Initial Description of a Quantitative, Cross-Species (Chimpanzee–Human) Social Responsiveness Measure

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Objective: Comparative studies of social responsiveness, an ability that is impaired in autism spectrum disorders, can inform our understanding of both autism and the cognitive architecture of social behavior. Because there is no existing quantitative measure of social responsiveness in chimpanzees, we generated a quantitative, cross-species (human–chimpanzee) social responsiveness measure. **Method:** We translated the Social Responsiveness Scale (SRS), an instrument that quantifies human social responsiveness, into an analogous instrument for chimpanzees. We then retranslated this "Chimpanzee SRS" into a human "Cross-Species SRS" (XSRS). We evaluated three groups of chimpanzees (n = 29) with the Chimpanzee SRS and typical and human children with autism spectrum disorder (ASD; n = 20) with the XSRS. **Results:** The Chimpanzee SRS demonstrated strong interrater reliability at the three sites (ranges for individual ICCs: 0.534 to 0.866; mean ICCs: 0.851 to 0.970). As has been observed in human beings, exploratory principal components analysis of Chimpanzee SRS scores supports a single factor underlying chimpanzee social responsiveness. Human subjects' XSRS scores were fully concordant with their SRS scores (r = 0.976, p = .001) and distinguished appropriately between typical and ASD subjects. One chimpanzee known for inappropriate social behavior displayed a significantly higher score than all other chimpanzees at its site, demonstrating the scale's ability to detect impaired social responsiveness in chimpanzees. **Conclusion:** Our initial cross-species social responsiveness scale proved reliable and discriminated differences in social responsiveness across (in a relative sense) and within (in a more objectively quantifiable manner) human beings and chimpanzees. J. Am. Acad. Child Adolesc. Psychiatry, 2011;50(5):508–518. **Key Words:** comparative cognition, autism, Social Responsiveness Scale, chimpanzee, nonhuman primate

Comparative social cognition research is a valuable approach for studying childhood social development. By determining whether certain cognitive functions are conserved across species, comparative social cognition research can elucidate the mechanisms of social behavior that are unique to human beings.[1] Comparative studies of chimpanzees and human beings have identified key causal reasoning abilities, involving unobservable variables,[2] that we believe are uniquely human and necessary for the emergence of higher social cognitive abilities, such as Theory of Mind (ToM). Cross-species investigations can thus provide novel insight into human neurodevelopmental disorders such as autism, in which both evolutionarily conserved aspects of social relatedness and human-unique abilities, such as ToM, may be impaired. More precise quantitative characterization of highly evolved aspects of nonhuman primate social behavior may further our understanding of the developmental trajectory of core autistic symptoms, which could improve our diagnostic proficiency, particularly at early ages, and guide future therapies.

In turn, autism, with its characteristic profile of social deficits, provides a model to explore the

This article is discussed in an editorial by Dr. Hanna E. Stevens on page 438.

cognitive architecture underlying social behavior. We and others have proposed that effective social behavior requires a hierarchy of interdependent, social domain–specific and domain–general cognitive abilities.[3,4] These span from evolutionarily conserved cognitive functions not unique to human beings, such as gaze following,[5] to human-unique cognitive functions, such as higher-order relational reasoning, the ability to simultaneously recognize similarities between the relationships of multiple distinct entities (e.g., as tested with Raven's Progressive Matrices[6]). We hypothesize[4] that higher-order relational reasoning is necessary but not sufficient for certain human-unique, social domain–specific aspects of cognition, such as theory of mind (ToM),[7] which has consistently been shown to be disrupted in autism.[8,9]

The occurrence of complex social interactions in many nonhuman species suggests that a significant degree of social functioning is mediated by evolutionarily conserved cognition that is not unique to human beings. Studies examining specific aspects of social behavior across species are thus uniquely suited to tease apart the roles of human-unique and evolutionarily conserved cognitive abilities that are interdependent in human beings and that contribute to social function. Clarifying the relationship between domain-general cognition, ToM, and evolutionarily conserved elements of social behavior may provide novel insights for the field of social cognition as well as autism, in which social impairment entails a range of capacities in addition to ToM.

As a first step in this process, we must know which of the variations in social function that characterize autism and that are quantitatively distributed in the entire human population can be measured in nonhuman primates. Studies of social behavior in chimpanzees have demonstrated that individual differences in personality can be reliably detected by surveying human raters,[10] and that surveys can be used to detect quantitative differences in normal characteristics, such as subjective well-being,[11] as well as pathological characteristics, such as psychopathy.[12] We therefore designed an initial experiment to test whether quantitative variation in aspects of social function relevant to autism could be reliably captured in chimpanzees, ideal candidates given their close phylogenetic relationship to human beings and their sophisticated, well-studied social behavior.

We developed a cross-species measure of social function based on the Social Responsiveness Scale (SRS), a well-validated instrument designed to quantify the severity of social impairment related to characteristic symptoms of autism spectrum disorders.[13-15] SRS scores are continuously distributed in the general human population, demonstrating that the SRS measures quantitative variation in traits that comprise autism.[16] Analysis of the factor structure of autistic traits represented by the SRS suggests that the autistic phenotype stems from a heritable, unitary dimension of social function which maps to all three categories of autistic symptomatology, namely reciprocal social behavior, the ability to engage in emotionally appropriate, turn-taking interactions; language development; and stereotypic behaviors, including repetitive mannerisms and/or restricted interests.[17,18] Hence, the SRS operationalizes "social responsiveness" as a behavioral domain whose disruption results in social deficits, communication deficits, and stereotyped behaviors characteristic of autism spectrum disorders.

To test whether this construct of social responsiveness could be measured in chimpanzees, we translated the human SRS into an initial version applicable to chimpanzees. We distributed this "Chimpanzee SRS" to raters associated with chimpanzee populations at a three distinct sites to evaluate the reliability of our measurements. We hypothesized that chimpanzee social responsiveness would parallel human social responsiveness, both in regard to the distribution of levels of social responsiveness in the chimpanzee population and its factor structure. Furthermore, we asked whether deviance in chimpanzee social behavior would be ascertainable with the Chimpanzee SRS. Our results suggest that our initial cross-species measure is reliable and can detect meaningful variation in social behavior. The development of a cross-species measure of social responsiveness has implications not only for improving understanding of the core features of autism throughout development, but also for understanding the evolutionary conservation of brain systems related to social function.

METHOD

Subjects

We invited consecutive subjects participating in ongoing studies in the Cognitive & Perceptual Develop-