on the surface to be somewhat similar. As will be discussed below, theory-theorists and simulation theorists have, to varying degrees, taken the first possibility to be the case. In contrast, the views of some proponents of enactive theories of mind are much more in line with the second possibility.

Individuals with autism do not process the relevant input during development, so that their brain does not develop to process that sort of stimuli. In other words, they do not attend to social stimuli as infants. As a result, their brains do not develop typical methods and brain regions for processing social stimuli. Irreversible developmental damage is done long before the individual might have the opportunity to penetrate the deficit cognitively.

Above, I have focused more on discussion of *why* mindreading deficits in autism might be cognitively impenetrable and less on discussion *that* these deficits are cognitively impenetrable. This is not meant to imply that there is not evidence that the mindreading deficits in individuals with autism are cognitively impenetrable. In fact, understanding why the deficit may be cognitively impenetrable provides additional evidence that the deficit is cognitively impenetrable. In this case, there are a variety of aspects of autism that give strong reason to believe that individuals with this disorder will not be able to cognitively penetrate their social deficits. For example, typicals and individuals with autism do not complete social tasks in the same manner. Individuals in these groups react differently, both behaviorally and neurally, to social cues. Individuals with autism, both infants and adults, do not preferentially search out

[14] I am not particularly wedded to multiple people sharing the *same* concept, in a strong sense, just however strong a sense in which two people can share a concept.

social stimuli in the environment. Adults with autism appear to have a different *sort* of understanding of social information, a different connection to it.

In addition, there is more direct evidence that the mindreading deficits in individuals with autism are cognitively impenetrable. There is evidence from adults, such as Temple Grandin, who are highly motivated to develop typical, implicit mindreading capacities. Despite learning much about the deficit, however, these individuals do not succeed in penetrating it. They must continue to actively interpret others, just as they would solve any other reasoning problem. There is also a variety of evidence from work with children. For example, children involved in Applied Behavioral Analysis (ABA), a particularly intense therapy for autistics emphasizing behavior and social interactions, receive full-time training in social interactions and behavior, including a substantial increase in the amount and variety of social interactions over the average child with autism. These children appear to be the best candidates for learning to relate to others in a typical ways and for developing intuitive mindreading capacities. Children in this therapy seem to be making vast improvements in behavioral and social skills, including performance on mental state tasks. There is evidence, however, that they develop the same explicit capacity as other individual with autism studied, not the implicit mindreading capacity of typicals. This holds, not just for children in ABA, but in many intervention and social training programs. Howlin, Baron-Cohen, and Hadwin (1999) describe a wide variety of methods that have been used to teach children with autism how to complete social reasoning tasks. An important aspect of this training is to make the children motivated to learn. Reward systems (e.g., receiving candy for correct answers) are put in place for the children such that they are often highly motivated to learn to complete the tasks. Again, these children make substantial improvements in their ability to

complete these tasks, but the skills acquired do not generalize into general improvement in social functioning. These children remain unable to navigate the social world.

4 This is a substantive claim: Not all cognitive deficits are impenetrable

Above I have outlined what we have good reason to believe is the typical manner in which, or capacity through which, typically developing individuals 'read' the minds of others and understand the social significance of their gestures and facial expressions. When a person with typical mindreading capacities experiences sees a face they interpret as angry, they "just know" the face is angry. Phenomenologically, there is (in the usual, "bedrock"[15] cases) no explicit interpretation or problem-solving. The "interpretive" aspect is, one might say, implicit. This is in contrast to individuals with autism, who often must explicitly interpret the behaviors and facial expressions of others. The phenomenology of their social experiences, which is strikingly different from that of typicals, provides a window into the cognitive processes involved in their social interactions and evaluations.

I have argued that the social, and specifically mindreading, deficits in individuals with autism are not cognitively penetrable. There is nothing that individuals with autism can believe, think about, or focus their attention upon that will affect the way in which social stimuli are processed such that those individuals develop, or even experience, typical mindreading capacities. Even if these deficits are not cognitively penetrable, however, this does not mean that the lives of individuals with autism cannot be positively affected with respect to the effects of these deficits. Although the mindreading deficits in individuals with autism are not cognitively penetrable, the *effects* of autistic deficits are, in some sense, cognitively penetrable. The effects of the deficits on the lives of individuals with autism can be affected by the beliefs and desires they hold. For example, complex social environments can be particularly confusing and

[15] This is a term used by Hacking (2009).

frightening for individuals with autism, especially children. Social situations are commonly described by writers with autism as "intense" (e.g. Grandin, 2006). This can be decreased through gradual desensitization and the determination to gain the ability to withstand these sorts of situations.

A clear distinction needs to be drawn between affecting a deficit, on the one hand, and affecting the effects of a deficit, on the other: between curing an illness and relieving the symptoms. As stated above, only the effects of the mindreading deficits in individuals with autism, not the deficits themselves, are cognitively penetrable. To make this clearer, consider that I have the following deficit: One of my legs is shorter than the other.[16] I could *manage* my deficit by putting a lift in my shoe, such that the distance between my hip and the bottom of my shoe is the same for each leg. I have not affected the deficit itself, but I have affected the effects of the deficit: I have not cured myself of the short leg, but I have relieved the symptoms of it. The deficit no longer affects my life in the same way as before (i.e. I no longer walk with a limp). On the other hand, I could *treat* my deficit. I could, for example, have my leg lengthened surgically. In this case, there is no longer any effect of the deficit, because the deficit itself has been eliminated. Treating and managing deficits both come in degrees, of course. To use the previous example, suppose that I put a lift in my shoe that is not tall enough. I am made better off by managing the effects of my deficit in this way. The lengths of my legs are closer than before; and my limp is lessened. The effects of my deficit, however, have not been completely compensated for. Similarly, my surgery could be less than successful, leaving one leg (now only slightly) shorter than the other.

Similar to putting a lift in one's shoe, relieving the symptoms, so to speak, of mindreading deficits in autism represents the management, not treatment, of the deficits.

[16] Thanks to George Graham for this example.

It could be claimed that this lack of cognitive penetrability in autistic deficits is merely an uninteresting implication of the fact that it is a *deficit*. A person could not have, in other words, a genuine deficit and yet that deficit be penetrable (affectible, changeable) by their beliefs or attitudes. In this case, arguing for the cognitive impenetrability of autistic deficits would be trivial. Cognitive impenetrability is part of what it means to have a deficit, so the argument might go. This is not the case. The claim that the cognitive deficits associated with autism are cognitively impenetrable is not an empty claim. I will argue, using the cognitive rehabilitation of deficits associated with focal seizures as an example, that cognitive impenetrability is not entailed in the very idea of a deficit. Only the effects of the mindreading deficits in individuals with autism are cognitively penetrable. For individuals with focal seizures, however, cognitive deficits associated with the condition are themselves cognitively penetrable. Individuals with focal seizures can, through holding and acting on particular beliefs, affect not only their symptoms, but the cognitive deficits themselves.

To be clear, this example is not meant to act as a comparison between autism and focal seizures. These afflictions are very different. For example, although both are neurological disorders, autism is a neuro*developmental* disorder, with widespread, pervasive affects on the development of the system. This sort of effect may be possible in a case of focal seizures (e.g. if the onset was during infancy) but is not the case in most patients with focal seizures. Likewise, the individuals with these afflictions are very different. On the other hand, individuals with autism are prone to epilepsy (Frith, 2008). It is possible that a more systematic comparison between these two populations would prove fruitful. That is not, however, the purpose of the example. The purpose of the example is to show that there are genuine deficits that can affected

merely by the beliefs and attitudes of the person with the deficit: So, some deficits are cognitively penetrable.

Focal seizures, common to patients with temporal lobe epilepsy, are seizures which, on outset, affect only a part of the brain. Patients with these seizures often exhibit deficits in memory and attention (Corcoran & Thompson, 1993; Giovagnoli, Mascheroni, & Avanzini, 1997; Kälviäinen, Aikiä, Helkala, Mervaala, & Riekkinen, 1992; Perrine & Kiolbasa, 1999). Cognitive rehabilitation therapy can take one of two common routes, retraining or compensation (or some combination). After neurocognitive functioning has been diminished or impaired by injury or disease, the retraining method attempts either to retrain neural pathways to regain or improve neurocognitive functioning. The compensation method, taking the neurological damage for granted, attempts to teach strategies which the patient can use to compensate for the effects of the deficit (Halligan & Wade, 2005). In the discussion beginning this section, these methods are represented by "treating a deficit" and "managing a deficit," respectively.

With respect to the problem at hand, only deficits affected through retraining methods will show that the deficit is cognitively penetrable. Cognitive rehabilitation therapies featuring retraining methods have been shown to be effective in patients with epilepsy (Aldenkamp & Vermeulen, 1991; Johanson, Chaplin, & Wedlund, 2001), schizophrenia (Hayes & McGrath, 2000), traumatic brain injury (Carney et al., 1999; Lincoln, Majid, & Weyman, 2000), and multiple sclerosis (Plohmann, Kappos, & Brunnschweiler, 1994), among others. One study on patients with epilepsy, although finding compensation and retraining equally effective on average, found greater improvement in cognitive functioning, in terms of generalizability of function, in individuals who underwent retraining than individuals undergoing compensatory training (Engelberts et al., 2002). These studies show that cognitive impenetrability is not

entailed by cognitive or neurological deficits. To say, as I have, that the mindreading deficits in individuals with autism are cognitively impenetrable is a substantive claim. It is to say that the deficits present in individuals with autism are a special kind of deficit. It is to say that, unlike other cognitive or neurological deficits, the deficits in autism are not the right kind of thing to be affected by the individual's beliefs and desires.

5 Enactive Social Cognition and Autism

I have argued above that the mindreading deficit in autism is cognitively impenetrable. That is, the deficit *itself* is not, and cannot be, importantly affected by the beliefs, desires, background knowledge, or utilities of the individual. It has also been argued that the cognitive impenetrability of this deficit is not, as it were, "to be expected" in a trivial way. Cognitive impenetrability is a substantive feature of a deficit, both in terms of the person's relationship with the deficit and with respect to cognitive deficits in general. Whether cognitive impenetrability is part of the very idea of these mindreading deficits or not, however, the larger project remains: We need to understand just what this deficit is. In learning the conditions under which the deficit is impenetrable, we learn about the deficit, we learn about autism, and (hopefully) we discover paths to intervention.

The path to intervention may not be a direct route. Barring the possibility that the next brain scan in an autism study were to find an instruction manual on how to cure autism, interpretation of the data is going to be required. The data will need to be put into context, into a framework for understanding the deficit. Above, it was said that the sorts of things that "count" as well-working in a person's psychological or biological economy may be dependent on her stage of development. Similarly, what "counts" as well-working is also likely to be dependent on the people around her, the sorts of capacities the person, in some sense, "should" have. This means that a proper understanding of mindreading deficits requires a proper understanding of mindreading capacities. Fortunately, as mentioned above, the study of these deficits can contribute to an understanding of social interactions more generally. Discovering things about the nature of the mindreading deficit, i.e. gaining better understanding of exactly what it is that

individuals with autism *cannot* do, aids in understanding the capacity, just what it is that typically developing individuals *are* doing, which, in turn, can contribute back to a better understanding of the deficit, and, thereby, autism.

There are various ways of understanding social cognition. There are models that appear very different, while sharing fundamental suppositions. There are also models that can appear very similar, yet have suppositions which explicitly contradict one another. Debates about social understanding have been dominated for the past three decades by discussion regarding two main models, one growing out of so-called "theory-theory" and the other growing from "simulation theory." Briefly, according to theory-theory and simulation theory, what I have referred to as 'mindreading' is the capacity to attribute mental states to oneself and others and to understand that others have mental states that are not the same as one's own. I have attempted to use the term 'mindreading' in a very broad sense, as whatever it is that we are doing when we "read the minds" of others, the general types of capacities discussed by theorists of each persuasion. As theory-theory and simulation theory have dominated the folk psychology debate over the past three decades, little will be said about them in this paper. For present purposes, the most important feature of theory-theory and simulation theory is that they both assume a "representationalist" or "cognitivist" framework. Under this sort of paradigm, social cognition is viewed as a passive, third-person activity in which the observer constructs a "model" of sorts which represents the observed person. Internal theorizing or simulation is conducted to understand and predict the behaviors of others. This description is obviously simplified, although not to the point of caricature. Gallagher and Hutto succinctly describe relevant aspects the two main theories: "Theory theory (TT) and simulation theory (ST), the standard and dominant approaches to social cognition, share the important supposition that when we attempt to

understand the actions of others, we do so by making sense of them in terms of their mental processes to which we have no direct access. That is, we attempt to 'mind read' their beliefs, desires, and intentions, and such mind reading or mentalizing is our primary and pervasive way of understanding their behavior" (Gallagher & Hutto, 2008, p. 18). Note that here, as elsewhere in this thesis, mindreading consists of the interpretation of others.

As was mentioned in the Introduction and elaborated over the following pages, it could be said that our dealings with the social world have two parts. The first part involves interpretation of the actions and behavior of others, i.e. knowing what it is that other people are thinking, doing, or feeling. The second part is about what role this interpretation plays, or should play, in appropriate social actions. Based on a distinction of this sort, one could ask the following question regarding the mindreading deficits in autism: Is the mindreading deficit in autism constituted merely by deficient interpretation of the behavior of others, or by a deficiency in the responses to others. Are individuals with autism deficient merely in "comprehending" others, or in behaving appropriately towards others?[17] Although this question makes sense from the representationalist position, a growing number of theorists would likely say that the question is based on a false dichotomy. A relatively new position, enactivism, emphasizes the role of organisms' interactions with the environment in the formation of the mind. Enactivism emerges from embodied cognition research (for an in-depth review, see Anderson, 2003), in which all aspects of the mind are shaped by aspects of the body. All cognition, even abstract ideas, concepts, and mental representations, are *embodied*, intimately connected with motor systems and representations. So, for the enactivist, the very idea of comprehension is action-oriented. Likewise, social comprehension is (social) action-oriented, interaction-oriented. I hope to show in the following sections that this intimate relationship between thought and action helps us to

[17] Thanks to George Graham for help in this.

understand what representationalist views do not. Many aspects of autism are brought together, and made sense of, through conceiving of proper social comprehension as action oriented. Mindreading, or interpersonal interpretation, is not properly understood as a "disembodied cognition." If proper mindreading capacities entail, in some sense, proper action, then a wide variety of the characteristics of autism are explained.

5.1 Enactive Social Cognition

Enactivism emphasizes the role of the environment and interactions in the structure and, importantly, development of the mind. This sort of position has been developed or supported by numerous philosophers and psychologists (De Jaegher & Di Paolo, 2007; Gallagher, 2001, 2004; Hobson, 1993, 2002; Hutto, 2004, 2007; Klin et al., 2003; Ratcliffe, 2007; Thompson, 2001). A succinct description of the general position is given by Hutto:

> The defining feature of the recent enactivist turn in cognitive science is that it challenges the representationalist paradigm, stressing instead the embedded and embodied nature of cognitive acts. In particular, the movement has been associated with the rejection of the very idea that we can make sense of the basis of everyday skills in terms of the manipulation of underlying tacit representations of a pre-given world. Typically, the binary divide between traditional and enactive approaches is presented in terms of their respective commitments to understanding cognition as based on knowing that as opposed to knowing how. (Hutto, 2005, p. 389)

Klin and colleagues, describe their enactive mind (EM) version of enactivism:

> [T]he EM approach ascribes importance to early disruptions in sociability because of its central premise that normative social cognition is embedded in social perception and experience. This principle states that social perception is perceptually guided social action, and social cognitive processes emerge only from recurrent sensorimotor patterns that allow action to be perceptually guided (hence the notion of 'embodied cognition'; Varela, Thompson, & Rosch, 1991). (2003, p. 351)

Fuchs and de Jaegher write:

> Rather than considering it [intersubjectivity] a straightforward end stage of the social cognitive machinery, we view it itself as the source of intersubjectivity. Instead of postulating a collaboration of interacting and reasoning, we present a non-representational, enactive and embodied concept of intersubjectivity.
> On this approach, social understanding is not realised by 'snapshot' activities of one individual's theorising or simulating but arises in the moment-to-moment interaction of two subjects. (Fuchs & De Jaegher, 2009, p. 466)

Enactivism and embodied cognitive science emphasize that *thinkers* can only be properly understood as *actors*; "perception and action are fundamentally inseparable" (Varela et al., 1991, p. 173). As such, social interpretation or mindreading cannot be understood separate from social action.

The following are just a few of the many possible examples of evidence in support of an embodied theory of social cognition. There is evidence that the perception-action loops of people involved in interaction become coupled and intertwined. For example, listeners unconsciously coordinate tiny motor movements to changes in speed, direction, and intonation of the speaker (Issartel, Marin, & Cadopi, 2007). Similar findings come from musicians playing together (Maduell & Wing, 2007). Fuchs and de Jaegher draw from the interlacing of their perception-action loops: "Through this, social agents are able to coordinate their sensemaking in social encounters—that is: they can participate in each other's sensemaking (De Jaegher & Di Paolo, 2007). Hence, social understanding emerges from a dynamical process of interaction and coordination of two embodied subjects coupled to each other" (Fuchs & De Jaegher, 2009, p. 470). Fuchs and de Jaegher also use an interesting example involving a tennis player: "In order to hit the incoming ball properly, the player incorporates its trajectory—he actually moves with the ball from where it starts and feels it approaching—and thereby adjusts his return to it from the very beginning (see also Dreyfus 2002)" (2009, pp. 473-474). This certainly seems to be an

accurate description of the phenomenology of tennis. Anyone who has played tennis understands the *feel* of the ball approaching.

The enactive approach to social cognition is still relatively new. There is not currently a generally accepted lexicon (Gallagher, 2005). As such, terminological disputes abound; and clarification regarding *actual* differences between accounts, as well as the integration of separate accounts yet theoretically similar systems, is beginning to be made. As such, many accounts are currently works-in-progress and many disputes remained unresolved. For example, Gallagher (2008) argues that capacities of primary and secondary intersubjectivity are not properly understood as precursors to "later developing capacities for using folk psychology or simulation routines. They are not," Gallagher argues, "replaced or displaced by such capacities in adulthood, but rather continue to operate as our ordinary and everyday basis for social cognition" (p. 163). He does not take into account, however, that the same behavior in infants, adults, and children throughout various developmental stages, or across different clinical populations, does not necessarily arise from the same cognitive or neural process (Karmiloff-Smith, 1992; Karmiloff-Smith, Klima, Bellugi, Grant, & Baron-Cohen, 1995). He does not seem to take into account that (at least) three distinct levels must be considered to say whether two processes are the same in this strong sense. This most likely does not constitute an “objection,” however, unless there is evidence suggesting that this sort of situation might be the case. If so, then he needs to address the evidence. If not, then he needn’t even acknowledge the objection. It simply says that Gallagher’s account does not account for the possibility that the data might turn out a particular way. This is not even to say that this possibility could not be accounted for. So, if the data turn out a particular way, then Gallagher will have to account for that. Until then, not.

I do not want to commit to any particular formulation of an enactive account of social cognition, nor to *enactivism* necessarily. Other camps have begun to assimilate some of the concepts and language of embodiment. Most notable of these is Simulation Theory. There are problems with Simulation Theory (Gallagher, 2007a, 2007b, 2009), as well as discrepancies between the fundamental suppositions of each camp (Gallagher, 2008; Hutto, 2005). At this time, however, it is yet to be seen whether it will be impossible for accounts which are not strictly enactivist to be acceptable. In what follows, I will draw from various enactive accounts of social cognition and connect this to the autism literature, not necessarily endorsing any one enactivist system, but staying true to the enactivist spirit. Although this will not be a comprehensive review of all relevant data on autism, several telling examples will be discussed. The examples are aspects of autism that are not only predicted by appeal to embodiment and enaction, but they are often difficult to explain otherwise. The discussion below is intended to show that a wide variety of the characteristics of autism are made sense of by means of an enactive, or embodied, understanding of humans' interactions with the world and each other.

Enactivists are not the first theorists to emphasize a connection between cognition and action. Neither are they the first to discuss the importance of individuals' interactions with one another and the world. It is possible that any insights into mindreading deficits in autism that might be gained from considering enactivism could be acquired through discussion of other embodied cognition theories or even representationalist theories. Gopnik, Meltzoff, and Kuhl, pivotal figures in the study of social interactions in infancy and developmental social cognition, argue fervently for Theory-theory (e.g., 1999). From a Theory-theory perspective, it might be argued, for example, that the social theory of the typically developing individual is different from

that of the individual with autism. As stated above, many simulation theorists have begun to use the language of embodiment.[18]

It is the emphasis on enaction and on individuals' developmental dependence on their environments and the de-emphasis of the third-person perspective that attracts the current author to enactive accounts of social cognition. The explicit, and widespread, integration of phenomenology into enactivist writings allows for a connection between what-it's-like to be an individual and *why* it might be like that. As I hope has been made clear, the "what-it's-like-ness" of social interactions in autism plays an important role in understanding mindreading deficits, as well as social deficits in general. In a sense, my purpose for making use of enactivism is much the same as the purpose Varela, Thompson, and Rosch had in originally outlining the position:

> For Merleau-Ponty, as for us, *embodiment* has this double sense: it encompasses both the body as a lived, experiential structure and the body as the context or the milieu of cognitive mechanisms. Embodiment in this double sense has been virtually absent from cognitive science, both in philosophical discussion and in hands-on research. We look to Merleau-Ponty, then, because we claim that we cannot investigate the circulation between cognitive science and human experience without making this double sense of embodiment the focus of our attention. This claim is not primarily philosophical. On the contrary, our point is that both the development of research in cognitive science and the relevance of this research to lived human concerns require the explicit thematization of this double sense of embodiment.
> (1991, p. xvi)

For current purposes, approaching the social and mindreading deficits from an enactivist perspective provides the right sort of emphasis to better understand these deficits and their cognitive impenetrability (even if it turned out to be the case that this understanding is possible without enactivism).

[18] This appears to be more common in the scientific literature than in philosophical discussion.

5.2 Enactive Social Cognition: Clarifying the Mindreading Deficits in Autism

Ramsey once characterized mental representations as "the maps by which we steer" (1931).[19] Individuals with autism, it could be said, have difficulty steering through their social environment. Our current understanding of the social deficits in autism can be assisted by positioning these deficits within an enactivism framework. For the representationalist, these maps are just that, mere pictures of the terrain. They are "disembodied." For the enactivist, these maps just are a form of steerage and are intimately connected with motor control mechanisms. Above it was argued that certain social deficits in autism are not cognitively penetrable. This section explores "where" that failure to penetrate is located. Traditional representationalist views, again the theoretical position that has dominated autism research, have been prone to locate this deficit, and its impenetrabilities, merely in mental representational capacities, in maps. Taking an enactive perspective suggests that the failure to penetrate is intimately connected with a failure of proper steerage.

As discussed above in the sections on topologies of salience, there is an increasing amount of evidence that both the "map" of the environment, as well as the environment itself, will actually be *different* for children with developmental disorders, such as autism, than typically developing children. For example, it has been shown that caretakers react strongly to overgeneralization by toddlers with developmental disorders, whereas caretakers are much more forgiving of overgeneralization by typically developing toddlers (Sigman et al., 1999). As overgeneralization can be an important learning mechanism, these children are slower than they might otherwise be to acquire proper concepts of things in the world. These sorts of subtle environmental changes cause subtle changes in gene expression, behavior, and cognitive

[19] Ramsey referred specifically to beliefs, but a distinction between beliefs and mental representations more generally is not important for the purposes of this illustrative metaphor. This description was later taken up by Armstrong (1973).

development (Karmiloff-Smith, 1998). As we have seen, individuals vary in what is sought out in their environments (Klin et al., 2002a, 2002b; Klin et al., 2009), leading to large variation between individuals' environmental "maps" (Clark, 1999). This in turn results in individual variation in neurofunctional specialization (LeDoux, 2003). This is all very much in keeping with enactivism.

An enactive understanding of social cognition predicts that the environment will be recreated differently, based on differences in dispositions to search for, and react to, various types of stimuli in differing ways and to differing extents (Maturana & Varela, 1973). Consider this description from Fuchs and de Jaegher:

> From an enactive point of view, organisms do not passively receive information from their environment which they then translate into internal representations; rather, they actively participate in the generation of meaning. Thus, a cognitive being's world is not a pregiven external realm represented by the brain. Rather, it is the result of a 'dialogue' between the sense-making activity of an agent and the responses from its environment (Varela et al., 1991; Varela, 1991, 1997; Torrance, 2005; Thompson, 2005, 2007; Di Paolo, Rohde, & De Jaegher, 2007). (Fuchs & De Jaegher, 2009, p. 470)

and Klin and colleagues:

> The radical assumption of this framework, therefore, is that it is not possible to disentangle cognition from actions, and that if this happened (e.g. a child was taught to perform a social cognitive task following an explicit drill rather than acquiring the skill as a result of repeated social engagement and actions), the given skill would represent a 'disembodied cognition', or a reasoning skill that would not retain its normative functional value in social adaptation (Markman & Dietrich, 2000). (2003, p. 351)

In order words, children who have, e.g., certain perceptual deficits, do not simply perceive the environment in an impoverished way. They develop an impoverished version of the environment. This view would also predict substantial social and communicative deficits in autism, given the discrepant perceptual salience topology that seems to be present in these individuals. According to this view, when typically developing children learn language, the symbols that they learn are unalterably attached to (i.e. inseparable from) the social context in

which they occur and the emotions, interactions, movements, etc. that are occurring. Children with autism, however, often learn language by associating a particular mouth movement, sound, and referent (Grandin, 2006). This limits them to more literal language options, as the color and complexity of the (typically embedded) social context is missing. As such, the meanings of words are not integrated within the social context in which they normally appear. Temple Grandin, for example, tells a story from her childhood in which she would repeatedly yell, "Prosecution!" when her kite hit the ground. Although she had no idea what the word meant, she liked the way it sounded (2006). This provides an explanation for the "substitute concepts" that seem to be present in individuals with autism. Under this view, individuals with autism actually *do* have substitute concepts for many aspects of social life. The meaning attributed to social gestures, such as pointing or waving, are "disembodied cognitions". The concepts possessed by these individuals are not connected to the right sorts of experiences to be like those of typicals. The difficulty which typically developing individuals have in imagining knowing the meaning of a pointing gesture and not spontaneously acting upon it, a dissociation common to individuals with autism, is itself evidence that proper social comprehension must be understood to be embodied.

Fuchs and de Jaegher, in giving their phenomenological account, state the following: "Incorporation is a pervasive characteristic of the lived body, which always transcends itself and partly merges with the environment" (2009, p. 472).This can be used as an illustrative way of thinking about the social deficits individuals with autism face. There is a significant sense in which individuals with autism are not incorporated into the social environment. This is, of course, two-sided. They do not incorporate themselves into social situations; and, often, *we* cannot incorporate them into the social domain. It is for precisely this reason that autism

intervention and behavioral therapy programs exist. These programs attempt to incorporate individuals with autism into the social environment. Interestingly, and as would be predicted by an enactive account, imitating individuals with autism can aid in connecting with them. Marco Iacoboni tells a story of an intervention worker who, on days when he had a particularly difficult time connecting with the patients, would begin to imitate them (2007). He would immediately, so the story goes, feel a connection with them and this type of interaction would often increase the productivity of those sessions. This is to be expected, both because of recent work on the use of imitation in autism intervention programs (Rogers, Hepburn, Stackhouse, & Wehner, 2003) and the fact that the earlier cited work on the coupling of perception-action loops extends to gestures, facial expressions, body postures, etc.

Although this has not been a comprehensive review of all the relevant data on autism, several telling examples have been used. The examples are characteristics of autism that are not only predicted by appeal to embodiment and enaction, but they are difficult to explain otherwise. The following final example helps to explain why typically developing individuals often become *very* uncomfortable around persons with autism (which leads to individuals with autism being harassed and bullied). Fuchs and de Jaegher use the concept of mutual incorporation to describe the dynamics of eye contact, in which there often seems to be an "intensive dialogue" or "fight of gazes": "My reaction to the other's gaze already influences his next action….Mutual incorporation implies a component of autonomy and otherness that is absent in unidirectional incorporation. The experience of even slight mismatches or unforeseen reactions suffices to establish a difference between self and other" (2009, pp. 474-475). The experience of disconnectedness between typically developing individuals and individuals with autism is explained by the connectedness typicals experience between one another. This phenomenology

of mutual incorporation is so pervasive in human life that its absence can be perceived as unnerving, sometimes even frightening. Initiating this incorporation, possibly through imitation, is the next step in improving the lives of individuals afflicted with this disorder.

6 Conclusions

In summary, autism is a neurodevelopmental disorder associated with severe social and communicative deficits. Cognitive impenetrability is the inability of a system to access information outside of itself. Individuals with autism are delayed in their performance on "mindreading" tasks, where mindreading is the interpretation of others which enables successful social interactions; and this task performance is not correlated with "everyday" social function in autism. These social deficits are in contrast with general intelligence and problem-solving abilities within the normal range and are resistant to cognitive or behavioral training. These facts suggest that individuals with autism are performing social tasks differently than typicals. I have argued that the mindreading deficit in autism is not cognitively penetrable. I then positioned this deficit within a theoretical framework, enactivism, emphasizing embodiment and environmental interactions in social cognitive development. This framework contributes to the understanding of these social deficits and their cognitive impenetrability by showing that social comprehension is inseparable from social action.

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