



# HHS Public Access

Author manuscript

*Clin Child Fam Psychol Rev.* Author manuscript; available in PMC 2024 September 01.

Published in final edited form as:

*Clin Child Fam Psychol Rev.* 2023 September ; 26(3): 665–689. doi:10.1007/s10567-023-00449-0.

## Social Knowledge & Performance in Autism: A Critical Review & Recommendations

Jacquelyn A. Gates,

Morgan L. McNair,

Jared K. Richards,

Matthew D. Lerner

Stony Brook University

### Abstract

Autistic social challenges have long been assumed to arise from a lack of social *knowledge* (“not knowing what to do”), which has undergirded theory and practice in assessment, treatment, and education. However, emerging evidence suggests these differences may be better accounted for by difficulties with social *performance* (“doing what they may know”). This distinction has important implications for research, practice, policy, and community support of autistic people. This review examines the theoretical and clinical implications and empirical status of the knowledge-performance distinction in autism. Current evidence suggests that social knowledge deficits are neither definitional nor reliably related to outcomes in autism. Prioritizing social knowledge, then, may produce unanticipated, problematic consequences in terms of accuracy of assessment, intervention effectiveness, and promotion of stigma. It may also yield unrealistic expectations around the value of knowledge for autistic people and their families, yielding important ethical considerations. Conversely, recent evidence highlights performance-related factors as being especially promising for better modeling and addressing social challenges in autism. Prioritizing performance, then, may offer new directions for assessment, substantially different intervention opportunities, and novel methods of inclusion and affirmation. This review touches upon each of these domains and implications, integrates these developments with broader models of social competence in youth, and provides direction for future research and practice regarding social competence in autism.

---

Social challenges are one of the core features of autism (R. P. Hobson, 2014) and have been central to intervention and treatment efforts. However, there has been varied understanding of the mechanisms driving social difficulties, which are evident in the mixed efficacy of many of these intervention efforts (Gates et al., 2017; Wolstencroft et al., 2018). In both lay theory and intervention work, the assumption has historically been that autistic people “do not know what to do” in social situations — or that these social challenges arise from deficits in acquiring social knowledge, or the ability to acquire, retain, and understand social

---

Correspondence concerning this article should be addressed to Matthew D. Lerner, Ph.D., Department of Psychology, Stony Brook University, Stony Brook, NY 11794-2500. 631-632-7660. matthew.lerner@stonybrook.edu.

We have no conflicts of interest to disclose.

norms and rules (Gresham et al., 2010). This assumption has informed the treatment of autistic youth, which has focused on teaching social “skills” via primarily didactic means (Bishop-Fitzpatrick et al., 2017; Lerner & White, 2015). However, recent work has begun to question the weight of social knowledge difficulties in autism, suggesting difficulties also lie in, and may be better explained by, the *performance* of such skills — or that autistic people have difficulties enacting *already known or acquired* skills in social situations (Gates et al., 2022; Guivarch et al., 2017; Keifer et al., 2020; Lerner & Mikami, 2012; Mendelson et al., 2016).

Gresham (1997) provided a social learning taxonomy to explain why some children struggle to engage in reciprocal social behavior. This framework distinguishes between social acquisition deficits (referred to here and elsewhere as *social knowledge deficits*), in which children lack knowledge of the social behaviors they should perform, and *social performance deficits*, in which children know the social behaviors that can or “should” be performed yet have trouble doing so. Thus, while Gresham (1997) considered both knowledge and performance to be necessary for competent social functioning in broader social functioning, research has only recently begun to understand the impact of social performance deficits, and the extent of the division between social knowledge and social performance skills, in autistic social difficulties (Gates et al., 2022; Lerner et al., 2014; Matson et al., 2007).

Understanding whether an autistic individual’s social difficulties are more attributable to social knowledge or social performance deficits has direct implications for the etiology of such difficulties and provides direction for therapeutic content (e.g., increasing absent social information necessary for interaction versus determining factors that prevent the enactment of the already known behavior). If a person does not possess reliable social knowledge deficits (i.e., they already know what to do), then delivery of social knowledge-oriented interventions may be inappropriate and potentially ineffective (Nixon, 2001). Thus, better understanding the gap in social knowledge and social performance is an essential step in the advancement of understanding of autism, creating more effective social supports, and improving outcomes related to social skills challenges, such as high rates of loneliness and reduced social connection (Deckers et al., 2017; Kasari & Sterling, 2013), which is aligned with needs of both research and autistic communities (Bottema-Beutel et al., 2016).

This paper outlines the conceptual and theoretical foundations of this gap, the shift from focusing on knowledge difficulties to performance difficulties in the field, as well as implications for conceptualization, measurement, and treatment of social interventions. It also examines how this shift away from addressing knowledge deficits and toward performance-based interventions does (and does not) align with the emerging focus on neurodiversity in autism interventions and provides directions for future research in this regard.

## Social Knowledge Deficits as Definitional

### Historical Assumptions

Throughout much of the history of autism research, it has been assumed that social challenges either amounted to or derived from *social knowledge* deficits, or difficulty acquiring information on rules and norms and constructing social schemas. This long-standing assumption has influenced the trajectory of theories about social challenges in autism, given rise to the most common lay theories of the condition, and undergirded many interventions.

**Knowledge as a Long-Presumed Foundation**—Considerable research has attempted to explain social difficulties in autism. Many have converged around the notion that autistic people do not readily develop the requisite understanding about social skills, which results in them being unable to engage in interactions - so-called *social knowledge deficits*. These presumptions around skill acquisition deficits have been present from autism’s earliest conception, such as Kanner (1943) suggesting that children “fail... to develop” social awareness. Later work continued to implicate these difficulties, such as work focusing on the ability for autistic people to conceptualize non-autistic rules and social schemas and store memory of social skill information (Bishop-Fitzpatrick et al., 2017), lack of knowledge of implicit social rules (Travis et al., 2001), difficulties with perspective taking (ability to understand the thoughts, feelings and emotions of others or “theory of mind;” Baron-Cohen, 1989), and deficits in the ability to identify and understand the expression of emotions (emotion recognition; Lozier et al., 2014). Findings that autistic individuals tend to be especially systematic (i.e. rules-bound) in their cognitive processes (Baron-Cohen & Belmonte, 2005; Qian & Lipkin, 2011), especially with reference to social information (Hoyt et al., 2006; Krasny et al., 2003; Laugeson et al., 2009), added to this presumption that lack of knowledge of specific social rules lead to reduced enactment of social behavior, which has persisted despite substantial work showing autistic children *do appear to possess greater social knowledge* than would be expected if their deficits were purely knowledge-based (Happé, 1995; Laugeson et al., 2009; Rump et al., 2009). Indeed, it has been suggested that autistic children may possess “latent social skills” that are suppressed by differences in processing of social and emotional information (Andari et al., 2010; Mendelson et al., 2016), suggesting the presence of a performance deficit. Nonetheless, the question of whether social deficits in autistic individuals are primarily knowledge- or performance-based has rarely been tested directly (Gates et al., 2022).

**Lay Theories**—In schools, family groups, community publications, etc., it is considered virtually *de facto* to say that children with autism “do not know what to do” socially (Bottema-Beutel et al., 2018). For example, if you ask a clinician or teacher in the field, “Why is this child unable to make friends with their classmates?” many will respond with, “They don’t know what to do or how to do so.” While in some instances requisite knowledge may be required, this lack of knowing is often not the case. Table 1 illustrates several examples extrapolated from clinical experience that underscore the limitations of relying on social knowledge and the pitfalls of focusing solely on these deficits when supporting social interaction in autistic people.

Each of the Table 1 scenarios demonstrate pitfalls of knowledge-based ways of approaching autistic social difficulties and, as a result, how many existing social skill interventions are conceptualized. These approaches follow the metaphor of attempting to program a social computer with all the rules necessary to mimic neurotypical human social behavior. While this can yield a simulacrum of social interaction, it also hits upon three problems. First, a computer has far more capacity to quickly recall and implement specific responses when specific situations arise - this type of “if-then” contingency is at the heart of computer programming. Second, even if we could teach people to learn and respond in such an “if-then” intentional fashion, both humans and computers would immediately run into issues of scale and complexity. That is, while systems have long been able to mimic (and even exceed) human behavior in structured games like chess, human social interaction (especially live interaction, with context and nonverbal behaviors and pragmatics) is exponentially more complex than chess - so even the most powerful computers (let alone people) would hit an implementation limit. Finally, it bears stating that the goal is *not* to teach autistic people to *mimic neurotypical interaction* but instead to give individuals the capacity and opportunity to have rich, rewarding social interactions that work for them, ideally on their own terms. For these reasons, the “moral” is that such a programmatic approach may be fundamentally mismatched to its goals.

While increasing social knowledge provides an anchor for individuals to navigate interactions, successful (i.e., neurotypical) social performance requires flexibility of social knowledge components as well as other social skills like social creativity, prediction, and information processing.

**Conceptual Model of Social Competence**—Conceptually parsing social competence difficulties into social knowledge and social performance is necessary when assessing social competence in youth (Gresham, 1981, 1997, 2016; Gresham et al., 2010) and these elements underlie many models of social competence. Perhaps the most widely known model, social information processing (Crick & Dodge, 1994), offers a sequence of processing steps necessary to generate appropriate social responses and arrive at adequate social interaction. The model highlights the importance of social knowledge in social competence which includes factors such as social schemas, knowledge of rules and social norms, and memory storage (Crick & Dodge, 1994; see Figure 1). Similarly, this whole system defines the necessary and sufficient conditions for performance, where social knowledge interacts with a series of steps, or performance-related factors, which operate to interact constantly with a social knowledge “database”, resulting in behavioral enactment. Both social knowledge and social performance skills are present to form social competence, yet this framework centers *social knowledge as important, but not sufficient*, for social functioning. This model has been formative in the modern development of social competence frameworks and provides a foundation for current conceptualizations of social functioning in autism, underscoring the complex, but distinct, interaction between social knowledge and social performance, and how these processes may differ in autistic people and lead to social challenges.

## Knowledge-based Intervention

Intervention efforts have usually focused on increasing social knowledge. Many have focused on skills such as following manners or “appropriate” speech (e.g., “please,” “thank you,” “proper” greetings, how to engage in spontaneous conversation), eye-contact, and “appropriate” verbal and non-verbal communication (Matson et al., 2007). The routine and didactic teaching of these skills are present across several manualized interventions and lay understanding of social skills instruction. For example, some interventions explicitly target social knowledge and evaluate the effectiveness of the intervention via the direct assessment of an increase in such knowledge (Zheng et al., 2021). However, as interventions have been critically evaluated and scrutinized, it has become increasingly clear that these efforts to increase social knowledge result in little gain in generalized social competence. In fact, several recent systematic reviews (Reichow et al., 2012) and meta-analyses (Gates et al., 2017; Wolstencroft et al., 2018) show modest gains in social competency as a result of social skills interventions, with further analyses showing that a majority of these gains are a result of gains in social knowledge, while measures and raters that assess the generalization and performance of skills — particularly in novel settings — show much less improvement in social functioning (Gates et al., 2017).

**What kind of social knowledge has been implicated in autism?**—Given the longstanding presumptions of the centrality of social knowledge deficits in autism, one must contend with a fundamental question: what kind of social knowledge is intended? There has been debate in the literature regarding the *content* of skills that constitute social knowledge; for instance, knowledge of others’ perspectives or emotions and knowledge of conventions of etiquette have often been included (Gresham, 1981). However, there are several putative types of social knowledge, each with specific implications for how they could play out in autism, which are described in Table 2.

The class of knowledge that has achieved the greatest consensus as constituting domain-general social knowledge (and, thereby, the one that has been considered *requisite* for social skill acquisition) is *propositional knowledge* based on the explicit understanding of factual information about social skills (Bye & Jussim, 1993). Many have focused on these deficits as stemming from challenges in recognizing and identifying social and emotional cues in other people (Kasari & Patterson, 2012) and differences in social-emotional understanding (Bauminger, 2002), and as a result, theories have largely focused on propositional knowledge (i.e., factual knowing of what to do in social situations) in these difficulties. Though considered less than propositional knowledge, theories of difficulties with *procedural* and *situational knowledge* are also targeted through strategies such as modeling and role-playing, which attempt to *increase knowledge of “how” to engage in social skills* (Mesibov, 1984; Parsons & Mitchell, 2002). However, many with already acquired propositional social knowledge continue to struggle in the performance of these skills during social interactions.

Explicit propositional knowledge is not identical to, or even necessarily involved in, acquisition of social skills (that is, knowing ‘about’ a social skill, or even being able to describe a social behavior, is not the same as doing it, even at all). In fact, ample literature

indicates propositional knowledge is, at best, modestly related to social development, including among those with autism (Klin et al., 2003). For example, if one has acquired the skill of “ending disagreements calmly,” it is of course the case that a child need not be able to describe the specific behaviors involved in doing so – such behaviors are so numerous, complex, and context-dependent that describing a specific one may be close to meaningless. However, the same child almost certainly now knows (either by descriptive reflection, strategic planning, knowledge of cues, or otherwise) something about what is involved (i.e., propositionally; what is involved in disagreements that end calmly), how and when (procedurally; i.e., the actions/words to be said; at what point in a disagreement it may be ended calmly), where (situationally; i.e., in what contexts they can end disagreements calmly), and with whom they may do so. Thus, at least *one* of these forms of knowledge is implicated when a child has acquired such a skill. Further, this also indicates said knowledge may be absent if one cannot perform this skill *at all* (i.e., never engages in the skill) – that is, if a child does not ever end disagreements calmly, it is clear there is *something* they do not know about doing so (e.g., what is involved; when to try; with whom to try; how to try).

However, being able to engage in a social skill at least some of the time *does* necessarily require that *some level* of knowledge (be it propositional, procedural, or situational) must be present, and such knowledge *must* be absent if one cannot or does not *ever* engage in said skill. From a practical and intervention standpoint, the vast majority of existing social skill interventions focus on teaching propositional social knowledge as a core element (Gates et al., 2017), and many conceptions of ASD posit a lack of social knowledge as a cardinal feature (Keifer et al., 2020), far more frequently than they consider social performance. This is, in part, because knowledge is treated as *necessary* for social skill enactment.

Given that social knowledge involves much more beyond propositional knowledge, it is clear that at least some social knowledge is necessary, though not sufficient, for skill engagement – but not vice versa. For instance, if a child who has never roller skated (i.e., has not acquired any knowledge about the skill) wishes to do so, reading about roller skating (i.e., they have propositional knowledge of the skill) will not necessarily change their skating behavior. However, once they have learned to roller skate at least some of the time (i.e., they have procedural knowledge of the skill), by the above rationale, they also now have some knowledge of roller-skating (e.g., they can describe and/or demonstrate successful skating), even if this acquired knowledge is not enough to skate on its own consistently.

### **Current empirical status of social knowledge in autism**

Existing research has attempted to elucidate empirical evidence for reduced or impaired social knowledge in autism. The theory of social knowledge as central to autistic social functioning rests on two assumptions: 1) if social knowledge deficits are the central problem of social difficulties in autism, then, on average, in whatever ways social knowledge is measured, autistic individuals will demonstrate more social knowledge deficits than their non-autistic peers; and 2) if social knowledge matters, higher scores of social knowledge measures *should* relate to higher instances of actually *doing* social skills (i.e., “better” social outcomes). However, the empirical status around social knowledge is inconclusive.



**Comparison of Autistic and Non-Autistic Youth**—Early research exploring autism quickly concluded that a dearth of knowledge explained differences in social interaction as compared to non-autistic people, forming the bedrock of the assumption that social knowledge deficit is definitional to autism. For example, early studies investigating differences in theory of mind quickly informed foundational theories of social differences. Results underscored differences in autistic and non-autistic youth on theory of mind tasks, including comparisons to neurotypical and Down’s Syndrome cases (Baron-Cohen et al., 1985), leading researchers to conclude that autistic people had unique challenges in social and communicative functioning, specifically at understanding the thoughts, intentions, goals, and emotions than non-autistic people. Other work investigated differences in emotion recognition scores between autistic and non-autistic youth, concluding that autistic children had inadequate understanding of complex emotions and did not *know* how to recognize emotions (Harms et al., 2010). Findings such as these led to assumptions that autistic children required direct instruction in order to expand emotional repertoires (Bauminger, 2002; Howlin, 1999) and understand and process social norms and rules (Attwood, 2000; Kuncze & Mesibov, 1998).

Despite these seemingly consistent early findings, later work failed to corroborate them. More recent studies investigating more direct comparisons of social knowledge between autistic and non-autistic youth *do not show* evidence of consistent, systematic differences in social knowledge (i.e., similar levels of measured knowledge as neurotypical samples), but do demonstrate variability of social knowledge in autistic samples (Freden et al., n.d.; Gates et al., 2022; Lerner, 2013; Marro et al., 2019). More methodologically precise studies with larger participant samples have demonstrated heterogeneity within autism samples, demonstrating little to no differences in theory of mind scores between autistic and neurotypical populations (Scheeren et al., 2013). Better characterization of populations, like controlling for factors like generativity, IQ, verbal ability, and attention, appear to explain differences more accurately in theory of mind, above and beyond autism (Baker & Myles, 2003; Green et al., 2020; Livingston & Happé, 2017). Advancements in methodologies, such as artificial intelligence and machine learning, show important insight into facial emotion recognition in autistic people, suggesting that knowledge of emotion is accurately encoded in neural signals, but difficulties emerge when decoding or deploying facial emotion information within the neural signal (i.e., a performance-based difficulty; Torres et al., 2022). And investigations of more precise questions related to direct social knowledge have highlighted that autistic and non-autistic youth do not appear to differ on measures of social knowledge but do significantly differ on parent-reported social performance and observed social performance (Freden et al., n.d.). Exploration of social profiles in autistic and non-autistic youth demonstrate that autistic youth do appear to have more of knowledge and performance deficits, and less skill strengths, than non-autistic youth; however, group-specific analyses show knowledge deficits as the *least prevalent* aspect of autistic social profiles, while performance deficits are the most prevalent aspect (Gates et al., 2022). Importantly, this pattern of social profile that autistic people demonstrate (i.e., high performance deficits and lower acquisition deficits), mirror the pattern seen in non-autistic youth – a pattern that has long been highlighted in work in these populations (Gresham, 1981).

While early work appeared to show a unique and defining quality of social knowledge deficits in autism, as work has improved in this area, evidence of group differences in these areas between autistic and non-autistic groups is less definitive. In fact, emerging evidence suggests that autistic challenges may be more defined by youth who know what to do, but don't reliably perform these skills.

**Correlations of Knowledge with Social Outcomes**—For years, it has also been assumed that better social knowledge should relate to better social functioning, as demonstrated by intervention efforts to directly increase social knowledge (Laugeson et al., 2012). Studies have shown a relationship between reduced social knowledge and negative outcomes, such as increased instances of bullying and difficulties managing friendships (Mendelson et al., 2016). However, work in this area has not as clearly demonstrated a link between more social knowledge and meaningful social outcomes for autistic individuals. Research has shown that higher social knowledge scores are actually *not* associated with improved outcomes and that engagement in treatments promoting rules-based social knowledge may inadvertently inhibit authenticity of interaction (Bottema-Beutel et al., 2018). Other studies directly investigating the impact of implicit (i.e., unconscious integration of social information) and explicit (i.e., effortful acquisition of social information) social cognition factors on social competence in autistic youth find that while both types of factors are implicated in social challenges, explicit, conscious integration of social knowledge in autistic interactions do not adequately explain challenges in social interaction (Keifer et al., 2020). Work has also suggested that social knowledge is not related to autism diagnostic status (Freden et al., n.d.) nor ADOS-2 scores (Gates et al., 2022; Lerner & Girard, 2018). Further, work utilizing more direct measurement of social knowledge and enacted social behavior found no relationship between social knowledge and observed or parent-reported social performance (Freden et al., n.d.).

**What have we learned about social knowledge in Autism?**—Contrary to lay understanding and long-standing assumptions, social knowledge deficits do not appear to categorically define autism. While reduced compared to their non-autistic peers among a subset of individuals, many autistic individuals do have intact *explicit propositional knowledge* about social skills. As methodologies have refined, many of the findings that have supported the theories around reduced social knowledge shrink significantly and sometimes disappear. Lastly, work has shown that knowing about social skills does not reliably correlate with meaningful outcomes.

## Social Performance: an Offramp from Knowledge

*Social performance difficulties* arise when an individual is unable to engage in a social skill reliably and consistently despite (or regardless of) having the requisite knowledge to do so (Gates et al., 2022; Gresham, 1981). These types of challenges are *distinct* from social knowledge deficits, as a person may *already* have the requisite knowledge about the skill (be it propositional, procedural, situational), but still not engage in it.

A number of theoretical models of autistic social functioning have posited the centrality of performance challenges (Gates et al., 2022; Greenspan & Wieder, 1998; Gutstein et al.,



2007; Lerner et al., 2014; Lerner & Levine, 2007; Mendelson et al., 2016). Rather, an array of factors common to autism may play an equally important (if not more important) role in predicting social difficulties. For instance, in ADHD populations, impulsivity (De Boo & Prins, 2007) and working memory difficulties (Kofler et al., 2011) have been shown to represent social performance-related factors. For autistic youth, three common factors across many non-knowledge-based models of social difficulties include differences in prediction (Cannon et al., 2021), social creativity (R. P. Hobson et al., 2009), and social information processing (Lerner, White, et al., 2012; McPartland et al., 2011; McPartland & Pelphrey, 2012; Mendelson et al., 2016; Rump et al., 2009). As these factors exist independently of social knowledge but may still directly affect an individual's ability to perform known social skills (Gresham, 1997; Nixon, 2001), they may be considered to represent *social performance difficulties*.

Crucially, these performance-related factors would not be improved via increasing social knowledge alone and the limitations of the impact of knowledge on outcomes are neither novel to autism nor limited to the social domain. A substantial body of work in non-autistic populations reveals limits of knowledge on skilled performance in areas such as sports, music, games, and science, showing that, while knowledge (and working-memory capacity) is also reflected in high-levels of skills in these areas, the utilization of deliberate practice methods (i.e., practice in the performance of activities and skills designed to increase competence in a given area) is necessary to achieve a high skill level (Hambrick & Meinz, 2011). Thus, performance-related factors are often more important than knowledge to achieve skilled outcomes.

### What are Social Performance-Related Factors?

While there are numerous putative performance-related factors, herein we highlight three. One such factor is social creativity, defined as the application of collective imagination to solving a problem (Fischer et al., 2005; Mouchiroud & Bernoussi, 2008) and the use of original solutions to solve a social problem (Mouchiroud & Bernoussi, 2008; Mouchiroud & Lubart, 2002). Social creativity has been cited as a core underlying feature of autism (Gutstein et al., 2007; Herbert & others, 2005; Rapin, 2002). Flexibly responding to social situations requires the ability to engage in a social environment adaptively and creatively without the use of predefined, prescribed behaviors (i.e., engage a peer fluidly and successfully; Koenig et al., 2009). Crucially, social creativity, so defined, has been shown to be associated with measures of social competence and peer acceptance (Mouchiroud & Bernoussi, 2008).

*Prediction* (or predictive learning impairment) is another performance-related factor associated with autism (Sinha et al., 2014). Recent work has highlighted that many autistic traits may be explained by differences in underlying predictive processes, making the world appear less structured and more difficult to navigate (Gomot & Wicker, 2012; Van de Cruys et al., 2014). Autistic individuals may have difficulty with the processes that occur in response to antecedent events and involve the activation of learned associations between antecedents and consequence (Sapey-Triomphe et al., 2022). This includes individuals assessing the probability of certain events occurring within this time to anticipate how

the situation/interaction might go and what potential responses will be required (Cannon et al., 2021). If autistic people have difficulties with prediction and predictive learning impairments, this can impact the ability for one to predict what may happen in social situations and could be contributing to social skill difficulty. Importantly, this type of difficulty, one in which it is difficult for an autistic person to predict or anticipate social environments, cannot be “taught” via social knowledge strategies.

Social information processing speed (*SIPS*), or the processing of social stimuli like faces, has also been cited as a unique and key area of challenge for autistic individuals (Mendelson et al., 2016; Rump et al., 2009). Such processing underlies the ability to rapidly discriminate increasingly subtle emotions, an ability which typically develops at a consistent pace throughout childhood and early adolescence (McKone et al., 2007). Slower *SIPS* may lead autistic individuals to fail to “catch” social information when it happens (McPartland et al., 2011), leaving autistic individuals a fraction of a second behind in peer interactions and impact the development and maintenance of social relationships (Mendelson et al., 2016). This may lead them to struggle to keep up in fluid peer settings, leading to downstream effects on prosocial behavior, encoding of social information, and perspective-taking. There is abundant evidence that points to *SIPS* in autism.

### Current Empirical Status of Social Performance in Autism

Emerging research has begun to investigate the impact of performance-related difficulties on social competence in autistic individuals. Similar to social knowledge deficits, the theory of social performance deficits should rest on two assumptions: 1) if social performance deficits are most central to social difficulties in autism, then, on average, in whatever ways social performance is measured, autistic individuals will demonstrate more deficits than their non-autistic peers; and 2) if social performance matters, higher scores of social performance measures *should* relate to higher instances of actually *doing* social skills (i.e., “better” social outcomes).

### Comparisons of Social Performance to Non-Autistic Youth

Comparisons to non-autistic youth have yielded important empirical evidence for performance-related differences in autistic youth. As mentioned, direct measurement of social profiles have shown that social performance deficits are the most prevalent aspect of autistic social functioning, being both *twice* as large as non-autistic youth and more prevalent within-autistic profiles than both knowledge deficits and social skills strengths (Gates et al., 2017). Further, specific between-group findings have underscored that there is a unique difference in several specific performance factors, such as social creativity, prediction, and *SIPS*.

**Social Creativity.**—Research surrounding differences in social creativity between autistic and non-autistic youth have produced variable results. For example, Lerner & Girard (2018) found that the range of socially creative responses to social problems and situations does not differ much from non-autistic youth, while J. A. Hobson et al., (2013) found autistic youth demonstrate less socially creative play than non-autistic youth.

**Prediction.**—Comparisons to non-autistic youth have suggested specific differences in prediction abilities, which were reviewed in a recent review assessing the empirical evidence of prediction impairment in autism that suggested specific differences in prediction in autistic individuals (Cannon et al., 2021). Studies showed autistic adults have more difficulty predicting events occurring in social situations than non-autistic individuals (Amoruso et al., 2019; Chambon et al., 2017). Functional imaging studies have found differences in differences in prediction related to rewards (Balsters et al., 2017) and repetition suppression (i.e., neural activation in response to repeatedly presented stimuli) to faces (Ewbank et al., 2017; Kolesnik et al., 2019). EEG studies have noted that, while autistic adults do integrate vocal stimuli to anticipate meaning similar to non-autistic adults, this process is slower in the autistic group than the non-autistic group (Barzy et al., 2020). However, Cannon and colleagues (2022) underscore the importance of further investigating prediction in autism to better understand the impact on social interaction.

**SIPS.**—Studies investigating SIPS underscore a number of differences between autistic and non-autistic youth. Social information processing, as measured by both behavioral (Bal et al., 2010; Rump et al., 2009) and electrophysiological measures (Kang et al., 2018; McPartland et al., 2011; McPartland & Pelphrey, 2012), appear uniquely slower than non-autistic youth. When shown visual stimuli of faces varying in emotional expressions, emotion recognition has been shown to be slower in autistic youth compared to non-autistic youth (Georgopoulos et al., 2022). The N170 is an event-related potential (ERP) component whose latency is thought to index speed of automatic, obligatory (i.e. prior to voluntary or effortful) processing (but not subsequent cognitive, more prefrontal evaluation) of configural information (Bentin et al., 1996) in faces, be modulated by emotional information (Blau et al., 2007), and respond increasingly quickly through development in childhood (Batty & Taylor, 2006). This component, however, also consistently exhibits a temporally delayed response to social and emotional information in autistic individuals across the lifespan (Batty et al., 2011; Dawson et al., 2002, 2004, 2005; McPartland et al., 2011; McPartland & Pelphrey, 2012; O'Connor et al., 2007; Webb et al., 2006). Notably, this delay does not appear to index generally slowed information processing, evincing a processing challenge unique to social information.

### Correlations of Performance with Outcomes

Studies have also begun to examine the relationship between social performance-related factors and social outcomes.

**Social Creativity.**—In non-autistic youth, social creativity has been shown to be associated with greater social competence as well as positive sociometric rating (i.e., popularity; Mouchiroud & Bernoussi, 2008). Likewise, difficulties with social creativity may contribute to more general social performance difficulties observed in autism (R. P. Hobson et al., 2009). For example, higher social creativity scores in autistic youth have been associated with more prosocial interaction (Lerner, 2013; Lerner & Girard, 2018). Conversely, poorer social creativity has been associated with not only greater clinician-rated ASD symptom severity but also more parent-reported social communication and interaction difficulties (Keifer et al., 2020; Lerner & Girard, 2018). This emerging literature shows

promise in helping to elucidate social challenges, but more research is needed to better understand the impact of social creativity on outcomes.

**Prediction.**—Research has begun to examine the link between difficulties with prediction and outcomes. Sinha and colleagues (2014) noted the relationship between predictive impairment to increased novelty of the environment and resulting difficulties recalling and integrating past experiences to inform social behavior. Further, the study noted that predictive impairment is related to differences in reactions to humor, which requires a deviation from what is predicted in a social context to be received. They also noted the relationship between prediction difficulties and motor and body control movements, all of which may impede the performance of prosocial behavior. Overall, the research on the impact of predictive impairment on social outcomes is more limited, however, the emerging studies reviewed show promise in explaining difficulties in social performance.

**SIPS.**—SIPS has been shown to be related to several social outcomes. Impaired processing speed has been associated with higher scores on both the ADOS communication and reciprocal social interaction scales (Haigh et al., 2018). Other work in large samples has found slower SIPS to be correlated with autism symptoms and communication abilities (Webb et al., 2023), and other measures of social cognition (Lerner et al., 2013). Longer latencies of the ERP components N170 and N100 to facial and vocal stimuli, respectively, have been shown to be related to more socially ambiguous peer interaction behaviors in autistic youth (Keifer et al., 2020).

Emerging theory and research demonstrate that continued investigation of factors that impede social interaction *beyond* social knowledge can better inform understanding of autistic social functioning and how best to support individuals in research and practice.

### **Importance of delineation of social knowledge and performance mechanisms in research and practice**

Critically, addressing the questions of how best to conceptualize research on social functioning and how best to support social development in practice will require ensuring that the theory and research of the mechanisms sustaining social deficits is both accurate and consonant with chosen intervention strategies. Currently, intervention strategies consonant with social knowledge deficits focus on directly teaching social knowledge by *didactically* providing information on appropriate actions (e.g., when to make eye contact, how to initiate a conversation), while intervention strategies consonant with social performance deficits focus on providing a context in which socially skilled behaviors may be effectively enacted by mitigating those factors that prevent an individual from such enactment.

Notably, both social knowledge- and social performance-training interventions for autistic youth may employ reinforcement of skilled social behavior. While social knowledge programs may encourage the performance of skills through modeling, role-play, and other means, these would not be considered performance-based strategies, as these interventions do so after specifying (nomothetic) target behaviors, and practice the employment of such specific skills (e.g., role-play of specific conversational skills). In contrast, social performance interventions specifically target features such as reduced *social creativity*

(Mouchiroud & Bernoussi, 2008) and slowed *SIPS* (Mendelson et al., 2016) that may be blocking expression of *already known* behavior. These interventions do so using activities that may (ideographically) lead participants to engage, without prompting (i.e., rapidly, spontaneously, and creatively), in social behaviors they find to be reinforcing or successful, and to obtain greater naturalistic social reinforcement (through peers).

In practice, these factors of knowledge and performance differ by population, leading to differences in whether a given strategy constitutes knowledge- or performance-training, highlighting the importance of characterizing knowledge and performance in autism. For instance, among ADHD youth, didactic lessons on appropriate social behaviors on a playgroup constitute knowledge-training. However, providing reminders of those social behaviors prior to recess offers a context that mitigates their performance-related challenges related to working memory (Kofler et al., 2011), thus acting performance-training modules. Conversely, autistic youth are much less likely to experience such working memory deficits (Ozonoff & Strayer, 2001), and more likely to become more rigid about or focus on social rules (i.e., knowledge). This same behavioral reminder would operate as an extension of the original knowledge-training module in autistic youth by explicitly reinforcing preferred skills. Such knowledge-training strategies in this population focus on the didactic provision of *a priori* determined knowledge about social interaction strategies, and the contingent reinforcement of successful implementation of such strategies in session. They specify the importance of having social instruction activities mirror “real life” social interaction *as closely as possible* (A. P. Goldstein & McGinnis, 1997). As such, the goal is to ensure that a child *knows* specific behavioral steps to enact in a given setting, and then to train that child such that he or she *knows* to use those behaviors in analogous situations outside the intervention group setting. Hence, such strategies posit that the optimal pathway for achieving in-session and generalized competent social behavior among participants exists via the mechanism of increased knowledge and use of specific appropriate social behaviors.

### Performance-related factors

The outer circle of the Crick & Dodge (1994) model, shown adapted in Figure 1, further helps to explain the conceptualization of the utility of social performance deficits in autism. Several factors already explored help to explain difficulties that may occur at various steps, even when removing the interaction with social knowledge. At the first (encoding of cues) and second (interpretation of cues) steps of this model, numerous studies have shown performance-related factors which might impact social performance (and derail this cycle of interaction) in autism. Work exploring differences in attention and perception underscores that autistic people often have superior abilities to pick up on minute details. Further, eye-tracking studies have reliably found autistic people attend to different aspects of the environment than non-autistic people, which has been demonstrated in both social (Klin et al., 2003) and non-social (Wang et al., 2015) environments, suggesting the information autistic people pay attention to in social situations may cause individuals to miss social cues, which can impede the performance of social skills at this first stage. Delayed *SIPS* can also be considered to have impacts at this first and second stage, again impacting the speed at which someone is encoding and interpreting social cues. Difficulties with emotion regulation, which are common in autism (Mazefsky et al., 2013), may impact clarification of

goals (step three of this model), which requires an individual to engage in arousal regulation to set goals that are aligned with desired outcomes. Findings of reduced social creativity may impact the ability for an individual to construct variable social responses that may fit the social situation (step four - response access or construction), and this same difficulty may cause individuals to have difficulties updating their responses and decisions in various situations (step five - response decision) as the social environment and social cues rapidly change around the person. Challenges predicting the social environment can also impact the needed performance of steps four and five.

### **What have we learned about social performance in Autism?**

The above sections highlight that there are numerous factors other than knowledge that can impact social outcomes in autism, and a very different approach to intervention is implicated when they are targeted directly (Table 3). Rather than approaching social learning like programming a computer, these approaches instead imply the working of (perhaps underdeveloped) social-emotional “muscles.” That is, lack of opportunity to use these “muscles” can lead to atrophy, whereas working on a given performance-related process may be more like social-emotional *isometrics* - requiring targeted, repeated practice in ways that may not immediately produce evident change (e.g., no change in social behavior at first at all), but may nonetheless produce more durable outcomes over time that are more consonant with the way the given individual approaches the world. In other words, doing so is meant to make social interaction more authentic, personalized, effortless, rather than prescribed, general, and intentional.

### **Implications for the Conceptualization of Autism**

Increased clarity and consideration of the gap between social knowledge and social performance challenges has considerable impacts on conceptualization of autism, including across developmental, categorical, dimensional, and contextual domains (see Table 4). For example, a performance-based model suggests that the current approach to developmental understandings of autism is, at best, overly narrow, and at worst, offers a limited view of how to advance social developmental goals (e.g., making friends, building a trusting relationship with caregivers; e.g., Greenspan & Wieder, 1998). In terms of categorical implications, it is apparent that social knowledge are not exclusive autism nor solely characteristic of autism (Gates et al., 2022). Parsing knowledge- and performance-based origins of these difficulties is crucial to differentiate autism-specific manifestations of social difficulties and similar challenges irrelevant to autism diagnosis (Addington et al., 2006; Aduen et al., 2018; Lavoie et al., 2014; Weightman et al., 2014). Treating these social knowledge and social performance *dimensionally*, as opposed to a binary “have” or “have not”, may allow for better characterization of social competence, including understanding what factors may contribute to one having more or less social knowledge and social performance abilities. And lastly, contextual variation in social behavior has often been minimized in autism - framing individual “social skills deficits” in this population as almost trait-like phenomena, when in fact evidence points to differences in social behavior across settings and informants (Kang et al., 2013; Lerner et al., 2017). Social performance factors help to inform contextual variations in social challenges. Likewise, there exists variation in



whether or not, or to what extent, behavior is perceived by others as autistic, or whether one can “pass” as non-autistic (Libsack et al., 2021) - an even more extreme instance of variation in behavior by context. This process that may have downstream effects on self-esteem, emotional wellbeing, and the ability to build a social support network that allows one to flourish as their authentic self (Cook et al., 2021). Thus, there is a clinical and ethical imperative to better understand drivers of social variation by context in autism.

## Implications for Measurement and Assessment of Social Skills

Just like treatments, many of the measures that have been developed and used to assess social skills rest on and assess this knowledge-deficit. The rising importance of better understanding social performance challenges in assessing social functioning in autism, and the apparent centrality of performance to the autism experience, has impacts on how and what we use to assess autism.

### Existing evaluation of social skills

A vast number of measures designed to assess social skills in autism focus on knowledge, or assessing whether the person knows what to do in a social interaction. Too often, there is an assumption that improvement on these measures translates to performance. In other words, if an autistic person knows what to do in a social interaction, based on their responses to the social knowledge measure, they should, theoretically, be able to do it. An example of this is measures such as the Test of Adolescent Social Skills Knowledge questionnaire (TASSK; Laugeson et al., 2009), and the Children’s Assertive Behavior Scales (Michelson & Wood, 1982) which were specifically designed to assess social knowledge, via whether someone selects the appropriate or “correct” answer (by neurotypical standards) on a test of skills or in response to social situations, but not whether they would necessarily enact that specific response in a real-world social situation. These measures, particularly those developed with the autistic population in mind, focus on whether a person “can do” (or know) a social skill as opposed to doing said skill. Again, work has shown social knowledge performance on written measures often does not translate these skills to actual behavioral performance (Gates et al., 2017) and as such, better understanding of performance deficits requires assessment of what someone actually does.

Several measures have been developed with this framework in mind. The Social Skills Improvement System (Gresham & Elliott, 2008) attempts to better assess what an individual does by asking the informant to rate the frequency that a person engages in a particular social skill, which gets closer to assessing social performance. Alternative scoring methods afford an even more in-depth and person-centered examination, explicitly evaluating acquisition and performance deficits, and skill strengths, with an emphasis on which skills are important to that particular individual (Gresham et al., 2010). Similarly, the theory of mind inventory (Hutchins et al., 2012), measures the performance of behaviors (in this case, theory of mind), though understanding other’s perspectives does not necessarily equate to integrating that information into the enactment of social behaviors in live interaction. The Quality of Play Questionnaire (Frankel et al., 2010) captures observed behavior in this case, get together with peers, measuring what a child/person did as opposed to what they

know or essentially “can do.” Many adaptive behavior scales, such as the Vineland Adaptive Behavior Scale (Sparrow et al., 2016), also approach measurement of behaviors with a performance-based framework. The Vineland measures various types of daily behaviors but emphasizes whether a person does a skill independently (i.e., without prompts or support) rather than only capturing information on if they can perform the behavior.

The Social Interaction Observation Scale (SIOS; Bauminger, 2002) uses objective and standardized methods to assess the behaviors a person engages in, including blinded assessment of positive (e.g., verbal and nonverbal behaviors to initiate and maintain interaction, social communication, sharing objects), negative (e.g., physical and verbal aggression, avoidance, withdrawal), and low-level behaviors (e.g., proximity to others). While SIOS does capture what a person does in a social interaction, how behaviors are categorized may differ from how the person experienced that behavior, nor the social success (or failure) of a behavior in a social interaction. In other words, while a behavior may be coded as a low-level interaction, the behavior may still have been socially successful within that specific context. Thus, while this measure is a step in the right direction in terms of more accurately assessing what an individual *does*, there are other methods that should be considered.

Assessment and measurement methodologies that evaluate the in-vivo reading of emotions and applications to social behaviors may also better capture social competence. For example, the use of artificial intelligence systems along with assessment of neural patterns provide more information on the live performance of skills. Assessment of friendship-making may also yield a more comprehensive picture of social functioning, and can include several options, like the assessment of quantity of friends, the types of behaviors involved in the initiation and maintenance of friendships, and it can also assess the *kinds* of friends a person is making, such as assessing whether they are making acquaintances or are developing relationships that involve a deeper sense of quality.

Additionally, the field must expand its assessment beyond the quantification of friendships and skills, but the characteristics of the friendships themselves. Work has shown that in autistic-dyad connections, less eye contact and facial expressions were correlated with *more* friendships (Granieri et al., 2020). Most of the existing measurements reviewed have been developed from a neurotypical lens, and understanding the behaviors involved in friendship-making in autism, and how they differ from non-autistic friendship development, is crucial. This is only possible while understanding, and evaluating, what types of skills are being performed to engage in and develop such relationships and how these converge and diverge from what is displayed in non-autistic people. Lastly, it is important to consider the extent to which we actually need to consider performance of skills, regardless level of knowledge. For example, if a child develops friendships but continues to appear to not “know” social skills, is it important to increase social knowledge? If meaningful connections are being made, and an individual is engaged in their environment to their desired extent, are social-knowledge strategies and the measurement of such knowledge, just encouraging and assessing for a person’s ability to pass as non-autistic? These are important considerations when thinking about and building social behavior.

## What can we gather from clinical interviews?

Improvements to assessment and measurement can help capture social competence more accurately, and utilizing multi-method strategies, which is common in broader clinical practice, may help. In clinical practice, evaluation of behaviors, such as social skills, does not solely use a knowledge-based method. During interviews, assessments, and observations, clinicians often gather information on what behaviors an individual does *as well as* how often they do such behaviors and how the individual feels about the behavior (e.g., if the behavior is successful at getting the outcome they want). Task-based measures of social interaction, like the Autism Diagnostic Observation Schedule, 2nd Edition (ADOS-2; Lord et al., 2012), capture both social knowledge and performance, allowing clinicians to observe not only an individual's skills within both domains but also any discrepancy in skill between the two. If a multi-method, performance-based approach to information gathering about behaviors is clinically standard, measurement and evaluation of social skills in autism, as well as design of social skill interventions, should also rise to these standards.

Further, it is important to gain information from multiple informants when assessing social competence and particularly prioritizing self-report of both the engagement in social skills and the importance of that social skill to that person. Studies have found scores of social functioning vary based on informant reports (Gates et al., 2017; Lerner, Calhoun, et al., 2012; McMahon & Solomon, 2015), and understanding the perspectives of these different individuals can help paint the picture of someone's social competence. For example, having a report of social engagement in school vs. home vs. work will help better elucidate the *contextual* factors that both encourage and impede social interaction for an individual.

Considerations of developmental appropriateness are needed, and specifically re-evaluation of what would be expected of a person to actually know and do. Both a five-year-old neurotypical and a five-year-old autistic child may not engage in a specific social skill such as shaking someone's hand when greeting them, yet autistic individuals are often expected to engage in social interactions that are actually *beyond* their chronological developmental level. This may, in turn, cause the autistic individual to stand out from their peers even more, further perpetuating social differences and possible isolation. Similarly with social knowledge, it begs the question if we are setting the expectations too high for autistic youth to "know" the "correct" answers to these social skills when non-autistic children are not always held to this same standard.

Lastly, it is important to consider what the desired outcome is and begin to shift this multi-method approach to orbit around these outcomes. As we have demonstrated, knowing more about social skills does not reliably translate to improved outcomes. Methodologies should focus on outcomes that are important to the individual and the community more broadly, such as decreased loneliness, depression, and anxiety, and increased connection and quality of friendship and social interactions.

## Considering co-occurring factors

A variety of co-occurring (i.e., factors not directly specific to the traits characteristic of autism that still may contribute to autism-related social differences) relevant to

social interaction are under-conceptualized when only social knowledge, but not social performance, is centered (Mundy et al., 2007). For example, a variety of internalizing symptoms and disorders which commonly co-occur in the autistic population (Lai et al., 2019) may interact with autism-related social difficulties to undermine social performance abilities. Anxiety in youth (Bellini, 2004) and adulthood (Maddox & White, 2015) as well as obsessive compulsive disorder (Chasson et al., 2011; Jansen et al., 2020; Jiujiyas et al., 2017) and mood disorders such as depression (Hudson et al., 2019) all may interfere with deployment of known social behaviors above and beyond the autism-related performance factors mentioned. For instance anhedonia, a core factor in depression, can lead to social inhibition and blunt the amount of pleasure one derives from social interactions (Hames et al., 2013; Neuhaus et al., 2019; Tse & Bond, 2004). Other cumulative life stressors, like adverse interpersonal experiences (Hoover, 2015; Kerns et al., 2015), peer victimization (Cappadocia et al., 2012; Schroeder et al., 2014), and PTSD and trauma-like symptoms (Couette et al., 2020; Haruvi-Lamdan et al., 2018; Hoover, 2015; Kerns et al., 2015; Scoglio et al., 2022), may impair social functioning and leave impressions upon autistic individuals that can make negative experiences salient and inhibit social performance. Overall, these internalizing factors can have major implications for social performance regardless of the amount of social knowledge one has.

Externalizing symptoms and co-occurring disorders in autism also serve as key modifier factors in the context of social performance in autism. Attention-deficit hyperactivity disorder (ADHD), highly prevalent among autistic people, is characterized by core factors such as hyperactivity, impulsivity, and attentional difficulties which are all factors that can stymie social performance despite efforts to effectively engage in social interactions (Harpin et al., 2016; Nixon, 2001). Many autistic people, regardless of meeting clinical thresholds for ADHD, experience difficulties with attention, impulsivity, and other forms of executive functioning such as cognitive flexibility, which can impede ability to perform socially, regardless of levels of social knowledge (Mikami et al., 2019; Roselló et al., 2017). Some autistic children also experience co-occurring externalizing conditions such as conduct disorder and oppositional defiant disorder (ODD), and/or have tendencies to exhibit aggressive behavior towards others (Kaat & Lecavalier, 2013). Attributing the social behaviors that stem from or may be exacerbated by the co-occurrence of these externalizing conditions with autism primarily or solely to knowledge deficits, would paint a wholly incomplete picture - in fact, many individuals who exhibit these types of externalizing behavior may socially perform in ways that explicitly and intentionally oppose the knowledge they have about what's socially "acceptable."

Difficulties regulating sensory input during social interactions are related to social competence in autistic youth (Hilton et al., 2007). A myriad of sensory-related experiences, such as audio, visual, olfactory, and interoceptive stimuli, may require additional regulatory and cognitive effort. The regulation of response to these external stimuli may impact the engagement in processes related to the social interaction, such as attending to complex combinations of subtle verbal and nonverbal cues, interpreting and processing cue, and formulating responses. These may inhibit interactions in specific settings, such as loud, crowded, or overwhelming environments and prohibit individuals from engaging

in environments where social interactions are frequent, such as cafeterias, movie theaters, birthday parties, and could contribute to missed opportunities for engagement.

### **When it is important (and necessary) to assess knowledge**

While we contend that, overall, it is less important to understand what a person knows as it is to understand what a person does (and in what), we do recognize several instances where it is necessary to assess social knowledge, and that it is, at times, important to explicitly intervene on these factors. Autistic individuals are at an increased risk of being abused (Hall-Lande et al., 2015), of having interactions with law enforcement (Copenhaver & Tewksbury, 2019), and of having difficulties safely navigating their communities (Kersten et al., 2020). In areas such as safety, privacy, employment, sexual and romantic relationships, and awareness of laws and interactions with law enforcement, autistic individuals likely require more explicit evaluation of their understanding of safety behaviors and explicit instruction in the recognition of unsafe behaviors in others. This might include evaluating what a person knows, and then aiming to increase understanding, awareness, and discrimination of dangerous situations, and what to do if they find themselves in these situations. For other scenarios, it may involve increasing awareness of their own behaviors, such as in sexual and romantic relationships, and when it comes to abiding by laws. However, in addition to this knowledge-based intervention, there should *also* be implementation of performance-based strategies and assessment of what performance-related factors may also impede a person from successfully navigating these situations. Again, knowledge here is necessary but not sufficient.

**Measurement and assessment in practice.**—It is likely that many clinicians reading this paper will recognize the application of many of the knowledge- and performance-based methods, whether formal or informal, in evaluating clients and attempting to assist in social interaction. Many may already be thinking about the importance of ensuring the maintenance of learned skills to actual social situations. An important takeaway that can be yielded from this review of the status of social competence is that emphasizing social knowledge is a potentially futile endeavor. The application of knowledge to the performance of social skills is not seamless in this population, thus, transitioning treatment and support to address these performance-based difficulties more effectively should be considered.

### **Implications for Treatment and Supports**

Understanding whether autistic social difficulties are derived from social knowledge or social performance difficulties provides direction for intervention content, such as providing social information that is absent versus determining factors that prevent enactment of known behaviors. Social skills interventions targeting social deficits in autistic individuals have existed for almost three decades (Mesibov, 1984). The status of social skills interventions was questionable in the late 90s, with one meta-analysis concluding they were ineffective (Kavale et al., 1997). Since, there has been a significant increase in research on these interventions (e.g., Lerner et al., 2014; Matson et al., 2007; Rao et al., 2008; Schreiber, 2011; White et al., 2007), with reviews and meta-analyses yielding heterogeneous and inconclusive results (Koenig et al., 2009) and showing moderate effectiveness (Gates et al.,

2017; Wolstencroft et al., 2018). Effect sizes have varied widely - from extremely small to large on standardized metrics - between studies, target outcomes (i.e., Theory of Mind, prosocial behavior, emotion recognition), populations (i.e., school- versus community-based, person-specific factors, across age groups), modalities (i.e., group versus individual), and methodologies (i.e. cognitive-behavioral, role play, peer modeling). Importantly, exploration of intervention effectiveness found differences in effect sizes across informants (i.e., who is reporting on social skills) and measurement tools — large effect sizes are driven solely by self-reported increases in social knowledge measurement, while tools that look at teacher, parent, and observational data, and do not explore social knowledge, find no change in intervention (Gates et al., 2017). In other words, increased knowing in these interventions is not translating to increased doing.

The clinical and theoretical importance of distinguishing between social knowledge- and performance-based deficits has been acknowledged for some time in clinical (e.g., Aduen et al., 2018; Wheeler & Carlson, 1994; Wheeler Maedgen & Carlson, 2000) and general populations (Gresham et al., 2010). Yet, this importance has been largely absent in work with autistic populations (Gates et al., 2017; Keifer et al., 2020; Koenig et al., 2009; Lerner et al., 2014), which has primarily provided knowledge-based interventions. This (minimally effective) method of attempting to ameliorate challenges has persisted despite work showing more intact social knowledge than previously hypothesized (Happé, 1995; Laugeson et al., 2009; Rump et al., 2009), and if children do not possess reliable social knowledge deficits, delivery of social knowledge-oriented interventions may be inappropriate and ineffective (Nixon, 2001). In fact, use of this approach can be counterproductive (Table 5).

Performance-based strategies have a common key feature: *never telling people “what to do” socially*. These types of interventions aim to facilitate opportunities for engagement in enriched, rewarding, *in-vivo* social interactions in a scaffolded environment, where *access* to peer interaction is accessible without explicit instruction on rules, norms, or how an interaction “should” go (Marro et al., 2019; McDonald et al., 2022). By providing this type of social environment, where individuals are able to interact in naturalistic and motivating interactions, people are able to construct social conventions and schemas without any didactic or explicit instruction, which have downstream impacts on social outcomes like engagement in and generalizability of prosocial behavior, increased friendship development, and engagement in social skills (Corbett et al., 2014, 2016; Lerner & Mikami, 2012). Below, we highlight the ways in which performance-based interventions can target performance-based factors hindering goal-directed social behavior.

### Social Creativity

Performance-based strategies to enhance social creativity, then, aim to promote generation of a wide and varied set of novel responses to (realistic or outlandish) social scenarios, regardless of their practical feasibility (Guli et al., 2008) to enhance preparedness for and responsiveness to unstructured interaction (Guli, 2004, p. 200; Guli et al., 2013). Likewise, by providing a broad sample of social behaviors and responses, these strategies may aid participants in considering novel social perspectives, thus promoting perspective-taking and emotion recognition (T. R. Goldstein & Winner, 2012). Crucially, these aim to promote



the spontaneous generation and execution of social responses without pre-specification of what such behaviors might look like (i.e., without specifically highlighting rules of “correct” social behavior), to preclude employment of the rigid, rules-based cognitive processing style. The performance-related factor of social creativity may lead to a limited and inflexible social behavioral repertoire that may leave the individual ill-prepared for the complexity of *in vivo* peer interactions (R. P. Hobson et al., 2009).

### Prediction

The factor of predictive impairment in autism, or the idea that autistic people have difficulty anticipating the probability of events occurring, may contribute to difficulties for autistic individuals to activate learned associations between social stimuli and behavior (Cannon et al., 2021; Sinha et al., 2014). Thus, the social environment may appear to be unpredictable and therefore an uncertain and anxiety-inducing experience. Performance-based strategies or interventions to enhance or support this unpredictable experience may include a variety of responses. First, having difficulty predicting the sequence of events may relate to social struggles. The unpredictable environment may become an anxiety-inducing experience, and many individuals might have increased intolerance of uncertainty in these environments. Theater-based and improvisation skills interventions apply exposure-based principles by creating various types of unpredictable social situations where individuals can practice social interactions in a safe and accepting environment (i.e., exposures). These types of interventions also pull from Acceptance and Commitment Therapy (ACT; Hayes et al., 1999) principles, such that individuals also learn they can handle the feeling of uncertainty (i.e., exposure to the feeling of uncertainty and sitting with the emotion).

### SIPS

The factor of slower SIPS may lead participants to fail to “catch” social information when it happens (McPartland et al., 2011; Mendelson et al., 2016), leaving autistic youth a fraction of a second behind in peer interactions. This may lead them to struggle to keep up in fluid peer settings, leading to downstream effects on prosocial behavior, encoding of social information, and perspective-taking. Strategies to enhance SIPS have participants quickly and repeatedly identify (Lerner et al., 2011) or discriminate between (Faja et al., 2012) social and emotional stimuli (e.g., faces), in hopes that this will accelerate their ability to automatically do so in social settings.

While strategies to remediate each of these factors may be considered atomistically, naturalistic social performance-training interventions aim to incorporate them in tandem during structured and unstructured games (Guli et al., 2008; Lerner & Levine, 2007). Additionally, social performance-training interventions do not require intervention activities to closely mirror “real life” social interactions, as they tend to prioritize motivated interactions and creative, rapid response over the use of accurate social scripts.

### What is the point of social intervention?

Is the goal of social intervention to teach individuals to engage in neurotypical interactions or fit into environments structured to exclude them ‘as is?’ Or is it to foster successful interaction, reduce loneliness, and increase development of meaningful social connections?

We have reviewed the impact of social-knowledge interventions on increasing robotic and mechanical interactions as well as the engagement of PAN (and the subsequent negative impact of engaging in such strategies; Chapman et al., 2022; Libsack et al., 2021; Miller et al., 2021) and the lack of generalizability of these skills to performance. If we are hoping to increase social connection, continuing to center social-knowledge in our interventions will continue to result in modest-at-best gains and harmful-at-worst outcomes (e.g., further ostracization). Focusing on performance-based strategies has the potential to both increase latent social knowledge *and* allow individuals to gain experience engaging in interactions in a variety of settings and develop skills related to areas of difficulty, such as increasing flexibility and creativity in social interactions, learning coping strategies to manage the uncertainty of social environments (that is often difficult for many to predict), and managing the contextual variability in real-world social interactions. By targeting social *interactions* over skills, individuals have the opportunity to engage in more social situations, learn from natural successes - and pitfalls - during these interaction practices (and do so in environments that are accepting, supportive, and understanding of autistic differences), and build confidence in their abilities to navigate the unpredictability of future social interactions.

### **Need for Person-centered, neurodiversity-affirming models and interventions**

While we have outlined the importance of performance-based interventions, there is also the need for person-centered, neurodiversity-aligned approaches to such interventions. Historically, successful social interactions have been characterized from a neurotypical lens, such that interaction behaviors have been defined by what is considered socially effective to *non-autistic* individuals. However, this (erroneously) assumes interaction behaviors that fall outside of these defined norms are not socially successful. Prior literature has shown autistic individuals have successful social interactions with other autistic individuals, even when using “atypical” behaviors (Heasman & Gillespie, 2019), and often effectively express social interest in uniquely autistic ways (Jaswal & Akhtar, 2019). Thus, performance-based interventions must also expand beyond the biases of promoting “typically” successful social interaction behaviors and create space - and acceptance - of successful social performance that may appear outside the norm. If the goal of performance-based social interventions is to foster successful interaction, reduce high rates of loneliness, and increase the development of meaningful social connections, we must also understand that successful social performance does not need to also look the same as it may for non-autistic individuals.

In this vein, neurodiversity-affirming models of and interventions for interpersonal functioning in autism must be informed by the concept of double empathy (Milton, 2012), which highlights the mutual role non-autistic people share with autistic people to produce effective social interactions. The historical tendency to assume social knowledge is one of the, if not the most, central factors in the interpersonal “success” or “failure” of autistic people, and the social interventions designed in alignment with this assumption, have arguably put disproportionate burden on autistic people to learn how to conform to neurotypical social standards. Meanwhile, not much emphasis, if any at all, has been placed on corresponding efforts to teach non-autistic people how to foster neurodiversity-affirming

social interactions or create environments that give autistic people the space they need to practice social performance of *genuinely* reciprocal interactions with others. Social interaction is a two-way street, and while it is true that the “real world” is not always too forgiving of non-conforming ways of socially interacting with others, and that it is unrealistic to assume it will be easy to quickly foster neurodiversity-affirming culture at large, it is nonetheless irresponsible for us, as researchers and clinicians in the autism field, to make autistic individuals change their social behavior without asking the non-autistic people around them to make an effort to meet them in the middle, and without scrutinizing neurotypical social norms and their necessity in the first place (Oliver, 2013).

### Key Principles and Conclusions

This review is meant to identify the current status and future directions of the literature regarding social knowledge and performance deficits in - and consequent model of and interventions for - autism. Several key principles emerge. First, it seems evident that *social knowledge is rarely enough*, either to understand and define autism, nor to achieve intended social outcomes. Second, *there are contexts where knowledge is primary, but they are the exception not the rule*. There certainly are situations - particularly related to safety or professional contexts - where explicit social knowledge is required, but they are relatively rare across the panoply of social life. Third, *performance is about what is getting in the way for a given person* - that is, it requires understanding what is getting in the way for a given individual at a given developmental stage. Mapping out the factors that function in this way provides a crucial and likely fruitful direction for the field. Fourth, *performance is intimately tied to context and situation* - individuals vary in their social behavior by context, and autistic individuals are no different in this way. Thus, future effort should continue to aim to identify the types of contexts that can be most effective for a given individual. Finally, *the goal of interventions is social connection, not appropriate social behaviors*. While both performance- and knowledge-based interventions (and approaches that mix both) will continue to abound and bear ongoing investigation, it is most essential to always keep in mind the central aim of intervention and study in this field: to facilitate effective, meaningful, rich, and reciprocal social interactions for autistic individuals, and to advance a social world that makes this easier for all to reach this goal.

### Acknowledgments

In the course of preparing this manuscript, Dr. Lerner received support from NIMH (grant R01MH110585; principal investigator: Lerner), the Health Resources and Services Administration (grant T73MC42026; principal investigator: Ballan).

### References

- Addington J, Saeedi H, & Addington D (2006). Influence of social perception and social knowledge on cognitive and social functioning in early psychosis. *The British Journal of Psychiatry*, 189(4), 373–378. [PubMed: 17012662]
- Aduen PA, Day TN, Kofler MJ, Harmon SL, Wells EL, & Sarver DE (2018). Social Problems in ADHD: Is it a Skills Acquisition or Performance Problem? *J Psychopathol Behav Assess*, 40(3), 440–451. 10.1007/s10862-018-9649-7 [PubMed: 30287981]

- Amoruso L, Narzisi A, Pinzino M, Finisguerra A, Billeci L, Calderoni S, Fabbro F, Muratori F, Volzone A, & Urgesi C (2019). Contextual priors do not modulate action prediction in children with autism. *Proceedings of the Royal Society B*, 286(1908), 20191319. [PubMed: 31409253]
- Andari E, Duhamel J-R, Zalla T, Herbrecht E, Leboyer M, & Sirigu A (2010). Promoting social behavior with oxytocin in high-functioning autism spectrum disorders. *Proceedings of the National Academy of Sciences*, 107(9), 4389–4394.
- Attwood T (2000). Strategies for improving the social integration of children with Asperger syndrome. *Autism*, 4(1), 85–100.
- Baker J, & Myles BS (2003). *Social Skills Training for Children and Adolescents with Asperger Syndrome and Social-communication Problems*. Autism Asperger Publishing Company.
- Bal E, Harden E, Lamb D, Van Hecke AV, Denver JW, & Porges SW (2010). Emotion recognition in children with autism spectrum disorders: Relations to eye gaze and autonomic state. *Journal of Autism and Developmental Disorders*, 40, 358–370. [PubMed: 19885725]
- Balsters JH, Apps MA, Bolis D, Lehner R, Gallagher L, & Wenderoth N (2017). Disrupted prediction errors index social deficits in autism spectrum disorder. *Brain*, 140(1), 235–246. [PubMed: 28031223]
- Baron-Cohen S (1989). The autistic child's theory of mind: A case of specific developmental delay. *J Child Psychol Psychiatry*, 30(2), 285–297. 10.1111/j.1469-7610.1989.tb00241.x [PubMed: 2523408]
- Baron-Cohen S, & Belmonte MK (2005). Autism: A window onto the development of the social and the analytic brain. *Annu. Rev. Neurosci*, 28, 109–126. [PubMed: 16033325]
- Baron-Cohen S, Leslie AM, & Frith U (1985). Does the autistic child have a “theory of mind”? *Cognition*, 21(1), 37–46. [PubMed: 2934210]
- Barzy M, Black J, Williams D, & Ferguson HJ (2020). Autistic adults anticipate and integrate meaning based on the speaker's voice: Evidence from eye-tracking and event-related potentials. *Journal of Experimental Psychology: General*, 149(6), 1097. [PubMed: 31714095]
- Batty M, Meaux E, Wittmeyer K, Rogé B, & Taylor MJ (2011). Early processing of emotional faces in children with autism: An event-related potential study. *Journal of Experimental Child Psychology*, 109(4), 430–444. [PubMed: 21458825]
- Batty M, & Taylor MJ (2006). The development of emotional face processing during childhood. *Developmental Science*, 9(2), 207–220. [PubMed: 16472321]
- Bauminger N (2002). The facilitation of social-emotional understanding and social interaction in high-functioning children with autism: Intervention outcomes. *Journal of Autism and Developmental Disorders*, 32, 283–298. [PubMed: 12199133]
- Beck JS, Lundwall RA, Gabrielsen T, Cox JC, & South M (2020). Looking good but feeling bad: “Camouflaging” behaviors and mental health in women with autistic traits. *Autism*, 24(4), 809–821. [PubMed: 32429817]
- Bellini S (2004). Social skill deficits and anxiety in high-functioning adolescents with autism spectrum disorders. *Focus on Autism and Other Developmental Disabilities*, 19(2), 78–86.
- Bentin S, Allison T, Puce A, Perez E, & McCarthy G (1996). Electrophysiological studies of face perception in humans. *Journal of Cognitive Neuroscience*, 8(6), 551–565. 10.1162/jocn.1996.8.6.551 [PubMed: 20740065]
- Bishop-Fitzpatrick L, Mazefsky CA, Eack SM, & Minshew NJ (2017). Correlates of Social Functioning in Autism Spectrum Disorder: The Role of Social Cognition. *Res Autism Spectr Disord*, 35, 25–34. 10.1016/j.rasd.2016.11.013 [PubMed: 28839456]
- Blau VC, Maurer U, Tottenham N, & McCandliss BD (2007). The face-specific N170 component is modulated by emotional facial expression. *Behavioral and Brain Functions*, 3(1), 1–13. [PubMed: 17214890]
- Bottema-Beutel K, Haerin P, & Kim SY (2018). Commentary on Social Skills Training Curricula for Individuals with ASD: Social Interaction, Authenticity, and Stigma. *Journal of Autism and Developmental Disorders*, 48, 953–964. 10.1007/s10803-017-3400-1 [PubMed: 29170937]
- Bottema-Beutel K, Mullins TS, Harvey MN, Gustafson JR, & Carter EW (2016). Avoiding the “brick wall of awkward”: Perspectives of youth with autism spectrum disorder on social-focused intervention practices. *Autism*, 20(2), 196–206. 10.1177/1362361315574888 [PubMed: 25882390]

- Bye L, & Jussim L (1993). A Proposed Model for the Acquisition of Social Knowledge and Social Competence. *Psychology in the Schools*, 30, 143–161.
- Cage E, & Troxell-Whitman Z (2019). Understanding the reasons, contexts and costs of camouflaging for autistic adults. *Journal of Autism and Developmental Disorders*, 49(5), 1899–1911. [PubMed: 30627892]
- Cannon J,O',B, Bungert L, & Sinha P (2021). Prediction in autism spectrum disorder: A systematic review of empirical evidence. *Autism Research*, 14(4), 604–630. 10.1002/aur.2482 [PubMed: 33570249]
- Cappadocia MC, Weiss JA, & Pepler D (2012). Bullying experiences among children and youth with autism spectrum disorders. *Journal of Autism and Developmental Disorders*, 42, 266–277. [PubMed: 21499672]
- Cassidy S, Gould K, Townsend E, Pelton M, Robertson A, & Rodgers J (2020). Is camouflaging autistic traits associated with suicidal thoughts and behaviours? Expanding the interpersonal psychological theory of suicide in an undergraduate student sample. *Journal of Autism and Developmental Disorders*, 50, 3638–3648. [PubMed: 31820344]
- Chambon V, Farrer C, Pacherie E, Jacquet PO, Leboyer M, & Zalla T (2017). Reduced sensitivity to social priors during action prediction in adults with autism spectrum disorders. *Cognition*, 160, 17–26. [PubMed: 28039782]
- Chapman L, Rose K, Hull L, & Mandy W (2022). “I want to fit in... but I don't want to change myself fundamentally”: A qualitative exploration of the relationship between masking and mental health for autistic teenagers. *Research in Autism Spectrum Disorders*, 99, 102069.
- Chasson GS, Timpano KR, Greenberg JL, Shaw A, Singer T, & Wilhelm S (2011). Shared social competence impairment: Another link between the obsessive-compulsive and autism spectrums? *Clinical Psychology Review*, 31(4), 653–662. [PubMed: 21482323]
- Cook J, Hull L, Crane L, & Mandy W (2021). Camouflaging in autism: A systematic review. *Clinical Psychology Review*, 89, 102080. [PubMed: 34563942]
- Copenhaver A, & Tewksbury R (2019). Interactions between autistic individuals and law enforcement: A mixed-methods exploratory study. *American Journal of Criminal Justice*, 44, 309–333.
- Corbett BA, Key AP, Qualls L, Fecteau S, Newsom C, Coke C, & Yoder P (2016). Improvement in Social Competence Using a Randomized Trial of a Theatre Intervention for Children with Autism Spectrum Disorder. *Journal of Autism and Developmental Disorders*, 46(2), 658–672. 10.1007/s10803-015-2600-9 [PubMed: 26419766]
- Corbett BA, Swain DM, Coke C, Simon D, Newsom C, Houchins-Juarez N, Jenson A, Wang L, & Song Y (2014). Improvement in social deficits in autism spectrum disorders using a theatre-based, peer-mediated intervention. *Autism Research*, 7(1), 4–16. [PubMed: 24150989]
- Couette M, Mouchabac S, Bourla A, Nuss P, & Ferreri F (2020). Social cognition in post-traumatic stress disorder: A systematic review. *British Journal of Clinical Psychology*, 59(2), 117–138. [PubMed: 31696974]
- Crick N, & Dodge K (1994). A Review and Reformulation of Social Information-Processing Mechanisms in Children's Social Adjustment. *Psychological Bulletin*, 115(1), 74–101. 10.1037/0033-2909.115.1.74
- Dawson G, Carver L, Meltzoff AN, Panagiotides H, McPartland J, & Webb SJ (2002). Neural correlates of face and object recognition in young children with autism spectrum disorder, developmental delay, and typical development. *Child Development*, 73(3), 700–717. [PubMed: 12038546]
- Dawson G, Webb SJ, Carver L, Panagiotides H, & McPartland J (2004). Young children with autism show atypical brain responses to fearful versus neutral facial expressions of emotion. *Developmental Science*, 7(3), 340–359. [PubMed: 15595374]
- Dawson G, Webb SJ, & McPartland J (2005). Understanding the nature of face processing impairment in autism: Insights from behavioral and electrophysiological studies. *Developmental Neuropsychology*, 27(3), 403–424. [PubMed: 15843104]
- De Boo GM, & Prins PJ (2007). Social incompetence in children with ADHD: Possible moderators and mediators in social-skills training. *Clinical Psychology Review*, 27(1), 78–97. [PubMed: 16814435]

- De Jong T, & Ferguson-Hessler MG (1996). Types and qualities of knowledge. *Educational Psychologist*, 31(2), 105–113.
- Deckers A, Muris P, & Roelofs J (2017). Being on your own or feeling lonely? Loneliness and other social variables in youths with autism spectrum disorders. *Child Psychiatry & Human Development*, 48, 828–839. [PubMed: 28070762]
- Dienes Z, & Perner J (1999). A theory of implicit and explicit knowledge. *Behavioral and Brain Sciences*, 22(5), 735–808. [PubMed: 11301570]
- Ewbank MP, Pell PJ, Powell TE, Von dem Hagen EA, Baron-Cohen S, & Calder AJ (2017). Repetition suppression and memory for faces is reduced in adults with autism spectrum conditions. *Cerebral Cortex*, 27(1), 92–103. [PubMed: 27909005]
- Faja S, Webb SJ, Jones E, Merkle K, Kamara D, Bavaro J, Aylward E, & Dawson G (2012). The effects of face expertise training on the behavioral performance and brain activity of adults with high functioning autism spectrum disorders. *Journal of Autism and Developmental Disorders*, 42, 278–293. [PubMed: 21484517]
- Fischer G, Giacardi E, Eden H, Sugimoto M, & Ye Y (2005). Beyond binary choices: Integrating individual and social creativity. *International Journal of Human-Computer Studies*, 63(4–5), 482–512.
- Foti F, De Crescenzo F, Vivanti G, Menghini D, & Vicari S (2015). Implicit learning in individuals with autism spectrum disorders: A meta-analysis. *Psychological Medicine*, 45(5), 897–910. [PubMed: 25126858]
- Frankel F, Myatt R, Sugar C, Whitham C, Gorospe CM, & Laugeson E (2010). A randomized controlled study of parent-assisted children’s friendship training with children having autism spectrum disorders. *Journal of Autism and Developmental Disorders*, 40, 827–842. [PubMed: 20058059]
- Freden CE, Gates JA, Hauschild KM, Libsack EJ, McNair ML, & Lerner MD (n.d.). Social performance, but not social knowledge, predicts autism. In Preparation.
- Gates JA, Gerber AH, Miller CE, & Lerner MD (2022). Quantifying Social Skill Deficits and Strengths Profiles in Autistic Youth. *Child Development*.
- Gates JA, Kang E, & Lerner MD (2017). Efficacy of group social skills interventions for youth with autism spectrum disorder: A systematic review and meta-analysis. *Clinical Psychology Review*, 52, 164–181. 10.1016/j.cpr.2017.01.006 [PubMed: 28130983]
- Georgopoulos MA, Brewer N, Lucas CA, & Young RL (2022). Speed and accuracy of emotion recognition in autistic adults: The role of stimulus type, response format, and emotion. *Autism Research*, 15(9), 1686–1697. [PubMed: 35338609]
- Goldstein AP, & McGinnis E (1997). *Skillstreaming the adolescent: New strategies and perspectives for teaching prosocial skills*. Research Press.
- Goldstein TR, & Winner E (2012). Enhancing empathy and theory of mind. *Journal of Cognition and Development*, 13(1), 19–37.
- Gomot M, & Wicker B (2012). A challenging, unpredictable world for people with autism spectrum disorder. *International Journal of Psychophysiology*, 83(2), 240–247. [PubMed: 21968196]
- Granieri JE, McNair ML, Gerber AH, Reifler RF, & Lerner MD (2020). Atypical social communication is associated with positive initial impressions among peers with autism spectrum disorder. *Autism*, 24(7), 1841–1848. [PubMed: 32498545]
- Green CC, Brown NJ, Yap VM, Scheffer IE, & Wilson SJ (2020). Cognitive processes predicting advanced theory of mind in the broader autism phenotype. *Autism Research*, 13(6), 921–934. [PubMed: 31566923]
- Greenspan SI, & Wieder S (1998). *The developmental individual-difference relationship-based (DIR) model*. Bethesda, MD: The Interdisciplinary Council on Developmental and Learning Disorders.
- Gresham FM (1981). Assessment of Children’s Social Skills. *Journal of School Psychology*, 19(2). 10.1016/0022-4405(81)90054-6
- Gresham FM (1997). Social competence and students with behavior disorders: Where we’ve been, where we are, and where we should go. *Education and Treatment of Children*, 233–249.
- Gresham FM (2016). *Social Skills Assessment and Intervention for Children and Youth*. Cambridge Journal of Education, 46(3), 319–332. 10.1080/0305764x.2016.1195788



- Gresham FM, & Elliott SN (2008). Social Skills Improvement System—Rating Scales. NCS Pearson.
- Gresham FM, Elliott SN, & Kettler RJ (2010). Base rates of social skills acquisition/performance deficits, strengths, and problem behaviors: An analysis of the Social Skills Improvement System—Rating Scales. *Psychol Assess*, 22(4), 809–815. 10.1037/a0020255 [PubMed: 20804259]
- Guivarch J, Murdmootoo V, Elissalde SN, Salle-Collemiche X, Tardieu S, Jouve E, & Poinso F (2017). Impact of an implicit social skills training group in children with autism spectrum disorder without intellectual disability: A before-and-after study. *PLoS One*, 12(7), e0181159. 10.1371/journal.pone.0181159 [PubMed: 28715464]
- Guli LA (2004). The effects of creative drama-based intervention for children with deficits in social perception. The University of Texas at Austin.
- Guli LA, Semrud-Clikeman M, Lerner MD, & Britton N (2013). Social Competence Intervention Program (SCIP): A pilot study of a creative drama program for youth with social difficulties. *The Arts in Psychotherapy*, 40(1), 37–44.
- Guli LA, Wilkinson AD, & Semrud-Clikeman M (2008). SCIP, Social Competence Intervention Program: A drama-based intervention for youth on the autism spectrum. Research Press.
- Gutstein SE, Burgess AF, & Montfort K (2007). Evaluation of the relationship development intervention program. *Autism*, 11(5), 397–411. [PubMed: 17942454]
- Haigh SM, Walsh JA, Mazefsky CA, Minshew NJ, & Eack SM (2018). Processing speed is impaired in adults with autism spectrum disorder, and relates to social communication abilities. *Journal of Autism and Developmental Disorders*, 48, 2653–2662. [PubMed: 29500756]
- Hall-Lande J, Hewitt A, Mishra S, Piescher K, & LaLiberte T (2015). Involvement of children with autism spectrum disorder (ASD) in the child protection system. *Focus on Autism and Other Developmental Disabilities*, 30(4), 237–248.
- Hambrick DZ, & Meinz EJ (2011). Limits on the Predictive Power of Domain-Specific Experience and Knowledge in Skilled Performance. *Current Directions in Psychological Science*, 20(5), 275–279. 10.1177/0963721411422061
- Hames JL, Hagan CR, & Joiner TE (2013). Interpersonal processes in depression. *Annual Review of Clinical Psychology*, 9, 355–377.
- Happé FG (1995). The role of age and verbal ability in the theory of mind task performance of subjects with autism. *Child Development*, 66(3), 843–855. [PubMed: 7789204]
- Harms MB, Martin A, & Wallace GL (2010). Facial emotion recognition in autism spectrum disorders: A review of behavioral and neuroimaging studies. *Neuropsychology Review*, 20, 290–322. [PubMed: 20809200]
- Harpin V, Mazzone L, Raynaud J, Kahle J, & Hodgkins P (2016). Long-term outcomes of ADHD: a systematic review of self-esteem and social function. *Journal of Attention Disorders*, 20(4), 295–305. [PubMed: 23698916]
- Haruvi-Lamdan N, Horesh D, & Golan O (2018). PTSD and autism spectrum disorder: Comorbidity, gaps in research, and potential shared mechanisms. *Psychological Trauma: Theory, Research, Practice, and Policy*, 10(3), 290. [PubMed: 28726442]
- Hayes SC, Strosahl KD, & Wilson KG (1999). Acceptance and commitment therapy. Guilford press New York.
- Heasman B, & Gillespie A (2019). Neurodivergent intersubjectivity: Distinctive features of how autistic people create shared understanding. *Autism*, 23(4), 910–921. [PubMed: 30073872]
- Herbert MR & others. (2005). Autism: A brain disorder or a disorder that affects the brain. *Clinical Neuropsychiatry*, 2(6), 354–379.
- Hilton C, Graver K, & LaVesser P (2007). Relationship between social competence and sensory processing in children with high functioning autism spectrum disorders. *Research in Autism Spectrum Disorders*, 1(2), 164–173.
- Hobson JA, Hobson RP, Malik S, Bargiota K, & Caló S (2013). The relation between social engagement and pretend play in autism. *British Journal of Developmental Psychology*, 31(1), 114–127. [PubMed: 23331110]
- Hobson RP (2014). The coherence of autism. *Autism*, 18(1), 6–16. 10.1177/1362361313497538 [PubMed: 24151128]

- Hobson RP, Lee A, & Hobson JA (2009). Qualities of symbolic play among children with autism: A social-developmental perspective. *Journal of Autism and Developmental Disorders*, 39, 12–22. [PubMed: 18509752]
- Hoover DW (2015). The effects of psychological trauma on children with autism spectrum disorders: A research review. *Review Journal of Autism and Developmental Disorders*, 2, 287–299.
- Howlin P (1999). *Children with autism and Asperger syndrome: A guide for practitioners and carers*. Wiley.
- Hoyt E, Kang H, & Swain J (2006). *Unwritten Rules of Social Relationships: Decoding Social Mysteries through the Unique Perspectives of Autism*.
- Hudson CC, Hall L, & Harkness KL (2019). Prevalence of depressive disorders in individuals with autism spectrum disorder: A meta-analysis. *Journal of Abnormal Child Psychology*, 47, 165–175. [PubMed: 29497980]
- Hull L, Petrides K, Allison C, Smith P, Baron-Cohen S, Lai M-C, & Mandy W (2017). “Putting on my best normal”: Social camouflaging in adults with autism spectrum conditions. *Journal of Autism and Developmental Disorders*, 47, 2519–2534. [PubMed: 28527095]
- Hutchins TL, Prelock PA, & Bonazinga L (2012). Psychometric evaluation of the Theory of Mind Inventory (ToMI): A study of typically developing children and children with autism spectrum disorder. *Journal of Autism and Developmental Disorders*, 42, 327–341. [PubMed: 21484516]
- Jansen M, Overgaauw S, & De Bruijn ER (2020). Social cognition and obsessive-compulsive disorder: A review of subdomains of social functioning. *Frontiers in Psychiatry*, 118.
- Jaswal VK, & Akhtar N (2019). Being versus appearing socially uninterested: Challenging assumptions about social motivation in autism. *Behavioral and Brain Sciences*, 42. 10.1017/S0140525X18001826
- Jiujias M, Kelley E, & Hall L (2017). Restricted, repetitive behaviors in autism spectrum disorder and obsessive-compulsive disorder: A comparative review. *Child Psychiatry & Human Development*, 48, 944–959. [PubMed: 28281020]
- Kaat AJ, & Lecavalier L (2013). Disruptive behavior disorders in children and adolescents with autism spectrum disorders: A review of the prevalence, presentation, and treatment. *Research in Autism Spectrum Disorders*, 7(12), 1579–1594.
- Kang E, Keifer CM, Levy EJ, Foss-Feig JH, McPartland JC, & Lerner MD (2018). Atypicality of the N170 event-related potential in autism spectrum disorder: A meta-analysis. *Biological Psychiatry: Cognitive Neuroscience and Neuroimaging*, 3(8), 657–666. [PubMed: 30092916]
- Kang E, Lerner MD, & Gadow KD (2023). The Importance of Parent-Teacher Informant Discrepancy in Characterizing Autistic Youth: A Replication Latent Profile Analysis. *Journal of Clinical Child & Adolescent Psychology*, 52(1), 108–118. 10.1080/15374416.2022.2154217 [PubMed: 36548459]
- Kanner L (1943). Autistic disturbances of affective contact. *Nervous Child*, 2(3), 217–250.
- Kasari C, & Patterson S (2012). Interventions addressing social impairment in autism. *Current Psychiatry Reports*, 14, 713–725. [PubMed: 23055002]
- Kasari C, & Sterling L (2013). Loneliness and social isolation in children with autism spectrum disorders. *The Handbook of Solitude: Psychological Perspectives on Social Isolation, Social Withdrawal, and Being Alone*, 409–426.
- Kavale K, Mathur S, Forness S, Rutherford R, & Quinn M (1997). Effectiveness of social skills training for students with behavior disorders: A meta-analysis. *Advances in Learning and Behavioral Disabilities*, 11, 1–26.
- Keifer CM, Mikami AY, Morris JP, Libsack EJ, & Lerner MD (2020). Prediction of social behavior in autism spectrum disorders: Explicit versus implicit social cognition. *Autism*, 24(7), 1758–1772. 10.1177/1362361320922058 [PubMed: 32484000]
- Kerns CM, Newschaffer CJ, & Berkowitz SJ (2015). Traumatic childhood events and autism spectrum disorder. *Journal of Autism and Developmental Disorders*, 45, 3475–3486. [PubMed: 25711547]
- Kersten ML, Coxon K, Lee H, & Wilson NJ (2020). Traversing the community is uncertain, socially complex and exhausting: Autistic youth describe experiences of traveling to participate in their communities. *Journal of Transport & Health*, 18, 100922.

- Klein PD (1971). A Proposed Definition of Propositional Knowledge. *The Journal of Philosophy*, 68(16), 471–482. 10.2307/2024845
- Klin A, Jones W, Schultz R, & Volkmar F (2003). The enactive mind, or from actions to cognition: Lessons from autism. *Philosophical Transactions of the Royal Society of London. Series B: Biological Sciences*, 358, 345–360. [PubMed: 12639332]
- Koenig K, De Los Reyes A, Cicchetti D, Scchill L, & Klin A (2009). Group intervention to promote social skills in school-age children with pervasive developmental disorders: Reconsidering efficacy. *J Autism Dev Disord*, 39(8), 1163–1172. 10.1007/s10803-009-0728-1 [PubMed: 19326199]
- Kofler MJ, Rapport MD, Bolden J, Sarver DE, Raiker JS, & Alderson RM (2011). Working memory deficits and social problems in children with ADHD. *Journal of Abnormal Child Psychology*, 39, 805–817. [PubMed: 21468668]
- Kolesnik A, Begum Ali J, Gliga T, Guiraud J, Charman T, Johnson MH, Jones EJ, & Team B (2019). Increased cortical reactivity to repeated tones at 8 months in infants with later ASD. *Translational Psychiatry*, 9(1), 46. [PubMed: 30700699]
- Krasny L, Williams BJ, Provencal S, & Ozonoff S (2003). Social skills interventions for the autism spectrum: Essential ingredients and a model curriculum. *Child and Adolescent Psychiatric Clinics*, 12(1), 107–122.
- Kunze L, & Mesibov GB (1998). Educational approaches to high-functioning autism and Asperger syndrome. *Asperger Syndrome or High-Functioning Autism?*, 227–261.
- Lai M-C, Hull L, Mandy W, Chakrabarti B, Nordahl CW, Lombardo MV, Ameis SH, Szatmari P, Baron-Cohen S, Happé F, & others. (2021). Commentary: ‘Camouflaging’ in autistic people—reflection on Fombonne (2020). *Journal of Child Psychology and Psychiatry*, 62(8).
- Lai M-C, Kasseh C, Besney R, Bonato S, Hull L, Mandy W, Szatmari P, & Ameis SH (2019). Prevalence of co-occurring mental health diagnoses in the autism population: A systematic review and meta-analysis. *The Lancet Psychiatry*, 6(10), 819–829. [PubMed: 31447415]
- Lai M-C, Lombardo MV, Ruijgrok AN, Chakrabarti B, Auyeung B, Szatmari P, Happé F, Baron-Cohen S, & Consortium MA (2017). Quantifying and exploring camouflaging in men and women with autism. *Autism*, 21(6), 690–702. [PubMed: 27899710]
- Laugeson EA, Frankel F, Gantman A, Dillon AR, & Mogil C (2012). Evidence-based social skills training for adolescents with autism spectrum disorders: The UCLA PEERS program. *Journal of Autism and Developmental Disorders*, 42, 1025–1036. [PubMed: 21858588]
- Laugeson EA, Frankel F, Mogil C, & Dillon AR (2009). Parent-assisted social skills training to improve friendships in teens with autism spectrum disorders. *Journal of Autism and Developmental Disorders*, 39, 596–606. [PubMed: 19015968]
- Lavoie M-A, Battaglia M, & Achim AM (2014). A meta-analysis and scoping review of social cognition performance in social phobia, posttraumatic stress disorder and other anxiety disorders. *Journal of Anxiety Disorders*, 28(2), 169–177. [PubMed: 24239443]
- Lerner MD (2013). Knowledge or performance—Why youth with autism experience social problems. University of Virginia.
- Lerner MD, Calhoun CD, Mikami AY, & De Los Reyes A (2012). Understanding parent–child social informant discrepancy in youth with high functioning autism spectrum disorders. *Journal of Autism and Developmental Disorders*, 42, 2680–2692. [PubMed: 22456819]
- Lerner MD, De Los Reyes A, Drabick DAG, Gerber AH, & Gadow KD (2017). Informant discrepancy defines discrete, clinically useful autism spectrum disorder subgroups. *Journal of Child Psychology and Psychiatry*, 58(7), 829–839. 10.1111/jcpp.12730 [PubMed: 28449247]
- Lerner MD, & Girard RM (2018). Appreciating and Promoting Social Creativity in Youth with Asperger’s Syndrome. In Kaufman SB (Ed.), *Twice Exceptional: Supporting and Educating Bright and Creative Students with Learning Difficulties*. Oxford University Press.
- Lerner MD, Hutchins TL, & Prelock PA (2011). Brief report: Preliminary evaluation of the theory of mind inventory and its relationship to measures of social skills. *Journal of Autism and Developmental Disorders*, 41, 512–517. [PubMed: 20628800]

- Lerner MD, & Levine K (2007). The Spotlight Program: An integrative approach to teaching social pragmatics using dramatic principles and techniques. *Journal of Developmental Processes*, 91, 91–102.
- Lerner MD, McMahon CM, & Britton N (2014). Autism spectrum disorder in adolescents: Promoting social and emotional development. In *Encyclopedia of Primary Prevention and Health Promotion: Adolescence* (2nd ed., Vol. 3). Springer.
- Lerner MD, McPartland JC, & Morris JP (2013). Multimodal emotion processing in autism spectrum disorders: An event-related potential study. *Developmental Cognitive Neuroscience*, 3, 11–21. [PubMed: 23245216]
- Lerner MD, & Mikami AY (2012). A preliminary randomized controlled trial of two social skills interventions for youth with high-functioning autism spectrum disorders. *Focus on Autism and Other Developmental Disorders*, 27(3), 147–157. 10.1177/1088357612450613
- Lerner MD, & White SW (2015). Moderators and mediators of treatments for youth with autism spectrum disorders. In Marija M, Prins PJM, & Ollendick TH (Eds.), *Moderators and Mediators of Youth Treatment Outcomes* (p. 146). Oxford University Press.
- Lerner MD, White SW, & McPartland JC (2012). Mechanisms of change in psychosocial interventions for autism spectrum disorders. *Dialogues Clin Neurosci*, 14(3), 307–318. [PubMed: 23226955]
- Libsack EJ, Keenan EG, Freden CE, Mirmina J, & Iskhakov N (2021). A Systematic Review of Passing as Non-autistic in Autism Spectrum Disorder. *Clinical Child and Family Psychology Review*, 1–30. [PubMed: 33428069]
- Livingston LA, & Happé F (2017). Conceptualising compensation in neurodevelopmental disorders: Reflections from autism spectrum disorder. *Neuroscience & Biobehavioral Reviews*, 80, 729–742. [PubMed: 28642070]
- Lord C, Rutter M, DiLavore PC, Risi S, Gotham K, & Bishop SL (2012). Autism diagnostic observation schedule, (ADOS-2) modules 1–4. Western Psychological Services.
- Lozier LM, Vanmeter JW, & Marsh AA (2014). Impairments in facial affect recognition associated with autism spectrum disorders: A meta-analysis. *Developmental and Psychopathology*, 26(4 Pt 1), 933–945. 10.1017/S0954579414000479
- Maddox BB, & White SW (2015). Comorbid social anxiety disorder in adults with autism spectrum disorder. *Journal of Autism and Developmental Disorders*, 45, 3949–3960. [PubMed: 26243138]
- Marro BM, Kang E, Hauschild KM, Normansell KM, Abu-Ramadan TM, & Lerner MD (2019). Social performance-based interventions promote gains in social knowledge in the absence of explicit training for youth with autism spectrum disorder. *Bull Menninger Clin*, 83(3), 301–325. 10.1521/bumc.2019.83.3.301 [PubMed: 31502873]
- Matson JL, Matson ML, & Rivet TT (2007). Social-skills treatments for children with autism spectrum disorders: An overview. *Behav Modif*, 31(5), 682–707. 10.1177/0145445507301650 [PubMed: 17699124]
- Mazefsky CA, Herrington J, Siegel M, Scarpa A, Maddox BM, Scahill L, & White S (2013). The Role of Emotion Regulation in Autism Spectrum Disorder. *Journal of the American Academy of Child & Adolescent Psychiatry*, 52(7), 679–688. [PubMed: 23800481]
- McDonald RG, Khawar S, Yacoub N, Cargill MI, Lerner MD, & Kang E (2022). Performance-and Theater-Based Interventions for Supporting Social Cognition and Social Communication in Autistic Youth: A Review and Theoretical Synthesis. *Seminars in Speech and Language*, 43(04), 255–276. [PubMed: 35896405]
- McKone E, Kanwisher N, & Duchaine BC (2007). Can generic expertise explain special processing for faces? *Trends in Cognitive Sciences*, 11(1), 8–15. [PubMed: 17129746]
- McMahon CM, Lerner MD, & Britton N (2013). Group-based social skills interventions for adolescents with higher-functioning autism spectrum disorder: A review and looking to the future. *Adolesc Health Med Ther*, 2013(4), 23–28. 10.2147/AHMT.S25402 [PubMed: 23956616]
- McMahon CM, & Solomon M (2015). Brief report: Parent–adolescent informant discrepancies of social skill importance and social skill engagement for higher-functioning adolescents with autism spectrum disorder. *Journal of Autism and Developmental Disorders*, 45, 3396–3403. [PubMed: 26077952]

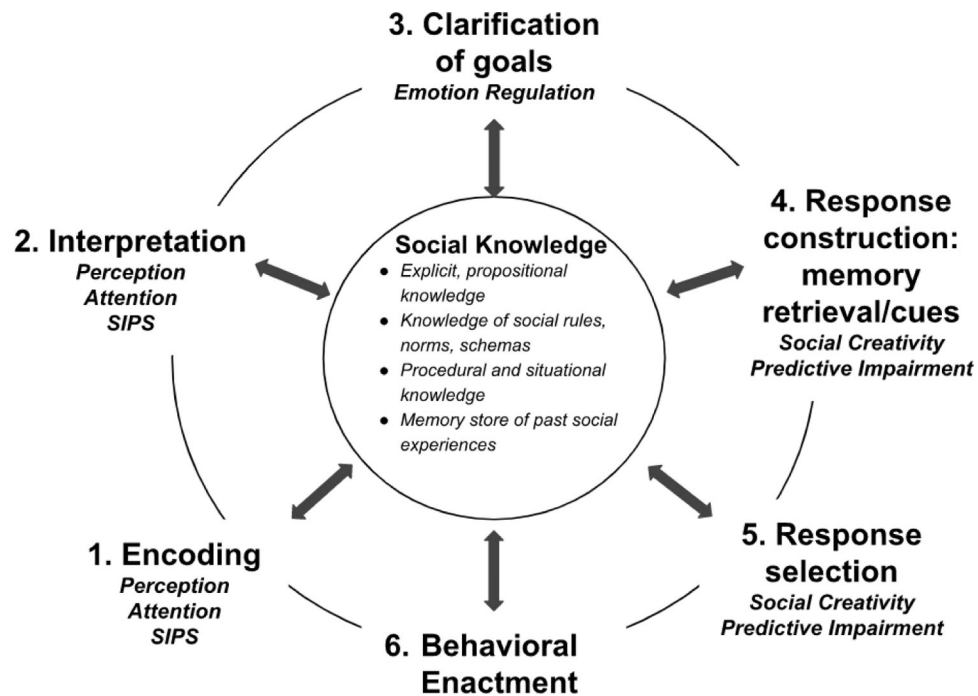
- McPartland JC, & Pelphrey KA (2012). The implications of social neuroscience for social disability. *Journal of Autism and Developmental Disorders*, 42, 1256–1262. [PubMed: 22456816]
- McPartland JC, Wu J, Bailey CA, Mayes LC, Schultz RT, & Klin A (2011). Atypical neural specialization for social percepts in autism spectrum disorder. *Social Neuroscience*, 6(5–6), 436–451. [PubMed: 21777159]
- Mendelson JL, Gates JA, & Lerner MD (2016). Friendship in school-age boys with autism spectrum disorders: A meta-analytic summary and developmental, process-based model. *Psychol Bull*, 142(6), 601–622. 10.1037/bul0000041 [PubMed: 26752425]
- Mesibov GB (1984). Social skills training with verbal autistic adolescents and adults: A program model. *J Autism Dev Disord*, 14(4), 395–404. 10.1007/BF02409830 [PubMed: 6520094]
- Michelson L, & Wood R (1982). Development and psychometric properties of the Children's Assertive Behavior Scale. *Journal of Behavioral Assessment*, 4, 3–13.
- Mikami AY, Miller M, & Lerner MD (2019). Social functioning in youth with attention-deficit/hyperactivity disorder and autism spectrum disorder: Transdiagnostic commonalities and differences. *Clinical Psychology Review*, 68, 54–70. 10.1016/j.cpr.2018.12.005 [PubMed: 30658861]
- Miller D, Rees J, & Pearson A (2021). "Masking is life": Experiences of masking in autistic and nonautistic adults. *Autism in Adulthood*, 3(4), 330–338. [PubMed: 36601640]
- Milton DE (2012). On the ontological status of autism: The 'double empathy problem.' *Disability & Society*, 27(6), 883–887.
- Mouchiroud C, & Bernoussi A (2008). An empirical study of the construct validity of social creativity. *Learning and Individual Differences*, 18(4), 372–380.
- Mouchiroud C, & Lubart T (2002). Social creativity: A cross-sectional study of 6-to 11-year-old children. *International Journal of Behavioral Development*, 26(1), 60–69.
- Mundy PC, Henderson HA, Inge AP, & Coman DC (2007). The modifier model of autism and social development in higher functioning children. *Research and Practice for Persons with Severe Disabilities: The Journal of TASH*, 32(2), 124. [PubMed: 19898685]
- Neuhaus E, Webb SJ, & Bernier RA (2019). Linking social motivation with social skill: The role of emotion dysregulation in autism spectrum disorder. *Development and Psychopathology*, 31(3), 931–943. [PubMed: 30957732]
- Nixon E (2001). The social competence of children with attention deficit hyperactivity disorder: A review of the literature. *Child Psychology and Psychiatry Review*, 6(4), 172–180.
- O'Connor K, Hamm JP, & Kirk IJ (2007). Neurophysiological responses to face, facial regions and objects in adults with Asperger's syndrome: An ERP investigation. *International Journal of Psychophysiology*, 63(3), 283–293. [PubMed: 17267061]
- Oliver M (2013). The social model of disability: Thirty years on. *Disability & Society*, 28(7), 1024–1026.
- Ozonoff S, & Strayer DL (2001). Further evidence of intact working memory in autism. *Journal of Autism and Developmental Disorders*, 31(3), 257–264. [PubMed: 11518480]
- Parsons S, & Mitchell P (2002). The potential of virtual reality in social skills training for people with autistic spectrum disorders. *Journal of Intellectual Disability Research*, 46(5), 430–443. [PubMed: 12031025]
- Qian N, & Lipkin RM (2011). A learning-style theory for understanding autistic behaviors. *Frontiers in Human Neuroscience*, 5, 77. [PubMed: 21886617]
- Rao PA, Beidel DC, & Murray MJ (2008). Social skills interventions for children with Asperger's syndrome or high-functioning autism: A review and recommendations. *J Autism Dev Disord*, 38(2), 353–361. 10.1007/s10803-007-0402-4 [PubMed: 17641962]
- Rapin I (2002). The autistic-spectrum disorders. *New England Journal of Medicine*, 347(5), 302–303. [PubMed: 12151466]
- Reichow B, Steiner AM, & Volkmar F (2012). Social skills groups for people aged 6 to 21 with autism spectrum disorders (ASD). *Campbell Systematic Reviews*, 8(1), 1–76.
- Roselló B, Berenguer C, Navío P, Baixauli I, & Miranda A (2017). Executive functioning, social cognition, pragmatics, and social interaction in attention deficit hyperactivity disorder and autism spectrum disorder. *Current Developmental Disorders Reports*, 4, 72–77.



- Rump KM, Giovannelli JL, Minshew NJ, & Strauss MS (2009). The development of emotion recognition in individuals with autism. *Child Development*, 80(5), 1434–1447. [PubMed: 19765010]
- Sapey-Triomphe L-A, Weilhhammer VA, & Wagemans J (2022). Associative learning under uncertainty in adults with autism: Intact learning of the cue-outcome contingency, but slower updating of priors. *Autism*, 26(5), 1216–1228. [PubMed: 34533061]
- Scheeren A, de Rosnay M, Koot H, & Beeger S (2013). Rethinking theory of mind in high-functioning autism spectrum disorder. *Journal of Child Psychology and Psychiatry*, 54(6), 628–635. [PubMed: 23072222] *Journal of Child Psychology and Psychiatry*, 54(6), 638–635. 10.1111/jcpp.12007
- Schreiber C (2011). Social skills interventions for children with high-functioning autism spectrum disorders. *Journal of Positive Behavior Interventions*, 13(1), 49–62.
- Schroeder JH, Cappadocia MC, Bebko JM, Pepler DJ, & Weiss JA (2014). Shedding light on a pervasive problem: A review of research on bullying experiences among children with autism spectrum disorders. *Journal of Autism and Developmental Disorders*, 44, 1520–1534. [PubMed: 24464616]
- Scoglio AA, Reilly ED, Girouard C, Quigley KS, Carnes S, & Kelly MM (2022). Social functioning in individuals with post-traumatic stress disorder: A systematic review. *Trauma, Violence, & Abuse*, 23(2), 356–371.
- Sinha P, Kjelgaard MM, Gandhi TK, Tsourides K, Cardinaux AL, Pantazis D, Diamond SP, & Held RM (2014). Autism as a disorder of prediction. *Proceedings of the National Academy of Sciences*, 111(42), 15220–15225.
- Sparrow SS, Cicchetti DV, & Saulnier CA (2016). Vineland-3: Vineland adaptive behavior scales. PsychCorp.
- Torres JMM, Clarkson T, Hauschild KM, Luhmann CC, Lerner MD, & Riccardi G (2022). Facial emotions are accurately encoded in the neural signal of those with autism spectrum disorder: A deep learning approach. *Biological Psychiatry: Cognitive Neuroscience and Neuroimaging*, 7(7), 688–695. [PubMed: 33862256]
- Travis L, Sigman M, & Ruskin E (2001). Links between social understanding and social behavior in verbally able children with autism. *Journal of Autism and Developmental Disorders*, 31, 119–130. [PubMed: 11450811]
- Tse WS, & Bond AJ (2004). The impact of depression on social skills: A review. *Journal of Nervous and Mental Disease*.
- Van de Cruys S, Evers K, Van der Hallen R, Van Eylen L, Boets B, De-Wit L, & Wagemans J (2014). Precise minds in uncertain worlds: Predictive coding in autism. *Psychological Review*, 121(4), 649. [PubMed: 25347312]
- Wang S, Jiang M, Duchesne XM, Laugeson EA, Kennedy DP, Adolphs R, & Zhao Q (2015). Atypical visual saliency in autism spectrum disorder quantified through model-based eye tracking. *Neuron*, 88(3), 604–616. [PubMed: 26593094]
- Webb SJ, Dawson G, Bernier R, & Panagiotides H (2006). ERP evidence of atypical face processing in young children with autism. *Journal of Autism and Developmental Disorders*, 36, 881–890. [PubMed: 16897400]
- Webb SJ, Naples AJ, Levin AR, Hellemann G, Borland H, Benton J, Carlos C, McAllister T, Santhosh M, Seow H, & others. (2023). The Autism Biomarkers Consortium for Clinical Trials: Initial evaluation of a battery of candidate EEG biomarkers. *American Journal of Psychiatry*, 180(1), 41–49. [PubMed: 36000217]
- Weightman MJ, Air TM, & Baune BT (2014). A review of the role of social cognition in major depressive disorder. *Frontiers in Psychiatry*, 5, 179. [PubMed: 25566100]
- Wheeler J, & Carlson CL (1994). The social functioning of children with ADD with hyperactivity and ADD without hyperactivity: A comparison of their peer relations and social deficits. *Journal of Emotional and Behavioral Disorders*, 2(1), 2–12.
- Wheeler Maedgen J, & Carlson CL (2000). Social functioning and emotional regulation in the attention deficit hyperactivity disorder subtypes. *Journal of Clinical Child Psychology*, 29(1), 30–42. [PubMed: 10693030]



- White S, Keonig K, & Scahill L (2007). Social skills development in children with autism spectrum disorders: A review of the intervention research. *J Autism Dev Disord*, 37(10), 1858–1868. 10.1007/s10803-006-0320-x [PubMed: 17195104]
- Wolstencroft J, Robinson L, Srinivasan R, Kerry E, Mandy W, & Skuse D (2018). A Systematic Review of Group Social Skills Interventions, and Meta-analysis of Outcomes, for Children with High Functioning ASD. *J Autism Dev Disord*, 48(7), 2293–2307. 10.1007/s10803-018-3485-1 [PubMed: 29423608]
- Zheng S, Kim H, Salzman E, Ankenman K, & Bent S (2021). Improving social knowledge and skills among adolescents with autism: Systematic review and meta-analysis of UCLA PEERS<sup>®</sup> for adolescents. *Journal of Autism and Developmental Disorders*, 1–16.



**Figure 1. Conceptual model of Social Competence — Performance. Developed based on the model of Crick & Dodge (1994).**

*Note.* Figure is based on the social information-processing model developed by Crick & Dodge (1994). This model demonstrates the interaction between factors related to social knowledge (inner circle) and the steps involved in the behavioral enactment of social skills (outer circle). Taken together, both the inner and outer circles capture social performance. Bidirectional arrows represent the continuous interaction that occurs between social knowledge at each step in the performance model. Italicized factors at each step throughout the model each illustrate autism-related, social performance-based factors that may impact engagement at each step, which potentially breaks the cycle and impedes social performance.

Table 1

## Examples of Social Knowledge Pitfalls

Example	Principle	Knowledge Pitfall
<p>a. Greeting pleasantries:  <i>Adult: "Hi, how are you?"</i>  <i>Child: "I'm good! How are you?"</i>  <i>Adult: "I'm doing alright, thank you for asking."</i>  <i>Child: "You are welcome!"</i>  <i>Adult: "What did you do at school today?"</i>  <i>Child: "I'm good, how are you?"</i></p>	<p>Knowledge may be necessary, but is not sufficient</p>	<p>Social knowledge of greeting pleasantries allowed surface level conversational skills but was insufficient in continuing the conversation once deviated from knowledge "script." In fact, the child fell back on knowledge of greetings in such a way that caused their social response an odd and inoperable for their conversational partner.</p>
<p>b. Making romantic connections:  <i>Autistic adult wanted to learn how to ask a person out on a date. Client demonstrated prerequisite knowledge for how to approach others and rehearsed skills but continued to be unable to implement such skills and knowledge live settings.</i></p>	<p>Knowledge is not (always) the problem</p>	<p>Presumptions of a knowledge deficit, and that "knowing more" will lead to doing more, discounts factors such as nerves and anxiety, increased sensory input, lack of predictability in the environment. "Banked" knowledge acquired - and knowledge-based intervention strategies employed - were not sufficient in allowing the individual to engage in goal-directed social behavior, resulting in them not meeting their wants and needs.</p>
<p>c. Bad timing:  <i>Autistic adolescent utilized their own laughter as a "fall back" strategy in all conversations, including serious and somber discussions.</i></p>	<p>Knowledge can be compensatory</p>	<p>The individual had the knowledge that laughter is associated with jokes and that jokes can be brushed off if they do not land well. They utilized this laughter to account for potential social error. However, this led to odd conversational style and potentially offensive laughter at inappropriate times.</p>
<p>d. Mechanized speech:  <i>Autistic high school student has been working on initiating social interaction. As a result, they utilize rote speech in their social interactions in class, manifesting in the near-identical words, tone, and prosody in every morning greeting they employed and in their interactions with others throughout the day, resulting in an almost mechanical interaction style.</i></p>	<p>Knowledge can backfire</p>	<p>Interventions that provide <i>too much structure</i> and not enough naturalistic opportunities for interaction may inadvertently reinforce this echoed or rote use of language and may perpetuate stigmatizing, odd interactions with others, and reduce authenticity in interaction.</p>

Table 2

## Types of Knowledge

Concept	Definition	Example
<i>Propositional or conceptual knowledge</i>	Knowing "that;" top-down, or deductive knowledge. This type of knowledge that can be expressed based on logical reasoning and language (Klein, 1971). Having propositional knowledge does not equate being able to engage in the task but can involve being able to describe it.	Knowing the steps of swimming (e.g., move arms, kick legs, be in water), is considered propositional knowledge.
<i>Procedural knowledge</i>	Knowing "how" how to do something; bottom-up, or inductive knowledge. This type of knowledge is applied to a domain-specific situation or a functional action (De Jong & Ferguson-Hessler, 1996). One need not describe or demonstrate said knowledge using communication or words, can be shown based on <i>doing</i> .	If a person is <i>ever</i> observed swimming, they are considered to have some knowledge of "how" to swim. One may only be able to demonstrate this procedural knowledge under certain conditions (e.g., only in one specific pool), which precludes it being equated with competence (being able to swim in any body of water).
<i>Situational knowledge</i>	Knowledge about how a particular situation typically appears, identifying discrepancies when it does not match existing schema, adjusting expectations, and applying other knowledge as needed to fit the changing situation (De Jong & Ferguson-Hessler, 1996). This type of knowledge is also gained through experience of engaging in a task and can be applied towards navigating a situation and problem-solving.	One can discriminate between successful (i.e., staying afloat, gliding through the water) and unsuccessful (i.e., flailing arms, difficulty staying afloat) swimming. This understanding may, itself, not be sufficient to reliably calibrate one's swimming behavior to a given situation in real time.
<i>Implicit Knowledge</i>	Implicit knowledge involves the unconscious, effortless recall of past experience to engage in a task (Dienes & Perner, 1999)	Automatic retrieval of learned information about swimming to stay afloat and move through the water. Implicit learning is acquired from performing a task and is typically gained without direct intention or instruction (Foti et al., 2015)
<i>Explicit Knowledge</i>	Explicit knowledge includes the active and conscious recall of information to engage in a task.	Writing down or verbally reciting the steps of a recipe in order to complete the meal.

**Table 3**

## Key Principles of Social Performance in Autism

<b>Key Principle</b>	<b>Meaning</b>	<b>Impact</b>
Doing does not explicitly require knowing	Many successful social interactions do not reliably require knowing what to do (propositional knowledge), and only sometimes require knowing how to do it (procedural knowledge)	During social interactions, being able to employ underlying performance-based mechanisms rapidly and fluidly is more likely to produce naturalistically successful outcomes.
Performance-based interventions may not “look like” interventions at all	Such interventions do not require formal teaching procedures and manifest in many different settings, contexts, and methods.	These interventions allow for connections and interactions to play out in more generalizable settings and allow for more naturalistic skills and scenarios to be contacted.
Implicit learning is still learning	Much of the learning that happens in performance-based interventions and settings is likely to be implicit and occur via successful and unsuccessful interactions.	Social learning that arises through interaction attempts is vital for implicit, incidental learning (Foti et al., 2015).
Performance takes all shapes	Successful social performance can manifest in many ways, particularly across neurodiverse populations.	Performance-based approaches allow for this, focusing instead on the mechanisms that get in the way of social performance, and the outcomes that constitute social success (e.g., friendship-making).

Table 4

## Implications of Social Knowledge and Performance for Conceptualization of Autism

Domain	Impact	Implication	Recommendations
Developmental	Features of autism emerge as a developmental cascade, where early differences in engagement impact later development (e.g., Enactive Mind Model; Klin et al., 2003)	Assessment of known skills in developmental contexts fails to consider challenges related to performing known behaviors, offers limited view	Consider models that assess how and when individuals engage with environments, and how this impacts development of skills
Categorical	<ul style="list-style-type: none"> <li>Social knowledge challenges alone do not distinguish autism from other conditions (Addington et al., 2006; Aduen et al., 2018).</li> <li>Social knowledge challenges are the least prevalent aspect of autistic social challenges (Gates et al., 2022).</li> </ul>	<ul style="list-style-type: none"> <li>Addressing only knowledge-based challenges may be futile.</li> <li>Ignoring performance factors will perpetuate social difficulties, even in the face of increases in knowledge.</li> </ul>	Parsing knowledge- and performance-based origins is crucial to differentiate autism-specific manifestations of social difficulties and similar challenges irrelevant to autism diagnosis.
Dimensional	Both social knowledge and performance exist on continua. Autistic people with social struggles may vastly differ on strengths and challenges in social situations.	Treating social challenges in binary ways (i.e., “does” or “does not” have skill knowledge or performance, generally) fails to account for these differences.	<ul style="list-style-type: none"> <li>Utilize social profiles to inform treatment plans.</li> <li>Generate more precise subgrouping into social support groups based on dimensional profiles.</li> <li>Allow for more person-centered approaches based on strengths, needs, and goals.</li> </ul>
Contextual	Contextual variation in social behavior has often been minimized - framing individual “social skills deficits” in this population as almost trait-like phenomena, and reinforces the historical presumption of knowledge (i.e., someone who “does know what do to” is thought to lack this knowledge everywhere).	<ul style="list-style-type: none"> <li>Evidence reveals considerable within-individual variation in social behavior across contexts in autism (Kang et al., 2023; Lerner et al., 2017).</li> <li>Social performance factors may help explain this variation, as challenges with social creativity, for instance, may be more evident in novel settings rather than familiar ones.</li> </ul>	Consider the contextual differences in social behavior to help to reveal performance-related factors inhibiting or facilitating social situations.
Reframing “skills”	Current conceptualization implies that one must use prior knowledge to demonstrate use and that those increases in knowledge are what is considered “competent” or “skilled.”	This ignores the possibility that autistic individuals can (and do) achieve normatively defined social success <i>irrespective of</i> their level of measured social knowledge.	Consider that “successful” interactions among autistic individuals may not conform to normatively-defined social success terms at all, yet still achieve outcomes that are “competent” (Heasman & Gillespie, 2019; Milton, 2012).



Table 5

## Implications for treatment and supports

Pitfall of Knowledge-based intervention	Examples	Potential downside	Recommendations
Teaching of impractical rules	<ul style="list-style-type: none"> <li>Targeting non-autistic social rules and norms (i.e., teaching how something “should go;” increasing non-autistic behaviors)</li> <li>“If-then” instructions, such as “when I am in public, I must not engage in stimming/engage in other autistic traits”</li> </ul>	<ul style="list-style-type: none"> <li>Promoting non-generalizable expectations of social environments and interactions</li> <li>Placing unrealistic expectations of social behavior on autistic people</li> <li>Teaching suppression of autistic behaviors in favor of “neurotypical” behaviors (Libsack et al., 2021)</li> </ul>	<ul style="list-style-type: none"> <li>Avoid direct instruction on “what to do” socially</li> <li>Provide access to peer interactions (Marro et al., 2019).</li> <li>Facilitate opportunities for interaction in a scaffolded environment that is motivating and enriching (McDonald et al., 2022).</li> </ul>
Promoting robotic, mechanical interactions (Bottema-Beutel et al., 2018)	<ul style="list-style-type: none"> <li>Learning and memorizing social rules, norms, social scripts</li> </ul>	<ul style="list-style-type: none"> <li>Inhibits authenticity of interactions</li> <li>Leaves out confounding factors related to contextual, cultural, and setting-specific factors</li> <li>Reinforce rigidity to rules</li> </ul>	<ul style="list-style-type: none"> <li>Assess factors that impede performance</li> <li>Use of strategies that help manage the factors that impede reliable performance of skills</li> </ul>
Increase performance-related challenges (Gates et al., 2022)	<ul style="list-style-type: none"> <li>Simply increasing social knowledge deficits will not improve the performance of social skills (Bishop-Fitzpatrick et al., 2017; Gates et al., 2022; McMahon et al., 2013)</li> </ul>	<ul style="list-style-type: none"> <li>Increasing what someone knows will potentially increase the number of skills that one knows how to do, but is not able to perform reliably</li> </ul>	<ul style="list-style-type: none"> <li>Assess factors that impede performance</li> <li>Provide opportunities to target performance-related factors</li> </ul>
Promoting masking, camouflaging, or “passing as non-autistic” (Libsack et al., 2021)	<ul style="list-style-type: none"> <li>Use of regulatory strategies to camouflage autistic traits to navigate social situations and behaviorally present as non-autistic (Cook et al., 2021; Hull et al., 2017; Lai et al., 2021)</li> <li>Strategies that teach autistic people to engage in unnatural non-autistic social behaviors (e.g., eye contact, inhibition of sensory behaviors), can teach individuals to PAN (Bottema-Beutel et al., 2018).</li> </ul>	<ul style="list-style-type: none"> <li>Negative impacts on mental health outcomes (Beck et al., 2020; Cage &amp; Troxell-Whitman, 2019; Cassidy et al., 2020)</li> <li>Engenders negative associations with autistic behaviors as unwanted/“bad”</li> <li>Impacts on identity formation and expression (Bottema-Beutel et al., 2018; Lai et al., 2017)</li> </ul>	<ul style="list-style-type: none"> <li>Carefully consider intervention strategies used</li> <li>Never promote the suppression of autistic traits for the benefit of social norms</li> </ul>