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Review

Social functioning in youth with attention-deficit/hyperactivity disorder and autism spectrum disorder: transdiagnostic commonalities and differences

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HIGHLIGHTS

- Youth with ADHD and youth with ASD have transdiagnostic similarities and differences in social problems.
- Shared as well as distinct intervention approaches to address social problems may be needed for youth with each disorder.
- Youth who have both ADHD and ASD may have social problems that reflect features of each disorder.

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ABSTRACT

Attention-Deficit/Hyperactivity Disorder (ADHD) and Autism Spectrum Disorder (ASD) are both neurodevelopmental disorders originating in childhood with high associated impairments and public health significance. There has been growing recognition of the frequent co-occurrence, and potential interrelatedness, between ADHD and ASD without intellectual disability. In fact, the most recent (5th) edition of the DSM is the first to allow ADHD and ASD to be diagnosed in the same individual. The study of transdiagnostic features in ADHD and ASD is important for understanding, and treating, these commonly co-occurring disorders. Social impairment is central to the description and prognosis of both disorders, and many youth with some combination of ADHD and ASD present to clinics for social skills training interventions. However, the aspects of social functioning that are impaired may have both shared and distinct features between the two disorders, relating to some overlapping and some diverse etiologies of social problems in ADHD compared to ASD. These findings have implications for interventions to address social problems in youth with these conditions. We conclude with a discussion about areas for future research and novel intervention targets in youth with ADHD, ASD, and their comorbidity.

1. Introduction

Attention-Deficit/Hyperactivity Disorder (ADHD) and Autism Spectrum Disorder (ASD) are both neurodevelopmental disorders that originate in childhood. Prior to the 5th edition of the Diagnostic and Statistical Manual (DSM-5; American Psychiatric Association, 2013), ADHD and ASD were not permitted to be diagnosed in the same individual. However, recently there has been growing awareness of the high comorbidity between ADHD and ASD without intellectual disability, and calls to search for transdiagnostic features between these disorders to explain shared etiologies, associated impairments, and prognoses (Ameis, 2017).

The purpose of this paper is to compare and contrast the manifestation and etiology of social problems that occur in ADHD relative to ASD. Social functioning is a major, and central, domain of impairment in both disorders which significantly affects prognosis. Our review leads to some shared and also some diverse implications for interventions in each disorder. We focus on school-aged children and adolescents because these are the developmental periods during which most research has occurred, and for whom the establishment of positive peer relationships sets the stage for future adjustment (Pedersen, Vitaro, Barker, & Borge, 2007).

2. Distinct disorders, or two manifestations of the same condition?

ADHD affects 5–8% of youth and the corresponding figure for ASD is 1–2%, with prevalence rates for both disorders having increased

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substantially in recent years (Boyle et al., 2011). Approximately 70% of children with ASD (and most children with ADHD) do not have an intellectual disability (Christensen et al., 2016) and we target this group. Many of the social problems shown by children with ASD and intellectual disability are attributable to their intellectual capacity as opposed to, or in addition to, their ASD (e.g., Dyck, Ferguson, & Shochet, 2001). Therefore, the presence of intellectual disability is a confound when disentangling the shared versus unique features of social functioning in ASD relative to ADHD.

The diagnosis of ADHD has two primary presentations among school-age youth: the Combined presentation, marked by developmentally-inappropriate inattention and hyperactive/ impulsive behavior, and the Inattentive presentation, consisting of predominantly inattentive symptoms (Baeyens, Roeyers, & Walle, 2006). The diagnosis of ASD, by contrast, is characterized by difficulties in social interaction and social communication, as well as restricted/repetitive interests and behaviors. Until DSM-5, if a child had symptoms fitting both disorders, the diagnosis was ASD. The thought was that ASD was the more severe disorder, and that inattention displayed by children with ASD could be explained by their lack of interest in social relationships (Craig et al., 2015). However, recent findings of similarities between ADHD and ASD in terms of genetic, environmental, and developmental risk motivated the revision in DSM-5 to allow both conditions to be diagnosed in the same individual (Craig et al., 2015).

Indeed, the comorbidity rate between the two disorders has been found to be quite high. Many children with a primary diagnosis of ASD have significant symptoms of ADHD, with estimates ranging from 31 to 95% (Antshel, Zhang-James, Wagner, Ledesma, & Faraone, 2016). Additionally, 15–25% of youth with primary diagnoses of ADHD demonstrate ASD symptoms (Grzadzinski, Dick, Lord, & Bishop, 2016; Kotte et al., 2013). ADHD and ASD may possess a common genetic basis, with shared familial transmission and suggestions that 50–72% of the contributing genetic factors in the disorders overlap (Rommelse, Geurts, Franke, Buitelaar, & Hartman, 2011). Research using causal modelling to identify pathways between co-occurring ADHD and ASD also reveals substantive ways through which their respective symptoms influence one another (Sokolova et al., 2017). Collectively, this evidence has led some researchers to speculate that "both disorders are expressions of one overarching disorder, with ADHD being the milder expression" (Rommelse, van der Meer, Hartman, & Buitelaar, 2016 p. 957). Despite the controversial nature of this stance, the presence of active discussion about whether ADHD and ASD reflect two manifestations of the same disorder demonstrates the importance of identifying the transdiagnostic versus diagnosis-specific features and processes between the two conditions.

Relevant transdiagnostic issues pertain not only to the shared causes that lead to a child developing one disorder or the other (or both), but also to the shared mechanisms that predict adjustment and associated impairments in both disorders (Craig et al., 2016; Rommelse et al., 2016). Visser, Rommelse, Greven, and Buitelaar (2016, p. 245) argue that insights gained from a transdiagnostic approach to ADHD and ASD "will inform intervention research and lead to a re-shift in focus away from rather fixed developmental/diagnostic outcomes to more causal processes." To achieve this end, a sophisticated understanding of similarities and differences between ADHD and ASD is needed not only in terms of etiology, but also in terms of associated impairments and the mechanisms behind these impairments. This is a timely topic that has only recently begun to be explored.

2.1. Social impairment in ADHD and ASD

This paper focuses on a central feature of both ADHD and ASD: social impairment. In ASD, problems in social communication and interaction are part of the diagnostic criteria. Although this is not the case for ADHD, social problems are nonetheless a severe challenge for those with ADHD and are a common way that symptoms fulfill the impairment criterion in this disorder; social problems also are linked closely with the core symptoms of ADHD.

Social impairment is a useful domain in which to explore transdiagnostic commonalities and differences between the two disorders. It has been described as a "behavioral cusp", meaning that impairment in the social domain has wide-reaching effects on development, and that improving social functioning has positive consequences beyond the change in this domain itself (Matson & Wilkins, 2007). Indeed, social problems augment the risks associated with childhood ADHD alone for a variety of negative outcomes in adolescence and adulthood (e.g., Mrug et al., 2012) – even after statistical control of the earlier, childhood levels of adjustment. Similarly, social problems are thought to undergird the array of challenges that emerge in ASD, including impaired adaptive behavior and achievement (Hillier, Fish, Cloppert, & Beversdorf, 2007), and even foreshortened lifespan (Hirvikoski et al., 2016). Concern about social impairment motivates many families to seek treatment for this issue in their youth. Yet, the similarities and differences in social functioning among youth with ADHD versus ASD result in some overlapping and also some diverse treatment implications. Taken together, these findings underscore the clinical significance of social impairment, and the relevance of understanding transdiagnostic, as well as diagnosis-specific, processes related to social functioning in ADHD relative to ASD.

2.2. The current paper

The first aim of this paper is to descriptively characterize the social problems found in children and adolescents with ADHD versus ASD without intellectual disability, with attention to transdiagnostic similarities as well as differences. The second aim is to compare and contrast the etiology of social problems in each disorder. Our third aim is to use this information to present empirically-informed and tailored intervention recommendations for each population, with discussion of which intervention strategies are likely to be transdiagnostically useful for youth with either ADHD or ASD or their combination, versus which strategies seem more suitable for youth with one condition but not the other. Throughout this review we emphasize studies that directly compare participants with ADHD to participants with ASD, and/or comorbid ADHD + ASD; methodological details about these comparative studies are in Table 1.

3. Categories and magnitude of social problems in ADHD and ASD

In this section we review impairment shown by youth with ADHD relative to ASD in three categories of social functioning. Social behavior, social cognition, and peer regard are distinct but interrelated facets of social competence, and problems in any one area incrementally predict maladjustment above and beyond the others (Dirks, Treat, & Weersing, 2007).

3.1. Social behavior

Problems in social behavior are defined as inappropriate or unskilled verbal or nonverbal actions displayed in peer situations. This could consist of the presence of negative behaviors, or alternatively, the absence of positive behaviors.

ADHD. Elevated negative social behaviors among youth with ADHD are well-documented (Gardner & Gerdes, 2015). Related to the core hyperactive/impulsive symptoms of the disorder, and particularly found in children with the Combined presentation of ADHD (Baeyens et al., 2006), these youth often barge into a game without waiting their turn (Ronk, Hund, & Landau, 2011) or show poor sportsmanship (Abikoff et al., 2002). In addition to the presence of negative behaviors, children with ADHD also demonstrate the absence of positive behaviors. Relative to typically developing children, they can lack prosocial skills such as empathetic responding in peer situations (Braaten &

Table 1
Summary of comparative studies about ADHD, ASD, and ADHD + ASD.

Study	Sample	Measures	Results
Ames & White (2011)[1]	55 ASD, comorbid ADHD symptoms dimensionally assessed (ages 7–13)	Lab-based tests of Theory of Mind, inhibitory control	ASD symptom severity, but not ADHD symptom severity, related to Theory of Mind deficits. ADHD symptom severity, but not ASD symptom severity, related to inhibitory control.
Antshel, Zhang-James, Wagner, Ledesma, & Faraone (2016)[4]	Review paper	Genetics and neurobiology; neuroimaging; cognitive phenotypes; behavioral phenotypes; treatment implications	Shared features exist in genetics, brain structure/function, and executive functioning. ADHD + ASD > ASD in behavioral impairments. Little is known about psychosocial interventions for ADHD + ASD.
Antshel et al. (2011)[1]	21 ASD, 25 ASD + ADHD, 37 ASD + anxiety (ages 8–12)	Parent ratings of social skills	ASD + ADHD received less benefit than ASD, ASD + anxiety from social skills training.
Baeyens, Moniquet, Danckaerts, & van der Oord (2017)[5]	885 portrayals of ADHD and 2071 portrayals of ASD in current Flemish newspapers	Observers coded the depiction of ADHD and ASD	ASD was portrayed more positively than ADHD in newspapers.
Bora & Pantelis (2016)[4]	Meta-analysis of 44 studies comparing ADHD to typically developing participants, and 17 studies comparing ADHD to ASD (ages 8–37)	Lab-based tests of facial and vocal emotion recognition, Theory of Mind	ASD < ADHD < typically developing in emotion recognition and Theory of Mind. In ADHD, impairment relative to typically developing participants was smaller among adults than among youth.
Cervantes et al. (2013)[3]	61 ASD, 36 ADHD, 80 "atypical" clinic-referred but no diagnosis yielded (ages 6–16)	Parent ratings of social behaviors	ADHD > atypical in hostile behavior and inappropriately assertive behavior. ASD < ADHD, atypical in adaptive/appropriate behavior.
de Boer & Pijl (2016)[3]	464 students in general education classrooms; of these, 14 students with ADHD and 14 with ASD (ages 12–14)	Self-reports on a vignette measure about acceptance of a hypothetical classmate with ADHD or ASD; Peer sociometric nominations of real-life classmates.	Students reported less acceptance of the hypothetical classmate with ADHD compared to with ASD on the vignette. Real-life students with ADHD were less accepted and more rejected on sociometric nominations than comparison students; students with ASD were in between those with ADHD and comparison students.
Demurie, Roeyers, Baeyens, & Sonuga-Barke (2012)[1]	39 ADHD, 34 ASD, 46 typically developing (ages 8–16)	Lab-based test of temporal discounting (preferring smaller immediate rewards over larger delayed rewards)	ADHD > ASD, typically developing in temporal discounting.
Dyck, Ferguson, & Shochet (2001)[6]	35 ADHD Inattentive type, 20 autistic disorder, 28 Asperger's, 34 mild intellectual disability, 14 anxiety, 36 typically developing (ages 9–16)	Lab-based tests of emotional empathy, Theory of Mind	After statistical control of intellectual functioning, autistic disorder < ADHD < typically developing in empathy; Asperger's did not differ from any other group. Autistic disorder < ADHD, typically developing in Theory of Mind; Asperger's did not differ from typically developing but performed worse than the ADHD group and better than the autistic disorder group.
Factor, Ryan, Farley, Ollendick, & Scarpa (2017)[2]	32 ASD, 25 ASD + elevated ADHD symptoms (ages 3–17)	Parent ratings of social problems	ASD + elevated ADHD symptoms < ASD in social communication, social awareness.
Geurts, Luman, & Van Meel (2008)[1]	22 ADHD, 22 ASD, 33 typically developing (ages 8–13)	Response time and accuracy on a Flanker task across social motivation and control conditions	Children with ADHD and typical children responded to social motivation; children with ASD did not.
Geurts, Verte, Oosterlaan, Roeyers, & Sergeant (2004)[1]	54 ADHD, 41 ASD, 41 typically developing (ages 6–12)	Lab-based tests of executive functioning; parent and teacher ratings of pragmatic language	ASD < ADHD < typically developing in pragmatic language and in planning/ flexibility. ADHD, ASD < typically developing in inhibition and fluency.
Hutchins, Prelock, Morris, Benner, LaVigne, & Hoza (2016)[1]	29 ADHD, 67 ASD, 49 typically developing (ages 5–14)	Lab-based tests of Theory of Mind; parent ratings of social behaviors related to Theory of Mind	ASD < ADHD, typically developing in lab-based tests of Theory of Mind. ASD, ADHD < control in parent ratings of Theory of Mind behaviors.
Kohls et al. (2014)[1]	15 ASD, 16 ADHD, 17 typically developing (ages 9–18)	Response time and accuracy on a Go-No Go task; fMRI neural activation across social and monetary reward conditions	ADHD and ASD both displayed atypical responsiveness to rewards. ADHD = hyperactivation to social rewards that are immediately provided; ASD = lower activation to all rewards.
Kuijper, Hartman, Bogaerds-Hazenberg, & Hendriks (2017)[1]	36 ASD, 34 ADHD, 36 typically developing (ages 6–12)	Narrative production observed during Autism Diagnostic Observation Schedule; parent ratings of language; lab-based tests of working	ASD, ADHD < typically developing in skillful language structure and pragmatic language. Theory of Mind

(*continued on next page*)

Table 1 (*continued*)

Study	Sample	Measures	Results
		memory, Theory of Mind, and response inhibition.	and working memory associated with language proficiency.
Luteijn et al. (2000)[1]	64 autistic disorder (no intellectual disability), 190 PDD-NOS, 152 ADHD, 98 PDD-NOS + ADHD, 65 other disorders (ages 5–12)	Parent ratings of behavior problems, social problems	PDD-NOS + ADHD, autistic disorder (no intellectual disability) > ADHD, PDD-NOS in problems in social interaction and social communication.
Miranda, Berenguer, Roselló, Baixauli, & Colomer (2017)[1]	52 ASD, 35 ADHD, 39 typically developing (ages 7–11)	Lab-based tests of Theory of Mind; parent ratings of social behaviors related to Theory of Mind; teacher-reported executive functioning	ASD, ADHD < typically developing in lab-based test (contextual + verbal). ASD < ADHD < typically developing in parent ratings of Theory of Mind behaviors. Inhibition, behavioral regulation correlated with Theory of Mind in ADHD sample, not ASD sample.
Oerlemans et al. (2014)[7]	Probands (47 ASD, 43 ASD + ADHD), 79 unaffected siblings of probands, 139 typically developing (ages 6–13)	Lab-based tests of emotion recognition	ASD + ADHD < ASD < unaffected siblings < typically developing in facial emotion recognition and affective prosody.
Rommelse, Geurts, Franke, Buitelaar, & Hartman (2011)[4]	Review paper	Brain-based endophenotypes (heritable traits linking genes and behavior)	Substantial overlap existed in shared genes and endophenotypes between ADHD and ASD.
Rommelse, van der Meer, Hartman, & Buitelaar (2016)[1]	144 probands with elevated ADHD + ASD symptoms, 110 unaffected siblings of probands, 360 comparison children from a population sample (ages 5–17)	Cognitive tests of motor output, working memory, emotion recognition, attention	Using cognitive profiling to create latent classes, a class existed of participants with high impairment in cognitive tasks and high parent-rated symptoms of both ADHD and ASD.
Sinzig, Morsch, & Lehmkuhl (2008)[1]	30 ADHD, 19 ASD, 21 ASD + ADHD, 29 typically developing (ages 6–18)	Lab-based tests of facial emotion recognition, executive functioning	ASD + ADHD < ASD; ASD + ADHD < typically developing in joy (eyes) and surprise (faces). ADHD < typically developing in overall affect (faces), overall affect (eyes), and joy (eyes). ASD + ADHD < typically developing in overall affect (eyes).
Scheeren, Koot, & Begeer (2012)[1]	156 ASD, comorbid ADHD symptoms dimensionally assessed (ages 6–19)	Parent ratings of behavioral style	"Active but odd" behavioral style associated with both parent and teacher ratings of comorbid ADHD symptoms.
Semrud-Clikeman, Walkowiak, Wilkinson, & Butcher (2010)[1]	76 ADHD Combined presentation, 77 ADHD Inattentive presentation, 52 Asperger's, 24 nonverbal learning disability, 113 typically developing (ages 9–16)	Lab-based tests of emotion recognition and understanding; parent, teacher, and self-ratings of behavior problems	Asperger's < ADHD (all presentations) < typically developing in emotion recognition and emotional understanding. Asperger's > ADHD > typically developing on parent and teacher ratings of social withdrawal.
Sokolova et al. (2017)[1]	Probands (317 ADHD, 130 ASD, 139 ASD + ADHD), 393 unaffected siblings of probands, 414 comparison children without ASD or ADHD	Parent and teacher report of ADHD symptoms; parent report of ASD symptoms; IQ testing	Links existed between impulsivity (ADHD) to understanding social information (ASD), and hyperactivity (ADHD) to repetitive behaviors (ASD). Associations between inattention (ADHD) and understanding social information (ASD) were mediated by IQ.
Sprenger et al. (2013)[2]	70 ASD, 56 ASD + ADHD (mean age = 12 for ASD group and 15 for ASD + ADHD group)	Parent ratings of behavior problems, social problems	ASD + ADHD > ASD in social interaction problems.
Taurines et al. (2012)[4]	Review paper	Neuropsychological functioning in attention, reward processing, and social cognition; brain imaging	ADHD and ASD both show impairment relative to typically developing children. ASD is affected by more severe deficits in social cognition, and may have more atypical connectivity, than ADHD.
Visser, Rommelse, Greven, & Buitelaar (2016)[4]	Review paper	Behavioral, affective, and neuropsychological functioning in early childhood	Similarities in behavioral, affective, and neurological impairments exist in ADHD and ASD, but may manifest themselves differently in each disorder and depending on age.

Note. [1] Intellectual disability explicitly stated to be an exclusionary criterion. [2] Intellectual disability not specified as exclusionary, but all group mean IQ scores are in the Average range. [3] Information about intellectual functioning unavailable. [4] Review paper or meta-analysis summarizing varied studies. [5] Not applicable. [6]Allowed comorbid intellectual disability for autistic disorder group, but covaried intelligence in data analysis. [7]Exclusionary criterion was IQ less than or equal to 60.

Rosén, 2000). Perhaps related to the core inattentive symptoms of the disorder, they may have trouble with positive behaviors representing the pragmatic aspects of language such as keeping up with the pace of a conversation and modulating communication to match a partner's needs (Bignell & Cain, 2007).

In an observational study comparing impairment in positive relative to negative behaviors in a summer camp setting, boys with ADHD were no different than comparison boys in their frequency of prosocial and nonsocial behaviors; however, the boys with ADHD showed more aggression and noncompliance (Erhardt & Hinshaw, 1994). Similarly, Abikoff et al. (2004) found that children with and without ADHD displayed no differences in their observed frequency of initiating positive or neutral social behaviors to their classroom peers, but children with ADHD were over twice as likely to initiate negative social behaviors.

ASD. The social behavior difficulties of children with ASD may instead most pertain to the absence of positive behaviors (Matson & Wilkins, 2007). Early descriptions of this disorder focused on a child who does not seek peers (Wing & Gould, 1979). Indeed, children with ASD demonstrate less social play and initiate fewer social interactions compared to typically developing children (Corbett et al., 2014). Using naturalistic observations at recess, one study found that children with ASD spent 30% of their time in solitary activities (the corresponding figure was 9% for classmates without ASD; Locke, Shih, Kretzmann, & Kasari, 2016). The significant research documenting pragmatic language impairments may also be characterized as a lack of positive behavior in social situations. In conversations, youth with ASD often omit appropriate gestures and eye contact and may show poor prosody in language (Peppé, McCann, Gibbon, O'Hare, & Rutherford, 2007).

However, some children with ASD do display negative social behaviors. Such children may initiate social interaction, but do so in an unskilled or unusual way such as by giving a monologue about a personal intense interest or standing too close to a peer (Bauminger-Zviely & Agam-Ben-Artzi, 2014). In fact, historically children with ASD have been classified into subtypes of “active but odd,” compared to “passive” and “aloof,” reflecting the observation that some children with ASD possess an interaction style characterized predominantly by the presence of negative behavior (see Wing & Gould, 1979). Nonetheless, the effect size of deficits in the absence of positive behaviors may be larger than for the presence of negative behaviors. For example, Wing and Gould (1979) estimated the proportion of “active but odd” children with ASD to be 30%, whereas the remainder were primarily withdrawn and aloof.

Summary. Transdiagnostic commonalties in social behavior problems among children with ADHD relative to ASD exist, in that children with both disorders show more negative behaviors and fewer positive behaviors in peer contexts as compared to typically developing children. Nonetheless, within this finding there are differences, whereby children with ADHD are more likely to demonstrate the presence of negative behaviors (related to acting without thinking or over-reactivity). By contrast, children with ASD tend to show the absence of positive behaviors (related to poor social-pragmatic language or the appearance of apathy).

Studies comparing children with ADHD, children with ASD, and typically developing children (summarized in Table 1) confirm this pattern, finding that whereas the ADHD and the ASD groups are both impaired relative to controls, the pattern of deficits between the two clinical groups is somewhat different. Specifically, children with ASD less often use skilled pragmatic language (Geurts, Verte, Oosterlaan, Roeyers, & Sergeant, 2004), are less likely to start conversation (Cervantes et al., 2013), and show more social withdrawal (Luteijn et al., 2000), than children with ADHD. However, children with ADHD are more likely than children with ASD to show hostility, to brag, or to be bossy in peer situations (Cervantes et al., 2013).

Another contrast is that preference for “sameness” and “sticky attention” in children with ASD may manifest itself in ASD-related inappropriate social behaviors (e.g., rigidity when routine is not followed, conversational inflexibility). However, a tendency to be overly drawn to novelty among children with ADHD may manifest in ADHD-related social behavior problems (e.g., moving peers' game pieces when they are taking too long; see Antshel et al., 2016). For instance, although children with ADHD and children with ASD both show negative behaviors on playdates, children with ADHD may most display these behaviors when they are losing a game, whereas children with ASD may do so when peers deviate from the rules of the game (Frankel, Gorospe, Chang, & Sugar, 2011; Frankel & Mintz, 2011). Therefore, different situational triggers may elicit transdiagnostic social behavior problems across the two disorders.

3.2. Social cognition

Social cognition involves the ability to interpret emotional signals (emotion recognition) and to perceive others' mental states correctly and as potentially different from one's own (Theory of Mind), and this is the focus of the current section. Although social cognition can also encompass social information processing, and accurate perception of one's own behavior, less research has been done directly comparing these areas in ADHD relative to ASD.

ADHD. Some research finds a different pattern of neural responses to emotional faces in ADHD populations relative to in typically developing youth (Tye et al., 2014). Children with ADHD may also have trouble identifying emotions in faces (Uekermann et al., 2010) or matching their affect with that of a character in a story (Braaten & Rosén, 2000). Problems in emotional understanding appear in youth with both the Combined and Inattentive presentations of ADHD (Dyck et al., 2001; Semrud-Clikeman, Walkowiak, Wilkinson, & Butcher, 2010), suggesting the relevance of these delays across presentations. However, other research finds that children with ADHD perform similarly to comparison children in such lab-based tasks, particularly when they are basic. For instance, most children with ADHD pass first-order false belief tasks such as Happé's Strange Story Test similar to the performance of typically developing children (Hutchins et al., 2016), although they may fail second-order tasks that require understanding of complex mental states and irony (Kuijper, Hartman, Bogaerds-Hazenberg, & Hendriks, 2017). In another study using eye tracking, children with ADHD and typically developing children were similar in where they directed their attention during an emotion knowledge task (Serrano, Owens, & Hallowell, 2018). Further, meta-analytic results find that most children with ADHD outgrow any difficulties they may show on Theory of Mind or emotion recognition tasks with age (Bora & Pantelis, 2016).

ASD. Delays in social cognition are a hallmark characteristic of youth with ASD (Baron-Cohen, 2000). Group differences between children with ASD and typically developing children have been robustly established in interpreting facial expressions (Lozier, Vanmeter, & Marsh, 2014; Tye et al., 2014). These difficulties in emotion recognition may relate to a different pattern of neural correlates compared to typical controls (Kang et al., in press). Further, impairments are significant in Theory of Mind (Baron-Cohen, 2000; Mazza et al., 2017). Children with ASD underperform typically developing children by greater than 1 SD on both first order as well as more advanced second order false belief tasks (Hutchins et al., 2016). Unlike what is found in ADHD, emotion recognition and Theory of Mind impairments fail to remit – and may even be exacerbated – with age (Lozier et al., 2014; Pedreño, Pousa, Navarro, Pàmias, & Obiols, 2017).

Summary. There are indications that problems in social cognition affect both disorders, suggesting that this may be a transdiagnostic feature. Nonetheless, the severity and consistency of social cognitive impairments are thought to be greater in ASD as compared to ADHD. Comparative studies about social cognition are listed in Table 1. Semrud-Clikeman et al. (2010) found that children with ASD were poorer at understanding emotional cues in a videotaped vignette measure relative to children with ADHD, and both groups performed

more poorly than typically developing children. Dyck et al. (2001) reported that empathic ability was more impaired in children with ASD relative to ADHD, after covarying intelligence. Additionally, while children with ASD as well as children with ADHD showed deficiencies in some executive functioning processes reflecting social cognition (Geurts et al., 2004), and in tests of Theory of Mind (Dyck et al., 2001; Miranda, Berenguer, Roselló, Baixauli, & Colomer, 2017), the impairment in the ASD group was broader and more pervasive. Another study found that Theory of Mind problems were uniquely related to ASD symptom severity, and not ADHD symptom severity (Ames & White, 2011). These studies illustrate the conclusion from a recent meta-analysis that ASD populations are more impaired than ADHD populations in social cognition, although both groups show more difficulties than controls (Bora & Pantelis, 2016).

Notably, the poorer performance of children with ASD relative to ADHD on Theory of Mind tasks may be most likely to manifest in basic, lab-based tests (where children with ASD, but not children with ADHD, may differ from typically developing controls). By contrast, in advanced lab-based tests, children with ASD and ADHD may be similarly impaired (Hutchins et al., 2016; Kuijper et al., 2017). In addition, both groups demonstrate social behavior difficulties in real world peer situations where they can appear unresponsive or nonempathetic to social cues that peers are bored or upset – difficulties which are sometimes conceptualized to directly result from a lack of Theory of Mind (Hutchins et al., 2016). Yet, it is notable that the majority of children with ADHD show these deficits in social behaviors but pass social cognition tasks in lab settings. By contrast, the corresponding difficulty on lab-based tests of social cognition in children with ASD may be more consistent with their displayed social behavior problems. This potentially suggests a distinct etiology of social behavior problems in ADHD versus ASD populations, as discussed later in this paper.

3.3. Peer regard

Peer regard refers to the social bonds between children. A common consideration is whether children are accepted (liked) by their peers, versus rejected (disliked; Pedersen et al., 2007). Whereas acceptance/rejection refers to peers' social impressions, friendship is a mutual, reciprocal relationship between two children (Pedersen et al., 2007).

ADHD. In the Multimodal Treatment Study of Children with ADHD, 50–80% of children with ADHD were rejected by their classmates, an effect size of greater than 1.1 relative to comparison children (Hoza et al., 2005). A meta-analysis by Waschbusch (2002) concluded that the effect sizes for peer rejection in ADHD populations were large, ranging from between 0.72 and 1.25 (without versus with comorbid conduct problems). Another meta-analysis recently found the average weighted effect size of peer regard between children with ADHD and comparison children to be $r = -0.33$, or medium, but larger than the effect sizes for problems in social behavior or social cognition (which were both $r = 0.27$; Ros & Graziano, 2018). The variability in estimates may be partly attributable to children with the Combined presentation of ADHD being more peer-rejected than those with the Inattentive presentation; however, low peer acceptance affects both presentations of ADHD (Baeyens et al., 2006).

Children with ADHD also display impairments in dyadic friendship, although these may be less severe than the impairments in peer rejection. In the Multimodal Treatment Study sample, effect sizes for quantity of friends was $d = -0.53$ relative to comparison children, in contrast to the effect sizes for rejection which were greater than 1.0 (Hoza et al., 2005). Nonetheless, children with ADHD also have poor friendship quality, whereby their friendships have more conflict and less closeness as compared to friendships of typically developing children (Gardner & Gerdes, 2015; Normand et al., 2013). Friendship stability may also be lower for children with ADHD (Gardner & Gerdes, 2015).

ASD. Children with ASD demonstrate substantial impairment in friendships (Mendelson, Gates, & Lerner, 2016). Difficulties manifest in terms of fewer friendships, poorer quality of friendships such as less security or closeness, and lower friendship stability (Bauminger-Zviely & Agam-Ben-Artzi, 2014; Chamberlain, Kasari, & Rotheram-Fuller, 2007). Chamberlain et al. (2007) reported that on average, children with ASD received only 2 of 15 possible reciprocated friendship nominations; the corresponding figure for randomly selected classmates was 7 of 12. Still, youth with ASD do make some friends, which differs from historical depictions of this population as having zero desire or capability for friendships (Mendelson et al., 2016).

Children with ASD are also less liked and more disliked by peers compared to typically developing youth (Chamberlain et al., 2007; Dean et al., 2014). In these studies, effect sizes of peer rejection were medium to large ($d = 0.7$–1.0; *partial eta squared* $= 0.26$). However, the data from Chamberlain et al. (2007) and Dean et al. (2014) suggest that youth with ASD may have more trouble achieving reciprocated friendship as compared to acceptance.

Summary. Problems in peer regard affect youth with ADHD as well as ASD, suggesting that this is a transdiagnostic feature. However, within this finding, youth with ADHD may have more difficulties in being accepted (and not rejected) by the larger peer group. By contrast, youth with ASD may have the greatest impairment in establishing friendships. Interestingly, one study found suggestive evidence that children ASD were less impaired compared to children with ADHD on peer sociometric measures of liking and disliking in their general education classrooms (friendship was not assessed), although both groups were less accepted and more rejected than comparison children (de Boer & Pijl, 2016; see Table 1). Given that negative social behaviors impede peers' initial impressions (liking) more than friendship, but positive social behaviors are needed to deepen close relationships (friendship; Erhardt & Hinshaw, 1994), the relative pattern of impairments in social behaviors between ADHD compared to ASD may explain their corresponding difficulties in distinct aspects of peer regard.

3.4. Comorbid ADHD + ASD

The functioning of youth with comorbid ADHD + ASD is a fairly new topic. In general, individuals with ADHD + ASD may display the additive deficits of both disorders, as opposed to representing an entirely different phenotype (Antshel et al., 2016). Although speculative, the social problems in children with ADHD + ASD may similarly be additive. Interestingly, among children with ASD, the presence of both negative and positive social behaviors may be associated with comorbid ADHD, whereas children with ASD alone more often show only the absence of positive social behaviors (Scheeren, Koot, & Begeer, 2012).

We wonder if social behavior patterns that alternate between aloofness (ASD) and intrusiveness (ADHD) may have more ramifications for impaired social cognition, as youth with this pattern may be least likely to gain the peer experiences that teach perspective-taking. Relatedly, this behavior pattern may be associated with the most peer rejection and lack of friendship, because of its unpredictability. Although these are speculations, they potentially explain why results from several studies (listed in Table 1) find that children with ADHD + ASD are poorer in social awareness, social cognition, emotion recognition, and social communication when compared to children with ASD alone (e.g., Factor, Ryan, Farley, Ollendick, & Scarpa, 2017; Oerlemans et al., 2014; Sinzig, Morsch, & Lehmkuhl, 2008; Sprenger et al., 2013).

4. Etiology of social problems in ADHD versus ASD

This section compares the similarities and differences in etiology of each domain of social problems in ADHD versus ASD, information which will ideally lead to empirically-informed intervention recommendations.

4.1. Social behavior

Social behavior problems have been conceptualized as either potentially attributable to inadequate knowledge of what to do (knowledge deficits) versus inability to enact the skills that are known (performance deficits; Gresham, 1997). Broadly, a transdiagnostic similarity between ADHD and ASD is that both populations may have performance deficits. However, a difference is that children with ADHD are thought to possess intact knowledge about "what to do", with the problem being that they "don't do what they know" (Barkley, 2015). By contrast, knowledge deficits in addition to performance deficits may affect a plurality of children with ASD (Koenig, De Los Reyes, Cicchetti, Scahill, & Klin, 2009; Matson & Wilkins, 2007).

Key studies find that, on tests of social knowledge, children with ADHD perform similarly to typically developing children (Maedgen & Carlson, 2000), and that parents and teachers report them to have few knowledge deficits – but many performance deficits – compared to their peers (Aduen et al., in press); of note, this most applies to children with the Combined presentation of ADHD (Barkley, 2015). In contrast, children with ASD sometimes show less knowledge of correct social behavior relative to typically developing children, even when they have intact intellectual abilities (Pedreño et al., 2017). These findings are consistent with the observation that children with ADHD pass basic lab-based Theory of Mind tests that children with ASD do not, yet both groups show demonstrated impairments in social behaviors thought to result from Theory of Mind in real world peer situations, such as noticing when a peer is bored of the topic of conversation (Hutchins et al., 2016). In fact, some work suggests that lack of emotion recognition and other social cognitive skills specifically underlie real world social behavior problems in ASD (Trevisan & Birmingham, 2016). Nonetheless, other work finds youth with ASD to have intact knowledge of the behaviors that they are supposed to enact in social situations (Lerner & Girard, in press). Therefore, whereas results fairly consistently suggest that social knowledge deficits do not explain social behavior problems in children with ADHD, inadequate social knowledge likely affects some but not all children with ASD.

For those children with intact knowledge about correct social behavior, the impediments to successful performance of that knowledge have similarities and differences between each condition. Aberrant reward processing, present in both ADHD and ASD, may be a shared feature that affects performance deficits (Taurines et al., 2012). Children with ADHD demonstrate temporal discounting, meaning that, relative to children with ASD and typically developing children, they prefer small and immediate rewards over larger, delayed rewards (Demurie, Roeyers, Baeyens, & Sonuga-Barke, 2012), and demonstrate heightened neural responsiveness to immediate reinforcement (Kohls et al., 2014). Temporal discounting may relate to the problems in attentional control (self-monitoring, response inhibition, and self-regulation) found in this population, in that these executive functions are needed to inhibit impulses to procure a reward that is available immediately (Patros, Sweeney, Mahone, Mostofsky, & Rosch, 2018). Relevant to social problems, this may pertain to the tendency for children with ADHD to enact unskilled behaviors in the heat of the moment (despite knowing the correct thing to do); they fail to restrain impulses to engage in negative behaviors, even at the cost of missing larger benefits later (e.g., better peer regard). These factors may help to explain why the salient impairment in social behavior for children with ADHD is presence of negative social behaviors as opposed to absence of positive social behaviors. Perhaps the purpose of attentional control is inhibiting competing disruptive impulses, as opposed to motivating prosocial actions.

In ASD, by contrast, aberrant reward processing is thought to predominantly manifest in reduced sensitivity to social rewards (Kohls et al., 2014; Taurines et al., 2012). Low social motivation in ASD, or a low degree of reward experienced from social interaction as well as reduced drive to initiate and persist in social behavior, may translate into unwillingness to enact prosocial behaviors, or at least a limited desire to do so when faced with social challenges (Chevallier, Kohls, Troiani, Brodkin, & Schultz, 2012). Support for this idea comes from Geurts, Luman, and Van Meel (2008) who found that, whereas competition with a peer improved the motivation of children with ADHD on a game and brought their accuracy closer to that of the typically developing group, this manipulation did not affect children with ASD. Thus, children with ASD may not be motivated by the same social contexts that encourage typically developing children and those with ADHD. In addition, evidence that oxytocin inhalation facilitates social interactions and eye contact in ASD populations suggests that increasing social motivation (via oxytocin) may help youth with ASD display skills that they already know (Parker et al., 2017). Finally, some research suggests a lower brain reactivity to social rewards (but not monetary rewards) among children with ASD relative to typical children (Delmonte et al., 2012), although other studies find that hyposensitivity to reward is not specific to reinforcements that are social in nature, but does differentiate youth with ASD from those with ADHD (Kohls et al., 2014).

In addition, recent work in ASD populations suggests that the speed or efficiency of initially processing social information may contribute to downstream impairment in social behavior (Lerner, McPartland, & Morris, 2013). Capacity to capture and process social stimuli in real time may be impacted by differential neural processing of those stimuli (Kang et al., in press), providing a gating function that can permit (or fail to permit) subsequent enactment of known socially skilled behaviors. This conceptualization may help explain why the central difficulty in ASD is lack of positive social behaviors. The problem in ASD is less in inhibiting impulses to do negative actions that are rewarding in the short term but not the long term; rather, it is motivating oneself to capitalize on opportunities to do positive actions, and doing so in a well-timed manner such that the social context perpetuates and remains rewarding.

We speculate on another potential transdiagnostic mechanism that contributes to social behavior problems in both disorders: poor relationship quality with adults. Many children with ADHD have conflictual interactions with parents and teachers, who are often correcting the child's behavior (Deault, 2010). This type of conflict with adults can engender resistance, leading to oppositional or conduct problems, and the development of negative social behaviors, in youth with ADHD (Deault, 2010). In contrast, poor relationship quality with adults may also affect social behavior problems in ASD, but for different reasons. Rather, some infants who are developing ASD have atypical interactions with parents, perhaps because of these infants' poor social cognitive skills and the diminished reward value of social stimuli. These altered interactions may lead to increasing loss of motivation for future socializing (Dawson, 2008). Such processes likely persist across development, and thus unrewarding relationships with parents and teachers during childhood and adolescence may also be relevant for explaining the lack of positive behaviors that characterize school-age youth with ASD.

Summary. The barriers to demonstrating positive social behaviors and inhibiting negative social behaviors have similarities and differences in ADHD and ASD, as summarized in Table 1. Youth with ASD are more likely than youth with ADHD to lack adequate knowledge about the correct behavior to do. Nonetheless, impairment in translating knowledge to performance, specifically related to aberrant reward processing and poor relationship quality with adults, may be a transdiagnostic feature across the two disorders.

4.2. Social cognition

The conceptualization that children with ADHD (at least the Combined presentation) have problems with performance as opposed to knowledge (Barkley, 2015) potentially explains why many children with ADHD pass emotion recognition or Theory of Mind tasks

comparable to typically developing children, particularly on lab-based or simple tasks (Hutchins et al., 2016). Lab-based tests simulate optimal environments where hot executive functioning processes are not taxed, and children have maximal motivation to perform well. When children with ADHD do fail lab-based tests of social cognition, it is possible this is attributable to the attentional demands of the task, as opposed to their lack of social cognitive skills; for instance, one study found that difficulties in inhibition and behavioral regulation were associated with lab-based Theory of Mind performance for children with ADHD but not children with ASD (Miranda et al., 2017). Again, the often successful performance of children with ADHD on lab-based tests of Theory of Mind and emotion recognition may indicate that children possess intact skills in these areas. Their failure to enact these skills in real life (e.g., actual social behavior) may reflect performance deficits.

Among children with ASD, some youth may lack developmentally-appropriate Theory of Mind or emotion recognition skills fundamentally, suggesting inadequate social knowledge (Baron-Cohen, 2000). Deficiencies in these social cognitive skills may also be attributable to slowed or inefficient processing of social stimuli (Kang et al., in press). That is, selective attention to salient social stimuli usually produces a cascade of contextual social learning leading to adaptive social cognition over time; lack of such selective attention early in development – either as a cause or consequence of such slowed processing of social stimuli – may derail this process in ASD (Klin, Jones, Schultz, & Volkmar, 2003). However, another contributing factor to the failure of children with ASD to pass lab-based social cognition tests may be that they are not motivated by aspects of the testing context that typically developing children and children with ADHD find motivating, such as the social desire to please an examiner (Peterson, Slaughter, Peterson, & Premack, 2013).

Lacking opportunities to learn or practice social cognitive skills is another potential mechanism explaining social cognition difficulties. This factor may apply transdiagnostically to children with ADHD as well as ASD. For instance, negotiating a conflict with a friend requires children's perspective taking and accurate emotion reading. Children with ADHD as well as ASD are less likely to have playdates relative to typically developing children (Frankel et al., 2011; Frankel & Mintz, 2011), meaning that children in both clinical groups have fewer opportunities to learn and practice these skills. Nonetheless, regarding differences between the two conditions, social cognition may be more facilitated by close dyadic relationships as opposed to superficial social interactions, because it is in friendship contexts where complex emotion recognition and perspective taking skills are most needed (Hartup, 1996). This may relate to the finding that children with ASD are more impaired in friendship relative to children with ADHD, whereas children with ADHD may be more impaired in peer acceptance relative to children with ASD. Social cognition impairments may have driven, and result from, the unique impairments in peer regard in each disorder.

Summary. The conceptualization that children with ADHD and children with ASD both possess deficits in performance, but children with ASD may have deficits in knowledge as well as in performance, may explain the similarities and differences in social cognition seen between the two disorders. These comparative studies are listed in Table 1. A shared contributor to social cognition difficulties may be a lack of playdate opportunities to learn and practice social cognitive skills among children with ADHD as well as ASD.

4.3. Peer regard

A transdiagnostic factor contributing to the problems in peer regard evident in ADHD and ASD may be peers' stigmatizing perceptions of both conditions. Desire for social distance from children with ADHD has been found among typically developing children on explicit and implicit stigma measures (O'Driscoll, Heary, Hennessy, & McKeague, 2012; Pescosolido, Perry, Martin, McLeod, & Jensen, 2007). When children were told they were going to interact with a peer who had ADHD symptoms (even when, in fact, the peer was typically developing), this expectation alone led children to be less friendly to these peers as rated by observers (Harris, Milich, Corbitt, Hoover, & Brady, 1992). Additionally, typically developing individuals across age groups report unwillingness to interact with peers with ASD (Brosnan & Mills, 2016), including after only 10 s of exposure to their real world social behavior (Sasson et al., 2017). We are unaware of any empirical studies that have directly compared stigma of ADHD to ASD. However, we note research finding that adults reported social distance from children with ADHD (that was greater than toward typically developing children; Ohan, Visser, Moss, & Allen, 2013), whereas a different sample of adults reported less social distance from children with ASD without intellectual disability than found in the previous study about ADHD (Ohan, Ellefson, & Corrigan, 2015). Another study coded media portrayals of ADHD as more negative than of ASD in current Flemish newspapers (Baeyens, Moniquet, Danckaerts, & van der Oord, 2017; see Table 1).

Nonetheless, within the finding that stigma exists against both ADHD and ASD, possible differences in perceptions of personal control over each disorder may influence the manifestation of stigma against each condition. The public views ADHD symptoms as generally under personal control and, therefore, ascribes blame to children for their ADHD behaviors (O'Driscoll et al., 2012). In fact, in the National Stigma Study of Children, even among respondents who correctly identified a child in a vignette to have ADHD symptoms, 19.1% did not consider ADHD to be a real mental illness (Pescosolido et al., 2007). By contrast, the recent emphasis on biogenetic explanations for ASD may have led to public perceptions of ASD as a valid disorder that is outside of personal control (Ohan et al., 2015).

Attributions of controllability are relevant because when the public views mental illness as outside of personal control, this may reduce social rejection of individuals with mental illness (Lebowitz, Rosenthal, & Ahn, in press). Crucially, symptoms of ADHD (more so than symptoms of depression) are viewed as justifiable grounds for social exclusion specifically because the child is seen as being able to control the behavior (O'Driscoll, Heary, Hennessy, & McKeague, 2015). On the other hand, however, views that mental illness is outside of someone's control may simultaneously increase perceptions of the person as fundamentally flawed, as well as decrease empathy (Lebowitz et al., in press). Therefore, even if the public expresses less overt social distance and exclusion toward others who they perceive to have no control over their mental illness, at the same time it may reinforce perceptions of difference from those with mental illness (Hinshaw & Stier, 2008). Although speculative, perhaps this may explain the differences in peer regard seen in ADHD versus ASD. We wonder if peers currently view ADHD as more under the child's personal control, and therefore perceive rejection of children with ADHD to be more acceptable than rejection of children with ASD. On the other hand, believing that children with ADHD can control their behaviors may also lead to more willingness to befriend them compared to peers' inclinations to befriend those with ASD.

Summary. Stigma against ADHD and ASD is a transdiagnostic feature that contributes to the problems in peer regard seen in youth with both conditions. Nonetheless, potential differences in the type of stigma associated with each disorder, related to the attribution of controllability, may explain distinctions in the pattern of peer regard in ADHD relative to ASD.

4.4. Comorbid ADHD + ASD

We are unaware of any studies that have examined the etiology of social problems in children with comorbid ADHD + ASD, compared to children with either condition alone. However, we wonder if children with ADHD + ASD are at greatest risk for a process by which diverse deficits in knowledge and blocks to performance compound social impairment over development. Children with ADHD + ASD may not only

have reduced social motivation to approach and engage with peers (ASD), but this lack of social motivation may also lead to decreased impetus to inhibit unskilled competing responses (ADHD) because the perceived benefits for doing so are less salient. Therefore, the reasons for social problems in ASD and ADHD may build off one another in children who have both conditions.

5. Intervention approaches for social problems in ADHD versus ASD

This section provides recommendations for interventions to address social problems in ADHD versus ASD, with consideration of the transdiagnostic similarities as well as differences in types of social problems and the etiologies of problems in each disorder. The goal is for treatment to be more theoretically- and empirically-informed.

5.1. Social behavior

Social skills training is a common intervention provided for youth with ADHD, ASD, or the combination of both disorders, to improve social behavior problems. At least as it is typically offered in clinic-based settings, social skills training tends to focus on skills teaching through didactic instruction and role play practice in session (Gates, Kang, & Lerner, 2017; Mikami, Smit, & Khalis, 2017). Common topics covered are conversation skills, conflict resolution, and emotion recognition. The general presumption is that children engage in unskilled social behaviors because they do not know the correct social behavior to do, so instruction is mainly tailored to addressing inadequate knowledge.

To the extent that social behavior problems in ADHD are predominantly attributable to performance deficits (particularly in the Combined presentation; Barkley, 2015), traditional social skills training approaches may be ill-matched. This may explain why social skills training has poor efficacy for children with ADHD, a topic about which has been extensively written (Evans, Owens, Wymbs, & Ray, 2018). Lack of efficacy may directly follow from the mismatch in targets: addressing deficient knowledge versus barriers to performance (Mikami et al., 2017). In fact, scholars have observed children with ADHD to receive social skills training in a clinic group about “negotiating conflicts with friends” where they learn the correct behavior to do, and then fight about seating arrangements on the bus ride home from session (Abikoff et al., 2004).

By contrast, to the extent that some children with ASD do possess knowledge deficits in terms of not knowing the correct behavior to do in social situations, the emphasis of social skills training may have utility. There is evidence that overall, clinic-based social skills training is efficacious, with medium effect sizes, for increasing social functioning in ASD (Gates et al., 2017). Interestingly, the effect sizes are larger on outcome measures of social knowledge about the correct behavior to do or the correct interpretation of a situation, and smaller (indeed, for some outcomes, null) on measures of actual enactment of positive social behaviors in real life situations (Gates et al., 2017). This empirical evidence underscores the idea that social skills training tends to focus on instruction in knowledge as opposed to enhancing performance, and consequently may have the most success in increasing knowledge as opposed to changing enacted social behaviors.

Therefore, an important difference in treatment recommendations across the two disorders is that whereas traditional, clinic-based social skills training is likely ineffective for ADHD populations, it can be helpful for ASD populations under specific situations. One specifier is that social skills training is most useful for children with ASD to the extent that knowledge about how to behave in a discrete and predictable situation can be taught. This may be why the Social Stories approach (Gray, 1998) provides knowledge about scripts to enact in problematic, but well-defined social scenarios (e.g., going to the dentist), and may improve children's social behaviors in these particular scenarios. By contrast, teaching decision rules to be flexibly applied to varied social situations may not lend itself well to social skills training. However, some researchers have speculated that teaching knowledge about discrete social behaviors is less useful because it cannot generalize to the diversity of social situations that happen, or it inhibits authentic social behavior (Bottema-Beutel, Park, & Kim, 2018).

Another specifier regarding the utility of social skills training for ASD populations is that it is possibly most helpful for the children with ASD who have substantial knowledge deficits, and not for the children with ASD who (similar to children with ADHD) have performance deficits in addition to, or instead of, knowledge deficits. Along these lines, Matson and Wilkins (2007) explicitly recommend that the first step before beginning intervention in ASD populations should be assessing whether social problems in a child stem from lack of knowledge, or a block to performance (which they predominantly conceptualize as low social motivation), or both. They suggest that a social skills knowledge questionnaire or a role-play in a clinic setting be administered to determine if children have knowledge of the “correct” things to do. Given that social skills training attempts to address insufficient knowledge, it should only be provided for children with ASD who do show knowledge deficits (Matson & Wilkins, 2007).

We recommend two intervention approaches that may address blocks to performance, based on the aforementioned etiologies of deficits in social behavior in both disorders. Crucially, both approaches may have transdiagnostic utility in helping children with ADHD as well as those with ASD, but for different reasons. First, positive relationships with adults may improve children's actual performance of social behavior. However, this may be primarily useful for children with ADHD because it reduces defensiveness and defiance against adult instructions. Evidence-based behavioral management interventions for ADHD social behavior problems, such as the Summer Treatment Program or behavioral parent training (see Evans et al., 2018) contain emphasis on the adult (parent, teacher, or counselor) and the child developing a positive relationship to encourage the child to follow instructions and accept adult guidance. Some activities to build the relationship are prescribed, and common recommendations to this end for the adult are increasing labeled praise and “catching the child being good.”

Positive relationships with parents and non-parental adults may also be an important feature in interventions to address social behavior problems in ASD, but for different reasons. Rather, such a relationship may bolster the child's desire for social contact. This may operate through decreasing learned aversion whereby youth have, through repeated experiences of social situations as confusing and overwhelming, understandably learned that social interactions are unrewarding and therefore have become less motivated to engage in them (Dawson, 2008). A positive bond with an adult may also provide a model for a successful social relationship that generalizes to the peer context (Lerner, White, & McPartland, 2012). Supporting this idea, among children with ASD, a combination of high Theory of Mind plus high attachment security with parents was associated with more social responsiveness with friends (Bauminger, Solomon, & Rogers, 2010). Socio-dramatic affective relational intervention (SDARI; Lerner & Mikami, 2012; Lerner, Mikami, & Levine, 2011) is an approach that is aligned with these findings, specifically prioritizing the interpersonal connection between counselors and youth in order to demonstrate to youth with ASD how to have a rewarding, positive social bond.

A second way to address performance deficits that contribute to difficulties in enacting socially skilled behaviors is by structuring the environment to elicit appropriate behavior in real world situations. This technique may also apply transdiagnostically to youth with ADHD as well as ASD, however, different environmental structures may be required for each disorder. It is probably crucial for youth with ADHD to be provided reminders and incentives at the point of performance (e.g., in the heat of the moment) to enact socially skilled behaviors. For example, a child with ADHD may not remember to let the guest choose the game to play when faced with this situation on a playdate, even if

the child has talked about this exact scenario in social skills training at a different time. It may help for the parent to remind the child during the time of choosing the game to remember to let the guest pick, and to offer praise (or an immediate tangible reinforcer) for the child performing the desired behavior (Mikami, Lerner, Griggs, McGrath, & Calhoun, 2010). Reminders at the point of performance may be useful because negative behaviors in children with ADHD (particularly the Combined presentation) are thought to result from their inability to suppress competing impulses, despite knowing the "correct" behavior to do (Barkley, 2015). Further, immediate incentives for socially skilled behaviors may motivate children with ADHD to enact these behaviors, given their accelerated discounting of delayed rewards (Taurines et al., 2012).

Using behavioral principles to reinforce appropriate social behaviors at the point of performance may similarly be helpful for children with ASD as it is for children with ADHD, but modifications may be needed. Applied behavioral analysis approaches for ASD can be used to provide immediate reinforcement for children displaying positive actions in peer situations (Koegel, Werner, Vismara, & Koegel, 2005). However, such interventions often encourage simple social behaviors that are clearly defined (e.g., eye contact, voice volume; Leaf, Dotson, Oppeneheim, Sheldon, & Sherman, 2010). This differs somewhat from the nature of the in-the-moment reinforcements that children with ADHD require. In ASD, some children lack the underlying social cognitive skills or motivation to enact basic behaviors, so intervention aims to identify and reinforce the most atomistic unit of social behavior, building it from the ground up (Leaf et al., 2010). By contrast, children with ADHD are thought to know, and have the motivation for, engaging in complex socially skilled behaviors, but they cannot suppress competing impulses. Behavioral reinforcement for ADHD should therefore focus on altering the contingencies that maintain the child's negative social behaviors, and the behaviors targeted are typically more complex than in ASD. A reminder by the parent to "think about if your guest wants to go first, that's being a good friend" right before a game is more likely to be useful for a child with ADHD. Whereas, for a child with ASD, the parent might instead use a more concrete prompt such as "remember, first it's her turn, and then it's your turn, and then it's her turn."

There are additional environmental changes that may be more important to maximally elicit positive social behaviors (especially complex ones) from children with ASD relative to those with ADHD. Because a prototypical difficulty in ASD is having the social motivation to produce effective social behaviors with peers, the environment should also increase motivation and opportunities for rewarding social interactions. SDARI (Lerner & Mikami, 2012; Lerner et al., 2011) employs social games that are non-didactic (i.e., no social rules are taught directly) and are entirely open-ended (i.e., children provide the content, and it can be based on their interests). These features maximize the capacity for the games to be intrinsically motivating, while helping youth experience successful peer interactions. Such an approach is designed to reduce the unique factors in ASD that interfere with performance of skilled social behaviors.

Summary. We recommend shared features to potentially improve the utility of social skills training for both youth with ADHD as well with ASD: encouraging positive relationships with adults, and altering environmental structures to reinforce socially skilled behavior in the moment. These techniques address transdiagnostic commonalties in the etiology of social behavior problems across the two conditions. However, the techniques may need to be applied in slightly different ways for youth with each condition, related to differences in what maintains social behavior problems. In addition, children with ASD, but not ADHD, are more likely to also benefit from direct instruction to increase knowledge about the correct behaviors to enact.

5.2. Social cognition

The treatment implications for addressing social cognition deficits may be similar to those for social behavior problems. Frequently, social skills training includes the teaching of perspective taking and emotion recognition. The presumption is that social cognitive deficits often underlie social behavior problems (Trevisan & Birmingham, 2016); that is, children may react poorly in a conflict because they lack the knowledge about the peer's perspective or cannot read the peer's social cues showing anger. However, this intervention model still assumes that children have knowledge deficits in addition to, or as opposed to, performance deficits. Notably, this may not be true for children with ADHD who pass social cognitive tests in lab-based settings (at least when they are simple) at rates matching typically developing children, yet nonetheless show social behavior problems (Hutchins et al., 2016). As such, social skills training containing instruction in social cognitive skills is not indicated for children with ADHD (Evans et al., 2018).

In ASD populations, clearly some children demonstrate difficulties in lab-based social cognition tests, unlike children with ADHD, suggesting that key social cognition skills may be underdeveloped (Baron-Cohen, 2000). It is possible that the children with poor social cognitive capacities will benefit most from social skills training focused on these skills (Matson & Wilkins, 2007). Nonetheless, instruction in skills may not always result in better social cognition, or in performance of better social behavior presumed to follow from social cognition. For instance, attempts have been made to teach children with ASD the thought bubbles that emerge from each character's head in classic Theory of Mind tasks such as Sally-Ann. These interventions improve Theory of Mind performance on the tasks to which they are matched, with some generalization to other lab-based tasks (Paynter & Peterson, 2013). However, they do not necessarily result in improved empathy (presumed to be a real world manifestation of Theory of Mind skills) or social behaviors (Begeer et al., 2011). It has been speculated that some children learn to "hack" the correct solution to a Theory of Mind problem through rote memorization, but this does not increase actual mentalizing (Frith, 1994).

Environmental changes may instead be needed to improved social cognition, demonstrated at the point of performance, in both ADHD and ASD populations. However, the specific changes required may be somewhat distinct in ADHD relative to ASD. It is possible that arranging a socially motivating setting can encourage youth with ASD to practice social cognitive skills in a way that they would not otherwise do. For example, in the SDARI approach (Lerner & Mikami, 2012; Lerner et al., 2011), youth with ASD might play a game in which one child has to demonstrate something that they are doing (e.g., baking a cake) without any words, while another child watches and describes the child's actions with the goal of deducing the scenario. The latter child therefore engages in a Theory of Mind-like task (i.e., understanding what the other child is attempting to convey without knowing the information), as does the first child (i.e., determining how to modify his or her actions to be comprehensible to the peer). This activity is experienced as a game by the participants, and they may elect to play it independently of the clinician; in doing so, this activity supports development of Theory of Mind without "teaching to the test" in a way that could impede generalization.

By contrast in ADHD, the presumption is that children (particularly those with the Combined presentation) already know how to recognize emotions or understand peers' perspectives under ideal circumstances (Barkley, 2015). Similar to the techniques to improve social behavior, reminders and reinforcements in the heat of the moment may be required for children with ADHD to demonstrate known social cognitive skills at the point of performance.

Summary. To address the transdiagnostic commonality that youth

with ADHD and ASD experience blocks to performance of social cognitive skills that they already know, we recommend environmental changes to improve perspective taking and emotion recognition in real world peer situations for children with either condition. However, the particular environmental supports needed may differ somewhat in ADHD versus ASD, related to diverse blocks to enacting social cognitive skills in each condition. Similar to as recommended for addressing social behavior problems, some youth with ASD may benefit from direct skills instruction about social cognition to address a fundamental lack of knowledge in this area, but this is unlikely to be the case for youth with ADHD.

5.3. Peer regard

There is a longstanding presumption in the intervention literature that if children improve their social behaviors and social cognitive skills, peers will respond with liking and friendship. Although there is strong evidence that children who display poor social behaviors engender peer disliking, the reverse pathway does not necessarily occur (Mikami et al., 2017). Rather, peers selectively remember negative things that disliked children do while forgetting positive things, and they interpret ambiguous actions of disliked children as negative; these biases are reversed to favor liked children (Mikami, Lerner, & Lun, 2010). In other words, peers seem cognitively predisposed to retain their initial impressions about a child whom they already dislike, even in the face of disconfirming behavioral evidence. To improve peer regard among youth with ADHD and/or ASD, we therefore speculate that changing social behavior and social cognition may be necessary but not sufficient conditions. Additional efforts may be required to increase peers' inclusiveness, and reduce stigma (Mikami et al., 2017). Despite the fact that the potential reasons for stigma may be slightly different in ADHD relative to ASD, there are strong transdiagnostic commonalities in the recommended approaches to address stigma.

Psychoeducation and contact interventions have been found to reduce stigma toward mental disorders (Corrigan, Michaels, & Morris, 2015). The aim of psychoeducation is to dispel stereotypes about mental illness by providing fact-based information. Psychoeducation is often paired with contact, in which someone who has lived experience with a mental illness tells a personal story to humanize that disorder, reduce fear, and help relatability. Effect sizes for psychoeducation and contact approaches tend to be small and may not persist over time; further it is largely unknown whether these interventions improve peers' liking of real life youth with mental disorders as opposed to solely self-reported inclinations for social distance from hypothetical persons with mental disorders (Corrigan et al., 2015). Nonetheless, psychoeducation and contact are efficacious for reducing stigma against a wide range of disorders as well as "mental illness" generally, without moderation by disorder type (Corrigan et al., 2015). Therefore, these anti-stigma interventions may be a shared strategy that is useful for improving the peer regard of children with ADHD as well as ASD.

Of note, we wonder if social customs and policies have facilitated the ability of ASD advocacy groups to disseminate psychoeducation in recent years, which may have differentially reduced stigma and improved peer regard for youth with ASD relative to youth with ADHD. The neurodiversity movement aims to dismantle negative stereotypes and encourage the public to relate to individuals with ASD (Kapp, Gillespie-Lynch, Sherman, & Hutman, 2013). Although we are not aware of empirical research on the effects of the neurodiversity movement on stigma, we acknowledge the presence of "Autistic Pride Day" without a similarly widespread parallel for ADHD. Because ASD advocacy groups often focus their public relations messages on infants, this may make it easier to pique public empathy, allowing more opportunity to provide psychoeducation about ASD compared to ADHD advocacy groups. Moreover, educational policy supports differential treatment of children with ASD and ADHD, whereby in the United States, children with ASD receive more comprehensive services at school. Such a discrepancy may reinforce a public view of ASD as a real diagnosis versus ADHD as illegitimate, and have contributed to a potentially larger reduction in stigma against ASD over time compared to ADHD.

Nonetheless, although this is admittedly speculative, we wonder if improvements can be made to existing psychoeducation and contact anti-stigma interventions if the end goal is increasing peer regard. Psychoeducation often focuses on the biological basis of disorders (Corrigan et al., 2015). Although biological emphases reduce misperceptions that the person with the disorder can control symptoms but chooses not to, thereby lowering blame of the person (which can reduce rejection and discrimination), it may also lead to public perceptions that people with mental illness are fundamentally different (which prevents friendship and connectedness; Lebowitz et al., in press). For this reason, some parts of the neurodiversity movement have rejected the push for biological explanations and cures for ASD, instead emphasizing celebration and acceptance of the disorder (Kapp et al., 2013).

We propose an alternative, transdiagnostic approach to improving peer regard that includes classroom teachers instructing, and modelling for peers, that students with ADHD and/or ASD have value to encourage peers' social inclusion of children with these conditions. Specifically, teachers can treat children with mental health conditions in ways that demonstrate that they like these children (despite or regardless of these children's behaviors). Also useful may be teachers' highlighting genuine positive personal attributes in these students that are unrelated to their disorder. These teacher practices may help peers gain favorable impressions of children with ADHD and/or ASD in a naturalistic way. Suggestive evidence supports this approach. Training teachers to undertake these strategies resulted in peers giving higher liking ratings, fewer negative nominations, and more friendship nominations to children with ADHD (Mikami et al., 2013). Further, encouraging peers to include children with ASD in play activities led to peers giving more friendship nominations to children with ASD (Kasari, Rotheram-Fuller, Locke, & Gulsrud, 2012). Both interventions improved peer regard more than comparison conditions that trained the child with ADHD or ASD in correct social behaviors; interestingly, the latter approach has been speculated to increase stigma because it communicates that the child with the disorder needs remediation (Bottema-Beutel et al., 2018; Mikami et al., 2017).

Summary. Similar interventions may address the stigma against ADHD as well as ASD, which may potentially lead to improvements in peer regard. These transdiagnostic approaches include psychoeducation, contact, and teachers encouraging peers' social inclusiveness by modelling for peers that children with behavioral differences have value.

5.4. Comorbid ADHD + ASD

Little empirical data exist that inform interventions for children with ADHD + ASD. Interestingly, one study suggested that among children with ASD receiving clinic-based social skills training, those with comorbid ADHD benefited less from the treatment (Antshel et al., 2011; see Table 1). This may have occurred to the extent that social skills training tackles knowledge deficits, and whereas children with ASD are thought to have both knowledge and performance deficits, children with ADHD predominantly have performance deficits.

Other intriguing work suggests that the Program for the Education and Enrichment of Relational Skills (PEERS) benefits children with ADHD (Frankel, Myatt, Cantwell, & Feinberg, 1997), as well as with ASD (Frankel et al., 2010). PEERS involves both social skills training with children, and groups where parents learn to structure the social environment to encourage children to enact skills. This parent component may tackle performance deficits, which may contribute to the success of PEERS for children with either disorder. However, existing published research evaluating PEERS has involved children with either

ADHD or ASD, but not together in the same group, and has excluded children with comorbid ADHD + ASD. Therefore, the utility of PEERS for youth with ADHD + ASD has not yet been formally assessed. Notably, studies evaluating PEERS also emphasize the need to tailor the topics to be different in groups of children with ADHD (not bragging) versus ASD (being flexible to peers' interests), based on the social behavior problems demonstrated in each condition (Gardner, Gerdes, & Weinberger, 2015). In practice, clinicians may face dilemmas in selecting appropriate topics in a group of children with the combination of both disorders.

6. Conclusion

Given recent changes in DSM-5 to allow ADHD and ASD to be diagnosed in the same individual, and the high comorbidity between these conditions, the study of transdiagnostic processes versus differences underlying ADHD and ASD is a timely topic. Such study is also in line with the National Institute of Mental Health Research Domain Criteria initiative in the United States (Cuthbert, 2015) to break mental disorders into their basic constituent components and identify the shared and dissimilar features across disorders. This review focused on developing a comprehensive understanding of social functioning in ADHD relative to ASD without intellectual disability. Social impairment is exceedingly common in each condition and represents a frequent reason for treatment referrals.

There are both commonalities and distinctions in the manifestation of social problems between ADHD and ASD without intellectual disability. Children with each condition show transdiagnostic impairments in social behavior, social cognition, and peer regard. Within that finding, however, the relative areas of difficulties appear slightly distinct. Many children with ADHD display disruptive, negative behaviors such as bossiness, aggression, and acting without thinking in peer situations. However, they are less likely to show impaired social cognition on lab-based tasks. In part because of these negative behaviors, which are off-putting to peers, children with ADHD are highly peer-rejected. By contrast, children with ASD may be more likely to lack positive or prosocial behaviors, instead omitting social gestures and appearing as if they do not care about social interactions. They may also have difficulties with social cognition in lab-based tasks as well as in real world peer situations. In part because of their impairment in positive social behaviors and social cognition, which are needed to build intimate relationships, children with ASD may have the relatively greatest problems in making and keeping friendships.

Transdiagnostic similarities and differences also exist in the etiologies for social problems. Difficulties in performance of skilled behaviors presumed to be known may be a shared feature across ADHD and ASD. However, a major distinction is that most children with ADHD (particularly those with the Combined presentation) are thought to have intact knowledge. That is, they know the correct behavior to do, and they have the requisite social cognitive skills, but their difficulty lies in performing these correct behaviors. By contrast, a plurality of children with ASD may have deficient knowledge in addition to problems in performance. They may not actually know the correct behavior to do, and may fundamentally lack the skills to engage in perspective taking or emotion recognition. Among children with intact social knowledge, however, transdiagnostic barriers to performance may include aberrant reward processing and poor relationships with adults, in both disorders.

Finally, stigma against ADHD and ASD likely contributes to the poor peer regard found in each disorder, making this a shared transdiagnostic feature. However, nuances in the manifestation of stigma against each condition may, in part, explain the different patterns of peer regard. Perhaps the societal tendency to view ADHD as less of a legitimate disorder, leading to the assumption that the child can control ADHD behaviors, results in peer rejection of children with ADHD. By contrast, stigma about ASD may be more likely to include beliefs that the child is fundamentally different. Whereas this may result in less blame of the child for his or her condition, it may also contribute to peers being unwilling to befriend children with ASD – as friendship requires an equal partnership between children.

6.1. Clinical implications

The Research Domain Criteria initiative (Cuthbert, 2015) has the direct aim of influencing future diagnostic classification and treatment, for example by identifying novel groups of participants across existing DSM-5 disorders characterized by shared underpinnings, or by finding tipping points on a continuum of psychopathology that mark the transition into disorder (Ameis, 2017). In line with this goal, we recommend taking a dimensional approach to characterizing the types of social impairments demonstrated when evaluating a child presenting with ADHD, ASD, or the combination of the two disorders. To do so, a clinician might examine the pattern of subscales on the Social Skills Informant System to identify which particular social behavior problems the child displays (Gresham & Elliott, 2008); other adult informant report questionnaires can be used to assess the myriad of relevant social cognition abilities (e.g., Theory of Mind Inventory; Hutchins, Prelock, & Bonazinga, 2012; Hutchins et al., 2016) or the different components of peer regard (e.g., Dishion Social Acceptance Scale; Dishion & Kavanagh, 2003). If feasible, reports from multiple informants and/or observations of social behaviors in peer situations, or lab-based tasks of social cognition, would offer the most comprehensive picture of the child's areas of social strengths and impairments. The information from such an assessment has the potential to directly inform treatment targets, and will facilitate tracking of the child's progress on specified areas of social deficiency as the child receives intervention.

Once the child's pattern of social impairments is identified and treatment targets chosen, we recommend that clinicians consider the etiology of the social impairment when selecting an intervention approach. Although it is not always necessary to address the presumed etiology of the problem in order to tackle it, doing so will likely increase the probability of success. Because a major consideration is whether problems in social behavior/social cognition stem from inadequate knowledge, blocks to performance, or both, we recommend that clinicians investigate these potential etiologies when devising a treatment plan. To this end, it may be possible to create multiple choice tests or interview the child about the “correct behavior to do” to assess if children have intact social knowledge (Matson & Wilkins, 2007). Administering lab-based tests of Theory of Mind or emotion recognition may provide information about whether the child possesses these social cognitive skills fundamentally, or under ideal circumstances. Additionally, some investigators have applied scoring metrics to the Social Skills Informant System to specifically inform the extent to which social behavior problems reflect knowledge versus performance deficits (Aduen et al., in press).

Treatment could then follow based on what the presenting social problems and etiologies of these problems may be, with consideration of the features which are shared between ADHD and ASD relative to the features that are distinct. That is, hypothetically, if inhibiting competing unskilled impulses to engage in negative behavior is identified as the primary problem (common in ADHD), then interventions could target this performance deficit; however, if lack of social cognitive skills is the main issue (common in ASD), then interventions might target this knowledge deficit. For children determined to have performance deficits (in addition to, or instead of, knowledge deficits), the specific ways to encourage skilled behavior at the point of performance may also differ somewhat for children with ADHD versus ASD because of distinct things that children with each condition find motivating. Alternatively, another strategy would be to begin with the treatment approaches that are applicable transdiagnostically. For instance, building a more positive relationship between children and parental as well as non-parental adults may equivalently tackle barriers to performance of known social skills in children with ADHD as well as ASD. Additionally, interventions

to reduce stigma of mental illness (which may improve peer regard) may operate similarly for children across conditions.

In summary, this review highlights the importance of assessing the particular social problems of a child, and then delivering a treatment that follows from this assessment, without wasting efforts attending to domains or processes where the child does not have deficits. However, within the existing DSM-5 classification system, treatments are provided (and reimbursed by insurance) based on a child's diagnostic category. Therefore, at least at the present time, there may be utility in devising treatments that are disorder-specific. To that end, the information in the current review potentially suggests that different empirically-supported treatments for social problems could be designed to be specific to ADHD, versus ASD, versus their combination (with each treatment containing both overlapping approaches across disorders and distinct approaches in each disorder). Still, although our synthesis of the literature suggests some features that tend to characterize children with ADHD relative to children with ASD (and vice versa), clearly heterogeneity also exists within each disorder. An unanswered question concerns how clinicians should balance tailoring services to a child's unique profile of needs with maintaining the integrity of an empirically-supported treatment. An additional implication is that clinicians would need to determine how to proceed when there are children with ADHD, ASD, and ADHD + ASD together in a treatment group, such that they cater to the needs of a mixed group. Alternatively, clinicians might prefer to restrict group enrollment to one diagnosis, but this seems unlikely to be feasible in practice.

6.2. Limitations and future research

Sex differences. There are several limitations of this review in regards to areas where more research is needed. First, both ADHD and ASD are more common in males than females (3:1 gender ratio for ADHD, and 4:1 for ASD) and girls with ADHD (Quinn & Madhoo, 2014) as well as those with ASD (Halladay et al., 2015) are underdiagnosed and undertreated. However, peer problems are a social construct and are inherently influenced by the social context of behaviors and peers' interpretation of these behaviors, all of which are affected by gender.

Specifically, girls with ADHD may show fewer negative behaviors as compared to boys with ADHD, despite displaying more negative behaviors than typically developing girls (Abikoff et al., 2002). This may be attributable to girls with ADHD being less likely to have comorbid disruptive behavior disorders relative to boys (Quinn & Madhoo, 2014). Interestingly, the tendency for girls with ADHD to have fewer comorbid conduct problems as compared to their male counterparts may lead to relatively lower peer disliking (Mikami & Lorenzi, 2011). On the other hand, some evidence suggests that when girls with ADHD do show equivalent conduct problems to boys with ADHD, the impact on their peer regard may be more severe (Mikami & Lorenzi, 2011). Perhaps, conduct problems in girls are more deviant from female norms, so peers respond with greater disapproval. Therefore, interventions to reduce stigma against ADHD are potentially most needed for females, but the stigma may also be most difficult to address in female peer groups (Mikami et al., 2013).

A consistent pattern in recent literature also suggests that girls with ASD may demonstrate fewer negative social behaviors relative to boys with this condition. The “female protective effect” suggests that girls' symptoms may, at least in childhood/adolescence, present in more peer-appropriate ways (Halladay et al., 2015). That is, girls' perseverative interests may focus on more normative topics (e.g., dolls and peer networks) and they may have subtler forms of aggression. Further, girls with ASD may be more likely than their male counterparts to camouflage their social challenges; for instance, because boys play more organized games than girls, it is more obvious when a boy with ASD is socially isolated (Dean, Harwood, & Kasari, 2017). As a result, boys with ASD may be more overtly peer-rejected, whereas girls may be more neglected, meaning that they are neither liked nor disliked (Dean et al., 2014). In summary, there remains a need for research on differences in manifestations, etiologies, and treatment implications for social problems in girls.

Lifespan issues. The extremely limited amount of longitudinal data leaves lingering questions about the way social functioning manifests and changes over time. Whether the same similarities and differences in social functioning across ADHD versus ASD that exist in childhood continue into adulthood, versus what new factors emerge, is largely unknown.

A benefit of adulthood is the ability to find one's own social niche in ways that are not possible in childhood and adolescence. Although this feature may help adults with ADHD as well as with ASD to improve their social behaviors, social cognition, and peer regard, we wonder if this feature differentially benefits those with ASD. In childhood, individuals with ASD are more likely to have personalized intense interests that are not shared by their classmates, as opposed to children with ADHD who may enjoy the same activities as their classmates but manifest unskilled social behaviors while they play them (Frankel et al., 1997; Frankel et al., 2010). Therefore, freedom to meet a wider range of people may especially help adults with ASD, because they will find peers who share their intense interest, and understand them.

On the other hand, it is developmentally appropriate for friendships to deepen in adulthood and to rely more upon emotional intimacy, and successful adult romantic partnerships are viewed as an extension of being able to establish childhood friendships (Hartup, 1996). Both adults with ADHD and with ASD are suggested to have poorer quality in close relationships relative to adults without these conditions (Orsmond & Kuo, 2011; VanderDrift, Antshel, & Olszewski, in press). However, to the extent that the social difficulties for individuals with ASD most pertain to establishing and maintaining close relationships (whereas this is relatively less true for those with ADHD), it may mean that adult relationships will remain challenging for adults with ASD more so than for adults with ADHD (Orsmond & Kuo, 2011).

Manifestations of ADHD and ASD. Most conclusions in this paper apply to youth with all presentations of ADHD, as they draw from research that includes children with the Combined as well as the Inattentive presentations. Nonetheless, children with the Combined presentation comprise the majority of the research literature as they are most frequently referred for treatment (Baeyens et al., 2006), therefore, they are over-represented in the findings reviewed (and in the overall knowledge base about ADHD). The description of a child with negative, disruptive, and intrusive social behaviors who has intact social knowledge but significant performance deficits most fits the Combined presentation (Baeyens et al., 2006; Barkley, 2015). By contrast, some investigators speculate that children with the Inattentive presentation are more likely to have both knowledge and performance deficits, as opposed to only performance deficits (Pfiffner et al., 2014).

The current paper also excludes the approximately 30% of children with ASD who have an intellectual disability (Christensen et al., 2016). Children with ASD + intellectual disability may show unique patterns of social impairment that are distinct from children with ASD and intact intellectual functioning, suggesting that intellectual disability (in addition to, or instead of, ASD) may be the cause of these social problems. Further, youth with ASD + intellectual disability are less likely to have comorbid ADHD or to present with diagnostic confusion between ASD and ADHD. Finally, youth with ASD and intellectual disability are less likely to be in general education classrooms and social skills training groups enrolling children with ADHD, compared to those with ASD and no intellectual disability. Therefore, we have focused on children with ASD and no intellectual disability because they are most relevant to the aim of this paper examining transdiagnostic similarities and differences in social functioning and intervention recommendations between ADHD and ASD. Nonetheless, the conclusions and recommendations from this paper do not generalize to youth with ASD + intellectual disability.

Study methodology. As can be seen in Table 1, all of the included comparative studies of social behavior problems in ADHD relative to

ASD and/or ADHD + ASD have relied upon parent report ratings of behavior, with infrequent inclusion of teacher report or youth self-report. No comparative studies to date have used observations or peer report to document social behavior patterns in children with each condition, despite the existence of many studies using these methods to examine social behaviors in either ADHD or ASD alone. This is a limitation, because parents have a unique view of their children's behaviors that is largely restricted to the home context, or may be influenced by their overall perception of their child. By contrast, many comparative studies of social cognition between the two disorders have relied upon observations of children's performance on lab-based tests, supplemented by parent ratings. Methodologically, the research comparing social cognition in ADHD relative to ASD and/or ADHD + ASD is the most sound of the three areas of social problems examined. Finally, comparative studies on peer regard in the two disorders are few. This is the least developed of the three areas of social problems reviewed. However, the little existing work available has used peer report, sociometric methods, and observations to compare peer regard and stigma in ADHD relative to ASD.

Social resilience. Not all children with ADHD have social impairment; in fact, approximately 20% may not (Modesto-Lowe, Yelunina, & Hanjan, 2011). In addition, youth with ADHD as well as with ASD show unique, individualized patterns of social strengths and weaknesses where they are unlikely to be impaired in all areas across the board, or all areas equally. Studies of factors predicting social resilience are rare, and needed in future work. Further, the extent to which predictors of social resilience may be similar versus distinct for youth with ADHD relative to ASD is, to our knowledge, entirely undocumented. Nonetheless, it is possible that positive relationships with parental and non-parental adults could be a transdiagnostic feature that foster better peer relationships in youth with ADHD (Modesto-Lowe et al., 2011) as well as ASD (Bauminger et al., 2010).

Comorbid ADHD + ASD. Another priority for future study is how social impairments develop and manifest in youth with ADHD + ASD relative to in those with either disorder alone. Given how newly the comorbid presentation has been allowed, it is not surprising that there is little systematic research about it to date. However, the rates of ADHD + ASD diagnoses will likely increase as clinicians and families adapt to the DSM-5. It may be fruitful to investigate how combinations of the relevant symptom dimensions lead to impairment; for example, how do inattention, hyperactivity/impulsivity, repetitive behaviors, and restricted interests interact to influence social behaviors, social cognition, and peer regard on a dimensional level?

We also know virtually nothing about efficacious treatment for social problems among youth with ADHD + ASD, even though this group presents quite frequently for help. Potentially, the strategy of conducting a thorough assessment to determine areas of impairment and select treatment targets will be most useful for children with ADHD + ASD relative to children with either ADHD or ASD, because social deficits may be most heterogeneous among children with comorbid diagnoses. It may also be possible to develop empirically-guided treatment recommendations for this population, including establishing similarities and distinctions between recommendations for children with ADHD + ASD relative to those with either disorder alone. Again, this raises questions about extent to which treatment should and can be tailored to individual children's specific profiles of social deficits, versus focus on transdiagnostic features between the disorders.

7. Summary

This review aimed to advance the study of transdiagnostic processes that underlie a major domain of impairment – social functioning - in ADHD as well as ASD. Understanding the shared versus distinct features and mechanisms contributing to social problems in these two conditions will hopefully inform interventions to alleviate burden for the affected youth and their families.

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