Psychological Bulletin

Friendship in School-Age Boys With Autism Spectrum Disorders: A Meta-Analytic Summary and Developmental, Process-Based Model

Jenna L. Mendelson, Jacquelyn A. Gates, and Matthew D. Lerner


CITATION

Friendship serves a range of crucial functions across the life span and has been hypothesized to be among the core fundamental human needs (Baumeister & Leary, 1995; Sullivan, 1953). Children, adolescents, and adults all list friendship among the things that matter most to them (Klinger, 1977), and lack of a close friendship in adolescence has been associated with depression and sadness extending into adulthood (Bagwell, 2004; Bukowski, Laursen, & Hoza, 2010). Deficits in component elements of social functioning (e.g., the use of eye contact, gestures, vocal intonation, and body posture for communicative purposes, as well as difficulty comprehending social cues from others) are central to autism spectrum disorders (ASD; American Psychiatric Association, 2013; Hobson, 2014). Indeed, putatively as a direct result of these deficits, children with ASD are at especially high risk for social isolation, peer victimization, and friendlessness (Chamberlain, Kasari, & Rotheram-Fuller, 2007; van Roekel, Scholte, & Didden, 2010). Despite these challenges, research indicates that individuals with ASD commonly express a strong desire for, but critical differences in, friendships (e.g., Bauminger & Kasari, 2000). Considering these differences and the primary nature of social deficits in this population, some have questioned whether meaningful social relationships, including friendship, are even possible in ASD (e.g., Hobson, 1993; Calder, Hill, & Pellicano, 2013; Mitchell & Locke, 2015). Given the centrality of friendship to social development in typical and atypical populations (Allen et al., 2015; Mikami, 2010), a systematic review and coherent model is needed to understand the emergence, development, predictors, and nature of friendship in ASD.

Friendship-making is considered a well-established domain of deficit for children with autism spectrum disorders (ASD; American Psychiatric Association, 2013), with this population sometimes described as incapable of making friends. However, the majority of children with ASD indicate a desire for friends, and many report having friends. To what degree, then, do youth with ASD succeed in achieving friendships with peers? If and when they do succeed, by what means do these friendships emerge relative to models of typically developing (TD) youths’ friendships? To address these questions, we first meta-analyzed the descriptive friendship literature (peer-reported sociometrics, self-report, parent-report) among school-age boys with ASD. Using random effects models, we found that youth with ASD do make friends according to peers and parents (Hedges’s $g > 2.84$). However, self-reported friendship quality (Hedges’s $g = -1.09$) and parent- and peer-reported quantity (Hedges’s $g < -0.63$) were poorer than TD peers. We consider these findings in light of 2 conceptual frameworks for understanding social deficits in ASD (social cognition and social motivation theory) and in view of a leading model of friendship in TD youth (Hartup & Stevens, 1997). We then present a model that synthesizes these domains through the construct of social information processing speed, and thereby present the first developmental, process-based model of friendship development among youth with ASD.

Keywords: ASD, friendship, meta-analysis, social cognition, social motivation

Jenna L. Mendelson
The University of North Carolina at Greensboro

Jacquelyn A. Gates and Matthew D. Lerner
Stony Brook University

Friendship in School-Age Boys With Autism Spectrum Disorders: A Meta-Analytic Summary and Developmental, Process-Based Model

Jenna L. Mendelson
Department of Psychology, University of North Carolina at Greensboro; Jacquelyn A. Gates and Matthew D. Lerner, Department of Psychology, Stony Brook University.

Thank you to Dr. Roseneder O. Nelson-Gray, Dr. Susan Keane, Dr. Janet Boseovsky, and Dr. Dayna Tounon for their invaluable input on earlier versions of this article, and Dr. Anne Moyer for her thoughtful insights on the analytic strategy. Matthew D. Lerner was partially supported by awards from the Brian A. Wright Memorial Autism Research Fund, the Center for Health Innovation at Adelphi University, the Simons Foundation (SFARI 381283), and the Alan Alda Fund for Communication; Jacquelyn A. Gates and Matthew D. Lerner were partially supported by an award from the American Academy of Arts & Sciences.

Correspondence concerning this article should be addressed to Matthew D. Lerner, Department of Psychology, Stony Brook University, Stony Brook, NY 11794-2500. E-mail: matthew.lerner@stonybrook.edu

2013; Hobson, 2014). Indeed, putatively as a direct result of these

friendship among this population, the processes and functions of friendship among typically developing (TD) individuals must first be thoroughly considered and understood. Although substantial bodies of literature exist concerning friendship and characteristics of individuals with ASD, respectively, these two complementary domains have yet to be integrated. Only once this integration is established will it be possible to provide a conceptual framework for friendship among these individuals to promote this crucial component of psychological well-being.

To date there has yet to be a theoretical model of individual characteristics and dyadic processes that might contribute to friendship-making in this population. Thus, herein we first consider the processes and benefits for school-age TD boys, drawing heavily from a foundational model of friendship development.
Hartup & Stevens, 1997). Next, we present a meta-analysis of the data on friendships in school-age youth with ASD to date, considering qualitative and quantitative differences between ASD and TD youth, and whether the quantity of friendships in youth with ASD differs from zero. Next, we consider these processes in light of two leading frameworks explaining key deficits among individuals with ASD: social cognition and social motivation theory. We present findings from the substantial body of research regarding each of these frameworks, highlighting inconsistencies in findings relating to each. We then integrate supportive research with these inconsistencies to present a new framework through which to consider the link between social challenges and friendship-making among individuals with ASD. Specifically, we consider the potentially distinct role of the efficiency of social information processing (Crick & Dodge, 1994) among individuals with ASD, proposing that they share a unique social information processing style with pervasive implications for social relationships, including friendship. Finally, we relate this framework to the processes and benefits of friendship in a new model of friendship for school-age boys with ASD, the first of its kind. This model focuses on the underlying processes through which friendship may arise or fail to do so; thus, in this paper we refer to it as a “process-based” model. We focus on a single developmental stage (the 8–12 age range) and gender (males) to allow for a more detailed examination of the specific mechanisms whereby friendships are formed and maintained; thus, our focus is process, with a careful consideration of the impact of developmental stage and specific ramifications for individuals with ASD.

Demographic Considerations

The 8- to 12-year-old age, sometimes called “school-age,” range is a period during which friendship plays an especially pivotal role in well-being in TD youth, with lasting implications for self-esteem and overall self-concept (e.g., Hartup, 1993; Parker & Asher, 1993). The school-age period is also especially critical for individuals with ASD, who are likely to experience increasing hardship with friendship formation during the approach to adolescence, as intimacy grows in importance (e.g., Rose & Rudolph, 2006). Given that roughly three fourths of all children with ASD are male (Elsabbagh et al., 2012), that friendship patterns differ during this period across genders (Rose & Rudolph, 2006), and that comparable differences have been found among populations of individuals with ASD (Dean et al., 2014), the model presented in this review has been designed to apply to males specifically.

Friendship Among TD Boys: A Model for Comparison

The leading model of friendship defines it by two main processes: surface level activities and deep structure reciprocity (Hartup & Stevens, 1997). The original Hartup and Stevens model was designed to be developmental, in that it was intended to describe the manifestation of friendship at various stages of the life span. Here, we review its implications for school-age boys, as well as the key role of affective sharing in its conceptualization (see Figure 1).

Processes of Friendship Among TD Boys

Surface level activities. Surface level activities are developmentally normative behaviors that may differ according to a range of factors (e.g., age, culture). Among TD North American boys aged 8–12, these activities consist of rough-and-tumble play, physical activities, organized games, and group play (Cote & Dodge, 1998; Rose & Rudolph, 2006; Smith & Boulton, 1990; Underwood, 2004).

Deep structure reciprocity. Through participation in surface level activities, individuals develop the deep structure reciprocity of friendship (behavioral and affective reciprocity). Reciprocity is especially important for friendship among children in the 8–12 age range, who contribute more equally to their interactions with each other than with nonfriends, and engage in less domination behavior (Bukowski, Motzoi, & Meyer, 2009).

Affective sharing and deep structure reciprocity. Affective sharing is central to friendships among school-aged boys (e.g.,
Foot, Chapman, & Smith, 1977; Howes, 1996; Nurmi, Einav, & Hood, 2012). Positive affective exchange is so central to reciprocal friendship that it has been found to distinguish not only reciprocal friendships from nonfriendships, but also reciprocal from unilateral friendships (Howes, 1983; McGuire & Weisz, 1982; Newcomb & Bagwell, 1995; Newcomb & Brady, 1982). Successful engagement in positive affective exchange hinges on the ability to comprehend subtle social cues and moderate one’s own facial expression, body posture, vocal intonation, verbal statements, and gestures to respond in kind: all of which could reasonably be expected to be challenging for boys with ASD.

Functions of Reciprocal Friendship Among TD Boys

Among the functions served by friendship in the school-age range is a fundamental human need for connectedness that spans the lifetime, with negative consequences if not met (Baumeister & Leary, 1995). Supporting the idea of social connectedness as a fundamental human need, friendships have been found to be among the things children will list as most important in their lives (Klinger, 1977), and the vast majority of children and adolescents report wanting and/or having a friend (e.g., Dunn, 1993). A lack of reciprocal friendships in childhood has been associated with greater degrees of loneliness and depression that can extend into adulthood (Bagwell, 2004; Parker & Asher, 1993). Perhaps in part due to its basis in shared positive affect (Newcomb & Bagwell, 1995), friendship has also been found to serve a unique buffering role against negative outcomes among at-risk children (Hodges, Boivin, Vitaro, & Bukowski, 1999; Laursen, Bukowski, Aunola, & Nurmi, 2007; Nangle, Erdley, Newman, Mason, & Carpenter, 2003), including against strains in other relationships (Bolger, Patterson, & Kupersmidt, 1998; Dunn, 2004; Gauze, Bukowski, Aquan-Assee, & Sippola, 1996; Rubin et al., 2004; Schwartz, Landsford, Dodge, Pettit, & Bates, 2012). These findings indicate that boys with ASD, who may be at a disadvantage in friendship formation given core features of ASD, may be at risk for psychopathology as a result.

Friendship and positive self-evaluation. The school-age period is a crucial time for the development of self-image and sense of competency (Hartup & Stevens, 1997). The positive affective quality of friendship serves an important role in the processes involved in positive self-evaluation and validation, contributing to the development of a sense of self-worth (Berndt & Keefe, 1995; Bolger, Patterson, & Kupersmidt, 1998; Furman & Robbins, 1985; Hartup, 1993; Hartup & Sancilio, 1986; Kringery et al., 2011; Newcomb & Bagwell, 1995). Difficulty engaging in affective sharing may place boys with ASD at risk for lower self-esteem.

Friendship and psychosocial development. Another key function of friendship is its provision of important developmental experiences (Sullivan, 1953). During early and middle childhood, friends discourage norm violations that can predict future antisocial behavior, while providing knowledge of societal behavioral norms and offering opportunities to develop social competency (Dunn, 2004; Furman & Robbins, 1985; Hartup, 1993; Howes, 1983; Weiss, 1974; Parker & Gottman, 1989). Positive affect plays a key role in this function as well, serving as reinforcement that encourages children to repeat behaviors that elicit positive affect from peers (Adams, Bukowski, & Bagwell, 2005). Difficulty forming reciprocal friendships may therefore serve as a double-edged sword for children with ASD by causing them to miss crucial opportunities to develop social competence.

Friendship Among Boys With ASD

Difficulty with subtle social communication, including eye contact, gestures, vocal intonation, and body posture are among the defining characteristics of an ASD diagnosis; moreover, difficulty forming friendships, as well as understanding the concept of friendship, are such common characteristics of individuals with this diagnosis that they are featured among the diagnostic criteria (DSM–5; Hobson, 2014). However, recent findings converge in suggesting that individuals with ASD often want and find friendships (e.g., Bauminger, Shulman, & Agam, 2004). How, then, might these friendships emerge, and do they differ structurally from those of TD youth? In this section, we first meta-analyze the current literature on friendship-making in ASD. Then, we consider how sometimes subtle social behavioral and cognitive impairments among boys with ASD may “scale up” to impact such friendships. Finally, we then propose a consistently found, but only recently specified, common factor as a candidate process that facilitates the link between ASD-related impairments and friendship-making.

Meta-Analysis of Findings to Date

To obtain a detailed picture of the current state of the literature on friendship among school-age boys with ASD, a systematic literature search was conducted. PsycINFO and PubMed databases were employed, using the following search criteria: (friendships or social relationships) AND (ASD or Autism or Asperger’s). The search was limited to articles published through November of 2014, and to “School Age (6–12)” and “Adolescence (13–17),” and included peer-reviewed papers, Dissertations, and indexed Abstracts. This yielded 374 publications from PsycINFO and 285 from PubMed. We then conducted a quality assessment of the obtained articles. Specifically, a master’s level coder evaluated them using the following criteria: (a) empirical study presenting quantitative data that had not previously been published; (b) peer-reviewed paper, dissertation or indexed abstract (i.e., not an online-indexed commentary or discussion); (c) claimed to include individuals with ASD; (d) included some confirmation of ASD diagnostic status (including school, clinician report, parent report, or formal diagnostic assessment); (e) mean age of participants was within one sample standard deviation of the 8–12 age range (to ensure that the sample adequately and comprehensively represents the target age range); (f) were not intervention studies; and (g) presented quantitative data on friendship, specifically (including report of friendship from one or multiple reporters, or observers). A blinded second master’s level coder, following the same criteria, coded the first 101 articles (27% of total) with findings sorted by relevance. This coder achieved 97% agreement (κ = .86; p < .001), differing on three papers. Given the importance of establishing a methodologically sound and rigorous estimate of friendship-making in ASD, we aimed to include only very strong study designs in this meta-analysis. As such, only those papers meeting all of the above inclusion criteria (i.e., high quality and strong designs) were included in the meta-analysis.

Additionally, a master’s level and doctoral level coder each conducted forward and backward citation searches of the obtained
papers using the above criteria to ensure comprehensive coverage of the literature. Several additional articles were found, all of which were evaluated in the same manner as above by the two independent coders. Finally, all authors were contacted to determine if any relevant unpublished data were available; if identical data were found in both dissertations and published articles, only the peer-reviewed publications were included. Discrepancies were adjudicated by the authors, who independently agreed with the first coder’s assignment in these cases. As such, the first coder’s selection was used for the final article set, which resulted in 18 total articles (see Table 1).

Each of the selected articles contained samples of both male and female youth with ASD in the target age range. As the focus of this paper is on friendships among boys with ASD, we attempted to contact all authors to obtain male-only subsets of ASD (and TD) data for direct comparison. While most authors responded to our queries, too few were able to retrieve and obtain their original data to conduct a boys-only meta-analysis. However, as is typical of ASD populations, males constituted the vast majority of the ASD samples (M%male = 85.46%).

**Meta-analysis procedure.** All 18 papers were then double-coded by two blinded raters on demographic variables (mean TD and ASD participant age; proportion of TD and ASD samples that were male; mean TD and ASD Full Scale IQ; ASD severity). The same procedure was used to code the component scales of self-reported friendship quality (companionship, security, closeness, providing help, and conflict [reverse-coded]), sociometrically reported friendship quantity (any reciprocated friendships, friendship nominations by peers [indegrees], nomination of peers as friends [outdegrees], number of connections, social network centrality, nonpreferred status, reciprocal listing of a friend in the top three friends in class), parent-reported friendship quantity (number of friends, duration of playdates with friends, frequency of playdates with friends), and observer-reported friendship quality (positive orientation, cohesiveness, harmony, coordinated play, responsiveness, control) as they appeared in each article. Agreement among these coders was excellent, ICC(1,2) > .97.

Once coding was complete, the variable set was evaluated. First, it was determined by consensus that outdegrees, as a pure self-reported sociometric measure, did not directly represent the peer-report aspect of sociometrics, and so this variable was dropped from subsequent analyses; doing so resulted in the omission of one article (Wainscot, Naylor, Sutcliffe, Tantam, & Williams, 2008) from the meta-analysis. Additionally, the nonpreferred variable may represent an orthogonal construct in the sociometric literature (e.g., Bell-Dolan, Foster, & Tishelman, 1989), and was represented in only two articles; as such, it was also omitted. Likewise, it was suspected, and subsequently confirmed by the authors (N. Bauminger, Personal Communication, August 20, 2015), that four of the articles represented a fully overlapping sample (Bauminger et al., 2008a, 2008b; Bauminger, Solomon, & Rogers, 2010; Solomon et al., 2011). As such, it was determined that only the article containing the most complete iteration of these data (Bauminger et al., 2008b) would represent this sample in the meta-analysis. However, as a result of this, it was found that all observer-report data emerged from this sample, and so no meta-analysis could be conducted. Finally, only two articles included means for specific ASD severity metrics; as such, this point estimate and potential moderator could not be used.

Overall, three separate meta-analyses were run: peer-rated sociometric, parent-reported quantity, and self-reported quality. For each of these, Cohen’s d’s (and confidence intervals) for the difference between ASD and TD means were calculated for each subscale in each study, then averaged to provide a more stable overall value for each study (to test the hypothesis that children with ASD have fewer, and lower-quality friendships than TD peers). For the friendship quantity variables, Z scores for subscales for ASD participants were calculated to estimate the standardized difference from zero (to test the hypothesis that children with ASD do not, on average, make any friends); these were then also averaged to provide one value per study.

Meta-analyses were conducted as random effects models (to maximize balance of the relative weights of each effect size) using Comprehensive Meta-Analysis 2 and 3 (Borenstein et al., 2007). For all three domains, Hedges’s g was calculated using the difference between means of the ASD group and the TD group, divided by the standard deviation, and weighted for sample size to correct for small sample bias (Hedges & Olkin, 1985; Lipsey & Wilson, 2001). For quantity analyses (parent- and peer-reported), to assess the question of whether youth with ASD do or do not make more than zero friends, we calculated the mean of the ASD group divided by the standard deviation for each measure, yielding a standardized mean difference from zero, which was then aggregated within, and then assessed across, studies. For each meta-analysis, if a significant main effect and significant variation (Q) were found across studies, fixed effects moderation analyses were attempted for theoretically meaningful potential moderators (e.g., age, FSIQ). However, due to the small k for any individual analysis (<10), these analyses were substantially underpowered (<.28 under the most generous estimates; Sánchez-Meca & Marín-Martínez, 1998); thus, they are not reported here.

Publication bias was investigated via funnel plots and a conservative tandem method (e.g., Ferguson & Brannick, 2012) including: the classic Fail-Safe N (which indicates the number of missing studies that would yield a main effect below the α = .05 threshold); Egger’s regression test (which, if significant, would indicate asymmetry in the funnel plot, and so possible publication bias; Egger & Davey-Smith, 1998); and Duval and Tweedie’s (2000) trim-and-fill method (which examines the funnel plot for potential asymmetry, removes potential asymmetrical values and imputes symmetrical values, and then calculates a new summary effect; if the effect is no longer significant, then this can be taken as evidence of publication bias).1

Finally, to probe the source and nature of overall effects, sub-scales that were available across studies were individually meta-analyzed in the same way as the overall measures (moderators were only probed when the overall measure was significant, to reduce multiple comparisons). Overall, the meta-analytic procedures employed in the paper adhere to all applicable Meta-

---

1 Due to the lack of variance among the standard deviations of the transformed standardized mean difference from zero effect sizes, publication bias statistics could not be calculated. Thus, the untransformed effects for each study were used to detect publication bias in these two analyses. This can be considered a highly conservative approach to publication bias estimation, as the variability in metrics across studies (e.g., total number of friends; duration of get-togethers/week) effectively penalizes the publication bias metrics.
<table>
<thead>
<tr>
<th>Domain</th>
<th>Citation</th>
<th>Subscale</th>
<th>ASD Mean (SD)</th>
<th>ASD N</th>
<th>TD Mean (SD)</th>
<th>TD N</th>
<th>Cohen’s d^a</th>
<th>ASD Standardized difference from 0^b</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parent report</td>
<td>Rowley et al., 2012</td>
<td>No. of friends</td>
<td>1.02 (.12)</td>
<td>100</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>8.50</td>
</tr>
<tr>
<td></td>
<td>Kuo et al., 2013</td>
<td>Duration</td>
<td>49.00 (26.20)</td>
<td>91</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>1.87</td>
</tr>
<tr>
<td></td>
<td>Mazurek &amp; Kanne, 2010</td>
<td>No. of friends</td>
<td>1.70 (1.00)</td>
<td>1,202</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>1.70</td>
</tr>
<tr>
<td></td>
<td>Bauminger et al., 2008</td>
<td>Duration</td>
<td>40.00 (28.32)</td>
<td>44</td>
<td>49.11 (36.78)</td>
<td>38</td>
<td>−.28</td>
<td>1.41</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Frequency</td>
<td>2.15 (.87)</td>
<td>44</td>
<td>2.7 (1.25)</td>
<td>38</td>
<td>−.52</td>
<td>2.47</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Overall</td>
<td>—</td>
<td>44</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>1.94</td>
</tr>
<tr>
<td></td>
<td>Bauminger &amp; Shulman, 2003</td>
<td>No. of friends</td>
<td>2.50 (1.16)</td>
<td>14</td>
<td>4.00 (2.08)</td>
<td>14</td>
<td>−.89</td>
<td>2.16</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Duration</td>
<td>21.8 (19.96)</td>
<td>14</td>
<td>44.57 (30.02)</td>
<td>14</td>
<td>−.89</td>
<td>1.10</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Frequency</td>
<td>2.79 (2.01)</td>
<td>14</td>
<td>5.38 (1.80)</td>
<td>14</td>
<td>−.36</td>
<td>1.39</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Overall</td>
<td>—</td>
<td>14</td>
<td>—</td>
<td>—</td>
<td>−1.05</td>
<td>1.24</td>
</tr>
<tr>
<td>Self-report</td>
<td>Calder et al., 2013</td>
<td>Companionship</td>
<td>3.53 (.57)</td>
<td>12</td>
<td>3.84 (.63)</td>
<td>11</td>
<td>−.52</td>
<td>—</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Security</td>
<td>3.98 (.91)</td>
<td>12</td>
<td>4.51 (.54)</td>
<td>11</td>
<td>−.70</td>
<td>—</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Closeness</td>
<td>4.00 (.70)</td>
<td>12</td>
<td>4.76 (.25)</td>
<td>11</td>
<td>−.14</td>
<td>—</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Help</td>
<td>3.73 (.89)</td>
<td>12</td>
<td>4.44 (.36)</td>
<td>11</td>
<td>−.03</td>
<td>—</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Conflict</td>
<td>−2.31 (.82)</td>
<td>12</td>
<td>−2.07 (1.00)</td>
<td>11</td>
<td>−.26</td>
<td>—</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Overall</td>
<td>—</td>
<td>12</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>−.79</td>
</tr>
<tr>
<td></td>
<td>Kasari et al., 2011</td>
<td>Companionship</td>
<td>13.35 (.49)</td>
<td>60</td>
<td>15.34 (.47)</td>
<td>60</td>
<td>−4.14</td>
<td>—</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Security</td>
<td>16.25 (.51)</td>
<td>60</td>
<td>17.74 (.49)</td>
<td>60</td>
<td>−2.98</td>
<td>—</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Closeness</td>
<td>19.35 (.51)</td>
<td>60</td>
<td>22.35 (.49)</td>
<td>60</td>
<td>−6.00</td>
<td>—</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Help</td>
<td>16.87 (.63)</td>
<td>60</td>
<td>20.25 (.47)</td>
<td>60</td>
<td>−6.08</td>
<td>—</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Conflict</td>
<td>−8.38 (.48)</td>
<td>60</td>
<td>−8.19 (.46)</td>
<td>60</td>
<td>−.40</td>
<td>—</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Overall</td>
<td>—</td>
<td>60</td>
<td>—</td>
<td>—</td>
<td>−3.92</td>
<td>—</td>
</tr>
<tr>
<td></td>
<td>Whitehouse et al., 2009</td>
<td>Total quality</td>
<td>74.26 (41.46)</td>
<td>35</td>
<td>104.31 (27.81)</td>
<td>35</td>
<td>−1.85</td>
<td>—</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Companionship</td>
<td>2.93 (1.32)</td>
<td>35</td>
<td>3.64 (1.05)</td>
<td>35</td>
<td>−.60</td>
<td>—</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Help</td>
<td>2.50 (1.10)</td>
<td>35</td>
<td>3.47 (.86)</td>
<td>35</td>
<td>−.98</td>
<td>—</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Conflict</td>
<td>−1.85 (.44)</td>
<td>35</td>
<td>−2.11 (.65)</td>
<td>35</td>
<td>.47</td>
<td>—</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Overall</td>
<td>—</td>
<td>35</td>
<td>—</td>
<td>—</td>
<td>−.37</td>
<td>—</td>
</tr>
<tr>
<td></td>
<td>Chamberlain et al., 2007</td>
<td>Companionship</td>
<td>3.63 (.94)</td>
<td>17</td>
<td>4.19 (.50)</td>
<td>17</td>
<td>−.74</td>
<td>—</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Companionship</td>
<td>3.55 (.66)</td>
<td>44</td>
<td>3.56 (.62)</td>
<td>38</td>
<td>−.02</td>
<td>—</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Closeness</td>
<td>3.92 (.66)</td>
<td>44</td>
<td>4.32 (.49)</td>
<td>38</td>
<td>−.68</td>
<td>—</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Help</td>
<td>3.35 (.91)</td>
<td>44</td>
<td>4.02 (.74)</td>
<td>38</td>
<td>−.80</td>
<td>—</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Conflict</td>
<td>−2.25 (.88)</td>
<td>44</td>
<td>−2.38 (.105)</td>
<td>38</td>
<td>.14</td>
<td>—</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Overall</td>
<td>—</td>
<td>44</td>
<td>—</td>
<td>—</td>
<td>−.34</td>
<td>—</td>
</tr>
<tr>
<td></td>
<td>Bauminger et al., 2008</td>
<td>Companionship</td>
<td>3.05 (.87)</td>
<td>14</td>
<td>4.00 (.44)</td>
<td>16</td>
<td>−1.41</td>
<td>—</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Security</td>
<td>3.15 (1.03)</td>
<td>14</td>
<td>4.26 (.61)</td>
<td>16</td>
<td>−1.33</td>
<td>—</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Closeness</td>
<td>3.57 (.94)</td>
<td>14</td>
<td>4.10 (.58)</td>
<td>16</td>
<td>−.69</td>
<td>—</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Help</td>
<td>2.95 (1.45)</td>
<td>14</td>
<td>4.47 (.44)</td>
<td>16</td>
<td>−1.46</td>
<td>—</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Conflict</td>
<td>−2.03 (.69)</td>
<td>14</td>
<td>−2.48 (.102)</td>
<td>16</td>
<td>.51</td>
<td>—</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Overall</td>
<td>—</td>
<td>14</td>
<td>—</td>
<td>—</td>
<td>−.88</td>
<td>—</td>
</tr>
<tr>
<td></td>
<td>Bauminger &amp; Shulman, &amp; Agam, 2004</td>
<td>Companionship</td>
<td>3.56 (.79)</td>
<td>22</td>
<td>4.01 (.38)</td>
<td>19</td>
<td>−.71</td>
<td>—</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Security</td>
<td>3.41 (.73)</td>
<td>22</td>
<td>4.17 (.54)</td>
<td>19</td>
<td>−1.17</td>
<td>—</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Closeness</td>
<td>4.28 (.44)</td>
<td>22</td>
<td>4.44 (.31)</td>
<td>19</td>
<td>−.42</td>
<td>—</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Help</td>
<td>3.24 (.99)</td>
<td>22</td>
<td>4.19 (.53)</td>
<td>19</td>
<td>−1.17</td>
<td>—</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Conflict</td>
<td>−2.35 (.81)</td>
<td>22</td>
<td>−2.20 (.79)</td>
<td>19</td>
<td>−.16</td>
<td>—</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Overall</td>
<td>—</td>
<td>22</td>
<td>—</td>
<td>—</td>
<td>−.73</td>
<td>—</td>
</tr>
<tr>
<td>Domain Overall</td>
<td>Dean et al., 2014</td>
<td>Connections</td>
<td>1.68 (2.10)</td>
<td>50</td>
<td>3.48 (2.20)</td>
<td>50</td>
<td>−.84</td>
<td>.80</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Indegrees</td>
<td>1.76 (1.80)</td>
<td>50</td>
<td>3.32 (1.90)</td>
<td>50</td>
<td>−.84</td>
<td>.98</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Overall</td>
<td>—</td>
<td>50</td>
<td>—</td>
<td>—</td>
<td>−.84</td>
<td>.89</td>
</tr>
<tr>
<td></td>
<td>Locke et al., 2013</td>
<td>SNC</td>
<td>.37 (.05)</td>
<td>26</td>
<td>.60 (.01)</td>
<td>338</td>
<td>−14.11</td>
<td>7.40</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Connections</td>
<td>3.86 (.42)</td>
<td>26</td>
<td>4.38 (.11)</td>
<td>338</td>
<td>−3.39</td>
<td>9.19</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Indegrees</td>
<td>3.70 (.53)</td>
<td>26</td>
<td>6.01 (.14)</td>
<td>338</td>
<td>−11.91</td>
<td>6.98</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Friend Recip</td>
<td>.27 (.09)</td>
<td>26</td>
<td>.44 (.02)</td>
<td>338</td>
<td>−5.05</td>
<td>3.04</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Top 5</td>
<td>.37 (.05)</td>
<td>26</td>
<td>.56 (.02)</td>
<td>338</td>
<td>−3.81</td>
<td>7.25</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Overall</td>
<td>—</td>
<td>26</td>
<td>—</td>
<td>—</td>
<td>−7.65</td>
<td>6.77</td>
</tr>
<tr>
<td></td>
<td>Kasari et al., 2011</td>
<td>SNC</td>
<td>1.38 (.09)</td>
<td>60</td>
<td>2.20 (.09)</td>
<td>60</td>
<td>−9.11</td>
<td>15.33</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Connections</td>
<td>2.76 (.33)</td>
<td>60</td>
<td>4.54 (.33)</td>
<td>60</td>
<td>−5.40</td>
<td>8.36</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Indegrees</td>
<td>1.48 (.24)</td>
<td>60</td>
<td>2.92 (.24)</td>
<td>60</td>
<td>−6.00</td>
<td>6.17</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Friend Recip</td>
<td>.11 (.08)</td>
<td>60</td>
<td>.45 (.07)</td>
<td>60</td>
<td>−4.33</td>
<td>1.35</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Top 5</td>
<td>.18 (.05)</td>
<td>60</td>
<td>.64 (.05)</td>
<td>60</td>
<td>−8.85</td>
<td>3.37</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Overall</td>
<td>—</td>
<td>60</td>
<td>—</td>
<td>—</td>
<td>−6.74</td>
<td>6.92</td>
</tr>
</tbody>
</table>

\* (table continues)
Table 1 (continued)

<table>
<thead>
<tr>
<th>Domain</th>
<th>Citation</th>
<th>Subscale</th>
<th>ASD Mean (SD)</th>
<th>ASD N</th>
<th>TD Mean (SD)</th>
<th>TD N</th>
<th>Cohen’s (d)</th>
<th>ASD Standardized difference from 0*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chamberlain et al., 2007</td>
<td>SNC</td>
<td>1.82 (.73)</td>
<td>17</td>
<td>2.41 (.62)</td>
<td>17</td>
<td>−.87</td>
<td>2.50</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Indegrees</td>
<td>2.88 (2.55)</td>
<td>17</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>1.13</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Top 3</td>
<td>.34 (.34)</td>
<td>17</td>
<td>.60 (.43)</td>
<td>17</td>
<td>−.67</td>
<td>1.00</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Overalla</td>
<td>—</td>
<td>17</td>
<td>—</td>
<td>17</td>
<td>−.77</td>
<td>1.54</td>
<td></td>
</tr>
<tr>
<td>Rotheram-Fuller et al., 2010</td>
<td>Connections</td>
<td>2.91 (2.45)</td>
<td>79</td>
<td>4.44 (2.36)</td>
<td>79</td>
<td>−.64</td>
<td>1.19</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Indegrees</td>
<td>−.71 (.96)</td>
<td>79</td>
<td>.15 (.79)</td>
<td>79</td>
<td>−.98</td>
<td>.74</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Overalla</td>
<td>—</td>
<td>79</td>
<td>—</td>
<td>79</td>
<td>−.54</td>
<td>.64</td>
<td></td>
</tr>
</tbody>
</table>

* \(N\) in this row is the sum of the total number of participants from each study within the domain.  
* The overall number is an average of subscales for each individual study.  
* Cohen’s \(d\) was calculated for the difference between means of the treatment group and the control group.  
* ASD group values were converted to Z-scores.  
* ADI score.


**Results.** The studies included in this meta-analysis include 1,768 participants with ASD (\(M_{\text{Age}} = 85.46; M_{\text{Age}} = 114.92\) months; \(M_{\text{IQ}} = 91.85\)).

**Sociometrics.** Youth with ASD were found to have lower sociometric status than TD peers, and this effect was large (Figure 2; \(N = 776\) [232 ASD]); there was significant variation across studies (Model Q(4) = 695.799, \(F = 99.425, p < .00001\)). No publication bias was evident according to the Fail-Safe N (216 studies) or Egger’s (\(b = −16.77, p = .247\)) methods. However, while no studies were trimmed to the left of the mean, one was trimmed to the right of the mean, and the effect was no longer significant after trim-and-fill, 95% CI [−4.86, .51]. Thus, the tandem criteria for ruling out publication bias were met—though two out of three criteria were—met.

However, youth with ASD also made more than zero friends across studies, and this effect was large (Figure 3; \(N = 232\)); there was significant variation across studies (Model Q(4) = 28.176, \(F = 85.803, p < .00001\)). No publication bias was evident according to the tandem method: Fail-Safe N = 82 studies; Egger’s (\(b = .21, p = .843\)); there were no trimmed studies to the right of the mean, one trimmed studies to the left of the mean, but the effect was still significant after trim-and-fill, 95% CI [1.15, 2.02].

The sociometric subscale of “number of connections” evinced a similar pattern of effects: ASD youth had fewer connections than TD peers (Hedges’s \(g = −2.528, K = 4, 95\% \text{ CI} [−3.43, −.0713], Z = −2.730, p = .006\), with a large effect and significant variation across studies (Model Q(3) = 198.044, \(F = 89.577, p < .00001\)). Youth with ASD made more than zero connections (\(M = 4.885, K = 4, 95\% \text{ CI} [0.476, 9.304], Z = 2.167, p = .030\), with a large effect and variation across studies (Model Q(3) = 304.902, \(F = 93.082, p < .00001\)).

The reciprocated friendships subdomain evinced the same overall effects—with ASD youth evincing fewer than TD peers (Hedges’s \(g = −4.69, K = 2, 95\% \text{ CI} [−5.408, −3.976], Z = −12.843, p < .00001\) but more than zero (\(M = 2.196, K = 2, 95\% \text{ CI} [0.810, 3.58], Z = 3.105, p = .002\), and both effects being large; there was no significant variation between studies (both Model Q(1) ≤ 2.800, \(F \leq 65.279, p \geq .09\)).

Youth with ASD were less frequently listed in classmates’ “top three friends in the class” than TD peers (Hedges’s \(g = −6.14, K = 3, 95\% \text{ CI} [−12.116, −0.169], Z = −2.015, p = .044\), and there was variation between studies (Model Q(2) = 304.902, \(F = 99.344, p < .00001\)). However, youth with ASD were listed in their classmates’ “top three” more than zero times (\(M = 3.874, K = 3, 95\% \text{ CI} [0.300, 7.448], Z = 2.125, p = .034\), with significant variation between studies (Model Q(2) = 19.948, \(F = 89.974, p < .00001\)).

For in-degrees (Hedges’s \(g = −4.884, K = 4, 95\% \text{ CI} [−8.551, −1.217], Z = −2.610, p = .009\), youth with ASD were less-nominated as friends by their peers, though there was significant variation across studies (Model Q(3) = 568.944, \(F = 99.473, p < .00001\)). However, youth with ASD were nominated significantly more than zero times (\(M = 3.199, K = 5, 95\% \text{ CI} [0.484, 5.914], Z = 2.309, p = .021\), with significant variation across studies (Model Q(4) = 38.378, \(F = 89.577, p < .00001\)).

For social network centrality (Hedges’s \(g = −7.99, K = 3, 95\% \text{ CI} [−16.405, 0.433], Z = −1.86, p = .06\), youth with ASD did not differ from TD peers, though there was significant variation across studies (Model Q(2) = 444.451, \(F = 99.550, p < .00001\), respectively). The social network centrality of youth with ASD differed from zero (\(M = 8.41, K = 3, 95\% \text{ CI} [1.077, 15.741], Z = 2.248, p = .025\), and there was significant variation across studies (Model Q(2) = 83.96, \(F = 97.618, p < .00001\)).

**Self-report.** Youth with ASD reported poorer-quality friendships than TD peers, and the effect was large (Figure 2; \(N = 400\) [204 ASD]); significant variation was found across studies (Model Q(6) = 99.093, \(F = 93.945, p < .00001\)). No publication bias was evident according to the tandem method: Fail-Safe N = 143 studies; Egger’s (\(b = −7.26, p = .398\)); there were no trimmed studies to the right of the mean, two trimmed studies to the left of the mean, but the effect was still significant after trim-and-fill, 95% CI [−2.20, −.59].

With one exception, the overall effect was evident across all self-reported subscales: all Hedges’s \(g \leq −1.140, K \geq 4, 95\% \text{ CI} [−2.157, −1.124], Z \geq −2.025, p \leq .043\); significant variation was found across studies (all Model Q(\(\geq 3\)) ≥ 32.21, \(F \geq 90.686, p < .00001\)). The exceptional subscale was conflict, wherein youth with ASD did not report differences from TD peers (Hedges’s \(g = 0.031, K = 6, 95\% \text{ CI} [−.296, .358], Z = 0.185, p = .853\), though there was variation across studies (Model Q(5) = 11.537, \(F = 56.663, p = .042\)).

**Parent-report.** Parents reported their children with ASD to have fewer and less frequent interactions with friends than parents...
Parents of youth with ASD reported their children to have more than zero friends (see Figure 3), and this effect was large (N = 1,451); there was significant variation across studies (Model Q(4) = 37.421, I² = 89.311, p = .00001). No publication bias was evident according to the tandem method: Fail-Safe N = 133 studies; Egger’s (b = 5.87, p = .054); no trimmed studies to the right or left of the mean.

Summary of meta-analysis. This meta-analysis reveals that youth with ASD do indeed have fewer—and lower-quality—friendships than TD peers according to sociometric, parent, and self-report measures. For sociometrics, this effect was consistent across the subdomains of number of connections, reciprocated friendships, indegrees, and being listed in a classmate’s top three friends. However, for social network centrality, youth with ASD did not differ from their TD peers. For self-report, this effect was consistent across companionship, security, closeness, and help subdomains. That said, youth with ASD did not report greater conflict in their friendships than did TD peers.

Crucially, both peer- and parent-reported friendship quantity were much greater than zero. This was consistent across all so-

---

**Figure 2.** ASD = autism spectrum disorder; TD = typically developing. Forest plot of meta-analyses for mean difference between ASD and TD friendships. 2a. Peer-rated Sociometric friendship quantity ASD versus TD. 2b. Self-report friendship quality for ASD versus TD. 2c. Parent-report friendship quantity for ASD versus TD. All models are random effects. All effect sizes are Hedge’s g. Plots with a square indicate Hedge’s g for individual studies within the domain. Diamond plots indicate overall effect size for the domain.
ociometric domains—meaning that by any blinded, peer-reported metric, youth with ASD do typically make friends. With the possible exception of ASD versus TD peer sociometrics, all obtained effects appear robust to publication bias.

The fact that the overwhelming majority of participants in the included studies were male indicates that the meta-analysis results are functionally applicable to school-age boys with ASD.

Discussion. Despite the widespread assumption that individuals with ASD do not make friends, this meta-analysis reveals that they do. In fact, this meta-analysis indicates that the majority of individuals with ASD have at least one friend, and their peers report this to be so as well. Indeed, effect sizes for the differences from zero in friendships among youth with ASD were larger than for the differences between youth with ASD and TD (Figures 2 and 3). Moreover, individuals with ASD perform comparably to their TD peers across several domains of sociometric and self-report measures.

However, this meta-analysis also reveals the friendships of children with ASD to be fewer in number and lower in quality than those of their TD peers across sociometric, parent-, and self-report measures. Thus, while children with ASD can and do form reciprocal friendships, the lower number and quality of these friendships may point to persistent factors associated with ASD that cascade from within-person atypicalities to genuine challenges connecting with peers at a developmentally normative rate.

Notably, boys with ASD scored comparably with their TD peers in terms of social network centrality, but not with regards to connections, reciprocated friendships, indegrees, or being listed as among a classmate’s top three best friends. This may suggest that school-age boys with ASD are able to insinuate themselves into social groups sufficiently to at least superficially “fit in,” but that they struggle to form deeper individual and reciprocal friendships with their peers.

Also of note, boys with ASD reported their friendship quality to be poorer than that of their TD peers in all self-report domains except for conflict, for which they reported comparable levels with those of their peers. Lower self-reported friendship quality suggests that boys with ASD are at least somewhat aware that their friendships may be of lower quality than those of their TD peers; this supports findings suggesting that children with ASD do have insight into their social performance (though they may also tend to overestimate their abilities or value different social behaviors than others do; Lerner, Calhoun, Mikami & De Los Reyes, 2012; Rankin et al., 2015).

Figure 3. ASD = autism spectrum disorder; TD = typically developing. Forest plot of meta-analyses for standardized mean difference from zero friendships. 3a. Peer-rated Sociometric friendship quantity for ASD versus 0. 3b. Parent-report of friendship quantity for ASD versus 0. All models are random effects. All effect sizes are Hedge’s g. Plots with a square indicate Hedge’s g for individual studies within the domain. Diamond indicates overall effect size for the domain.
Considered in light of lower scores on all other self-report domains, then, comparable levels of conflict with TD peers may be attributable to friendships that are overall more superficial in nature, leaving less opportunity for the conflicts that normatively enrich youth relationships. For example, TD children fight with friends as frequently as nonfriends, but experience these conflicts as less intense and resolve them more equally (Hartup, Laursen, Stewart, & Eastenson, 1988). These conflict-resolution experiences are considered a vital way in which youth learn to navigate peer relationships and establish deeper friendships. If youth with ASD are experiencing a similar amount of conflict in their friendships in the presence of poorer friendship quality, it may be that they are not deriving developmentally normative benefit from those conflicts, yielding more superficial relationships overall.

Even in light of some notable differences, findings from this meta-analysis suggest that boys with ASD are more similar to TD peers than they are different in terms of friendship-making. Boys with ASD consistently profess wanting friendship, report having friends, and are reported by their parents and peers to have at least some friends—even if they are fewer in number and lesser in quality than those of TD peers. Given the central role of affective sharing in the friendships of TD boys, the ability to form even one reciprocal friendship suggests that boys with ASD can engage in affective sharing at some level. Thus, these findings are consistent with the notion that youth with ASD engage in friendships using a comparable central process to TD boys (affective sharing). However, the question of how they achieve affective sharing in their friendships in light of characteristics associated with ASD remains unresolved. Moreover, what do differences from TD peers mean in terms of the benefits of friendship for boys with ASD? We now turn to a consideration of characteristics of ASD that may serve to explain this pattern of differences and similarities in friendship processes.

Models of Social Deficits in ASD: Implications for Friendships

We now turn to a consideration of major models of social deficits among individuals with ASD. There is a wide array of frameworks by which core social deficits in ASD can be understood (for a sampling, see Volkmar, Paul, Klin, & Cohen, 2005). Herein we focus on two leading exemplar frameworks to illustrate the precursor factors to friendships in ASD: social cognition and social motivation. We focus on these for several reasons. First, each of these models has significant contemporary impact on the field and in the conceptualization of ASD as a social psychology (e.g., Baron-Cohen, 2000; Chevallier, Kohls, Troiani, Brodkin, & Schultz, 2012a), and provides a clear explanatory framework for the specific deficits that may reasonably be expected to impact friendship. Second, these theories in particular speak directly to some of the main points of controversy surrounding individuals with ASD and friendship; namely, they address questions of capability for engagement in normatively defined reciprocal friendship (e.g., Hobson, 1993; Calder et al., 2013; Mitchell & Locke, 2015), as well whether individuals may, in some cases, simply not want to. Third, we focus on models that are broad in theoretical and contemporary empirical scope, drawing from an expansive research base so as to allow for the most complete explanatory coverage of findings related to deficits associated with ASD. Fourth, these models demonstrate important points of overlap with other theoretical models not considered in this review (described below).

We then highlight patterns of findings across these two frameworks, which implicate the efficiency with which social stimuli are received and encoded, or social information processing speed (SIPS), as a consistent factor. Specifically, we argue that SIPS is ideally suited as a means of linking social deficit models in youth with ASD to the meta-analytically derived friendships patterns via a revised version of the Hartup and Stevens (1997) models. Next, precursor models of social deficits in ASD and their relation to the original model of TD friendship are considered.

Social Cognition

Social cognition has been defined as “the cognitive mechanisms underlying social behavior,” and encompasses emotion recognition, perspective taking, and social reasoning (Lipton & Nowicki, 2009; McKown, Gumibner, Russo, & Lipton, 2009; Senju, 2013). We discuss each of these three components below.

Emotion recognition. Emotion recognition is defined as the ability to accurately identify others’ facial expressions, vocal intonations, body postures, and gestures as relating to a range of possible emotional states. A recent meta-analysis of emotion recognition among individuals with ASD indicates deficits that are present in childhood and increase as individuals age, providing “strong evidence” that individuals with ASD experience significant difficulties in emotion recognition (Lozier et al., 2014). These difficulties are important to consider in light of the fact that TD children who demonstrate greater skill at labeling facial expressions of different emotions have been found to be more likely to have a higher social status based on sociometric ratings, as well as higher social competence ratings from peers and teachers (Edwards, Manstead, & MacDonald, 1984; Field & Walden, 1982; Jones, Abbey, & Cumberland, 1998).

Despite strong evidence that individuals with ASD struggle with emotion recognition, their ability has been found to vary substantially across development and task (Lozier et al., 2014). Performance among individuals with ASD is characterized by periods of relative success interspersed with periods of difficulty relative to TD individuals (Harms, Martin, & Wallace, 2010; Tracy, Robins, Schriber, & Solomon, 2011). The 8–12 age range into adolescence appears to be a time of relative skill in this domain, with little to no difference in performance on emotion recognition tasks between children with ASD and TD children (e.g., Capps, Sigman & Yirmiya, 1995; Jones et al., 2011; Ozonoff, Pennington, & Rogers, 1991; Rump, Giovannelli, Minshew, & Strauss, 2009; Tracy et al., 2011). Emotion recognition among individuals with ASD also varies across tasks, with challenges most prominent on dynamic, quickly presented, or subtly displayed emotions. For example, individuals with ASD have been found to struggle relative to TD peers on relatively complex tasks to assess emotion recognition, including pairing faces with mismatching words (Grossman, Klin, Carter, & Volkmar, 2000), requiring them to recreate visual sequences of emotional expressions (Grossman & Tager-Flusberg, 2008), or tasks showing an approach-oriented facial expression paired with an avoidant expression (Akechi et al., 2014). Additionally, differences in control group matching procedures have also been found to impact whether individuals with ASD differ
from TD individuals in facial emotion recognition, suggesting IQ may play a significant role in emotion recognition among individuals with ASD (Harms et al., 2010). Overall, this literature has begun to converge in implicating slower/less efficient social emotional processing strategies in youth with ASD, and a dependency on more concretely presented information during emotion recognition tasks.

**Perspective-taking.** The ability to perceive, comprehend, and share in the cognitive and emotional experiences of others, known as perspective taking (and sometimes theory of mind), plays a similarly central role in social cognition. Individuals with ASD consistently demonstrate significant deficits in perspective taking. A meta-analysis comparing perspective taking among individuals with ASD as compared with schizophrenia found substantial impairment in both groups (Chung, Barch, & Strube, 2014), and a recent, extensive review of the literature highlighted perspective taking as among a triad of defining symptoms of ASD (Brundson & Happe, 2013). Consistent evidence across cross-sectional and longitudinal samples indicates that TD children develop this ability by the age of 4, and that even subtle variations in these abilities can impact friendship in TD boys (e.g., Dunn, 2004; Hughes & Leekam, 2004; Slomkowski & Dunn, 1996). As a result, perspective-taking has been theorized to impact friendship-making and affective sharing in ASD, including initiation and maintenance of deep structure reciprocity (e.g., Hobson & Meyer, 2005; Kan- ner, 1943).

However, recent research suggests impairment in perspective taking in ASD may not be as consistent as previously believed. Situations in which individuals with ASD perform better tend to be those in which the social scenario is presented in a more concrete format (Glenwright & Agbayewa, 2012) or when social inference “blanks” are filled in for them (e.g., Dziobek et al., 2008; Hirvela & Helkama, 2011). Relatedly, individuals with ASD have been found to demonstrate significantly longer response times than TDs while completing more naturalistic perspective taking tasks (Kaland, Mortensen, & Smith, 2011). Overall, findings indicate that individuals with ASD are capable of completing theory of mind tasks, but tend to complete tasks at a slower rate and to perform better when information is concretely presented.

**Social reasoning.** Also central to social cognition is social reasoning, or the incorporation of social and contextual cues, as well as social knowledge, attributions, and appraisals to make decisions informing social behavior. Individuals with ASD demonstrate comparable performance to TD children on laboratory tasks assessing social perceptions and attributions (Hirschfield, Bartmess, White, & Frith, 2007; Shulman, Guberman, Shiling, & Bauminger, 2012), but struggle in naturalistic settings (Callen- mark, Kjellin, Ronqvist, & Bolte, 2014; Klin, 2000; Ozonoff & Miller, 1995). Social reasoning plays a central role in social relationships of TD children, including friendship (Boivin & Begin, 1989; Dodge, 1980; Crick & Dodge, 1994; Koenig & Sabaugh, 2013). Overall, boys with ASD demonstrate a slower and more concrete approach to processing social information.

In sum, findings from the literature pertaining to social cognition suggest that individuals with ASD demonstrate inconsistent pockets of ability across all domains of social cognition. Similar to performance on emotion recognition and theory of mind tasks, they appear to perform best in relatively controlled settings, where information is streamlined and direct, and tend to struggle in more naturalistic settings. Additionally, even in situations when they perform well, individuals with ASD often take longer to complete presented tasks than TD peers (even controlling for IQ). We now turn to a similar discussion of a more recent, but highly influential theory of social challenges in ASD: social motivation theory.

**Social motivation theory.** In addition to differences in social reasoning, differences in social motivation have also been conceptualized as among the key factors in social impairment among individuals with ASD. Social motivation theory posits that social impairments among individuals with ASD result from a failure to find social interactions intrinsically rewarding, as do TD individuals (Chevallier et al., 2012b; Dawson, Webb, & McPartland, 2005). Children with ASD have consistently been found to show less interest in social stimuli than TD peers from within the first year of life (Chevallier et al., 2012b; Osterling & Dawson, 1994). In contrast, TD children enjoy and seek positive affective exchange from infancy (Gliga, Elsabbagh, Andrvizou, & Johnson, 2009; Rosa Salva et al., 2011), and this enjoyment plays a central role in typical friendships (Newcomb & Bagwell, 1995).

However, social motivation theory posits that individuals with ASD find social interactions less rewarding from infancy, resulting in lowered pleasure from and desire for social interaction. Indeed, some evidence suggests the presence of selective social anhedonia in children and adolescents with ASD (Chevallier, Grezes, Molesworth, Berthoz, & Happé, 2012a). However, many youth with ASD are often interested in and derive pleasure and reward from social contact, at least in some situations (Calder et al., 2013). In contrast to the hypothesis that individuals with ASD have a lowered desire for social interaction, most individuals with ASD report a desire for friendship (e.g., Carrington et al., 2003). Consistent with the concept of a basic need for connectedness as a key function of friendship, higher levels of loneliness, depression, and anxiety, which have been associated with lack of social relationships among TD individuals (Bukowski et al., 2010), are consistently found among individuals with ASD (Bauminger & Kasari, 2000; Strang et al., 2012; White & Roberson-Nay, 2009). Moreover, individuals with ASD show equivalent social interest to TD controls in studies using more naturalistic measures (Fletcher-Watson, Leekam, & Findlay, 2013).

In sum, although youth with ASD report wanting friends (Carrington et al., 2003) and do demonstrate social interest in naturalistic settings (Fletcher-Watson et al., 2013), they also demonstrate a disruption in neural reward systems commonly associated with social interactions (Dawson et al., 2005). Higher levels of loneliness, depression, anxiety, and suicidal ideation (Mayes, Gorman, Hillwig, Garcia, & Syed, 2013) among individuals with ASD, as well as the near-universal expression of a desire for friendship, suggest that the initial motivation to form social relationships is, indeed, intact, but that the neural and early developmental substrates of social reward may play out differently than among TD youth.

**From social motivation to social information.** If individuals demonstrate interest in others, yet fail to engage in social relationships and superficially appear to find them less pleasurable, it may be that this emerges from a slower rate of social processing that leaves them out of sync with peers. The tenets of social motivation theory may, therefore, leave individuals with ASD both seemingly less motivated to form friendships with peers (i.e., via accrued experience), and less able to fully experience the affective benefits
of friendship. Disruptions in this system may relate to differences in affective reciprocity commonly found among friendships of boys with ASD, with negative implications for quality of friendship-making. Findings thus point to a difference in SIPS that contributes to a distinct experience of social interactions. This difference may be a double-edged sword that both prevents boys with ASD from expressing the pleasure in social interactions (central to affective reciprocity), while also impeding their internal experience of reward from social relationships (Chevallier et al., 2012a); in so doing, SIPS may directly prevent them from achieving the range of benefits directly associated with the positive affective component of friendship.

Findings in both social–cognitive and social motivational domains converge in suggesting that challenges across an array of tasks and settings may in many cases be subtended by inefficiencies in processing social information. Next, we review the remarkably consistent evidence that implicates SIPS as atypical in ASD, then discuss its role as an explanatory factor linking social deficit domains to friendship problems in ASD.

**Social Information Processing Speed (SIPS) and ASD**

Though evidence regarding the SIPS construct has accumulated across domains of measurement and levels and type of analysis, in general can be construed as a *slowed*, or perhaps *inefficient* processing social stimuli—*specifically*—that underlie many social deficits in ASD. Indeed, we argue here that it can be implicated in many instances of social cognition and social motivation deficits in ASD. Crucially, SIPS may also be a process that *links* these deficit domains to friendship-making in ASD. Specifically, SIPS can be seen as a translational factor that allows such social deficits to pervade across social settings, thereby allowing them to “scale up” and impact the vast array of peer-oriented scenarios in which opportunities for friendship making occur. In doing so, we argue that SIPS can directly affect both participation in surface activities and engagement in affective sharing (see Figure 4). Thereby, it can then have a downstream effect on more deep structure processes and, in turn, impact developmental and psychosocial functions. Thus, we describe SIPS as a variable that yokes within-child precursor factors to between-person friendships. Herein, we articulate each step in this model.

**SIPS in ASD: A More Basic Construct**

SIPS as a key point of difference in social perception and encoding among individuals with ASD has growing support from psychophysiology and neuroscience domains. The N170 event related potential (ERP), for instance, has been implicated in face processing among TD individuals across a number of studies (e.g., Bentin, Allison, Puce, Perez, & McCarthy, 1996; George, Evans, Fiori, Davidoff, & Renault, 1996). Among TD individuals, the N170 ERP demonstrates faster response time to faces that appears unaffiliated with familiarity or recognition, suggesting that it represents early stage face processing (Eimer, 2000). In a study wherein ERPs were recorded in vivo during facial and vocal emotion recognition tasks, emotion recognition performance was
found not to be correlated across modalities, as predicted. However, latencies of the N170 (to face) and N100 (to voice) ERPs were robustly correlated with one another across modalities, as well as with behavioral performance within-modality, suggesting a potential overarching difficulty with speed of early processing of social information (Lerner, McPartland, & Morris, 2013). Pelli-Phipps, Morris, McCarthy, and LaBar (2007) reported similar findings from fMRI research of affect perception, including reduced activity in the amygdala and fusiform gyrus in response to dynamic emotional expressions and a lack of modulation of the amygdala, posterior superior temporal sulcus, and fusiform gyrus in response to static versus dynamic expressions. Individuals with ASD have been found to demonstrate slower processing speed in response to facial stimuli than do TD individuals (McPartland et al., 2011).

These findings point to a slower rate of SIPS as a possible key point of difference among individuals with ASD. Moreover, they position SIPS as a variable that can link within-person, obligatory responses to social stimuli in ASD to broader models of social functioning and, ultimately, to friendship-making patterns. Next, we demonstrate how SIPS is implicated in social cognition and social motivation patterns in ASD, and may serve as an explanatory vehicle for linking these patterns to friendship-making in this population.

**SIPS: A Link From Social Cognition and Social Motivation to Friendships**

**SIPS and emotion recognition.** Lab-based findings directly implicate SIPS deficits in the perceptual tasks underlying emotion recognition among individuals with ASD. Evidence from eye-gaze research consistently points to a slower rate of processing of social information among individuals with ASD. While individuals with ASD can accurately identify gaze direction (Baron-Cohen et al., 1995), they begin to struggle as stimuli are presented for increasingly brief periods of time (Wallace, Coleman, Pascalis, & Bailey, 2006). Additionally, individuals with ASD have been found to be equally adept at identifying inverted and upright faces, and to spend equal time looking at each, in contrast to TD individuals who more quickly identify upright faces (Hobson, Ouston, & Lee, 1988; Langdell, 1978). Moreover, while TD individuals have been found to orient to faces with direct gaze faster than those with averted gaze, individuals with ASD have also been found to orient to faces with direct and averted gaze at equivalent rates (Senju, 2013), further suggesting that individuals with ASD selectively process social stimuli at a slower rate than do TD individuals.

SIPS, then, provides a route to explaining variability in emotion recognition ability that can link it to friendship patterns. A SIPS explanation suggests that simpler and more basic stimulatory should be processed with sufficient efficiency to be utilized effectively, while more complex stimuli demand especially pronounced cognitive effort to “keep up” (Tager-Flusberg, 2007). Even subtle differences in the speed of processing emotional stimuli can have significant implications for participation in a reciprocal friendship, leading to a failure to successfully engage in rich and varied friendships, especially with larger friend groups. This is suggested by the meta-analytic results regarding sociometrics and friendship quality; for instance, this is intimated by the finding that school-aged boys with ASD perform worse than TD peers on all socio-metric domains reflective of reciprocal friendship, but not on one that may reflect a more basic level of group participation. Similarly, that boys with ASD report lower scores across nearly all domains of friendship quality also suggests a tendency to form friendships that may be less deeply reciprocal.

**SIPS and perspective-taking.** Atypical SIPS provides an integrative framework for findings relating to perspective taking among individuals with ASD. A SIPS model suggests that difficulty incorporating contextual cues to comprehend perspective states of others is driven by inability to “catch” these cues in real time; if this is the case, then individuals with ASD who are provided with these cues should respond comparably with TD individuals—as has been commonly found in the literature (e.g., Dziobek et al., 2008; Glenwright & Agbayewa, 2012; Hirvela & Helkama, 2011). As with emotion recognition, individuals with ASD may be able to compensate for slowed SIPS when completing perspective-taking tasks by utilizing compensatory cognitive strategies, but still show weaknesses when tasks are either rapid and automatic (Senju, 2013) or especially complex and difficult (Kaland et al., 2011). Considered in terms of friendship, this again may suggest a basic ability to follow along at a broad level with group activities (as reflected by comparable social network centrality to TD peers), but a struggle to keep up more nuanced and dyadic interactions (as reflected by fewer reciprocated friendships).

**SIPS and social reasoning.** Difficulty with SIPS can similarly explain some of the inconsistencies in findings relating to social reasoning. One might expect that an individual with slower SIPS would struggle to maintain the pace of reasoning of TD individuals, consistent with the finding that, even while performing successfully on lab-based tasks, individuals with ASD demonstrate characteristically atypical (and sometimes inefficient) reasoning approaches (Chiu et al., 2008). Relative difficulty with social reasoning during in vivo interactions (Callemark, Kielin, Ronnvist, & Bolte, 2014; Ozonoff & Miller, 1995) seems driven by a slower SIPS that yields increasing differences in performance between individuals with ASD and TD individuals as they move from relatively simple, concrete social tasks to complex, rapidly presented in vivo information. Inefficiencies in automatic reasoning about social scenarios should predict inflexibility in complex scenarios and difficulty achieving social synchrony in peer interactions—a prediction that converges with parent- and self-reports regarding friendship quality in ASD, as well as observational research indicating that boys with ASD have friendships that are characterized by less flexible conversation, less harmony, and less coordinated play than friendships among TD boys (Bauminger et al., 2008a).

**SIPS and social motivation.** Atypical SIPS also provides a framework for interpreting the social motivation literature. Slower processing of social information may inhibit individuals with ASD from deriving positive affect from interactions that occur too quickly for them to process, creating the appearance that they do not derive positive affect from social exchange, when in fact the exchange is simply occurring too quickly for them to fully process. This would account for the ongoing report of desire for friendship (e.g., Carrington et al., 2003). This is consistent with the hypothesis of a “vicious cycle,” (Grelotti et al., 2002); however, we propose that a slower SIPS precedes reduction in reward associated with social interactions. Slower SIPS may also contribute to
the difficulty some individuals with ASD experience in deriving positive affective experience from social interactions at all. In a study that included a dyadic observation of children with ASD and self-selected best friends engaging in play activities, children with ASD were found to engage in lower levels of expression of positive affect across several domains of the interaction, including a lower level of shared fun overall and lower levels of self-reported closeness and intimacy by both the child with ASD and the best friend (Bauminger et al., 2008b). Poorer friendship quality has not been consistently linked to loneliness among boys with ASD as it has been among TD peers (Bauminger & Kasari, 2000), which may result from slower SIPS modulating the usual link between friendship quality and a sense of social connection. While TD boys frequently describe friendships in terms of companionship, affection, and intimacy, boys with ASD rarely include these concepts in their descriptions of friendships, suggesting that impairments to cognitive empathy may impact their understanding of and ability to perceive these qualities (Bauminger & Kasari, 2000), and is reflected by the overall lower ratings of friendship quality among boys with ASD in this meta-analysis.

**Additional potential precursor models.** Of course, several other prominent frameworks bear consideration for their relation to friendship-making, and SIPS may be similarly useful in linking theoretical findings from these constructs to real-world social processes. Social pragmatics theory (social deficits in ASD are potentially driven by difficulties with production and comprehension of speech and nonverbal cues; Baltaxe, 1977; Baron-Cohen, 1988) and the social knowledge model (social difficulties arise from lack of awareness of social rules; Gresham, 1997), for instance, both rely on the same premises as social cognition, and SIPS is equally parsimonious in elucidating their links to friendship patterns. The same can be said regarding the relationship between both the social performance model (individuals may or may not have knowledge of correct behaviors, but fail to deploy those behaviors in vivo for other underlying or contextually mediated reasons; Lerner, 2013; McMahon, Lerner, & Britton, 2013) and the enactive mind model (individuals with ASD experience differences in development of social behavior early in development as the result of a lack of salience of social information and simultaneously excessive salience of nonsocial information; Klin, Jones, Schultz, & Volkmar, 2003) and social motivation. Meanwhile, both weak central coherence (characterizes ASD as a difficulty with understanding the “big picture” of presented information due to a tendency to overfocus on details; Frith, 1989; Happe & Frith, 2006; Happe, Briskman, & Frith, 2001) and executive functioning (difficulty controlling cognitions and attention as a source of deficits; Kenworthy, Black, Harrison, della Rosa, & Wallace, 2009) theories of ASD have not shown as consistent links with actual social behavior in ASD; likewise, neither of these models exclude a parallel perceptual factor such as SIPS as a driver of social behavior. Thus, we now turn to a consideration of SIPS and its impact on friendship processes for school-age boys with ASD.

**SIPS and Processes of Friendship Among Boys With ASD**

Friendship is a unique relationship in that it is completely voluntary and relies heavily on affective sharing that can take place in subtle and indirect forms (Rose & Rudolph, 2006). Thus, friendship may be especially vulnerable to even subtle differences in SIPS that disrupt the establishment of affective reciprocity, and as such provides a unique opportunity to examine its impact on real-world relationships. Importantly, we posit SIPS not as the cardinal mechanism of social deficits, but rather, a difference in perceptual processing that represents a common feature across these deficits and can be used to link them more directly to real-world friendship patterns in ASD. We now turn to a consideration of the direct impact of SIPS on friendship processes among school-aged boys with ASD, and an elaboration on the consequent Model (see Figure 4).

**Surface level activities.** Differences in social information processing speed (SIPS) can negatively impact participation in surface level activities. A slower rate of processing of social information likely leaves individuals with ASD more reliant on concrete feedback than are TD boys, which can render them cumbersome playmates. Additionally, this slower rate of processing is hypothesized to impact the pleasure derived from social interactions, making individuals with ASD less likely to seek out participation in surface level activities than are TD boys, despite a desire for friendship. Consistent with this hypothesis, boys with ASD have been found to engage in fewer “going out” activities with friends than do TD boys, as well as to meet up with their friends less often and for shorter periods of time (Bauminger & Shulman, 2003). Boys with ASD have been found to engage in “rough and tumble” physical play, a key surface level activity for TD school-age boys; however, they do so less frequently than TD boys in this age range, potentially due to the difficulty keeping up with the myriad social and affective cues implicated in successful participation in this nature of play (e.g., Bauminger & Shulman, 2003; Bauminger et al., 2004; Rotheram-Fuller et al., 2010; Wain-scot et al., 2008).

Given these differences, boys with ASD may require friends with some form of motivation to accept lower engagement in more typical activities (such as a shared interest in something nontypical). Perhaps for these reasons, boys with ASD have been found to be more likely to engage in cross-gender friendships with girls, who are often described as being more socially mature (Chamber-lain et al., 2007; Solomon, Bauminger, & Rogers, 2011). The need for friends with a unique set of characteristics that makes them more receptive to imbalances in affective sharing also relates to meta-analysis findings indicating fewer and lower quality friendships among boys with ASD.

**SIPS and affective sharing.** A slower rate of SIPS also has implications for the ability to successfully engage in affective sharing, as well as the subsequent formation of deep structure reciprocity. A slower rate of social processing leaves boys with ASD out of sync with those around them, resulting in the appearance of being less responsive to social overtures of peers (Sigman & Ruskin, 1999). The lower rates of flexible conversation, harmony, and coordinated play in friendships among boys with ASD (e.g., Bauminger et al., 2008) reflect an overall lower rate of reciprocity that is similarly attributable to slower SIPS. This may at times be due to the longer time necessary to fully process social cues, and at other times failure to comprehend cues that are presented too quickly to process. Either way, difficulty engaging in affective sharing likely renders boys with ASD less desirable activity partners for TD boys, who look to affective sharing not
only to define friendship itself, but also as a source of crucial socioemotional benefits. Similarly, difficulty comprehending the import of affective sharing likely renders friendship a less pleasurable experience for boys with ASD than it is for TD boys. Lower rates of affective sharing may further narrow the field of potential friends for boys with ASD to those who are willing to accommodate an imbalance in affective sharing (such as children with an especially “warm,” “kind,” and “socially mature” personalities; Bauminger & Shulman, 2003; Chamberlain et al., 2007). This is also reflected by lower overall sociometric ratings and lower numbers of friends among boys with ASD.

**Downstream effects of SIPS.** By interfering with the ability to engage in affective sharing at a comparable rate with TD peers, which is a central process of friendship among TD boys (Newcomb & Bagwell, 1995), SIPS likely interferes with the ability of boys with ASD to form the deep structure reciprocity of friendship even when they do happen to engage in surface level activities (see Figure 4). Indeed, boys with ASD consistently report their friendships to be lower in quality, suggesting that a slower SIPS, and consequently lower rates of affective sharing, may result in friendships that lack the depth of reciprocity found in TD friendships.

Through its potential to negatively impact the ability to comprehend positive affective responses from others, a slower SIPS may not only impact deep structure reciprocity, but may also render social interactions less rewarding and impact their ability to fulfill key roles, including the need for connectedness, positive social evaluation, and enforcement of social norms. As a result, despite needs that are comparable to those of TD boys, boys with ASD may be left reliant on what concrete feedback they can derive from participation in surface level activities.

Due to the impact of slower SIPS on affective sharing and, consequently, deep structure reciprocity, friendship may play a less central role as source of feedback for self-evaluation due to difficulty comprehending the import of affective cues. Instead, boys with ASD have been found to look to more concrete concepts, such as academic and athletic performance, in their self-evaluations (Bauminger et al., 2004; Bauminger & Kasari, 2000; Carrington et al., 2003; Marks et al., 2000). Along these lines, a disconnect has been found between description of desirable characteristics for oneself versus one’s friends, suggesting that boys with ASD may look to friendship for purposes of self-evaluation differently than do TD boys. This is reflected in lower self-reported friendship quality among boys with ASD as compared with their TD peers. Thus, youth with ASD do seem to have sufficient insight into their friendships to notice that they are different than those of TD peers, thereby rendering those friendships that do exist less rewarding—insufficient to meet the need for social connectedness.

Similarly, a slower rate of SIPS that results in lower rates of affective sharing and, as a result, less deeply reciprocal friendships, may leave boys with ASD reliant on more concrete cues than are typically provided during friend interactions, making friendship a less effective means of enforcing social norms. However, boys with ASD do form friendships with some degree of reciprocity, albeit at a lower rate than TD peers. Thus, boys with ASD may be most successful making friends in specific situations and with other boys with specific characteristics.

A slower rate of SIPS may be similarly reflected in poorer self-reported friendship quality in ASD, as well as findings regarding the comparable centrality of affective sharing and reciprocity in reciprocal friendships of boys with ASD (Bauminger-Zviely & Agam Ben-Artzi, 2014); although these friendships play out by similar processes, boys with ASD may demonstrate slower SIPS that inhibits their ability to engage in truly synchronous affective sharing, resulting in lower rates of friendship reciprocity and quality overall. Lower rates of participation in surface level activities among boys with ASD found in the literature (e.g., Bauminger & Shulman, 2003; Bauminger et al., 2004; Rotheram-Fuller et al., 2010; Wainscoat et al., 2008) are likely also a reflection of the impact of slower SIPS on perception and comprehension of social cues.

It bears mention, however, that lower self-reported friendship quality suggests that SIPS does not necessarily impact insight into social ability among boys with ASD (Lerner, Calhoun et al., 2012; Rankin et al., 2015). That is, youth with slower SIPS may still notice that they are experiencing poorer-quality friendships than their peers, but they may not be able to adjust their behavior in real-world social scenarios quickly or fluidly enough to use this awareness effectively. This may leave boys with ASD aware that they are not forming the rich relationships of their peers, but without the ready means to change their situation.

**Clinical and Research Implications**

This meta-analysis and the consequent process-based model of friendship in school-age boys with ASD presents a range of directions for future research. With affective sharing conceptualized as a key mediating factor in TD friendships, determining the relation not only between precursor factors and friendship, but also between precursor factors and outcomes of friendship, further research is warranted to examine whether affective sharing plays a comparable role among boys with ASD as it does among TD boys.

Perhaps most crucially, this meta-analysis offers strong evidence against the hypothesis that individuals with ASD, on average, do not form reciprocal friendships (e.g., Calder et al., 2013; Hobson, 1993; Mitchell & Locke, 2015). Based on these findings, not only are they capable, but, on average, youth with ASD are at least two standard deviations away from having no reciprocated friendships. For instance, calculating a weighted mean of raw reciprocated best friendships, 16.1% (SD = 8.5%) of best friendship nominations—and 30.4% (SD = 10.0%) of nominations within a child’s top three rated friends—if youth with ASD were reciprocated. In comparison, 43.9% (SD = 3.1%) of best friendship nominations—and 57.2% (SD = 7.5%) of top-three nominations—were reciprocated among TD youth. Further examination of the link between friendships and expected outcomes among individuals with ASD will assist in answering the question of whether boys with ASD are able to access comparable benefits from their friendships to their TD peers, and, if not, whether these needs are met differently or simply left unmet. This line of research will also assist in addressing the common question in intervention studies regarding with whom boys with ASD are mostly likely to experience their most successful friendships.

Along these lines, better understanding of the characteristics of friends of children with ASD may shed important light on factors that promote success in friendship-making among boys with ASD. Some reviewed literature suggests that boys with ASD may experience greater ease forming friendships with children who are...
particularly “warm,” “kind,” and “socially mature” (Bauminger & Shulman, 2003; Chamberlain et al., 2007); other literature suggests that less emotionally demanding friendships are preferred (Calder et al., 2013). A better understanding of the friend characteristics of children with ASD may inform friendship interventions in helping participants select friend partners with whom they are likely to experience success.

An intriguing question also emerges as to whether boys with ASD are best served by friendships with other boys with ASD, or by friendships with TD individuals. The few studies that have examined diagnostic status of friends of children with ASD have found that children with ASD are rather likely to form friendships with other children with ASD. For example, Bauminger et al. (2008a, 2008b) found that 26% of the children with ASD in their sample had friends who also had ASD. Similarly, Kuo et al. (2013) found that 23.7% of children with ASD in their sample had a friend with ASD. This suggests that at least some youth with ASD may opt to make friends with other children with ASD in addition to—or even instead of—TD peers. Indeed, given that some youth with ASD report experiencing different kinds of friendships than those of TD peers—specifically, those friendships that rely less on emotional connectedness (Calder et al., 2013)—it may be that some youth with ASD can be uniquely fulfilled by friendships with other children with ASD. If this is indeed the case, it would help explain curious social intervention findings wherein individuals with ASD experience significant improvements simply by spending recreational time with others with ASD (Hessemark et al., 2013). Intriguingly, this would also suggest that a different, and fundamentally unique, model of relationships among youth with ASD may be needed.

The present model not only provides an understanding of how friendship arises among individuals with ASD, but integrates individual and often piecemeal correlations between an array of variables into a coherent, integrative model that links within-person social–cognitive functioning to real-world outcomes via interpersonal processes. For example, facial emotion recognition has long been linked to friendship status and quality in TD children (Barth & Bastiani, 1997; Edwards, Manstead, & MacDonald, 1984); as such, emerging investigations into friendships in ASD may hypothesize this relationship. Should such relations between these complex constructs be found, the model presented here provides an outline for then testing how friendships may plausibly arise from a fleeting and atomistic social–cognitive ability (i.e., via examination of intermediate processes such as how efficiently facial stimuli are processed, relation of such processing to measures of participation in social activities and shared affect with peers, and subsequent relation to friendship quality). Conversely, if such a relation is not found (which is not unlikely given the inconsistent relations of other likely correlates of emotion recognition in ASD; Harms, Martin, & Wallace, 2010; Tracy, Robins, Schriber, & Solomon, 2011), this model crucially provides a lodestone for further inquiry, without prematurely jettisoning a process that may simply be more complex in ASD. That is, it is increasingly clear that more complex facial stimuli elicit especially substantial decrements in facial emotion recognition performance in youth with ASD (Akechi et al., 2014; Grossman et al., 2000; Grossman et al., 2008); it would be reasonable to hypothesize, then, that variability in performance on these stimuli (i.e., a proxy for more generalized SIPS) may (most) relate to variability in self- and peer-reported friendship quality (Bauminger et al., 2008b). Moreover, we have proposed above that SIPS may relate directly to the capacity to engage in rich affective sharing. Given the centrality of affective sharing to reciprocal friendship (Newcomb & Bagwell, 1995; Bauminger-Zviely & Agam-Ben-Artzi, 2014), it is also credible to hypothesize that variation in affective sharing (i.e., as measured by observation of peer play; Bauminger, 2002) may mediate relations between performance on complex emotion recognition tasks and friendship quality. Thus, this model is useful in accelerating coherent and systematic examination (rather than univariate exploration) of complex multivariate processes that yield real, high-quality friendships in ASD.

Similarly, associations between internal processes and more distal academic outcomes (represented as psychosocial functioning in Figure 4) may be better explained via this model. For instance, TD children with fewer friendships often demonstrate poorer academic outcomes (e.g., Kingery et al., 2011), and children with ASD often show poorer academic functioning than their cognitive abilities would suggest (Fleury et al., 2014). Given that boys with ASD demonstrate a lower rate of reciprocated friendship, and the positive association between friendship and academic outcomes among TD school age boys, lack of a reciprocated friendship—above and beyond instructional quality—is likely to play a role in the academic functioning of school age boys with ASD. If this is the case, then this process-based model provides guidance for considering novel sources of variation in academic functioning in ASD (e.g., SIPS may, via friendships, impact school performance, even when conventional processing speed measures are intact). This, in turn, may help explain otherwise curious findings in the literature (e.g., that academic instruction that promotes small-group social engagement can produce superior outcomes to intensive individual education in children with ASD; Ledford & Wehby, 2014), and highlights the crucial potential for effective social intervention to impact long-term academic (and, therefore, adaptive) outcomes in the population.

Interventions that focus on increasing the rate of processing social information may thus be effective not just for friendship, but also for improving social interactions as a whole. As such, SIPS is likely to have an impact on other important social relationships in addition to friendship. However, given friendships’ uniquely heavy emphasis on reciprocity in affect that establishes mutual liking, it may be especially vulnerable to differences in SIPS that could easily disrupt this process. For example, whereas familial relationships are governed largely by shared responsibility and love that may override liking (Floyd, 1997), friendship is voluntary and heavily dependent on shared enjoyment of the interaction. Thus, a disruption in SIPS may disrupt friendship in a more significant manner than it might other kinds of social relationships. Nonetheless, the liking aspect of other kinds of social relationships would likely be impacted by a disruption in SIPS, while one might hypothesize that their overall relation with SIPS would be smaller.

Given what is known about the presence of SIPS deficits early in development of children with ASD (see Webb et al., 2006; Webb et al., 2011), as well as the promising results of early interventions that target increased affective sharing and engagement (with parents; Dawson et al., 2010; Landa, Holman, O’Neill, & Stuart, 2011), it is plausible that change in SIPS represents one mechanism by which these interventions are operating. This model, then, provides a rich foundation for specific hypotheses.
regarding these variable relationships (e.g., Is baseline SIPS related to amount of affective engagement between parent and child? Does SIPS change in these interventions? Does this change mediate overall intervention response?), which, in turn, provides a testable foundation for the framework laid out here.

One such intervention, sociodramatic affective relational intervention, which involves providing children with ASD the opportunity to engage in a range of activities that require them to engage fluidly and rapidly with various social situations and emotional states, and which is posited specifically to affect SIPS, has already shown promising results (Lerner, 2013; Lerner & Mikami, 2012; Lerner, Mikami, & Levine, 2011; McMahon, Lerner, & Britton, 2013). Additionally, a range of extant friendship and social skills-based interventions also show promising findings (Frankel et al., 2010; Laugeson, Frankel, Gantman, Dillon, & Mogil, 2012); it may be worthwhile to examine if these findings may be at least partially attributable to changes in SIPS, or to examine whether their effects may be enhanced through addition of direct opportunities to help participants work toward increasing their rate of SIPS. For example, in addition to skills-based interventions, interventions that provide in vivo interactions that gradually increase in complexity may be especially helpful for children with ASD. Additionally, interventions that not only provide concrete feedback, but also allow children with ASD the opportunity to increase their rate of processing by gradually fading this feedback out, should be especially beneficial in increasing SIPS. An examination of the specific role of SIPS in both Social Motivation and social cognition, as well as the processes of friendship, will assist in shedding light on the underlying mechanisms of social difficulty among individuals with ASD.

Consideration of the potential impact of SIPS on friendships of TD boys may aid in providing a more nuanced understanding of processes of friendship more broadly. If SIPS is found to play a comparable role in the friendships of TD boys as it is proposed to play among friendships of boys with ASD, it may prove to be a key point of intervention for TD boys who struggle to form friendships but do not meet criteria for an ASD diagnosis. Consideration of SIPS among TD populations may present an opportunity to examine whether it represents a key precursor to social success more broadly, and to address the generalizability of this process-based model of friendship. If SIPS were to be isolated and tested among TD populations, and not found to link to friendship processes, given sufficient variability in rate of SIPS among TD individuals, this would indicate that SIPS is likely not a key process factor among individuals with ASD either, but instead a potential third variable. Indeed, better understanding of the role of SIPS among friendships of TD boys may lead to further consideration of its potential impact on friendship-making among other clinical populations—thus, consideration of the role of social insight in friendships of youth with ASD will be key. For instance, if such insight increases with age, this may facilitate friendship-making skills. Such a finding would track with patterns from ERP research indicating that SIPS-indexed variables increase over time among boys with ASD (Batty et al., 2011; Batty & Taylor, 2006; Webb et al., 2006; Webb et al., 2011)—that is, improvements in processing may truly translate into improvements in ability to make close friends. However, if friendship-making patterns over time are indeed similar to the enduring differences from TD youth found in this ERP literature, boys with ASD could be expected to continue to perform significantly worse than TD boys in terms of friendship number and quality, as well as most sociometric domains (i.e., the gap would narrow, but not close).

Moreover, level of cognitive functioning may have implications for friendship-making abilities among boys with ASD. Boys with ASD who have a higher IQ may be able to “hack out” social interactions by employing more effortful cognitive processes to engage in tasks involving more complex social information (Tager-Flusberg, 2007). If this were the case, boys with ASD who have higher IQs might be expected to do this sufficiently to receive some friend nominations from TD peers, causing them to look more similar to their TD peers across sociometric measures. However, these boys would be expected to still demonstrate a lower self-reported quality of their friendships and fewer (and less reciprocal) sociometric connections to TD peers, suggesting that they could “hack” social interactions sufficiently to engage successfully at a surface level, but may still struggle to engage in the more subtle behaviors associated with affective sharing.

Relatedly, while all participants in the reviewed literature carried an ASD diagnosis, the presence of capacity to self-report, the range of obtained IQ, and the usual inclusion in TD peer classrooms suggests that they were mostly—if not all—verbally able. Indeed, little to no research has examined friendships among minimally verbal individuals with ASD; consideration of the applicability of this model to this population would further test its specificity to ASD per se. Additionally, the model presented in this review may be useful in the examination of processes of friendship among different populations with social challenges (e.g., ADHD, anxiety). Further research among a range of populations will aid in the elaboration of SIPS as a construct and allow for further honing of SIPS-based interventions (e.g., Lerner et al., 2011; Lerner & Mikami, 2012; Lerner, White, & McPartland, 2012). Thereby, additional discoveries from social neuroscience may continue to help to refine the nature and structure of our understanding of friendship development in these populations.

Summary and Conclusions

Reciprocal friendship plays a pivotal role in the psychosocial functioning and development of school-age TD boys. Children list friendship as among the most important things in their lives (Klinger, 1977), and friendship has been associated with a range of benefits, including higher self-esteem and greater resilience in the
face of stressors (Berndt & Keefe, 1995; Howes, 1983; Kingery et al., 2011). In this meta-analysis and review, we considered how boys with ASD experience friendship, as well as its benefits. For this purpose, we built upon the model of friendship presented by Hartup and Stevens (1997) to create a framework that is grounded in well-established models of TD friendship development, and considered characteristics of ASD that might reasonably impact crucial elements of this framework.

Research into key process-focused models of social deficits (social cognition and social motivation) among individuals with ASD has yielded promising results, as well as challenging inconsistencies. Children with ASD demonstrate difficulties with social cognition across domains of emotion recognition, perspective taking, and social reasoning (e.g., Hobson, 1993); however, these challenges have been found to manifest to varying degrees based on the quantity and nature of information provided (Harms et al., 2010). Similarly, although boys with ASD have been found to show lower levels of Social Motivation in some lab-based studies (e.g., Chevallier et al., 2012b), the majority profess a desire for friendship (e.g., Carrington et al., 2003), and higher levels of depression and anxiety suggest they may suffer for their difficulty in forming reciprocal friendships.

Conceptualizing differences in socialization among individuals with ASD as relating to a slower rate of processing of social information (a.k.a. SIPS) may provide a connecting mechanism through which to consider impairments commonly attributed to domain-specific differences in social cognition and social motivation. Children with ASD demonstrate a slower rate of SIPS across fMRI, EEG, and eye tracking studies that presents a potential explanation for their relative facility with lab-based tasks as opposed to in vivo social experiences (Izuma et al., 2011; Lerner et al., 2013; Ozonoff & Miller, 1995).

A slower rate of SIPS could reasonably be expected to impact friendship at every level, including both processes and outcomes. Individuals with ASD participate in surface level activities to a lesser degree than TD individuals, due in part to distinct interests (including a lower interest in sports and physical play, e.g., Bauminger & Shulman, 2003), as well as difficulty perceiving and comprehending the social cues inherent to these activities (e.g., Chamberlain et al., 2007). Differences in social cognition and social motivation that may be commonly related to a slower rate of SIPS are also linked to difficulty forming deep structure friendships. Individuals with ASD struggle to form reciprocal friendships (e.g., Bauminger & Kasari, 2000), and even while interacting with friends they engage in affective sharing to a lower rate than do TD individuals (e.g., Bauminger et al., 2008a). Their friendships are overall lower in quality, as well in reciprocity (Bauminger et al., 2008b). However, despite these differences, recent findings suggest that affective sharing plays a comparable role among friendships of boys with ASD, although it occurs to a lesser degree than among TD friendships (Bauminger-Zviely & Agam-Ben-Artzi, 2014).

Importantly, the meta-analysis of the extant literature found that, despite these challenges, school-aged boys with ASD can and do make friends. However, they report fewer and lower quality friendships and receive lower sociometric ratings from peers. These differences in friendship number and quality, driven and compounded by differences in SIPS, may impact the ability of boys with ASD to reap the benefits of reciprocal friendship. While TD boys derive benefits including improved psychosocial functioning (Berndt & Keefe, 1995; Howes, 1983; Kingery et al., 2011) and improved awareness of social norms (e.g., Dunn, 2004), findings linking processes of friendship to its outcomes among individuals with ASD have not been clear-cut. Individuals with ASD appear to demonstrate an unusual connection between friendships, self-esteem, depression, and anxiety (e.g., Bauminger et al., 2004; Mazurek & Kanne, 2010), and individuals with ASD often struggle with depression and anxiety at higher rates than among TD individuals (Strang et al., 2012), potentially due to social isolation. A slower rate of SIPS may leave boys with ASD dependent on more concrete presentation of information than is typically available through friendships, such that even among boys with ASD who do form friendships, these relationships are less effective at providing benefits found among TD individuals.

The model presented in this paper is intended as a conceptual framework for use in better understanding the processes of friendship among boys with ASD, as well as a needed empirical framework through which specific hypotheses about the emergence of friendships may be tested. Research that focuses on underlying processes by which friendship may arise, either those put forth in this model, or others that may emerge from subsequent research efforts, will be critical to linking understanding of friendship among school-age boys with ASD to interventions that may be able to help this population form truly reciprocal friendships. Additionally, research that directly explores the link between processes of friendship and positive psychosocial outcomes will be necessary to determine whether friendship carries the same developmental meaning for boys with ASD as it does for TD boys.

References


FRIENDSHIP IN BOYS WITH ASD


Gresham, F. M. (1997). Social competence and students with behavior disorders: Where we’ve been, where we are, and where we should go. *Education & Treatment of Children, 20*, 233–249.


FRIENDSHIP IN BOYS WITH ASD