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Review article

Language acquisition can be truly atypical in autism: Beyond joint attention

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ABSTRACT

Language profiles in autism are variable and atypical, with frequent speech onset delays, but also, in some cases, unusually steep growth of structural language skills. Joint attention is often seen as a major predictor of language in autism, even though low joint attention is a core characteristic of autism, independent of language levels. In this systematic review of 71 studies, we ask whether, in autism, joint attention predicts advanced or only early language skills, and whether it may be independent of language outcomes. We consider only conservative estimates, and flag studies that include heterogenous samples or no control for non-verbal cognition. Our review suggests that joint attention plays a pivotal role for the emergence of language, but is also consistent with the idea that some autistic children may acquire language independently of joint attention skills. We propose that language in autism should not necessarily be modelled as a quantitative or chronological deviation from typical language development, and outline directions to bring autistic individuals' atypicality within the focus of scientific inquiry.

1. Introduction

In the current edition of the DSM (DMS-5; American Psychiatric Association, 2013), language is a mere specifier of the autism diagnosis. Under this conception, the linguistic profile of autistic children is heterogonous and should be independent of the intensity of core characteristics of autism. By contrast, atypicality in the social domain, and more specifically low rates of responding to or initiating shared attention is a core feature of autism, robustly attested during the second year of life (e.g. Zwaigenbaum et al., 2015). Accordingly, the absence of joint attention behaviors is a central sign of autism both in the DSM-5 and in the gold standard diagnostic tools (ADI-R; Le Couteur et al., 2003; ADOS; Lord et al., 2012).

Many autistic children display an atypical and clinically recognizable trajectory in the acquisition of structural language, that is of phonology, vocabulary and morphosyntax (Mottron and Gagnon (2023) argue that this trajectory is associated with a prototypical autism phenotype). Around the age of three, 50–60% of autistic children are still non- or minimally speaking, but by the age of six or seven, around 60–80% of autistic children develop expressive and receptive structural language, often at levels close or even superior to typical. Importantly, during this 3- to 7-years of age interval a variety of language trajectories are observed, from steady and relatively modest growth curves to surprisingly steep language gains, but after this point, language scores usually progress in relatively predictable fashion (on language profiles and outcomes in autism, see, for instance Anderson et al., 2007; Baghdadli et al., 2012; Ellis Weismer and Kover, 2015; Fountain et al., 2012; Georgiades et al., 2022; Pickles et al., 2014; Wodka et al., 2013). Language in autistic children remains imperfectly understood, and identifying the factors that may predict, favor or shape linguistic trajectories within this crucial 3-to-7 period remains one of the major scientific challenges in autism research.

The lion's share of the current literature on factors that may explain language trajectories and outcomes in autism focuses on socio-communicative abilities. Social interaction plays a central role in early typical language development, and responding to or initiating joint attention constitute the clearest evidence that the child is engaged in intersubjective communication (Tomasello, 2008). It makes sense to assume, therefore, that the ability to establish a shared attentional frame may increase the opportunities for autistic children to attend to linguistic stimuli and engage in communicative experiences. For instance, the meta-analysis by Bottema-Beutel et al. (2019) finds significant, small to moderate, correlations between initiating and responding to joint attention constructs and social functioning in autism (even though one

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of these estimates is based on a very small number of reports). Accordingly, a key assumption in the most supported intervention programs is that targeted gains in social communication, and more particularly joint attention, should facilitate cascading developments in structural language (e.g. Dawson et al., 2010; Green et al., 2010; Shih et al., 2021). However, while such developmental interventions seem to lead to significant gains in the domain of joint attention itself (Murza et al., 2016), a recent meta-analysis found the summary effects on language outcomes not to be significant (Sandbank et al., 2020).

In fact, linking language outcomes to joint attention in autism is somewhat paradoxical, as the significant proportion of autistic children who become verbal still have a diagnosis of autism, a core component of which is, precisely, atypically low joint attention. In other words, high language outcomes in autism should be possible despite low joint attention skills. However, there are numerous reports in the autism literature (reviewed below) that higher levels in joint attention are associated with better language abilities. This research is summarized in a meta-analysis by Bottema-Beutel (2016), which reports medium to strong summary associations, across autism studies, between language variables and response to joint attention. However, there are several reasons to question this conclusion and revisit the literature on joint attention and language in autism.

To begin with, the meta-analysis in Bottema-Beutel (2016) includes all the relevant effect sizes reported within each paper. In many cases, however, initial correlations between joint attention and language do not subsist when another factor, such as non-verbal intellectual quotient (NVIQ), is being controlled for (e.g. within hierarchical regressions). Including all these effects may skew the summary towards a positive relationship between joint attention and language, while only the most conservative estimates, controlled for confounding factors, may constitute unequivocal evidence for the predictive role of joint attention.

Relatedly, Bottema-Beutel (2016) does not distinguish different factors for which the link between joint attention and language is controlled. However, many domain-general cognitive skills influence both language acquisition and social skills. It is therefore desirable that the correlation between joint attention and language be controlled for NVIQ, which, along with initial language levels, emerges as a robust language predictor in many different studies (e.g. Brignell et al., 2018; Thurm et al., 2007) and is a significant moderator of various social functioning measures in autism (Bottema-Beutel et al., 2019). It is, therefore, an important aspect of each study whether it controls the relationship between joint attention and language for NVIQ (or a relevant proxy thereof).

Furthermore, in some of the studies reviewed in Bottema-Beutel (2016) children have a clear-cut diagnosis of autism, but other samples are more heterogenous, with some children having diagnoses of Pervasive Developmental Disorder-Not Otherwise Specified (PDD-NOS) or of autism 'spectrum'. As mentioned above, atypically low rates of joint attention behaviors constitute a core sign of prototypical autism. By contrast, the (DSM-IV-TR) PDD-NOS category, operationalized as the sub-threshold 'autism spectrum' score in the ADOS, is notoriously unspecific (Molloy et al., 2011). Children with such nosological profiles may, by definition, exhibit both better joint attention skills and higher language levels (e.g. Thurm et al., 2007) and, when included within studies, drive up the correlation between joint attention and language. For this reasons, it is also important to clearly tag studies that have less prototypical populations.

Finally, in the literature, the exact nature of the link between joint attention and language remains undetermined. Yet, there are at least three theoretically motivated ways to conceive of the relationship between joint attention and language, which have nontrivial consequences for our understanding of linguistic trajectories in autism. The strongest theoretical position is that joint attention is required throughout language acquisition, from the first words to complex morpho-syntax. Let us call this first hypothesis *Joint Attention across the board* ($JA_{across\ the\ board}$). The central prediction of $JA_{across\ the\ board}$ is that a strong correlation between joint attention skills and language should be observed in minimally speaking autistic children, but also in autistic children who are at more advanced stages of language acquisition.

This prediction may be too strong, however. Even in typical development, it is unclear whether the beneficial influence of joint attention extends beyond the early stages of vocabulary acquisition, around 24 months of age (e.g. Akhtar and Gernsbacher, 2007; Tomasello, 2008, p. 160; Tsimpli, 2013). Interestingly, while Bottema-Beutel (2016) reports strong to medium associations between language and joint attention in autism, the effect sizes she finds for typical development are weaker. Her explanation for this group difference is that, in typically developing (TD) children included in the studies she analyzed, the acquisition of language is advanced beyond the early stages at which joint attention is pivotal. A weaker hypothesis, then, let us call it *Joint Attention pivotal for language* ($JA_{pivotal}$), is that, in both autistic and non-autistic children, joint attention is a pre-requisite for language to take off, but may not necessarily play a role at later stages of linguistic development. The central prediction of $JA_{pivotal}$ is that a strong correlation between joint attention skills and language should be observed in autistic children only when language onset takes place, usually between (late) three and six years of age.

Both $JA_{across\ the\ board}$ and $JA_{pivotal}$ entail that only those autistic children who have better joint attention skills are likely to reach language between the ages of three to six-seven. However, as just argued, published evidence for this assumption is equivocal because of differences in stringency on the controlling variables and diagnostic criteria. It is, therefore, also possible that in some autistic children the mechanism of language acquisition may differ from typical development precisely in the extent to which it depends on joint attention skills. Let us call this the *Joint Attention not necessary for language* hypothesis ($JA_{not\ necessary}$). The main prediction of $JA_{not\ necessary}$ is that joint attention does not necessarily predict the emergence of first words or language growth towards more advanced levels.

Summing up, it is, as of yet, unclear whether the published studies clearly support the widespread assumption that linguistic outcomes are positively related to weaker manifestations of what is a core behavioral sign of autism: atypically low rates of joint attention behaviors. Our main research question is to which extent the three possible relations between joint attention and language outcomes just outlined—$JA_{across\ the\ board}$, $JA_{pivotal}$ and $JA_{not\ necessary}$—are supported by the literature:

- $JA_{across\ the\ board}$: joint attention skills are predictive of language in autism, from first words to complex morpho-syntax;
- $JA_{pivotal}$: joint attention skills are predictive of first milestones of language development in autism;
- $JA_{not\ necessary}$: in autism, joint attention skills do not necessarily predict the emergence of language or language growth towards more advanced levels.

While the first two hypotheses are presupposed (if not always distinguished) by much of the scientific literature on autism, the latter is much more controversial, but may bring the research community closer to fully acknowledging that language in autism may be truly atypical, and promote interest in hitherto overlooked areas of inquiry.

In what follows, we present a systematic review of the literature on joint attention and language outcomes in autism, with the objective to assess the extent to which joint attention predicts language in autism. The three possible relations between joint attention and language, $JA_{across\ the\ board}$, $JA_{pivotal}$ and $JA_{not\ necessary}$, provide the main dimension along which we structure our review. To reach a balanced preview of the strength of the evidence for each hypothesis, we take into account only the most conservative effects reported in each study, distinguish between studies that control for the potential influence of NVIQ and those that do not, and flag studies which include children with a less stringent diagnosis of autism. As discussed above, most of the significant changes in linguistic profiles in autism usually take place between the ages of two

to approximately seven. For this reason, we also include the information about the age range at study entry. Finally, we also include information about the sample size of each study.

2. Methods

2.1. Literature search

We used the PRISMA criteria (Page et al., 2021) to conduct our literature search, which is summarized in Fig. 1. Studies without new clinical data (reviews, meta-analysis) were excluded, but searched for further references. We also excluded papers prior to 1994—or those with diagnosis made before this time point—due to changes in diagnosis criteria. We excluded unpublished posters and abstracts, but we did include doctoral dissertations. We did not have any specific criteria regarding participant age, and, in the studies reviewed below, the age at which the relevant joint attention measures were taken ranges from 12 months to 12 years. We included only studies that reported a clear measure of structural language—vocabulary size, standardized language score etc.—and excluded those that comprised only measures of communication skills, such as the communication sub-scale of the Vineland, or where relationship between language and joint attention in a sample of children on the autism spectrum was not directly available. Table 1 summarizes the inclusion and exclusion criteria.

The second author searched on Pubmed, Linguistics and Language Behavior Abstracts (LLBA) and Scopus from November 2019 until June

Table 1
Inclusion and exclusion criteria for literature search.

	Inclusion criteria	Exclusion criteria
Design	Study includes primary data	Study uses only secondary data, is a review or a meta-analysis
Population	All ages; Participants have a diagnosis of ASD, including the DSM-IV definitions (ASD, Autism, Autism Disorder, Asperger Disorder)	Diagnosis made before 1994; Participants have a syndrome with concomitant ASD traits
Outcomes	Reports statistical estimates of the relationship between joint attention and structural language	Does not report joint attention measure; Does not report a measure of structural language; Does not analyze the link between joint attention and language

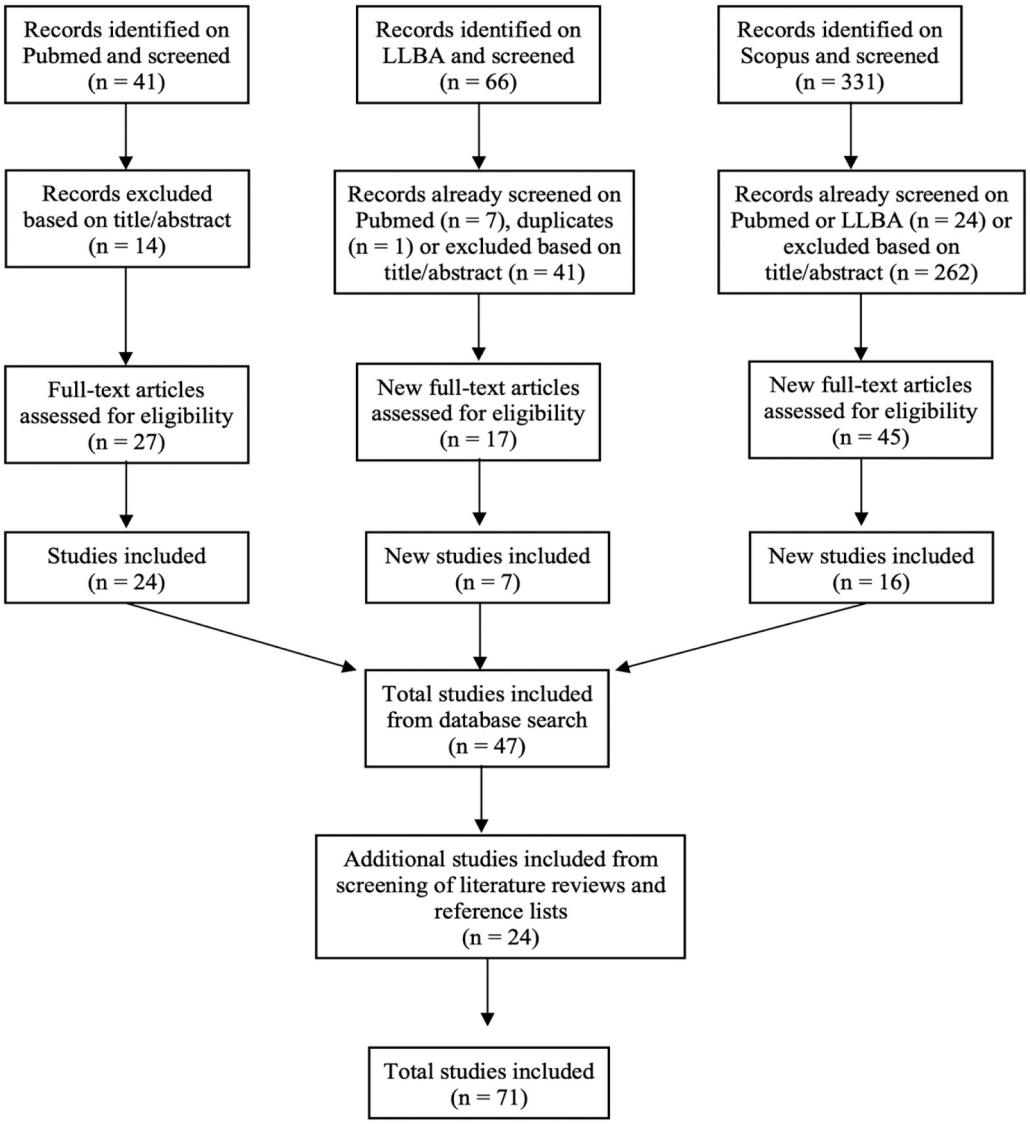

Fig. 1. Flow-chart of literature search.

2022 with the key words: 'autis* ' AND 'predictors of language' AND 'joint attention' (other combinations or search terms did not yield better results). She screened the titles and abstracts, as well as the reference lists for other sources. The first and the second author screened each record; when there was any uncertainty about the inclusion of a report, the third author was consulted, and a consensus process was used. Forty-seven studies were included from the database search, and an additional 24 studies were included from screen the reference lists of these studies or of literature reviews. In total 71 studies have been included within this review; see Fig. 1. The following data was extracted from every source: study type, reported diagnosis, sample size, age (at entry and, if relevant, end point), joint attention measure, language measures, and statistical estimates of the link between joint attention and language. For the latter, only the most conservative effect was included; for instance, if the paper reported both a simple correlation between response to joint attention and expressive language, and hierarchical regressions that included response to joint attention and other factors (such as NVIQ), only the estimate for response to joint attention from the best fitting

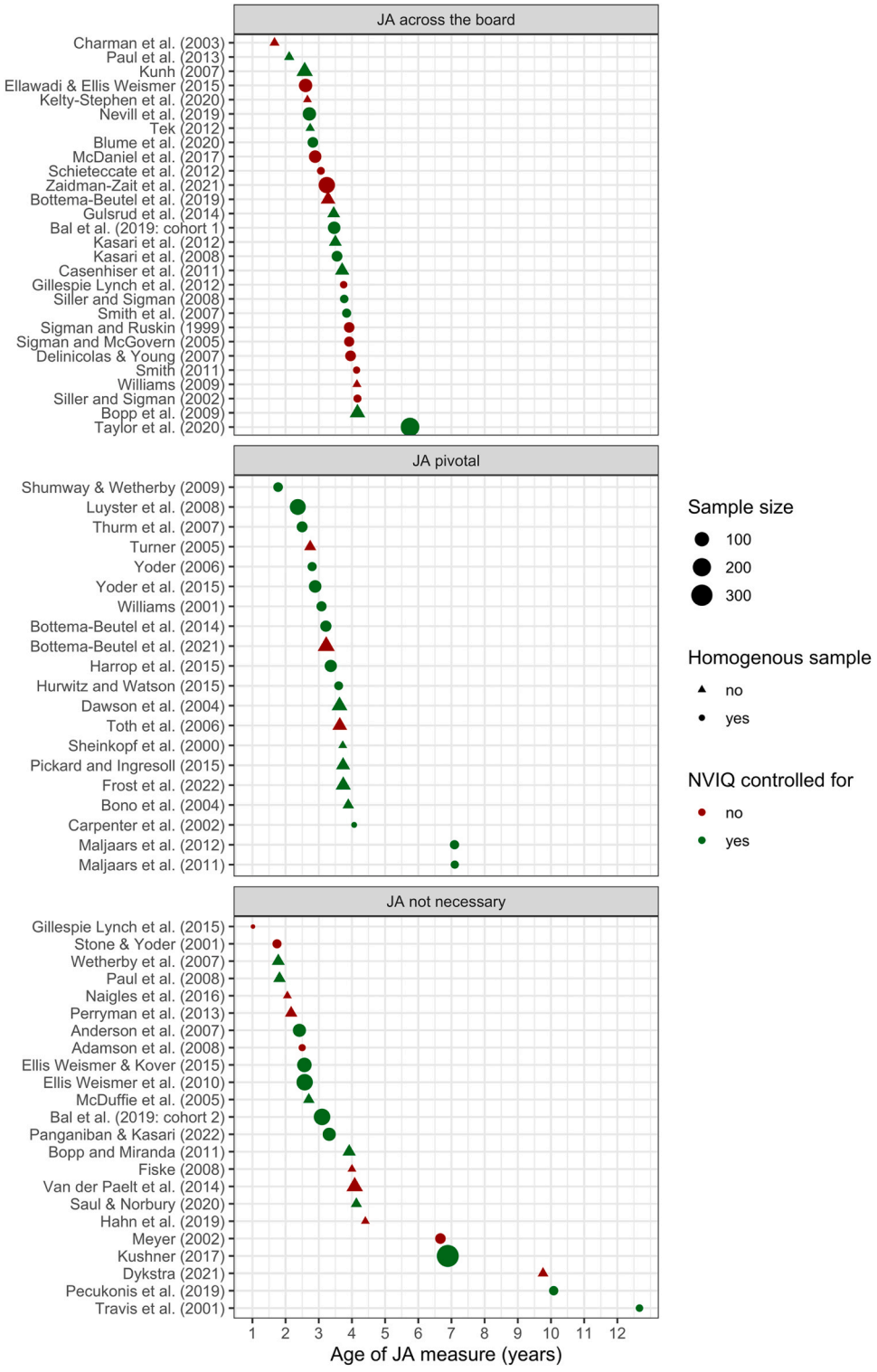

Fig. 2. Summary of studies included in the review. Each study is included under one of the three hypotheses about the relationship between joint attention (JA) and language for which it provides primary evidence. Each study is represented by a point, plotted against the authors and the year publication on the y-axis and against the mean age at which the measure of JA is taken on the x-axis; the point shape corresponds to whether the sample in the study is homogenous, viz. whether all children had a clear autism diagnosis; the point size corresponds to the sample size; the point color corresponds to whether the relationship between JA and language was controlled for NVIQ.

model was taken into account. Accordingly, we also indicated, for each estimate of the link between joint attention and language whether it was controlled for NVIQ. Results from language tests were further classified into two categories, only the former being relevant for the present review: structural (phonology, vocabulary, morphology or syntax) and pragmatic.

2.2. Literature analysis

The first and the last author independently read each source included in the review, and determined whether it provided evidence for $JA_{across\ the\ board}$, JA_{pivot} or $JA_{not\ necessary}$. If the source reported at least one significant correlation between a joint attention variable (response to or initiation of joint attention, in the majority of the studies) and language skills that went beyond first language milestones, the source was classified as $JA_{across\ the\ board}$. If the source reported a significant correlation between a joint attention variable and only first language milestones, it was classified as JA_{pivot}. We considered that the language outcomes predicted by joint attention did not exceed early language milestones when autistic children about whom this relationship was reported could be characterized as predominantly minimally or non-verbal or with verbal age equivalents below 24 months. Therefore, the distinction between for $JA_{across\ the\ board}$ and JA_{pivot} is not based on chronological age, but on the language levels with which joint attention measures correlate.

Finally, if the source provided either no correlation between joint attention and language or clear evidence of autistic children reaching language in spite of low joint attention skills, it was classified as $JA_{not\ necessary}$. Following the same procedure, we also coded whether the non-verbal intellectual quotient (NVIQ) has been controlled for, and whether the sample included children with a non-stringent diagnosis of autism (PDD-NOS or autism spectrum). Disagreement arose only in three cases concerning diagnosis categorization, and five for different joint attention hypotheses, and was resolved through consensus process.

3. Review

3.1. Evidence for $JA_{across\ the\ board}$

As can be seen from Fig. 2, among the 71 studies we reviewed, 28 report a link between joint attention skills and structural language levels which go beyond early language milestones, and, therefore, can be taken as evidence for $JA_{across\ the\ board}$. Some studies find that joint attention skills before the age of three predict language levels until five (Blume et al., 2021; Charman et al., 2003; Paul et al., 2013). In others, joint attention is measured between three and six, and its influence on structural language is reported within this critical interval (Bopp et al., 2009; Casenhiser et al., 2011, 2015; Schietecatte et al., 2012; Smith et al., 2007), but also well beyond (Gillespie-Lynch et al., 2012; Gulsrud et al., 2014; Sigman and McGovern, 2005; Sigman and Ruskin, 1999; Siller and Sigman, 2002; Zaidman-Zait et al., 2021). At the first glance, then, there is some evidence in the literature that in autism the influence of joint attention spans over various and advanced language levels.

However, 14 studies over 28 (in red in the topmost pane of Fig. 2) document a relationship between joint attention and structural language, but without controlling it for NVIQ. Furthermore, the autism diagnostic criteria were not stringent in 11 over the 28 studies included under the $JA_{across\ the\ board}$ header (represented by triangles on the topmost pane of Fig. 2). For instance, Kasari et al. (2008) documented a correlation between joint attention skills around the age of 3 and language one year later. Kasari et al. (2012) followed up on this sample later and still found that joint attention at 3 was a significant predictor of expressive vocabulary six years later; however, only 26 out of 40 children met criteria for autism, 8 met criteria for autism spectrum, and 6 did not meet any of these thresholds. Such studies are consistent with the idea that in children with a less prototypical autism presentation, joint attention levels are likely to predict language. But joint attention skills are also likely to be closer to typical in children who do not meet the threshold for a clear-cut autism diagnosis.

There are seven papers to which these caveats do not apply—green circles in the topmost pane of Fig. 2—and which can be seen as supporting $JA_{across\ the\ board}$. That said, even within some of these studies the evidence for $JA_{across\ the\ board}$ is not entirely clear-cut. In some studies, joint attention predicted language growth only in small sub-groups (Smith et al., 2007) or not in a consistent fashion across sub-groups (Bal et al., 2020; Blume et al., 2021). In three other studies, the links between joint attention and expressive vs receptive language are assymetrical (Nevill et al., 2019; Taylor et al., 2020; Williams, 2009), and in an another one language measure reduces to pronoun use (Kelty-Stephen et al., 2020).

All in all, there are two studies which provide unequivocal support for $JA_{across\ the\ board}$, that is for the hypothesis that higher joint attention levels are linked to better structural language skills that go well beyond early milestones. Siller and Sigman (2008) reported that joint attention in a sample of 28 three- to four-year-old autistic children predicted language growth over the next three-four years, and Tek (2010) documented links between joint attention and changes in various language measures over a year in three-year-olds.

3.2. Evidence for JA_{pivot}

Recall that JA_{pivot} consists in holding that joint attention is determining for language onset in autism, but is not necessarily related to more advanced linguistic skills. Accordingly, in studies that can be considered as providing evidence for JA_{pivot}, joint attention should discriminate between non-speaking autistic children and those who reach the first milestones of language development, roughly corresponding to what is attained by their typically developing peers around 24 months. Among the 71 papers we reviewed, 20 offered such evidence; these are represented in the mid pane of Fig. 2. In 8 of these studies, the diagnosis was not stringent (Bono et al., 2004; Bottema-Beutel et al., 2021; Dawson et al., 2004; Frost et al., 2022; Pickard and Ingersoll, 2015; Sheinkopf et al., 2000; Toth et al., 2006; Turner, 2005), and in 3 out of these 8 studies the link between joint attention and language outcomes was also not controlled for NVIQ (Bottema-Beutel et al., 2021; Toth et al., 2006; Turner, 2005). The remaining other 16 studies, however, offer robust and diversified evidence for the idea that, in autism, joint attention is determining for the speech onset to take place, and conversely, that low levels of joint attention are associated with the probability for an autistic child to be non-speaking. Four papers found a relationship between joint attention and early language in autistic children who were younger than three (Luyster et al., 2008; Shumway and Wetherby, 2009; Thurm et al., 2007; Yoder, 2006; Yoder et al., 2015), three cross-sectional studies reached the same result in autistic children around the ages of three or four (Carpenter et al., 2002; Harrop et al., 2015; Hurwitz and Watson, 2015), and one in autistic children with a significant intellectual disability and language delays (Maljaars et al., 2012). The predictive link between joint attention and minimal language level has also been document in two longitudinal studies (Bottema-Beutel et al., 2014; Williams, 2001).

3.3. Evidence for $JA_{not\ necessary}$

Twenty-three studies out of the 71 we reviewed—represented in the lower pane of Fig. 2—report no clear relationship between joint attention and language outcomes in autism. For instance, Anderson et al. (2007) reported that low joint attention skills were associated with a higher probability not to develop language. Crucially, however, in this study the growth of language skills in speaking autistic children was not systematically related to joint attention; in addition, joint attention did not predict whether a child ended up in most verbal groups. Likewise, Ellis Weismer and Kover (2015) reported a correlation between joint

attention and expressive language around two, but not with language outcomes around the age of five, and found considerable overlap in joint attention skill between children with lowest and the highest verbal outcomes.

In 11 studies, the absence of the link between joint attention and language outcomes was reported for heterogenous groups (Bopp et al., 2009; Dykstra, 2012; Fiske, 2008; Hahn et al., 2019; McDuffie et al., 2005; Naigles et al., 2016; Paul et al., 2008; Perryman et al., 2013; Saul and Norbury, 2020; Van der Paelt et al., 2014; Wetherby et al., 2007). Furthermore, 10 studies did not control the relationship between joint attention and language for NVIQ (Adamson et al., 2009; Dykstra, 2012; Fiske, 2008; Gillespie-Lynch et al., 2015; Hahn et al., 2019; Meyer, 2002; Naigles et al., 2016; Perryman et al., 2013; Stone and Yoder, 2001; Van der Paelt et al., 2014). This latter dimension is perhaps less relevant for $JA_{not\ necessary}$, however, as controlling for NVIQ usually makes it more difficult to reject the null hypothesis of a lack of relationship between joint attention and language.

Eight studies—the green circles in the bottom pane of Fig. 2—are not subject to these caveats (Anderson et al., 2007; Bal et al., 2020 cohort 2; Ellis Weismer et al., 2010; Ellis Weismer and Kover, 2015; Kushner, 2017; Panganiban and Kasari, 2022; Pecukonis et al., 2019; Travis et al., 2001). Three among these focus on older autistic children, in whom no correlation between structural language and joint attention is reported (Dykstra, 2012; Kushner, 2017; Travis et al., 2001). However, the kind of support that these studies provide to $JA_{not\ necessary}$ is somewhat equivocal, as in these older children, joint attention could have played a role earlier in language development; it is not obvious, also, that joint attention is still a valid socio-communicative construct after three-four years of age. Finally, Fig. 2 makes it apparent that in some of the studies that find no link between joint attention and language, sample sizes are very modest (e.g. Fiske, 2008; Gillespie-Lynch et al., 2015), but that in others sample sizes range from 90 to 180 (e.g. Anderson et al., 2007; Bal et al., 2020; Ellis Weismer and Kover, 2015). These latter studies seem to provide robust evidence for $JA_{not\ necessary}$.

4. Discussion

A significant proportion of autistic children who reach the critical age of three display little or no expressive language, but a significant proportion of them do reach functional language, usually be the age of seven. It is often assumed in the autism literature, and by many intervention programs, that joint attention skills play a crucial role in language outcomes in autistic children. Above we presented a systematic review of 71 studies, asking whether, in autism, joint attention predicts advanced or only early language skills, and whether it may be independent of language outcomes. We took into account only conservative estimates, and flagged studies that include heterogenous samples or no control for non-verbal cognition.

The positive role of joint attention in the acquisition of oral language that emerges the most robustly from our analysis is that of a pivot for the speech onset in autistic children—what we called the JA_{pivot} hypothesis. Joint attention skills increase the probability for the language acquisition to take off, as evidenced, for instance, by the acquisition of a minimal vocabulary of single words. By contrast, it is less clear that joint attention exerts a determining influence on more advanced language skills, what would correspond to the $JA_{across\ the\ board}$ hypothesis. In typically developing children joint attention is determining for reaching the first milestones of linguistic development, roughly before the age of two (Tomasello, 2008). In this respect, then, language acquisition in autism would mostly differ from typical development in the timing at which joint attention triggers language onset, but not in its pivot role for the earliest stages of language development.

However, our review also shows that some autistic children progress from minimally or non-speaking levels to advanced language levels even though they display low joint attention skills—what we called the $JA_{not\ necessary}$ hypothesis. There are both cross-sectional (e.g. Meyer, 2002; Pecukonis et al., 2019; Wetherby et al., 2007) and longitudinal studies (e.g. Adamson et al., 2009; Anderson et al., 2007; Bal et al., 2020 cohort 2; Ellis Weismer et al., 2010; Panganiban and Kasari, 2022; Paul et al., 2008) showing that the absence of joint attention behaviors does not prevent some autistic children from acquiring language. This linguistic pattern is dramatically different from what one would expect if language in autism were exclusively modelled on typical development, focusing on the role of overt manifestation of intersubjective relationships on language acquisition.

The first, rather traditional way to explain why some autistic children with low joint attention still become verbal is to argue, that, appearances notwithstanding, language onset is triggered by an improvement (or a recuperation) of socio-communicative skills, but that these skills are not accurately captured by overt joint attention behaviors. Several studies reviewed above suggest that children with or without functional language do not always differ in their ability to respond to joint attention, but that other factors, more or less related to social communication may be responsible for the variation in early language outcomes, such as symbol-infused joint action (Adamson et al., 2009) or play (Ellis Weismer et al., 2010; Panganiban and Kasari, 2022). Moreover, the situations and techniques used to elicit joint attention in autistic children are typically modelled on what would be expected from typically developing toddlers, and may therefore not be fully adapted to the specificities of cognitive and social functioning of autistic children, especially at older ages (Bean and Eigsti, 2012; Bottema-Beutel et al., 2019). As things currently stand, however, it is neither clear how such social mechanisms should be characterized nor the extent to which they would be related to language acquisition.

More generally, the absence of joint attention behaviors—or, at least, what counts as such by neurotypical standards—is a core component of autism diagnosis. Indisputably, fully verbal individuals, children and adults, can receive an unambiguous, expert-based and warranted diagnosis of autism and, as mentioned in the Introduction, language is currently conceived as a specifier of the autism diagnosis (DMS-5; American Psychiatric Association, 2013). Accordingly, there is no conceptual necessity to hold that autistic children who should display the best language outcomes should also be those with the lowest presence of such a central sign of autism.

Another way to interpret the reviewed literature is to genuinely endorse the idea that not only is language acquisition in autism often temporally delayed, but also that it can be inherently atypical. Lack of joint attention skills results in lower rates of shared communicative experience and hence, in lower availability of diversified and socially meaningful linguistic input. One can therefore speculate that, in some cases, the linguistic input on which the acquisition process is based is not prompted or cued in a communication context. There is preliminary evidence that in some autistic children, the interest in linguistic input is not primarily driven by a communicative motivation. One motivational factor could be preferential orientation towards complex, redundant structure (Mottron et al., 2021). Self-taught, precocious, and intense interest in, and mastery of written material is often reported in autistic children (Atkin and Lorch, 2006; Ostrolenk et al., 2017; Saldaña et al., 2009), and suggests that some autistic children are precociously engaged in learning from non-socially mediated linguistic material. Hyperlexia, like other savant abilities grounded on the self-taught manipulation of complex material in autism, could be underpinned by an enhanced interest in structural mapping between two highly structured domains (Mottron et al., 2013). However, there is no clear evidence that hyperlexia can lead to functional reading and, a fortiori, to spoken or signed language.

There are also a few case studies of autistic individuals who acquired a language with no clear communicative motivation, and outside any communicative context. The most famous case is that of the adult linguistic savant Christopher, who displayed an impressive ability to learn foreign languages on his own from mostly written input (Smith and Tsimpli, 1995). There is a growing body of case studies that documented

unexpected bilingual profiles in autistic children who displayed productive mastery of a language that was not used in communication around them, and that could be acquired exclusively from socially unmediated exposure to screens (Kadiri and Anasse, 2023; Kissine et al., 2019; Meir et al., 2023; Vulchanova et al., 2012; Zhukova et al., 2021). This phenomenon clearly attests to the fact that autistic individuals may be interested in language in and of itself. However, the current data for such unexpected bilingualism are still very limited and do not unambiguously show that it applies to the first language learned by the child (but see Dumont et al., 2022). Whether it is limited to second language acquisition or not, these cases of unexpected bilingualism raise important questions as to the kind of motivation factors, but also cognitive skills that drive such non-socially biased language learning in autism (Kissine, 2021a, 2021b).

5. Conclusion

Going beyond simply paying lip service to the concept of neurodiversity requires the scientific community to keep an open mind as to the existence of language learning mechanisms specific to autism—however unusual they may appear from what we know about non-autistic minds (Kissine, 2021a, 2021b; McCracken, 2021; Mottron et al., 2021). Early interactive experience with language users is deemed essential by any model of typical language acquisition, but the access to such socially mediated linguistic input is compromised by socio-communicative atypicalities inherent in the very definition of autism. In a sense, then, any autistic individual who acquires language does so in an exceptional way.

The existence of hyperlexia suggests that some autistic children are precociously engaged in learning from non-socially mediated linguistic material, but the extent to which such learning impacts language is still unclear. A first exciting direction for future research would be to longitudinally follow, in detail, the linguistic trajectories of pre-verbal autistic children who display hyperlexia or even intense orientation towards letters and digits. Second, the acquisition of a language that is not used for communication or even not understood in the child's environment would constitute the clearest example of a non-socially mediated language acquisition. Here again, independent descriptions of individual linguistic trajectories are urgently needed. These gaps in the empirical data emphasize the need for the field to turn back to detailed descriptions of individual cases.

6. Note about community involvement

The last author's group has a long history of autistic and non-autistic individuals contributing to autism research as equals, in equally diverse roles. Both the first and the last authors' labs work in close connection and collaboration with the autism community. However, the opinions expressed above should not be attributed to anyone else but the authors.

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