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Do Grammatical and Cognitive Phenotypes Illuminate Each Other? Reflections on Un-Cartesian Linguistics and the Language-ToM Interface

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1 Introduction

How language and thought interact is a hot topic of debate, and one that is refreshingly revisited by Hinzen in his paper entitled 'Reference across pathologies: A new linguistic lens on disorders of thought'. The work is situated within the 'un-Cartesian' linguistics research program, which seeks to illustrate that the organizational principles of grammar directly configure human-specific thought (Hinzen 2007; Hinzen 2012; 2013; a.o.). The un-Cartesian program may at first glance seem reminiscent of other approaches arguing for an influence of language on thought, however it differs from them in important ways. In contrast to linguistic determinism, for instance, it posits "(n)o unidirectional causal arrow lead(ing) from language to thought" (Section 2.1). In contrast to Neo-Whorfianism, un-Cartesian linguistics is concerned with the underlying grammatical principles common to all languages, thus cross-linguistic variations are not expected to give rise to cognitive variations. To sum up, for Hinzen, thinking is 'languaging' (Section 2.1) and any human language should arise together with human concepts, such as reference and propositional meaning. In light of this, Hinzen predicts both inter- and intra-species variations: These concepts should be absent from non-linguistic primates and, crucially, also be affected in instances of grammatical impairments within humans. Grammar, under this un-Cartesian lens, now becomes clinically relevant for cognitive disorders.

In this contribution, I will focus on a particular aspect of cognition and its relation to language, namely the ability to think about the thoughts of others, also known as theory of mind (ToM). ToM has been centre-stage of much psycholinguistic research trying to shed light on the role of language in conceptual reasoning (de Villiers and de Villiers 2000; Carruthers 2002). Hinzen remarks: "As a psychological construct, ToM remains described by its broad

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function and formally unspecified in terms of the generative mechanisms it is based on. How exactly does 'representing the mental states of others' work? Describing the lexical and grammatical structure and function of a sentence like *He thinks I am lying* would address this exact question" (Section 3.1.2). Indeed the implication seems again to be that 'languaging' would be required for a functional theory of mind. Much recent work, including my own (Durrleman and Franck 2015; Durrleman et al. 2016; 2017), has been inspired by this idea. There are nevertheless remaining questions and challenges for such an approach that arise in the face of intriguing findings on young neurotypical infants, primates, and children with autism, which I will briefly explore here.

2 Theory of mind in infants

The tests most frequently used to ensure that a metarepresentational ToM is in place are 'false belief' tasks such as illustrated below (Dennett 1978; Wimmer and Perner 1983). These assessments ensure that subjects are not merely reporting reality, but rather conceiving the contents of another mind (which is crucially in conflict with reality):

> Maxi puts his chocolate in the kitchen cupboard and leaves the room to play. While he is away (and cannot see) his mother moves the chocolate from the cupboard to a drawer. Maxi returns. Where will he look for his chocolate, in the drawer or in the cupboard? (Wellman et al. 2001)

Typically developing children have been consistently shown to succeed in responding accurately only around the age of 3 or 4 years (Sodian 2006). It appears that for children to understand that Maxi has a different belief to theirs, one that will cause him to look for his chocolate in the empty cupboard, they must also have a certain level of linguistic sophistication. Indeed nonverbal infants and primates, although they may have some grasp of intentions, desires and fears that are part of a common knowledge (Cheney and Seyfarth 1990; Meltzoff et al. 1999), nevertheless seem to fall short of ascribing a belief in this context (Call and Tomasello 1999; Krachun et al. 2010). Crucially, a close developmental link has also been reported to emerge between children's ToM skills and their grammatical abilities (Astington and Jenkins 1999; de Villiers and Pyers 1997; Ruffman et al. 2003). In particular, mastery of sentential complements such as 'The boy says/thinks that the chocolate is in the cupboard' has been argued to be the cognitive tool *par excellence* for them to accomplish belief reasoning (de Villers 1995; de Villiers and de Villiers 2000). This same finding

has also been reported for children with Autism Spectrum Disorders (Tager-Flusberg and Joseph 2005; Lind and Bowler 2009; Durrleman and Franck 2015; Durrleman et al. 2016), as well as children with other conditions affecting their linguistic development, such as Specific Language Impairment (Miller 2001; 2004; Durrleman et al. 2017) and deaf children of hearing parents (Schick et al. 2007). As would be predicted by Hinzen's un-Cartesian approach, the grammatical ability to embed propositions which "can engender forms of reference that correspond to expressions being true or false" (Section 2.6) does seem to relate to the understanding of the content of other minds, even when this is assessed by means of experiments themselves involving minimal language (Durrleman et al. 2016; 2017; Schick et al. 2007).

However the view that these complex linguistic abilities are *inextricable* from such ToM reasoning has become less obvious in recent years. Ingenious experimental research has now shown that children as young as 18 months can be successful on a ToM task during which they need to apply belief-reasoning to determine the goal of an adult, and accordingly help him to achieve it (Buttlemann et al 2009).[1] In this study, the infants observed an adult place a toy in box A which was either moved in front of the adult to box B (thus this adult had a true belief about its location), or moved in the adult's absence (thus he had a false belief about its location). In the first instance, when the adult truly knew the box was empty and still struggled to open it, the child would help him with the task of opening an empty box. In contrast, when the adult falsely believed the box contained the toy and tried to open the empty box, the infant no longer assisted him in that specific task, and instead opted to help him to open the *other* box, i.e. the one containing the toy. In short, already at a stage when the relevant embedded structures for false-belief reasoning have yet to be attested in children's speech, children were capable of imagining the

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[1] Children even younger than this show what has been called 'implicit ToM abilities' given tendencies in their spontaneous anticipatory looking patterns during a mind-reading task (e.g. Onishi and Baillargeon 2005). However these tasks may tap into a different system to ToM tasks requiring an explicit response from the subject, as Hinzen himself points out (Section 3.1.3), given that implicit mentalizing may rather depend on domain-general neurocognitive mechanisms (Heyes 2014a, 2014b). In light of this, I focus here on explicit ToM tasks, where explicit means that the subject has to take conscious action to respond, i.e. by answering verbally (e.g. as in classic ToM tasks such as that of Wimmer and Perner (1983)), or by helping someone out (e.g. as in Buttelmann et al. 2009; Buttelmann et al. 2017). We clearly cannot argue that the only true assessment of the mentalizing system must be obtained via a verbal response if we wish to elucidate the relation between ToM and language, because an obvious criticism would be that the ToM task contains a language confound which is itself responsible for the emerging links, and thus can indicate nothing fundamental about language being implied in ToM.

propositional content of another person's mind to determine his goal, so as to assist him to achieve it.

Now it has been claimed that infants may in fact already have grammatical competency far beyond what can be concluded based on their verbal productions, so one may well argue that this is simply how ToM tasks can be succeeded in infancy. Indeed Hinzen notes that "There is no time when humans only 'think' and then eventually they also have language; or when they have 'social cognition' but no 'linguistic cognition'" (Section 2.5). While there is indeed work suggesting an earlier sensitivity to grammar than previously believed (see e.g. Gleitman et al. 2005; Gertner et al. 2006; Yuan and Fisher 2009; Noble et al. 2011), it remains to be empirically determined that the specific, rather complex structures often associated with false belief reasoning (i.e. complement clauses) are already in place during such early phases. Indeed adherents of the language-ToM relation previously appealed to the delay in the acquisition of these structures so as to explain why children under 3 years could *not* succeed at false belief tasks. It would seem to be an important research aim for those working within the un-Cartesian enterprise to show indisputably that the complex structures implied in belief attribution are in fact already in place, in order to clearly account for these findings of ToM success in such young infants. This would more clearly allow maintaining their view that there can be no dissociation between ToM and its corresponding linguistic expressions.

3 Theory of mind in primates

Possibly a more challenging feat than accounting for ToM in infants might be explaining ToM in primates. As mentioned earlier, according to un-Cartesian linguistics we would not expect primates to show successful propositional attitude ascription, required during false belief tasks, as they arguably do not only lack the ability to externalize the relevant language (as might be argued for infants), but differ from humans precisely in their lack of a language faculty. In very recent research, however, again conducted by Buttleman and colleagues (2017), a mix of chimpanzees, orang-utans and bonobos participated in the same nonverbal assessment of belief reasoning as the infants in the previous study, and these great apes reportedly also responded by unlocking the box containing the object significantly more in the false-belief condition than in the true-belief condition. Moreover, the authors ensured that this behavior could not be the result of the apes attributing a state of 'ignorance' to the protagonist, rather than their actually imputing a false belief, because apes were also observed to behave

differently in ignorance and false-belief conditions. Taken together, these findings would appear to indicate that apes capitalized on knowledge of an experimenter's false belief to decide how to help him, and thus had to represent this somehow. It seems that Hinzen's approach predicts this sort of belief reasoning to be impossible without grammar, as beliefs imply propositional meaning. Can the un-Cartesian perspective be reconciled with the current findings on apes, who although they clearly do not have a grammatical system, nevertheless seem to be able to successfully represent the content of other minds?

Another view is one where the grammar of complementation is a useful tool for belief reasoning, but not the only one available under the sun. Language provides representational resources that can be solicited to encode and reason (Dennett 1993; Gentner 2003; Vygotsky 1934/1962), and surely language would be privileged for this purpose by humans, given its prominence in their minds, although other tools from our kit may also be applied for certain instances of encoding and reasoning (Gentner and Goldin-Meadow 2003). As an analogy, consider spatial orientation, which may also be enhanced by verbal tools (Pyers et al. 2010), including by specific grammatical elements such as prepositional forms (Feist and Geitner 2007), but may instead be achieved by means of visual tools, such as maps. Similarly, 'languaging', as well as alternative mechanisms, may be recruited for the task of representing and reasoning about beliefs (see e.g. work on mental files, Perner et al. 2015), both by very young infants and primates. The latter are surely not as sophisticated in their mind-reading abilities as older humans, given that they have fewer tools in their kit to accomplish these tasks, but some form of mind reading implying propositional meaning seems accessible to them nonetheless. Alternatively, how can the un-Cartesian approach of an indissociable relation between referential meaning and grammar propose to account for this recent experimental research shedding light on an apparent dissociation between (detectable) grammatical abilities and ToM in both young infants and primates?

In the next section we turn to the case of cognitive disorders, with a focus on Autism Spectrum Disorder (ASD), which is frequently associated with ToM deficits and related cognitive and social difficulties. Presenting ASD through an un-Cartesian lens, Hinzen comments that: "a language capacity that does not properly develop will deprive us of the power of one of our prime mind-reading tools" (Section 3.1.4). He develops the perspective "that without this mechanism properly developing at different levels of grammatical complexity, thought and experience will deviate in the autistic direction making mind-reading more difficult in particular" (Section 3.1.2). Grammar is thus taken to play a primary role in ToM and social anomalies commonly evident in individual with this disorder, and as such a "focus on the core process of converting lexical

concepts into grammatical and propositional forms of meaning through grammar could contribute to defining (their) cognitive phenotype" (Section 4). We will briefly review findings that, although partially suggestive of links between grammatical and cognitive traits in ASD, nevertheless call into question a strict, un-Cartesian association between grammar and ASD symptomatology.

4 Theory of mind in autism spectrum disorder

Difficulties in ToM are often attested in children with ASD and, as mentioned above, have been linked to various aspects of their linguistic development, including certain aspects of grammar. Complement structures may be delayed in some children on the spectrum (Durrleman and Zufferey 2009, 2013), and when they are mastered they appear clearly to boost ToM task success and thus have been argued to allow even children with core difficulties in the realm of ToM to explicitly figure out the correct response to ToM tasks (Tager-Flusberg and Joseph 2005; Lind and Bowler 2009; Durrleman and Franck 2015; Durrleman et al. 2016). ToM deficits in ASD have also been related to difficulties with other grammatical elements, namely deictic pronouns. Children with ASD often misuse these pronouns, either by inverting the first and second person (Kanner 1943), replacing them with proper names, or omitting them altogether (Jordan 1989; Lee et al. 1994; Shield et al. 2015). The underlying deficits in perspective shifting associated with ASD (Baron-Cohen et al. 1985; Happé, 1995; Yirmiya et al. 1998; Naito and Nagayama 2004) have been claimed to relate to deictic pronoun difficulty, both in production (Durrleman and Delage 2016) and comprehension (Hendricks, Overweg and Hartman 2017). The reasoning is that pronouns of the 1st and 2nd person shift in meaning depending on speaker-listener roles (Lee et al. 1994; Tager-Flusberg 1994; Wechsler 2010), and thus their mastery would be inextricably intertwined with corresponding perspective shifting abilities. This view would explain why difficulties spill over beyond grammatical forms such as pronouns, to also encompass gestures such as waving. Indeed some children with ASD have been reported to wave with their palm faced inward, arguably because this is what they see from their own perspective when someone waves at them (Ohta 1987).

Hinzen notes that problems in developing the grammatical mechanisms of clausal subordination and pronouns would explain deviations in mind-reading abilities associated with ASD. Regarding pronominal difficulty more specifically, Hinzen (Section 3.1.3) claims "a disturbance in the grammatical Person system as reflected in personal pronouns is a disturbance of selfhood, precisely insofar

as 1P forms of self-reference are essential to such human-specific forms of selfhood (Hinzen and Schroeder, 2015)". Again, according to this un-Cartesian view, grammar is the lens through which other difficulties associated with the autistic condition can be explained, such as a selfhood disturbance. Hinzen comments on the crucial significance of language in the neurocognition of ASD, saying "although (...) language impairment is widely regarded as secondary to a primary impairment in social interaction, available findings are highly interpretable in terms of deviant language development failing to allow normal cognitive and social development" (Section 3.1.3). While both sentential complements and pronouns in individuals with ASD have indeed been related to their challenges with mentalizing, as mentioned above, situating linguistic difficulties at the heart of their cognitive and social difficulties is nevertheless challenged by the following observations:

Firstly, studies assessing grammar within this condition have often identified subgroups with spared grammatical profiles (Kjelgaard and Tager-Flusberg 2001; Roberts et al. 2004; Durrleman and Delage 2016; Tuller et al. 2017), indicating that ASD, with its prototypical cognitive and social difficulties, can arise in the absence of detectible grammatical impairments. This linguistic heterogeneity seems difficult to reconcile with the un-Cartesian view that ASD "*systematically* implicate(s) language changes along with disorders of thought" (Section 1). One may of course argue that grammatical impairments are present throughout the spectrum despite being undetected, but then the responsibility lies in the hands of un-Cartesian linguists to devise sufficiently refined experimental tools to uncover these hypothesized impairments. Hinzen speculates that for such cases "initial phonological and syntactic difficulties shared between the groups appear to give rise to the higher-order semantic and pragmatic difficulties more prominent in (...) ASD" (Section 3.1.3). Still, what seems to be needed to substantiate this claim are longitudinal studies empirically proving the hypothesized evolution.

Secondly, groups of children with ASD have been reported to show grammatical development proportionately *more advanced* than their social and communicative development (Naigles and Tek 2017). This would again imply an asymmetry between the cognitive specificities of their condition and their grammatical development, possibly with grammar occupying a secondary position. If for even some children on the spectrum, their grammar is relatively spared compared to their grasp of meaning distinctions (including referential meaning) required for navigating the social world (Naigles 2002), then un-Cartesian predictions entailing a central, decisive role for grammar do not seem borne out.

Thirdly, postulating a pivotal role specifically for a Person feature disturbance in ASD, which would yield a disturbance in selfhood, needs more clear

justification in light of certain empirical findings. Indeed, difficulties reported for 1st (and 2nd) Person are *not unique* to ASD, given that similar errors with the corresponding pronominal forms have been attested in young typically-developing children before age 2;6 (e.g. Chiat 1982; Schiff-Myers 1983; Oshima-Takane 1992). If this type of error in the Person feature were indicative of a disturbance in selfhood characterizing the cognitive phenotype of ASD (Section 3.1.3), why would young neurotypical children display the same difficulty (Naigles and Tek 2017)? Similarly, difficulties with deictic pronouns, and thus with Person, although more predominant in ASD than TD, are still *not universal* in ASD, and have even been argued to be rather rare (Naigles et al. 2016). If such difficulties were at the heart of a disturbance in selfhood and ToM-related socio-cognitive impairments throughout the spectrum, it is unclear how these various findings can be explained.

5 Conclusion

The language network clearly plays a central role in human cognition. The un-Cartesian approach makes the bold claim that referential meaning would not become accessible without an intact grammar, thus predicting both inter- and intra-species cognitive variation. On the one hand, we have considered findings indicating that mastery of embedded propositions allows forms of reference corresponding to expressions being true or false, and enhances aspects of theory of mind such as false belief reasoning. This is in line with the un-Cartesian view. On the other hand, we have also considered recent findings revealing the presence of at least some forms of (first-order) false belief attribution, in both young infants and primates, and thus it would appear that propositional meaning could arise in the absence of evidence for the corresponding linguistic expressions. This poses a challenge for the un-Cartesian stance. We have furthermore examined the case of ASD; a condition frequently associated with difficulties in belief reasoning and social communication. An un-Cartesian claim is that this cognitive disorder would necessarily be accompanied by language-related symptoms (Section 1), including impairments in embedding and grammatical Person. While some individuals with ASD can display associations between grammar and their symptomatology, this is not the case throughout the spectrum. The idea that their grammatical impairments would critically explain their condition seems at odds with their high variability in grammatical abilities, and with their grammar seeming at times intact or at least relatively spared as compared to their grasp of referential meaning and social

understanding. Finally, the grammatical difficulties attested in subsets on the spectrum are also observed in subsets of young, typically developing children, who do not seem to have related disturbances reminiscent of ASD. Still, despite these challenges, the un-Cartesian enterprise offers interesting perspectives on human-specific thought, as well as far-reaching predictions, propelling research in new directions that may build exciting bridges between linguists, psychologists, anthropologists, philosophers and clinicians.

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