

Accounting for the preference for literal meanings in ASC

Abstract

Impairments in pragmatic abilities, that is, difficulties with appropriate use and interpretation of language – in particular, non-literal uses of language – are considered a hallmark of Autism Spectrum Conditions (ASC). Despite considerable research attention, these pragmatic difficulties are poorly understood. In this paper, we discuss and evaluate existing hypotheses regarding the *literalism* of ASC individuals, that is, their tendency for literal interpretations of non-literal communicative intentions, and link them to accounts of pragmatic development in neurotypical children. We present evidence that reveals a developmental stage at which neurotypical children also have a tendency for literal interpretations and provide a possible explanation for such behaviour, one that links it to other behavioural, rule-following, patterns typical of that age. We then discuss extant evidence that shows that strict adherence to rules is also a widespread feature in ASC, and suggest that literalism might be linked to such rule-following behaviour.

1. Introduction

What a speaker means by an utterance typically goes beyond the literal meanings of the words and sentences she has used. A key assumption underlying contemporary theories of human communication is that appropriate use and interpretation of language involves pragmatics skills – that is, the inferential capacities that enable us to bridge the gap between linguistic (literal/conventional) meanings and speaker meanings in context (see, e.g., Carston, 2002; Sperber & Wilson, 1986/1995).

Impairments in such pragmatic reasoning abilities, that is, difficulties with appropriate use and interpretation of language, are considered a hallmark of Autism Spectrum Conditions (ASC) (Tager-Flusberg, Paul, & Lord, 2005). In particular, individuals diagnosed with ASC are said to be excessively literalists, in the sense that they tend to prefer literal interpretations of words and utterances, even when speakers have non-literal intentions (Chahboun, Vulchanov, Saldaña, Eshuis, & Vulchanova, 2016; Chahboun, Vulchanov, Saldaña, Eshuis, & Vulchanova, 2017; Vulchanova,

Talcott, Vulchanov, & Stankova, 2012; Walenski & Love, 2017: see Section 2.4. for discussion of the evidence).^{1,2}

Recently, however, some studies have suggested that the largely heterogenous population of ASC individuals may not be characterized by global pragmatic impairments (Hochstein, Bale, & Barner, 2018), and that many high functioning ASC individuals are able to understand scalar implicatures (Van Tiel & Kissine, 2018) metaphors (Kasirer & Mashal, 2016), and even irony (Glenwright & Agbayewa, 2012). However, it is still true that most individuals on the spectrum have difficulties understanding non-literal uses of language, the underlying causes of which are debated (Norbury, 2014). Moreover, when a literalist bias is tested (as in Chahboun et al., 2016; Chahboun et al., 2017; Walenski & Love, 2017), the suggestion is that such difficulties relate to such literalist bias, and not just to difficulties with non-literal uses of language that may also appear in other conditions, such as in developmental language disorders (DLD: see below). Hypotheses include an impairment in ‘theory of mind’ abilities (Baron-Cohen, Leslie, & Frith, 1985) and consequent difficulties in understanding the speaker’s intention (Happé, 1993; Rundblad & Annaz, 2010a), ‘weak central coherence’, which biases towards local, detail-focused rather than global information processing and makes the integration of contextual information difficult (Happé, 1999), executive dysfunction (Hill, 2004) which impedes inhibition of the literal meaning and flexibility in going beyond rigid, literal interpretations, and lack of sufficient semantic/world knowledge (Norbury, 2014).

Despite considerable research attention, the pragmatic difficulties with non-literal uses in ASC are still poorly understood. In this paper, we discuss and evaluate existing hypotheses regarding the literalism of ASC individuals, and link them to accounts of pragmatic development in neurotypical children. While there appears to be a developmental stage at which neurotypical children also have a tendency for literal interpretations (Asch & Nerlove, 1960; Falkum, Recasens, & Clark, 2017; Köder & Falkum, 2020; Levorato & Cacciari, 2002; Nerlich, Clarke, & Todd, 1999; Winner,

¹ Vulchanova et al. (2012) is a case study about EV, a Bulgarian woman with outstanding language learning skills. They ran a number of tests on her L1 and L2 competence and compared it to a control group: among other things, she scored much lower than controls on idiom comprehension and her incorrect responses contained ‘literal interpretations’ (p. 20).

² Besides the empirical evidence we will discuss, there is ample evidence that autistic people exhibit a literalist bias in their daily lives (A. C. Wilson & Bishop, 2020b). See also: <https://autismguide.co.uk/fitting-into-the-world/being-autistic-aspergers-syndrome-and-understanding-idioms-or-common-phrases/>).

1988/1997), we know of no studies that have explicitly investigated whether ASC individuals' pragmatic difficulties could be linked to the same source as those that neurotypical children experience at a certain stage in pragmatic development. We discuss a possible explanation for the tendency for literal interpretations in neurotypical children, one that links it to other behavioural, rule-following, patterns typical of the pre- and early primary school age. Finally, considering extant evidence that shows that strict adherence to rules is also a widespread feature in ASC, we suggest that literalism might be linked to such rule-following behaviour.

The paper is structured as follows. In Section 2, we discuss how the different cognitive impairments underlying existing hypotheses may impact on the literalist preference observed in ASC, how they relate to one another, and how existing explanations are all unsatisfactory in one (specific) way or another. We also point out that they cannot explain a different set of data, which we introduce in Section 3, namely, that in the neurotypical development, children aged 3-4 seem to be less literalist than children aged 5-6. In Section 4, we introduce our own hypothesis, which is that such preference for literalist interpretations is an expression of a broader conventionalist attitude, probably derived from the difficulties that ASC people experience when trying to understand the social world in general. While it is still possible that the literalism of ASC people has a different origin than the literalism of 5-year-old neurotypicals, it is dubious that their literalism is related to factors that cannot explain the non-literalism of 3-year-olds and the observed difference between 3- and 5-year-olds.

2. Literalism and its explanations

What does it mean to be a 'literalist'? Most, if not all, words have several different meanings, and there is no reason to pick up one of them as *the* literal meaning. So, in a first pass, we will take it that someone is a literalist if he or she has a strong tendency towards understanding words and utterances as expressing one of their conventional meanings instead of some novel, ad hoc, meaning. According to this approach, a literalist person should not necessarily have problems understanding conventionalized metaphors or metonymies, given that these can be stored in the lexicon in the same way as ordinary 'literal' meanings. However, for a literalist, acquiring the meaning of a conventional metaphor or metonym should also be more costly than usual, and we should see a deficit in their comprehension and production of conventional metaphors and metonymies. Comprehension and production of conventional idiomatic expressions

should also be affected: a literalist will typically process an idiomatic expression compositionally and may not even realize that the expression *has to* have another meaning. A non-literalist who hears an idiomatic expression for the first time is likely to be aware that it does not mean what it compositionally means, even if they do not understand what the expression means. In contrast, a literalist may not even consider that the nonsensical combination of words *has to* have another sense.

2.1 Executive dysfunction

As said above, there are several hypotheses as to why ASC individuals are, overall, more literalist than their neurotypical peers. One hypothesis relates literalism to *executive dysfunction* (Hill, 2004). Executive function refers broadly to a set of cognitive abilities that are necessary for the cognitive control of behaviour, including inhibition, mental flexibility and working memory (Diamond, 2013). Individually, a deficit in each of these abilities could, in principle, lead to a tendency for literal interpretations of figuratively used expressions. An impairment in inhibitory control could make it difficult to suppress preponderant literal meanings, poor mental flexibility could make switching from one meaning (literal) to another (figurative) difficult, and a scarcity of working memory capacity could make it difficult to simultaneously process an expression's literal and figurative meaning.

It is a matter of debate whether executive function is globally impaired across the spectrum (Friedman & Sterling, 2019, Johnston, et al. 2019)) or whether it is a core deficit in autism (Demetriou et al., 2018). ASC individuals may perform differently on particular sub-tasks involving executive function. For instance, on the Stroop Task (Stroop, 1935), a classic test of *inhibitory control* where subjects have to inhibit a preponderant behaviour (e.g., the response primed by the colour of a colour word), some studies have shown that ASC children and adolescents are unimpaired (Ozonoff & Jensen, 1999; Russell, Jarrold, & Hood, 1999), while others find general patterns of deficits in inhibitory control (H. M. Geurts, van den Bergh, & Ruzzano, 2014). Several studies have shown impairments in *cognitive flexibility* in ASC, more specifically on task-switching using the Wisconsin Card Sorting Test (WCST) (Landry & Al-Taie, 2016; Willcutt, Sonuga-Barke, Nigg, & Sergeant, 2008), and lower scores on measures of *working memory* (Boucher, Mayes, & Biggam, 2012; Kercooda, Grskovicb, Bandac, & Begesked, 2014). In a meta-review, however, Friedman and Sterling (2019) show that many ASC individuals perform as well as neurotypicals on each of these constructs

(but, see Demetriou, et al., 2018). This does not show that executive dysfunction may not be responsible for literalism in the ASC population, as there might be a correlation between executive dysfunction and literalism (i.e. persons on the spectrum who have executive dysfunction also have problems interpreting language non-literally). If there exists such a correlation, this could, as we mentioned above, be for various reasons: lack of inhibition of the literal meaning; inflexibility in switching from one interpretation to another, or difficulties with having two different possible meanings in working memory.

An assumption underlying this family of explanations is that literal meanings of words are always activated. However, as Glucksberg (2008) claims: “[l]iteral meanings do not have unconditional priority, and so they are not necessarily easier to compute than nonliteral meanings” (see also D. Wilson & Carston, 2007). For instance, some models of metaphor processing have it that metaphorical meanings are accessed directly, without prior analysis of the complete literal meaning (Gibbs, 1994, 2002). Other models grant that relevant features of the literal meaning are activated and then suppressed (Rubio-Fernández, 2007), but suppression of features does not have to be the same as inhibition of a competing meaning. Suppression of features is also involved in understanding complex nominal expressions such as *stone lion* (Hogeweg, 2012) and *fake gun* (Del Pinal, 2015), processes that have been shown to be less costly than for instance, homonymy resolution (e.g., *bank, pupil*), where it seems necessary to inhibit a preponderant meaning to get to the intended, subordinate meaning (Frisson, 2009). That is, it is possible that inhibition is not involved in typical non-literal meaning processing after all.

The same kind of reasoning casts initial doubt on the working memory hypothesis. ASC individuals have been shown to have reduced working memory capacity (WM) (Habib, Harris, Pollick, & Melville, 2019). According to this view, the observed literalism could be a result of poor WM: it is not that ASC individuals cannot inhibit a particular piece of information (a literal meaning), but that they have difficulties having two different pieces of information in WM at the same time. So the question about literalism could ultimately be a question of being unable to hold two different interpretations of one word in WM, one literal and one non-literal, until one of them is selected. However, once again we do not really know whether retrieving a non-literal meaning involves accessing a literal meaning first and holding it in WM until it is discarded. Homonymy resolution seems to work like this (Swinney, 1979). Typically, the most frequent meaning is accessed while context also activates an alternative

meaning; then there is competition between both meanings, and the dominant meaning decays (or is inhibited). In this case, it may well be that both meanings are temporarily held in WM, and so that a poor WM capacity may give rise to problems with homonymy resolution. However, as we have discussed above, comprehension of non-literal uses such as metaphors, metonymies, hyperboles and other kinds of departures from conventional meaning does not necessarily work like this; i.e. there may not be competition between the literal and the figurative meaning. Moreover, the evidence concerning homonymy resolution in ASC does not suggest that individuals on the spectrum are unable to retrieve a subordinate meaning of a homonym (Hahn, Snedeker, & Rabagliati, 2015). One study, however, found that ASC individuals have difficulties disambiguating homographs in a reading task (López & Leekam, 2003): subjects chose the dominant pronunciation even when the context made clear that such pronunciation was not adequate (*tear* in *tear on her face* –dominant vs. *tear in the clothes* – subordinate). However, it is unclear whether these results concerning pronunciation disambiguation carry over to meaning disambiguation. If homonymy resolution is not seriously compromised in ASC individuals, the suggestion is that the difficulties concerning literalism are not related to inhibition or WM, both of which seem to be involved in homonymy resolution. However, caution is advised: given the heterogeneity of the spectrum, evidence concerning homonymy resolution would bear on the issue of literalism only if subjects who are able to disambiguate homonyms also show a strong preference for literal interpretations. We do not know of any study that has compared homonymy resolution and figurative meaning understanding in the same group of subjects.

Note that both the lack of inhibition and the WM explanations work well only if it is the case that literal meanings do receive a strong activation in the processing of non-literal uses of words and sentences. In the lack of inhibition explanation, literal meanings receive such a strong activation that they must be inhibited; in the WM explanation, literal meanings are accessed and fill out WM completely, given the assumed WM shortcomings in ASC. However, for all we know, that may happen *only if the subject is already a literalist*, that is, if literal meanings are more strongly activated than in the general population. Someone with inhibition or WM deficits would lean towards literal interpretations in figurative contexts only if such literal interpretations receive an atypical strong activation.

The same kind of considerations apply to explanations that involve a deficit in cognitive flexibility, a component of executive function involved in task switching. There is in principle no reason why a deficit in flexibility understood in this way should make non-literal meanings unavailable (again, unless one is already a literalist). However, flexibility may also have a broader, vaguer, meaning related to the more general rigidity that is observed in the behaviour and cognition of ASC individuals. The proposal about why some ASC individuals tend to be literalists, which we will outline in Section 4, could be understood as involving flexibility and linked to rigidity about social conventions in general. However, “flexibility” here would just be a descriptive term that applies to characteristic patterns of behaviour observed in ASC.

2.2 Theory of mind

A second major contender is *theory of mind* (ToM) capacities. According to the ToM account, ASC individuals tend to be literalists because they have difficulties reasoning about others’ mental states, including inferring what the speaker intends to communicate by her use of language (Baron-Cohen, Baldwin, & Crowson, 1997; Baron-Cohen et al., 1985; Happé, 1993). This hypothesis has its roots in pragmatic accounts of linguistic understanding which assume that the ability to infer speaker meanings is essentially a form of mentalistic reasoning (e.g., Grice, 1975/1989; Sperber & Wilson, 1986/1995). In a seminal study, Happé (1993) found a correlation between first-order theory of mind and metaphor understanding, and second-order theory of mind and irony understanding in ASC individuals, supporting the ToM account of pragmatic difficulties in ASC (see also Martin & McDonald, 2004; Whyte & Nelson, 2015). However, recent research has questioned the view that many of the pragmatic challenges in ASC are due to ToM deficits, for a long time believed to be widespread across the spectrum (but see Frith, Happé, & Siddons, 1994; Gernsbacher & Yergeau, 2019, for reasons to be skeptical about this view). First, there are studies that show that pragmatic reasoning is not universally impaired across the spectrum, and that some ASC individuals are able to handle pragmatic phenomena that are assumed to require inferences about the speaker’s intentions. Examples are scalar implicatures (Chevallier, Wilson, Happé, & Noveck, 2010; Hochstein et al., 2018), metaphor (Norbury, 2005) and even irony (e.g., Chevallier, Noveck, Happé, & Wilson, 2011). Other studies suggest that there may be no or only a weak correlation between ToM measures and non-literal understanding (e.g., Norbury, 2005). Even Happé’s original study found that

those ASC subjects who passed all ToM tests performed worse than typically developing adults on certain types of stories involving non-literal uses of language, so a ToM deficit is unlikely to be the whole story. Yet, it is still widely assumed both that ToM abilities are recruited for irony comprehension and other departures from literal meaning that routinely require mentalistic reasoning, and that the root of the problems ASC people experience with such departures is a scarce ToM capacity (Andrés-Roqueta & Katsos, 2020).

Recently, It has been suggested that mentalistic reasoning need not underlie all pragmatic inferencing (Andrés-Roqueta & Katsos, 2020; Jary, 2013; Kissine, 2016). Jary (2013) has argued that even if we assumed that accessing a non-literal meaning involves pragmatic inferencing (calculating implicatures), many implicatures do not require mentalistic reasoning. For instance, if you say “I’m thirsty” and you get the response “The bathroom is over there”, Jary claims that you do not need to reason about the speaker’s intentions in order to derive the implicature ‘You can drink water there’. The only things you need, according to Jary, are world knowledge and associative capacity. A less extreme position is taken by Andrés-Roqueta and Katsos (2020), who distinguish between linguistic and social pragmatics (for a similar proposal, see B. Geurts, Kissine, & van Tiel, 2019): whereas social pragmatics implies representing the mental states of another person, linguistic pragmatics seems to only require intact linguistic abilities, accompanied by enough world knowledge and associative capacity, as the speaker’s meaning can be accessed from an egocentric perspective. According to Andrés-Roqueta and Katsos (2020), linguistic pragmatics prototypically includes scalar implicatures and indirect requests, while irony is the paradigm case of social pragmatics.

While we do not wish to take a stance on this debate regarding the role of ToM in pragmatic reasoning here, we believe that in principle, figurative uses of language, along with linguistic pragmatics, do not require *explicit* conjecturing about the mental states of the speaker. Again, one surely has to do some mentalistic reasoning (e.g., “Why does she say that *Lawyers are sharks*, which is obviously false? What could she be meaning?”, etc.) *if one already has a strong tendency towards understanding things literally*. If one is initially more flexible about what words can express, processing a non-literal meaning can be a much simpler affair (e.g., Recanati, 2004; D. Wilson & Carston, 2007).

In a much-cited study, Norbury (2005) suggests that language abilities, and not ToM, predict figurative language abilities. Her study, which compared children with ASC (with or without language impairment) with children with Developmental Language Disorder (DLD), showed that children with language impairment, with or without concurrent autistic features, have difficulties with metaphor understanding (see also Bühler, Perovic, & Pouscoulous, 2018). To explain this, Norbury proposes that in order to understand a metaphor subjects need intact analogical reasoning (which ASC individuals apparently have: Morsanyi, Stamenković, & Holyoak, 2019) and the world knowledge required to grasp the analogy. Children with language delay may lack the required world knowledge due to shortage in their vocabulary or linguistic input in general. Thus, difficulties in metaphor understanding, according to Norbury, would derive from purely linguistic issues. While there are several problematic aspects of this study, which we will come back to in Section 2.4, ToM abilities do not uniformly predict figurative meaning understanding in atypical populations (see, e.g., Langdon, Davies, & Coltheart, 2002, on the relation between ToM and understanding of metaphor and irony in schizophrenia). However, as we have suggested, it might be that individuals who already have a strong literalist bias are forced to struggle with mentalistic reasoning in order to understand figurative uses of words. But again, an explanation for this previous literalist bias is required.

2.3 Central coherence

The next approach ascribes literalism in ASC to a weakness in so-called global or *central coherence* (CC), biasing towards local, detail-focused rather than global information processing, making the integration of contextual information difficult (Happé, 1999). Weak central coherence is observed in perception, where ASC individuals are reported to be less sensitive to overall gestalts and more attentive to details (Plaisted, Saksida, Alcántara, & Weisblatt, 2003). In language understanding, a weakness in global coherence means that the person will be less sensitive to contextual elements. Thus, there will be a difficulty in the integration of contextual factors, and the person may go word by word in interpreting a linguistic utterance. In principle, we think this could be a plausible account of the attested literalism of ASC individuals. However, following (Happé & Frith, 2006), there are two, apparently different ways in which weak CC could affect processing of non-literal utterances. According to the first, weak CC implies that subjects focus on features and details instead of getting the global gist.

According to the second, weak CC implies that subjects have difficulties in processing anything that departs, even slightly, from the things they are familiar with. Here they quote Kanner's (1943: 246) original observation: "A situation, a performance, a sentence is not regarded as complete if it is not made up of exactly the same elements that were present at the time the child was first confronted with it. If the slightest ingredient is altered or removed, the total situation is no longer the same and therefore is not accepted as such...". According to this second idea, individuals with ASC may be literalists because they are fixated on the literal meanings that "were present at the time the child was confronted with [the words]".³ However, if weak CC is simply a deficit in getting the global gist, it is not obvious that someone with such a condition should be unable to go beyond literal meanings. Weak CC is invoked in accounting for ASC children's difficulties using sentence context to disambiguate homographs (López & Leekam, 2003) but, as we have already mentioned, it is far from clear that the processes or mechanisms underlying understanding of non-literal uses of language are similar to those involved in resolving ambiguities. In addition, as also mentioned, there are studies of homonymy resolution suggesting that ASC children are unimpaired compared to TD children (Hahn et al., 2015). It may also be the case that central coherence is involved in understanding some types of non-literal uses but not in others. For instance, idiomatic expressions (Vulchanova, Saldaña, Chahboun, & Vulchanov, 2015) may be harder and may require a gestalt interpretation that is not required in understanding, for instance, metonymy, metaphor, hyperbole or other loose uses of words. In sum, we do not know how much of CC that is required in order to reach non-literal interpretations. Finally, it is not clear whether processing a unit of the size of a sentence should be affected by weak CC. Weak CC may impact the ability to keep track of more or less complex, or simply long, narratives, but not necessarily on the capacity to understand a non-literal meaning (Tirado & Saldaña, 2016). In this respect, the studies by Brock, et al. (2008) and Au-Yeung et al. (2018) suggest that context-integration in small linguistic units is unproblematic in autism.

2.4 Linguistic-semantic ability

According to Norbury (2005), the reason why many people diagnosed with ASC tend to have difficulties understanding metaphors is to be found in their poorer *linguistic*

³ This implies that they might be 'literalist' about some 'non-literal' meanings as well, if these were the first meanings that they were introduced to.

abilities compared to their typically developing peers. On this view, difficulties with metaphor comprehension are not exclusive to ASC, but common to all conditions in which linguistic abilities is compromised. Recently, Bühler et al. (2018) conducted a study which they take to support Norbury's view, showing that children with Developmental Language Disorder also have problems understanding metaphor and that their performance is not related to non-verbal intelligence.

Norbury (2005) suggests that metaphor understanding requires a degree of semantic knowledge that people with linguistic delay or linguistic impairment lack. However, it is unclear what such semantic knowledge amounts to. If this is world knowledge derived from scarce linguistic input, as Norbury herself proposes (e.g., the world knowledge required to grasp an analogy or shared properties of different entities), the real issue is not linguistic, but cognitive-conceptual (cf. Keil, 1986). But it can also be a question of competence in lexical integration following compositional rules, which would be properly semantic knowledge, or ease of processing, which is more of a performance issue. Moreover, as Norbury's study used the Test of Word Knowledge (TOWK) as a measure of participants' linguistic ability/semantic knowledge, which contains both metaphors and other types of figurative language, the correlation she found with metaphor understanding is not surprising (Rundblad & Annaz, 2010b). In any case, at least with respect to ASC, the evidence is far from clear cut: For instance, Chahboun et al. (2017) matched a group of ASC adults with a group of neurotypical adults by linguistic abilities, and found that ASC adults were slower in a lexical decision task involving metaphors. That is, even if linguistic impairments may predict difficulties with non-literal meaning understanding, such difficulties may persist in the absence of linguistic impairment.

A lack of world knowledge may explain why someone is unable to retrieve the shared properties between the source and the target in a metaphor. However, literalism in the interpretation of metonymy, certain types of implicatures or irony has to have a different kind of explanation. According to some researchers who find Norbury's account compelling (Andrés-Roqueta & Katsos, 2020), difficulties with irony comprehension can be explained by ToM deficits, while difficulties with scalar implicatures or other kinds of figurative meaning are anchored in structural language

problems (i.e. vocabulary and grammar)⁴. This kind of approach is unable to explain an overall literalist tendency in subjects who do not have language impairment. But, beyond that, the approach lacks an explanation as to how what they call ‘structural language’ problems impact figurative meaning understanding. And even if we assume that linguistic problems predict difficulties with figurative meanings, it is still unclear how linguistic problems would have an impact on flexibility in comprehension in general. Given that we as yet lack an explanation for the relation between these two factors, it cannot be excluded that the relation holds in virtue of a third factor. For instance, it could be that people who in general have problems comprehending others tend to follow linguistic conventions more strictly.

Finally, a capital question about the task design in Norbury (2005) is to what extent the kind of dichotomous paradigm she uses tells us much about literalism (i.e. the tendency to interpret language literally). This question also applies to other studies that take their results to support the structural language hypothesis (Bühler et al., 2018; Norbury, 2004). Regardless of the type of assessment chosen by the authors (which varies from multiple-choice tasks to verbal explanations), the problem lies in their labelling answers as either correct or incorrect, without further discrimination. This may obscure literalist patterns in the incorrect answers. In Norbury’s (2005) study, literalism is not even tested. The study only tests whether subjects can discriminate which candidate is the best metaphor, with tasks such as: “The heating had been left on overnight and the room was very warm. It was:

- a. an oven
- b. a blanket
- c. a grill
- d. a spice (Norbury, 2005: 399)”

While this paradigm tests whether subjects can comprehend metaphors it leaves no room for testing whether subjects interpret metaphors literally or not.

Even studies that have a different design and include a literalist option, such as Kasirer and Mashal’s (2014, 2016) studies on novel metaphors in ASC, or Norbury’s (2004) study on idioms, are not fine-grained enough to uncover a literalist bias. As mentioned above, these studies only consider ‘correct’ and ‘incorrect’ responses,

⁴ This kind of account does not address the issue of particularized implicatures like the ones Jary (2013) calls ‘material implicatures’, which, at least in principle, may not require mentalistic reasoning. Wilson and Bishop (2020b) report issues with this kind of implicatures as well.

without further exploration, such that a literalist response will not be distinguished from any other ‘bad choice’. Therefore, these studies cannot reflect whether autistic subjects exhibit a characteristic pragmatic style when faced with figurative meaning. Rather, they only indicate that individuals who have language delay also have difficulties concerning figurative language. Several studies show that people with language delay have problems understanding figurative language or idiomatic expressions (e.g., Bühler et al., 2018). Autistic individuals with language delay have those same problems (as do second language learners). What is not further explored is whether autistic people (or people with DLD, for that matter) also exhibit a literalist bias. Having issues with figurative language is not equal to having a literalist bias. Testing for the former does not mean that the latter is tested.

Even a ‘correct’ response need not mean figurative language has been processed in a ‘typical’ way. Figurative meanings, may incur higher processing cost. So it is possible that autistic people who give correct responses still exhibit a literalist bias. That is, this kind of testing leaves open the possibility that people with ASC, whether showing language delay or not, may process figurative language differently than control populations.

Other experimental paradigms, using reaction times, priming, or eye-movements, are more appropriate if the goal is to test a literalist bias. In general, testing for on-line performance seems preferable. For instance, Walenski and Love’s (2017) priming study on idiom comprehension found that both TD and DLD individuals contrast with ASC subjects in that both TD and DLD groups do not interpret idioms literally. While they predicted that high-functioning (HF), linguistically able, ASC children would perform like typically-developing children, their processing style was quite different compared to the other two groups, including the DLD group, which, on average, had less developed structural language than the ASC group. Walenski and Love assessed performance in a lexical decision task, in order to discover differences in the facilitation effects across the three selected groups (TD, DLD, ASC). Ambiguous idioms (those that also can have a literal meaning) were heard as priming stimuli. The target words could be related to the idiomatic meaning of the expressions or to their literal meaning. Autistic children were primed only by literal meaning, and not by idiomatic meaning. This contrasted with the DLD group, which exhibited the same pattern as TD children, with no inclination for the literal interpretation.

These results pose a challenge for the structural language hypothesis, since they find impairments in idiom comprehension in ASC children whose linguistic skills are more developed than those of the DLD group. More importantly, such results suggest that only autistic individuals tend to interpret idiomatic expressions literally. Chahboun et al.'s (2017) study on metaphor comprehension (see also Olofson et al., 2014) is another example, since they look at reaction times in a cross-modal lexical decision task within a priming paradigm. In the task, both conventional and novel metaphors are used as primes, and their facilitation effect is compared to that of a literal prime. As primes they used noun+adj combinations, and as targets isolated words (nouns or verbs) related either to the metaphorical meaning or to the literal meaning. For instance, in the novel metaphorical condition they would have *grey face* as a prime, and *sadness* as a target; in the conventional metaphorical condition, *guardian angel* and *protect*; and in the literal condition *strong man* and *muscle* (the original stimuli are in Spanish). They compare performance in four groups: ASC children, TD children, HF ASC adults, and TD adults. Their results are: (i) ASC children have the slowest response rates; (ii) ASC adults have slower response rates than TD adults, and similar rates as TD children, and (iii) ASC adults perform similarly to TD children in that there is no response time difference between literal and metaphorical prime-target pairs. Chahboun et al. (2017: 772) conclude: “we interpret these results as demonstrating that individuals with ASD, who show intact linguistic abilities, nonetheless show a delay in metaphorical processing, supporting the hypothesis that metaphorical reasoning requires skills beyond general structural language skills”. This study also found no correlation between reaction times and ToM skills. Recent work by Wilson and Bishop (2019, 2020a, 2020b) shows that autistic individuals have problems understanding implicit meanings, such as particularized implicatures, that are not predicted by linguistic skills. Interestingly, they suggest that failures to adequately derive implicatures and sticking to only what is explicitly said may relate to experiencing intolerance of uncertainty (South & Rodgers, 2017), which may give rise to strict adherence to rules.

Summing up so far: extant accounts of literalism in ASC appeal to deficits in cognitive functions that may not actually play a role in understanding non-literal meanings in neurotypical processing. The explanations that resort to executive function (EF) assume a strong literalist bias and assimilate processing of non-literal meanings to ambiguity resolution. However, it is not clear that such a strong literalist bias exists in neurotypicals or that non-literal meaning access is akin to ambiguity resolution (which,

on the other hand, may not be problematic in the ASC population). ToM explanations also assume a strong literalist bias. Without such a bias, interpreters do not need to resort to explicit reasoning about what the speaker may be trying to communicate. Weak CC, in turn, sees figurative meaning understanding as analogous to ambiguity resolution, and imputes difficulties in this terrain to failures in integrating contextual information. However, it is unclear whether figurative meaning understanding should be hindered by a more local processing of stimuli. Finally, the explanation that appeals to semantic (dis)ability or linguistic deficits in general has two problems: the first is that linguistically ‘normal’ ASC people can still be literalist; and the second is that there is no clear explanation for why linguistic impairment *per se* should result in literalism. In general, we may conclude, extant accounts fail to adequately explain why literalism occurs in ASC.

However, there is also a more general issue that we would like to raise for all these views, namely, that none of them predicts what may be happening in neurotypical development. While we may assume that neurotypical children of 3 years have less developed EF, ToM, central coherence and semantic abilities/structural language than 5-year olds, some studies show that 5-year-olds are actually more literalist than 3-year-olds. This points to a puzzling U-shaped development of non-literal meaning understanding that poses a deep problem to extant accounts of literalism in ASC, for it suggests that the cognitive functions invoked in such accounts do not play the role they are said to play in non-literal meaning understanding. We turn to this issue in the next Section.

3. Conventions in neurotypical development

While the early-emerging pragmatic competence of neurotypical children is increasingly documented across a variety of studies and pragmatic tasks – including pre-linguistic communication (Stephens & Matthews, 2014), word learning (Bloom, 2000) and referential communication (Matthews, Lieven, Theakston, & Tomasello, 2006) – a puzzling feature of typical pragmatic development is the difficulties children face with non-literal uses of language, where they have to go beyond the conventional senses of the words and sentences the speaker has used, to grasp the speaker’s intended meaning (Falkum, 2019). For instance, in the literature on the development of metaphor understanding, early studies found that the production of spontaneous ‘metaphors’ by young children decreases with increasing age (Billow, 1981; Gardner, Kircher, Winner,

& Perkins, 1975), and that primary school children tend to have difficulties understanding metaphors (Asch & Nerlove, 1960; Billow, 1975; Winner, Rosenstiel, & Gardner, 1976). This type of U-shaped developmental curve has been observed in several other cognitive domains (Karmiloff-Smith, 1992), including English past-tense morphology (Berko, 1958) and the interpretation of sentences with ambiguous linguistic scope (Conroy, Lidz, & Musolino, 2009). While some more recent studies have attributed children's literalism on metaphor comprehension tasks in part to the complexity of the tasks used, and attests instead to an early metaphorical ability emerging during the preschool years (Deamer, 2013; Pouscoulous, 2011; Özçalışkan, 2005), there is a general consensus that there something about non-literal uses which poses a specific challenge to children's acquisition (Di Paola, Domaneschi, & Pouscoulous, 2020; Falkum & Köder, 2020; Levorato & Cacciari, 2002), and which leads children to process such uses literally even though it does not make sense in the context.

Falkum, Recasens and Clark (2017) designed a forced-choice task to assess metonymy comprehension in neurotypical English-speaking children. Children were introduced to a context, then heard an utterance with included an expression that was used metonymically, and had to choose which of three pictures matched the meaning of the sentence better: one that represented the intended metonymy, one that represented the literal understanding of said utterance, and one distractor picture. They were then asked to justify their choice of picture. For instance, the context could be as follows: "Look very carefully at the people in this picture [where children would be shown a picture of two men, one of whom had a big moustache]. This story is about these two guys. It's a very hot day and they are about to relax in the shade.", followed by the metonymic target utterance "*The moustache* sits down first". The competing pictures shown to children were either of a person with a moustache sitting down, a plain moustache being sat, or a distractor picture. Intriguingly, 3-year olds chose the picture representing the metonymical interpretation more often than 5-year olds, who showed a clear literalist bias. This literal bias was also evident in the results of the justification task, which showed not only that children became better at explaining their picture choices with age, but that the 5-year-olds' explanations of their 'wrong' literal interpretations of metonymic expressions tended to focus on what the speaker had literally said (e.g., "Cause the giant ears are going to drive. That's what you *said*.").

In a subsequent replication of their study (Köder & Falkum, 2020), the authors observed the same U-shape in Norwegian-speaking children aged 3-8 years. However, in this study they also tracked online looking times at each picture while the target sentence was being uttered. All age groups looked longer at the target metonymic referent in the metonymy condition than they did in the literal condition. That is, 5-year olds were distinguishing between literal and non-literal meanings, despite choosing the literal one. Finally, they compared the performance of 4-5-year olds with a group of 6-to-8-year-olds, and found that the preference for the literal meaning reversed: 6-to-8-year-olds selected more often the picture representing the metonymic meaning.

The results of the offline task, which involved pointing at the picture that represents the intended meaning of the utterance, indicate that 5-year olds are more literalists than 3-year olds. The online results from eye-tracking, however, show that 5-year olds are clearly sensitive to metonymic uses of expressions. How can we explain their performance in the offline task, more specifically the U-shaped development of metonymy comprehension? 5-year olds have more developed executive function, and we may assume that they are less focused on details and more open to the global gist than 3-year-olds are. If there were a U-shaped development in central coherence, 5-year olds should be less sensitive than 3-year olds to similarities and contiguities between different objects or situations, and so less advanced in their conceptual development in general. Nothing indicates that this is the case. It could still be that 5-year-olds focus more on details in some specific areas compared to 3-year-olds, but there seems to be no evidence pointing in that direction either. Finally, it seems uncontroversial to assume that 5-year-olds have more developed theory of mind and semantic abilities than 3-year-olds.

Köder and Falkum (2020) hypothesize that the reason why 5-year-olds select representations of literal meanings instead of representations of metonymic meanings is that they are more attuned to conventions, that is, regularities in social behaviour on the basis of which we coordinate our actions (Lewis, 1969). A growing body of work attests to a strong disposition in children to infer, adhere to and enforce conventions across disparate domains, including language (Clark, 2007), artefact use (German, Truxaw, & Defeyter, 2007), categorisation (Kalish, 2007), social behaviour (Schmidt, Butler, Heintz, & Tomasello, 2016) and pretence games (Rakoczy, 2007). For instance, 3-year-olds have been shown to spontaneously infer a social convention from a single observation of adult intentional behaviour (Schmidt et al., 2016). This appreciation of

convention plays an important role in learning, and according to Pedagogy Theory (Csibra & Gergely, 2009), it reflects a specific human adaptation for acquiring generic cultural knowledge from ostensive communication.

In the domain of language, sense conventions are regularities in the uses of words to convey particular senses that have become stored elements in the public lexicon (Carston, 2020), and they play an important role in language acquisition (Clark, 1993; Sabbagh & Henderson, 2007). One assumption guiding children early on in learning the senses of words and constructions is ‘the principle of conventionality’: for certain meanings, there is a form that speakers expect to be used in a language community (Clark, 1993). On the basis of this principle children may assume that newly acquired senses are shared by the members of their speech community (Diesendruck & Markson, 2001), assess whether particular word forms are ‘right’ or ‘wrong’ (Sabbagh & Baldwin, 2001), and take an unfamiliar word form to have a meaning distinct from other forms they already know (Clark, 2007). However, while an appreciation of sense conventions may be crucial to lexical acquisition, it may be a source of interpretive inflexibility in cases where familiar word forms are used with non-conventional meanings, as in non-literal uses of language. If children are naturally attuned to attending to the conventional senses of the words and constructions used – not because they lack the pragmatic abilities to go beyond them in inferring speakers’ meanings, but because it serves an important function at a particular stage of language learning – it may result in the literalist tendency evidenced in the developmental literature.

Relating this to 5-year-olds’ literalism in metonymy comprehension (Falkum et al., 2017; Köder & Falkum, 2020), sensitivity to the sense conventions of the language they are acquiring might have led them to think that they were expected to select the picture of the conventional referent of the target metonymic expression in the offline task, even if it was at odds with the context. The suggestion is that this effect was stronger in the 5-year-olds compared to the 3-year-olds given their overall greater knowledge of sense conventions. Compared to 3-year-olds, 5-year-olds may have a more explicit awareness that word-meaning relationships are among those conventions that their community follows. This is consonant with the observation that when children at this age explicitly reflect on non-literal uses, either spontaneously or when prompted to do so in an experimental setting, they tend to find them quite puzzling or emphasise their literal meanings (Falkum & Köder, 2020). It is also at this age that children become more concerned with social conventions in general. Compared to 3-year-olds,

5-year-olds show a deeper understanding and vigilance of social conventions, often paired with an inflexible attitude towards them. In a study by Göckeritz, Schmidt, and Tomasello (2014), groups of 5-year-olds were invited to work on an instrumental task. The children created social norms about how the game should be played, and transmitted such stipulated norms in inflexible and authoritative ways to novices. So there may be a peak in inflexibility concerning rules/conventions around that age. The concern 5-year-olds show with respect to rules may also apply to linguistic practices governed by conventions.

Thus, their choice of representations of literal meanings in the metonymy comprehension tasks (Falkum et al., 2017; Köder & Falkum, 2020) may be a choice of the rule-governed meaning, an attachment to a convention. If children are naturally attuned to attending to conventional senses of the words and constructions used – not because they lack the pragmatic abilities to go beyond these in inferring speakers’ meanings but because they serve a crucial function at a particular stage of language learning – it may result in the tendency toward literal interpretations. As in Göckeritz et al.’s (2014) study, where children persevered on a convention even when proven maladaptive, the children in Falkum et al.’s studies chose the representation of the literal meaning even if it hindered effective communication. When pressed to choose between following a rule and an alternative, they choose to follow the rule. In short, children’s disposition to attend to conventions, which helps them understand and navigate the social world around them, including linguistic communication, inevitably causes a degree of inflexibility, until children have learned what constitutes acceptable exceptions and deviations from these conventions, which would enable them to be more flexible.

How does this relate to the persistent difficulties that ASC individuals face with non-literal uses of language? Could they be linked to a similar source as those experienced by neurotypical children at a certain stage in development?

4. The ASC profile and conventions

ASC people experience special difficulties in navigating the social world because they lack the required abilities, and because the social world is less stable and predictable than the natural or the virtual worlds: persons, their moods, their behaviour, and the way they interact are not subject to the regularities found in the physical and natural environments. Although the *DSM-5* (American Psychiatric Association, 2013)

highlights problems with social interactions in ASC, it is ambivalent concerning their aetiology, as they are characterized as follows: “Deficits in developing, maintaining, and understanding relationships, ranging, for example, from difficulties adjusting behaviour to suit various social contexts; to difficulties in sharing imaginative play or in making friends; to *absence of interest in peers*” (our italics). Jaswal and Akhtar (2019), however, have recently argued that the idea that ASC individuals are not interested in other people is unmotivated. According to them, social isolation is often generated not by disinterest, but by the incapacity to understand and coordinate with other people. While there may be cases of genuine social disinterest, we assume that many ASC individuals try to understand the social world, looking for scaffolding where possible (see, e.g., recent research on 'camouflaging' in High Functioning Autism: Hull et al., 2017; Livingston & Happé, 2017)

It is commonplace that many ASC individuals are rigid or inflexible, that they prefer things to be black and white and do not tolerate exceptions. Here we are not talking about what Kanner (1943) described as “need for sameness” and “resistance to (unexpected) change”, which is one of the core symptoms of autism according to the DSM-V. We are referring more specifically to ASC individuals’ relationship with rules: greeting people when they meet them, crossing the road only when the traffic light is green, having lunch at a certain, scheduled, time in the day, expecting an explicit apology from someone they think has done something wrong, not talking at school while the teacher is speaking, and so on. Although the perception (or even self-perception) that people diagnosed with ASC are rigid concerning rules is commonplace, there is little discussion of this trait in the scientific literature, possibly because it is assumed to be an expression of the abovementioned ‘need for sameness’⁵. However, while it may be the case that strict adherence to rules is part and parcel of such insistence on sameness, it is also possible that it is a different trait with a different functionality. To give an example that may be familiar to any reader: usually most people do not know how to approach relatives of a deceased person in a funeral. For many it is a disconcerting social space that we are unsure how to navigate. In such a case, we refuse to try to be spontaneous or flexible, and express our condolences using

⁵ An exception is Strang et al. (2017) , where, in their Flexibility Scale, they include an item labeled ‘rigid about rules; legalistic’. However, they scarcely discuss it. On the other hand, rigidity about rules could also relate to a different construct: intolerance of uncertainty (South & Rodgers, 2017). See Petrolini, Jorba and Vicente (ms) for a discussion about rigidity constructs in ASC.

some entrenched formulation because that is the safe thing to do. We follow a rule for interacting with people who have suffered the loss because the situation provokes social anxiety in us.

The rigidity-about-rules trait is discussed in blogs run by ASC individuals and in intervention webpages and books, often pointing at the cause of the prevalence of the trait: “Child feels safer with concrete, predictable rules and laws that remain constant” (Nason, 2014: 107) or “Rarely do rules and regulations (especially social rules) apply rigidly, without variation across situations and settings. Unfortunately, when you cannot read the fluctuations between situations, then you cannot adjust your thinking, and must hold tight to your rules and expectations” (Nason, 2014: 108).

The little research that has been done in this area (i.e. rigid rule-following) concerns the moral vs. conventional rules division. For instance, Shulman, Guberman, Shiling and Bauminger (2012) compared ASC and TD students on how they evaluated transgressions of moral vis-à-vis conventional rules. While both groups took social conventional rules to be more open to exceptions than moral rules, the TD group came up with considerably more situations when a given conventional rule could be not observed. The distinction between moral and conventional rules in the TD group was a pronounced one, while in the ASC group the distinction was more blurry. Note that participants were not asked directly about the moral/conventional distinction, but about whether transgressions to different examples of rules could be permitted, and when they would be permitted. The results of the study indicate that the ASC group was almost as inflexible about one kind of rules as about the other.

We do not know whether this kind of social rigidity is a cognitive problem or only a social problem (or a cognitive problem that is manifested only in the social domain). For instance, social rigidity may stem from social anxiety, which is quite widespread in the ASC population (Spain, Sinc, Linder, McMahond, & Happé, 2018). Or, as mentioned above, it may be motivated by the need to find some firm ground from where to approach social interactions⁶. In any case, we may suppose that attaching to conventions/rules may be a need for many people who have social impairments,

⁶ In research on “camouflaging” (Hull et al., 2017) it has been observed that many people try to come up with rules that they can use in interactions. In his short autobiographical piece in *Neurodiversity Studies: a new critical paradigm*, Matthew Belmonte (2020: 183) reflects on his experience looking for a job in academia: “The generalisable theme in this story is that *camouflagers are good at following algorithms*, but when nobody bothers to tell us the algorithm, the unexplained process of career progression can be as mystifying as the unexplained rules of kickball were, all those years ago” (our italics).

whatever the reason behind such an impairment. Rules put some order in an otherwise chaotic world. Similarly, Wilson and Bishop (2020a, 2020b) suggest that pragmatic difficulties in autism may relate to intolerance of uncertainty (South & Rodgers, 2017). One way to react to such uncertainty is to abide by rules, which provide some safe ground. At the same time, being clear about rules may be a first step in *understanding* social practices in general. In language acquisition, (Clark, 1993) suggests that following the principle of conventionality is a good learning strategy. As a way to start mapping concepts to words, it makes sense to work under the assumption that each word corresponds to only one concept. It is also plausible that in order to learn how things work in the social world it is good to begin with the assumption that patterns of interaction and/or behaviour more generally fall under one particular rule. For instance, many ASC individuals either learn or are explicitly instructed to greet other people. But then one can observe that they greet too much. It is likely that assuming that interactions begin with a “hello” or with shaking hands facilitates moving to the next step.

So, the observed social behavioural rigidity in many ASC individuals might be related to general needs to structure and organize a world that is particularly challenging. The social world may contain more stimuli that they are able to cope with; or it implies excessive load on a poor executive system, or problems with empathy or theory of mind make the social world simply un-understandable. Alternatively, it may be that behavioural inflexibility concerning social interactions simply manifests a domain-general cognitive inflexibility. According to this idea, ASC individuals would be rigid in general, unable to tolerate or accommodate exceptions. The reason why rigidity in behaviour is made manifest in the social domain more than in others is simply because the social world is much less rule-governed than others.

There is little discussion as to how rigidity facets develop in time. Bishop et al. (2013) report increased circumscribed interests with greater age, but Strang et al. (2017) do not find such a relation. Strang et al. also mention that that flexibility problems in general were less intense in the older participants in their study, but they recommend caution, since, as of today, there are no data from longitudinal studies. In the absence of such longitudinal studies, it is possible to speculate that high functioning (HF) ASC people may become more flexible about rules with time, once they realize that rule-following in neurotypicals admits many exceptions. Without being able to commit to suggesting any direct relationship, it seems that the same process of conscious realization may drive improvements in working out non-literal uses of language in the

course of HF autistic individuals development (who can attain a better understanding of figurative language, but not as good as TD adults: Chahboun et al., 2016; Chahboun et al., 2017). In both cases, ASC individuals may remain rigid and literalists at the deepest level, while succeeding at meeting the challenges of the typicals' world.

5. Concluding remarks

We suggest that ASC individuals' fixation with literal meanings is part and parcel of this general fixation with rules in the social realm. The rationale behind this explanation of literalism in ASC is: (i) words have conventional meanings, but they are also used non-conventionally by speakers, such that understanding what speakers mean involves being able to not follow/be flexible about a conventional rule; (ii) there is some evidence showing that when subjects are more literalist, they are also more rigid about conventions in general; (iii) many ASC people are rigid concerning social rules (there being various reasons that could explain it), so it is to be expected that they are also rigid concerning rules about what words mean. In this Section we have tried to support step (iii) of the argument by identifying a behavioural trait common to many ASC individuals that is not often discussed: strict adherence to rules. This kind of rule following inflexibility also seems to be present in TD children of a certain age, who also display less flexibility concerning meaning interpretation (Section 2). There is reason to believe that both kinds of behaviours are related, as in the terrain of meaning interpretation there are also conventions as well as exceptions to such conventions. So, given that we think that most accounts of literalism in ASC are unconvincing and that we find in ASC people a trait that is plausibly related to the literalism we find in typical development, our suggestion is that literalism in ASC may be related to their overall being stricter about rules. We hope that this may open up a new direction for empirical research into the sources of ASC individuals' difficulties in this important domain of social cognition and communication.

References

- American Psychiatric Association. (2013). *Diagnostic and Statistical Manual of Mental Disorders (DSM-5), Fifth Edition*. Washington, DC: American Psychiatric Association Publishing.
- Andrés-Roqueta, C., & Katsos, N. (2020). A distinction between linguistic- and social-pragmatics helps the precise characterisation of pragmatic challenges in children with Autism Spectrum Disorders and Developmental Language Disorder. *Journal of Speech, Language and Hearing Research*, 63(5), 1494-1508. doi:10.1044/2020_JSLHR-19-00263

- Asch, S., & Nerlove, H. (1960). The development of double function terms in children: An exploratory investigation. In B. Kaplan & S. Wapner (Eds.), *Perspectives in Psychological Theory: Essays in Honor of Heinz Werner* (pp. 47-60). New York: International Universities Press.
- Au-Yeung, S. K., Kaakinen, J. K., Liversedge, S. P., & Benson, V. (2018). Would adults with autism be less likely to bury the survivors? An eye movement study of anomalous text reading. *Quarterly Journal of Experimental Psychology*, *71*(1), 280–290. doi:10.1080/17470218.2017.1322621
- Baron-Cohen, S., Baldwin, D. A., & Crowson, M. (1997). Do children with autism use the speaker's direction of gaze strategy to crack the code of language? *Child Development*, *68*(1), 48-57. doi:10.2307/1131924
- Baron-Cohen, S., Leslie, A. M., & Frith, U. (1985). Does the autistic child have a “theory of mind” ? *Cognition*, *21*(1), 37-46. doi:10.1016/0010-0277(85)90022-8
- Belmonte, M. (2020). How individuals and institutions can learn to make room for human cognitive diversity: A personal perspective from my life in neuroscience. In H. B. Rosqvist, N. Chown, & A. Stenning (Eds.), *Neurodiversity Studies: A New Critical Paradigm* (pp. 183). London: Routledge.
- Berko, J. (1958). The child's learning of English morphology. *Word*, *14*(150-177). doi:10.1080/00437956.1958.11659661
- Billow, R. M. (1975). A cognitive developmental study of metaphor comprehension. *Developmental Psychology*, *11*(4), 415-423. doi:10.1037/h0076668
- Billow, R. M. (1981). Observing spontaneous metaphor in children. *Journal of Experimental Child Psychology*, *31*, 430-455. doi:10.1016/0022-0965(81)90028-X
- Bishop, S. L., Hus, V., Duncan, A., Huerta, M., Gotham, K., Pickles, A., & Lord, C. (2013). Subcategories of restricted and repetitive behaviors in children with autism spectrum disorders. *Journal of Autism and Developmental Disorders*, *43*(6), 1287-1297. doi:10.1007/s10803-012-1671-0
- Bloom, P. (2000). *How Children Learn the Meanings of Words*. Cambridge, MA: The MIT Press.
- Boucher, J., Mayes, A., & Bigham, S. (2012). Memory in autistic spectrum disorder. *Psychological Bulletin*, *38*(3), 458-496. doi:10.1037/a0026869
- Brock, J., Norbury, C., Einav, S., & Nation, K. (2008). Do individuals with autism process words in context? Evidence from language-mediated eye-movements. *Cognition*, *108*, 896–904. doi:10.1016/j.cognition.2008.06.007
- Bühler, D., Perovic, A., & Pouscoulous, N. (2018). Comprehension of novel metaphor in young children with Developmental Language Disorder. *Autism & Developmental Language Impairments*. doi:10.1177/2396941518817229
- Carston, R. (2002). *Thoughts and Utterances: The Pragmatics of Explicit Communication*. Oxford: Blackwell Publishers.
- Chahboun, S., Vulchanov, V., Saldaña, D., Eshuis, H., & Vulchanova, M. (2016). Can you play with fire and not hurt yourself? A comparative study in figurative language comprehension between Individuals with and without Autism Spectrum Disorder. *PLoS one*, *11*(12), e0168571. doi:10.1371/journal.pone.0168571
- Chahboun, S., Vulchanov, V., Saldaña, D., Eshuis, R., & Vulchanova, M. D. (2017). Can you tell it by the prime: A study of metaphorical priming in high-functioning autism in comparison with matched controls. *International Journal of Language and Communication Disorders*, *52*(6), 766-785. doi:10.1111/1460-6984.12314
- Chevallier, C., Noveck, I., Happé, F. G. E., & Wilson, D. (2011). What's in a voice? Prosody as a test case for the Theory of Mind account of autism. *Neuropsychologia*, *49*(3), 507-517. doi:10.1016/j.neuropsychologia.2010.11.042
- Chevallier, C., Wilson, D., Happé, F., & Noveck, I. (2010). Scalar inferences in Autism Spectrum Disorders. *Journal of Autism Developmental Disorders*, *40*(1), 104–1117. doi:10.1007/s10803-010-0960-8

- Clark, E. V. (1993). *The Lexicon in Acquisition*. Cambridge: Cambridge University Press.
- Clark, E. V. (2007). Conventuality and contrast in language and language acquisition. *New Directions for Child and Adolescent Development*, 115, 11-23. doi:10.1002/cad.179
- Conroy, A., Lidz, J., & Musolino, J. (2009). The Fleeting Isomorphism Effect. *Language Acquisition*, 16(2), 106-117. doi:10.1080/10489220902769242
- Csibra, G., & Gergely, G. (2009). Natural pedagogy. *Trends in Cognitive Sciences*, 13(4), 148-153. doi:10.1016/j.tics.2009.01.005
- Deamer, F. (2013). *An Investigation into the Processes and Mechanisms Underlying the Comprehension of Metaphor and Hyperbole*. PhD dissertation: University College London.
- Del Pinal, G. (2015). Dual Content Semantics, privative adjectives, and dynamic compositionality. *Semantics and Pragmatics*, 8(7), 1-53. doi:10.3765/sp.8.7
- Demetriou, E. A., Lampit, A., Quintana, D. S., Naismith, S. L., Song, Y. J. C., Pye, J. E., . . . AJ., G. (2018). Autism spectrum disorders: a meta-analysis of executive function. *Molecular Psychiatry*, 23(5), 1198-1204. doi:10.1038/mp.2017.75
- Di Paola, S., Domaneschi, F., & Pouscoulous, N. (2020). Metaphorical developing minds: The role of multiple factors in the development of metaphor comprehension. *Journal of Pragmatics*, 156, 235-251. doi:10.1016/j.pragma.2019.08.008
- Diamond, A. (2013). Executive functions. *Annual Review of Psychology*, 64, 135-168. doi:10.1146/annurev-psych-113011-143750
- Diesendruck, G., & Markson, L. (2001). Children's avoidance of lexical overlap: A pragmatic account. *Developmental Psychology*, 37(5), 630-641. doi:10.1075/lald.44.06fer
- Falkum, I. L. (2019). Pragmatic development: Learning to use language to communicate. In J. S. Horst & J. Von Koss Torkildsen (Eds.), *International Handbook of Language Acquisition*. London: Routledge.
- Falkum, I. L., & Köder, F. (2020). The acquisition of figurative meanings. *Journal of Pragmatics*, 164, 18-24. doi:10.1016/j.pragma.2020.04.007
- Falkum, I. L., Recasens, M., & Clark, E. V. (2017). 'The moustache sits down first': On the acquisition of metonymy. *Journal of Child Language*, 44(1), 87-119. doi:10.1017/S0305000915000720
- Friedman, L., & Sterling, A. A. (2019). A review of language, executive function, and intervention in Autism Spectrum Disorder. *Seminars in Speech and Language*, 40(4), 291-304. doi:10.1055/s-0039-1692964
- Frisson, S. (2009). Semantic underspecification in language processing. *Language and Linguistics Compass*, 3(1), 111-127. doi:10.1111/j.1749-818x.2008.00104.x
- Frith, U., Happé, F., & Siddons, F. (1994). Autism and theory of mind in everyday life. *Social Development*, 3, 108-124. doi:10.1111/j.1467-9507.1994.tb00031.x
- Gardner, H., Kircher, M., Winner, E., & Perkins, D. (1975). Children's metaphoric productions and preferences. *Journal of Child Language*, 2(1), 125-141. doi:10.1017/S0305000900000921
- German, T. P., Truxaw, D., & Defeyter, M. A. (2007). The role of information about 'convention', 'design', and 'goal', in representing artificial kinds. *New Directions for Child and Adolescent Development*, 115, 69-81. doi:10.1002/cd.183
- Gernsbacher, M. A., & Yergeau, M. (2019). Empirical failures of the claim that autistic people lack a theory of mind. *Archives of Scientific Psychology*, 7(1), 102-118. doi:10.1037/arc0000067
- Geurts, B., Kissine, M., & van Tiel, B. (2019). Pragmatic reasoning in autism. In K. Morsanyi & R. Byrne (Eds.), *Thinking, Reasoning and Decision Making in Autism* (pp. 113-134). London: Psychology Press.
- Geurts, H. M., van den Bergh, S. F. W. M., & Ruzzano, L. (2014). Prepotent response inhibition and interference control in autism spectrum disorders: two meta-analyses. *Autism Research*, 7(4), 407-420. doi:10.1002/aur.1369

- Gibbs, R. W. (1994). *The Poetics of Mind*. Cambridge: Cambridge University Press.
- Gibbs, R. W. (2002). A new look at literal meaning in understanding what is said and implicated. *Journal of Pragmatics*, 34(4), 457-486. doi:10.1016/S0378-2166(01)00046-7
- Glenwright, M., & Agbayewa, A. S. (2012). Older children and adolescents with high-functioning autism spectrum disorders can comprehend verbal irony in computer-mediated communication. *Research in Autism Spectrum Disorders*, 6(2), 628–638. doi:0.1016/j.rasd.2011.09.013
- Glucksberg, S. (2008). How metaphors create categories - quickly. In R. W. Gibbs (Ed.), *The Cambridge Handbook of Metaphor and Thought* (pp. 67-83). Cambridge: Cambridge University Press.
- Göckeritz, S., Schmidt, M. F. H., & Tomasello, M. (2014). Young children’s creation and transmission of social norms. *Cognitive Development*, 30, 81–95. doi:10.1016/j.cogdev.2014.01.003
- Grice, H. P. (1975/1989). Logic and conversation. In *Studies in the Way of Words* (pp. 22-40). Cambridge, Massachusetts: Harvard University Press.
- Habib, A., Harris, L., Pollick, F., & Melville, C. (2019). A meta-analysis of working memory in individuals with autism spectrum disorders. *PloS one*, 14(4). doi:10.1371/journal.pone.0216198
- Hahn, N., Snedeker, J., & Rabagliati, H. (2015). Rapid linguistic ambiguity resolution in young children with autism spectrum disorder: Eye tracking evidence for the limits of weak central coherence. *Autism Research*, 8, 717–726. doi:10.1002/aur.1487
- Happé, F. G. E. (1993). Communicative competence and theory of mind in autism: A test of relevance theory. *Cognition*, 48, 101-119. doi:10.1016/0010-0277(93)90026-R
- Happé, F. G. E. (1999). Autism: Cognitive deficit or cognitive style? *Trends in Cognitive Sciences*, 3(6), 216-222. doi:10.1016/S1364-6613(99)01318-2
- Happé, F. G. E., & Frith, U. (2006). The weak coherence account: detail-focused cognitive style in Autism Spectrum Disorders. *Journal of Autism and Developmental Disorders*, 36(1), 5-25. doi:10.1007/s10803-005-0039-0
- Hill, E. L. (2004). Executive dysfunction in autism. *Trends in Cognitive Sciences*, 8, 26-32. doi:10.1016/j.tics.2003.11.003
- Hochstein, L., Bale, A., & Barner, D. (2018). Scalar implicature in absence of epistemic reasoning? The case of autism spectrum disorder. *Language Learning and Development*, 14(3), 224-240. doi:10.1080/15475441.2017.1343670
- Hogeweg, L. (2012). Rich lexical representations and conflicting features. *International Review of Pragmatics*, 4, 209–231. doi:10.1163/18773109-00040205
- Hull, L., Petrides, K. V., Allison, C., Smith, P., Baron-Cohen, S., Lai, M.-C., & Mandy, W. (2017). “Putting on my best normal”: Social camouflaging in adults with Autism Spectrum Conditions. *Journal of Autism Developmental Disorders*, 47, 2519–2534. doi:10.1007/s10803-017-3166-5
- Jary, M. (2013). Two types of implicature: material and behavioural. *Mind & Language*, 28(5), 638-660. doi:10.1111/mila.12037
- Jaswal, V. K., & Akhtar, N. (2019). Being versus appearing socially uninterested: Challenging assumptions about social motivation in autism. *Behavioural and Brain Sciences*, 42, e82. doi:10.1017/S0140525X18001826
- Johnston, K., Murray, K., Spain, D., Walker, I., & Russell, A. (2019). Executive function: Cognition and behaviour in adults with Autism Spectrum Disorders (ASD). *Journal of Autism Developmental Disorders*, 49(10), 4181–4192. doi:10.1007/s10803-019-04133-7
- Kalish, C. W. (2007). Pragmatic and prescriptive aspects of children’s categorization. *New Directions for Child and Adolescent Development*, 115, 39-52. doi:10.1002/cd.181
- Kanner, L. (1943). Autistic disturbances of affective contact. *Nervous Child*, 2, 217–250.

- Karmiloff-Smith, A. (1992). *Beyond Modularity: A Developmental Perspective on Cognitive Science*. Cambridge, MA: The MIT Press.
- Kasirer, A., & Mashal, N. (2014). Verbal creativity in autism: Comprehension and generation of metaphoric language in high-functioning autism spectrum disorder and typical development. *Frontiers in Human Neuroscience*, *8*. doi:10.3389/fnhum.2014.00615
- Kasirer, A., & Mashal, N. (2016). Comprehension and generation of metaphors by children with autism spectrum disorder. *Research in Autism Spectrum Disorders*, *32*, 53–63.
- Keil, F. C. (1986). Conceptual domains and the acquisition of metaphor. *Cognitive Development*, *1*, 73-96. doi:10.1016/S0885-2014(86)80024-7
- Kercooda, S., Grskovicb, J. A., Bandac, D., & Begesked, J. (2014). Working memory and autism: A review of literature. *Research in Autism Spectrum Disorders*, *8*(10), 1316-1332. doi:10.1016/j.rasd.2014.06.011
- Kissine, M. (2016). Pragmatics as metacognitive control. *Frontiers in Psychology*, *6*, 2057. doi:10.3389/fpsyg.2015.02057
- Köder, F., & Falkum, I. L. (2020). Children's metonymy comprehension: Evidence from eye-tracking and picture selection. *Journal of Pragmatics*, *156*, 191-205. doi:10.1016/j.pragma.2019.07.007
- Landry, O., & Al-Taie, S. (2016). A meta-analysis of the Wisconsin Card Sort Task in autism. *Journal of Autism Developmental Disorders*, *46*, 1220–1235. doi:10.1007/s10803-015-2659-3
- Langdon, R., Davies, M., & Coltheart, M. (2002). Understanding minds and understanding communicated meanings in schizophrenia. *Mind & Language*, *17*(1-2), 68-104. doi:10.1111/1468-0017.00189
- Levorato, M. C., & Cacciari, C. (2002). The creation of new figurative expressions: psycholinguistic evidence in Italian children, adolescents and adults. *Journal of Child Language*, *29*, 127-150. doi:10.1017/S0305000901004950
- Lewis, D. K. (1969). *Convention: A Philosophical Study*. Cambridge, MA: Harvard University Press.
- Livingston, L. A., & Happé, F. (2017). Conceptualising compensation in neurodevelopmental disorders: Reflections from autism spectrum disorder. *Neuroscience & Biobehavioral Reviews*, *80*, 729-742. doi:10.1016/j.neubiorev.2017.06.005
- López, B., & Leekam, S. R. (2003). Do children with autism fail to process information in context? *Journal of Child Psychology and Psychiatry*, *44*(2), 285–300. doi:10.1111/1469-7610.00121
- Martin, I., & McDonald, S. (2004). An exploration of causes of non-literal problems in individuals with Asperger Syndrome. *Journal of Autism and Developmental Disorders*, *34*, 311-328. doi:10.1023/B:JADD.0000029553.52889.15
- Matthews, D., Lieven, E., Theakston, A., & Tomasello, M. (2006). The effect of perceptual availability and prior discourse on young children's use of referring expressions. *Applied Psycholinguistics*, *27*, 403-422. doi:10.1017/S0142716406060334
- Morsanyi, K., Stamenković, D., & Holyoak, K. J. (2019). Analogical reasoning in autism. In K. Morsanyi & R. Byrne (Eds.), *Thinking, Reasoning, and Decision Making in Autism* (pp. 59-74). London: Routledge.
- Nason, W. (2014). *Autism Discussion Page on the Core Challenges of Autism: A Toolbox for Helping Children with Autism Feel Safe, Accepted, and Competent*. London: Jessica Kingsley Publishers.
- Nerlich, B., Clarke, D. D., & Todd, Z. (1999). "Mummy, I like being a sandwich". Metonymy in language acquisition. In K. Panther & G. Radden (Eds.), *Metonymy in Language and Thought* (pp. 361-383). Amsterdam: John Benjamins.
- Norbury, C. F. (2004). Factors supporting idiom comprehension in children with communication disorders. *Journal of Speech, Language and Hearing Research*, *47*(5), 1179-1193. doi:10.1044/1092-4388(2004/087)

- Norbury, C. F. (2005). The relationship between Theory of Mind and metaphor: Evidence from children with language impairment and autistic spectrum disorder. *British Journal of Developmental Psychology*, *23*, 383-399. doi:10.1348/026151005X26732
- Norbury, C. F. (2014). Atypical pragmatic development. In D. Matthews (Ed.), *Pragmatic Development in First Language Acquisition* (pp. 343-362). Amsterdam: John Benjamins.
- Olofson, E. L., Casey, D., Oluyedun, O. A., Van Herwegen, J., Becerra, A., & Rundblad, G. (2014). Youth with autism spectrum disorder comprehend lexicalized and novel primary conceptual metaphors. *Journal of Autism and Developmental Disorders*, *44*(10), 2568-2583. doi:10.1007/s10803-014-2129-3
- Ozonoff, S., & Jensen, J. (1999). Brief report: Specific executive function profiles in three neurodevelopmental disorders. *Journal of Autism Developmental Disorders*, *29*, 171-177. doi:10.1023/A:1023052913110
- Petrolini, V., Jorba, M., & Vicente, A. (ms). *What does it take to be rigid? Reflections on the notions of rigidity in ASC.*
- Plaisted, K., Saksida, L., Alcántara, J., & Weisblatt, E. (2003). Towards an understanding of the mechanisms of weak central coherence effects: experiments in visual configural learning and auditory perception. *Philosophical transactions of the Royal Society of London. Series B, Biological sciences*, *358*(1430), 375-386. doi:10.1098/rstb.2002.1211
- Pouscoulous, N. (2011). Metaphor: For adults only? *Belgian Journal of Linguistics*, *25*, 51-79. doi:10.1075/bjl.25.04pou
- Rakoczy, H. (2007). Play, games, and the development of collective intentionality. *New Directions for Child and Adolescent Development*, *115*, 53-67. doi:10.1002/cd.182
- Recanati, F. (2004). *Literal Meaning*. Cambridge: Cambridge University Press.
- Rubio-Fernández, P. (2007). Suppression in metaphor interpretation: Differences between meaning selection and meaning construction. *Journal of Semantics*, *24*(4), 345-371. doi:10.1093/jos/ffm006
- Rundblad, G., & Annaz, D. (2010a). Development of metaphor and metonymy comprehension: Receptive vocabulary and conceptual knowledge. *British Journal of Developmental Psychology*, *28*, 547-563. doi:10.1348/026151009X454373
- Rundblad, G., & Annaz, D. (2010b). The atypical development of metaphor and metonymy comprehension in children with autism. *Autism*, *14*(1), 29-46. doi:10.1177/1362361309340667
- Russell, J., Jarrold, C., & Hood, B. (1999). Two Intact Executive Capacities in Children with Autism: Implications for the Core Executive Dysfunctions in the Disorder. *Journal of Autism and Developmental Disorders*, *29*, 103-112. doi:10.1023/A:1023084425406
- Sabbagh, M. A., & Baldwin, D. A. (2001). Learning words from knowledgeable versus ignorant speakers: Links between preschoolers theory of mind and semantic development. *Child Development*, *72*, 1054-1070. doi:10.1111/1467-8624.00334
- Sabbagh, M. A., & Henderson, A. M. E. (2007). How an appreciation of conventionality shapes early word learning. *New Directions for Child and Adolescent Development*, *115*, 25-37. doi:10.1002/cad.180
- Schmidt, M. F. H., Butler, L. P., Heintz, J., & Tomasello, M. (2016). Young children see a single action and infer a social norm: Promiscuous normativity in 3-year-olds. *Psychological Science*, *27*(10), 1360-1370. doi:10.1177/0956797616661182
- Shulman, C., Guberman, A., Shiling, N., & Bauminger, N. (2012). Moral and social reasoning in Autism Spectrum Disorders. *Journal of Autism Developmental Disorders*, *42*, 1364-1376. doi:10.1007/s10803-011-1369-8
- South, M., & Rodgers, J. (2017). Sensory, emotional and cognitive contributions to anxiety in autism spectrum disorders. *Frontiers in Human Neuroscience*, *11*(20). doi:10.3389/fnhum.2017.00020

- Spain, D., Sinc, J., Linder, K. B., McMahon, J., & Happé, F. G. E. (2018). Social anxiety in autism spectrum disorder: A systematic review. *Research in Autism Spectrum Disorders*, 52, 51-68. doi:10.1016/j.rasd.2018.04.007
- Sperber, D., & Wilson, D. (1986/1995). *Relevance: Communication and Cognition*. Oxford: Blackwell.
- Stephens, G., & Matthews, D. (2014). The communicative infant from 0-18 months. The social-cognitive foundations of pragmatic development. In *Pragmatic Development in First Language Acquisition* (pp. 13-35). Amsterdam: John Benjamins.
- Strang, J. F., Anthony, L. G., Yerys, B. E., Hardy, K. K., Wallace, G. L., Armour, A. C., . . . Kenworthy, L. (2017). The Flexibility Scale: Development and Preliminary Validation of a Cognitive Flexibility Measure in Children with Autism Spectrum Disorders. *Journal of Autism and Developmental Disorders*, 47(8), 2502–2518. doi:10.1007/s10803-017-3152-y
- Stroop, J. R. (1935). Studies of interference in serial verbal reactions. *Journal of Experimental Psychology*, 18(6), 643–662. doi:10.1037/h0054651
- Swinney, D. A. (1979). Lexical access during sentence comprehension: (Re)consideration of context effects. *Journal of Verbal Learning and Verbal Behavior*, 18(6), 645-659. doi:10.1016/S0022-5371(79)90355-4
- Tager-Flusberg, H., Paul, R., & Lord, C. (2005). Language and communication in autism. In D. J. Cohen & F. R. Volkman (Eds.), *Handbook of Autism and Pervasive Developmental Disorders* (3rd ed., pp. 335-364). New York: John Wiley and Sons.
- Tirado, M. J., & Saldaña, D. (2016). Readers with autism can produce inferences, but they cannot answer inferential questions. *Journal of Autism Developmental Disorders*, 46, 1025–1037. doi:10.1007/s10803-015-2648-6
- Van Tiel, R., & Kissine, M. (2018). Quantity-based reasoning in the broader autism phenotype: A web-based study. *Applied Psycholinguistics*, 39, 1373-1403. doi:10.1017/S014271641800036X
- Vulchanova, M., Saldaña, D., Chahboun, S., & Vulchanov, V. (2015). Figurative language processing in atypical populations: the ASD perspective. *Frontiers in Human Neuroscience*, 9(24). doi:10.3389/fnhum.2015.00024
- Vulchanova, M., Talcott, J. B., Vulchanov, V., & Stankova, M. (2012). Language against the odds, or rather not: The weak central coherence hypothesis and language. *Journal of Neurolinguistics*, 25(1), 13-30. doi:10.1016/j.jneuroling.2011.07.004.
- Walenski, M., & Love, T. (2017). The real-time comprehension of idioms by typical children, children with specific language impairment and children with autism. *Journal of Speech Pathology & Therapy*, 3(1), 130. doi:10.4172/2472-5005.1000130
- Whyte, E. M., & Nelson, K. E. (2015). Trajectories of pragmatic and nonliteral language development in children with autism spectrum disorders. *Journal of Autism and Developmental Disorders*, 45(2). doi:10.1016/j.jcomdis.2015.01.001
- Willcutt, E., Sonuga-Barke, E., Nigg, J., & Sergeant, J. (2008). Recent developments in neuropsychological models of childhood psychiatric disorders. In T. Banaschewski & L. A. Rohde (Eds.), *Biological Child Psychiatry. Recent Trends and Developments. Advances in Biological Psychiatry, Vol. 24* (pp. 195-226). Basel: Karger.
- Wilson, A. C., & Bishop, D. V. M. (2019). "If you catch my drift...": ability to infer implied meaning is distinct from vocabulary and grammar skills. *Wellcome Open Research*, 4, 68. doi:10.12688/wellcomeopenres.15210.3
- Wilson, A. C., & Bishop, D. V. M. (2020a). Registered report: investigating a preference for certainty in conversation among autistic adults compared to dyslexic adults and the general population. *PeerJ*, 8 : e10398 doi:10.7717/peerj.10398
- Wilson, A. C., & Bishop, D. V. M. (2020b). Second guessing yourself all the time about what they really mean...": cognitive differences between autistic and non-autistic adults in understanding implied meaning. *Autism Research*, 3. doi:10.1002/aur.2345

- Wilson, D., & Carston, R. (2007). A unitary approach to lexical pragmatics: Relevance, inference and ad hoc concepts. In N. Burton-Roberts (Ed.), *Pragmatics* (pp. 230-259). London: Palgrave.
- Winner, E. (1988/1997). *The Point of Words: Children's Understanding of Metaphor and Irony*. Cambridge, MA: Harvard University Press.
- Winner, E., Rosenstiel, A. K., & Gardner, H. (1976). The development of metaphoric understanding. *Developmental Psychology*, 12(4), 289-297. doi:10.1037/0012-1649.12.4.289
- Özçalışkan, Ş. (2005). On learning how to draw the distinction between physical and metaphorical motion: is metaphor and early emerging cognitive and linguistic capacity? *Journal of Child Language*, 32, 291-318. doi:10.1017/S0305000905006884