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Introduction: special issue on atypical development

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WHY STUDY ATYPICAL LANGUAGE DEVELOPMENT?

In 2010, JCL put out a call for papers for a special issue on Atypical Language Development. In that call, we asked for papers that 'would include theory and data on children who are acquiring their first language in atypical ways, attributable to either developmental (i.e., genetic, including but not limited to children with autism, Williams Syndrome, Down Syndrome, fragile X syndrome, Specific Language Impairment) or acquired (e.g., neonatal or early experienced brain damage or maltreatment) etiologies'. We suggested that relevant questions could involve what the attested language delays and deficits reveal about the PROCESSES of language acquisition, about the REPRESENTATION AND ORGANIZATION of language, or about the BIOLOGY/ NEUROPSYCHOLOGY/GENETICS of language. We received fifty-one submissions, subjected each to a rigorous process of peer review, and are pleased to publish eleven of the submissions in this volume as superb examples of current research into a wide range of disorders (Down syndrome, Williams syndrome, Fragile X syndrome, Dyslexia, Autism Spectrum Disorders, Specific Language Impairment, Pre/perinatal brain injury) manifested by children learning a range of languages (English, British Sign Language, Dutch, German, Hebrew, Kuwaiti Arabic). In this introductory article, we highlight some of the major reasons why researchers study atypical language development, and how the articles in this special issue bear on questions associated with the acquisition of language. We also touch on some methodological issues in our concluding remarks.

As can be seen from the call for submissions, our definition of 'atypical' targeted developmental atypicalities resulting from neurobiological atypicalities, not social (e.g. learning multiple languages or receiving below-threshold input) or sensory (e.g. learning without sight). To the extent that child language acquisition relies on the neural substrate of the brain, then

children with specific kinds of atypical neural substrates should show atypical processes and/or products of language development. However, given that the atypicality of language development in these children is acknowledged, we can ask why we should study them when (a) there are billions of typically developing children learning thousands of languages whose language development is not yet fully understood, and (b) children with atypical language development present with additional challenges for study, which include recruiting large enough samples of children with a disorder to conduct analyses that will be informative and allow generalization, deciding how best to match the group with a comparison group with typical language development, and assessing the children in appropriate ways to identify their language strengths and weaknesses.

From a clinical point of view, language development is studied in a specific atypical population in order to characterize just which aspects of language seem to be acquired with difficulty so that appropriate interventions can be designed and implemented. Thus, the typical case is the standard of comparison for the atypical case. From a research point of view, though, these are switched: the atypical case is investigated in order to better understand the typical case. Atypical cases provide 'natural experiments' (Gleitman, 1984) for revealing what is necessary and what is sufficient for child language acquisition to occur – and to succeed. That is, by investigating atypical language development in children, we hope to gain more understanding of (1) which underlying (non-linguistic) components are required and what they are required for, (2) which processes are resilient or robust, and (3) which components of language appear to be associated (i.e. either intact or impaired) within a given disorder. In the articles included in this special issue we see examples of all three of these.

For example, several neurodevelopmental disorders (Down syndrome (DS), Williams syndrome (WS)) negatively impact the overall IQ of the affected children. To what extent is 'normal' intelligence required for language acquisition? Early research on this question noted how tightly linked were mental age and vocabulary size (reviewed in Cicchetti & Beeghly, 1990); children's propensity to learn words clearly depends on their ability to form and integrate concepts. Using standardized test data, Finestack, Sterling and Abbeduto provide some compelling evidence that grammar is significantly impaired in school-age children with DS; more impaired than in mental-age-matched children with Fragile X syndrome or typically developing (TD) children. Moreover, as expected by the mental-age matching, vocabulary levels did not differ among the three groups; thus, grammar acquisition seems differentially more impacted by DS than is vocabulary. In their article, Levy and Eilam focus on just what might be impaired in the grammatical realm; they examine the spontaneous speech of

Hebrew-learning children with DS, WS, or TD at the onset of multiword speech. They report that the timing of emergence of a number of single-clause grammatical elements (markers for agreement, case, articles, etc.) was strikingly delayed for the WS and DS groups relative to the TD group. The authors argue that this latter delay is actually indicative of deviant acquisition. We conjecture that such delays may end up resulting in the impairments observed by Finestack *et al*. Yet, as Mengoni, Nash and Hulme's article reveals, not all computational aspects of language are impaired in DS. They show that in an oral word-learning task, school-age readers with DS benefit as much as children with TD from the added presence of a word in the orthography they have learned to read. That is, a phonological system is clearly available to these children with DS, even though their articulation is problematic. These articles highlight the limits of attributing language impairments to general cognitive impairments because they point out differentiation in areas of atypical language development: grammatical acquisition seems more severely affected (relative to cognition) while phonological acquisition seems less affected.

Social interaction and understanding have been proposed as critical underpinnings to typical language acquisition (Tomasello, 1992). The extent to which social abilities contribute to acquisition can be investigated via two atypical populations: autism spectrum disorders (ASD), whose affected children show marked restrictions in social interaction (APA, 2000), and WS, whose affected children are highly social and affiliative towards other people (Brock, Einav & Riby, 2008). Bedford *et al*. report on an investigation of toddlers at high risk for ASD's use of social feedback in a novel word-learning task. They found that, while these toddlers generally selected the correct referent at above-chance levels, they were not able to use an adult's corrective feedback when they chose incorrectly – and their difficulty in using this feedback was related to their concurrent receptive vocabulary size. Risk for social impairments, then, is shown to affect early vocabulary development. However, as Plesa Skwerer, Ammerman and Tager-Flusberg demonstrate, high sociability does not necessarily translate into skilled use of the social aspects of language: school-age children with WS were less likely to ask needed clarification questions in the context of a referential communication game. Thus, removing social engagement from the toolkit of child language learners impacts their ability to learn words; however, the presence of social engagement at high levels does not guarantee intact language development, neither within the pragmatics realm nor with respect to the timing of grammatical development (Levy & Eilam).

Another focus for research on atypical language development involves the question of what is RESILIENT (Goldin-Meadow, 2004). That is, what aspects of language development seem to proceed typically in children with disorders? Typical development and/or functioning in atypical

populations has traditionally been interpreted as evidence for modularity (Bellugi, Marks, Bihrle & Sabo, 1988; Pinker, 1994) of cognitive structure or process, based on the argument that some specific cognitive structure is intact in its neuropsychological representation while other structures are not. Again, the evidence presented in these articles suggests the issue is complicated. For example, Rescorla and Safyer investigated early vocabulary development in children with ASD compared with that of TD children, and replicated previous reports of delayed onset of vocabulary growth (e.g. Charman, Baron-Cohen, Swettenham, Cox, Baird & Drew, 2003). However, Rescorla and Safyer's detailed analyses of the actual content and organization of the children with ASD's vocabularies encompassing the first fifty words revealed striking similarities with the TD group: both groups produced nouns representing a variety of semantic categories. Evidently, the limited experiences often characteristic of children with ASD do not preclude their initially acquiring a wide range of words for things. Interestingly, the participants with ASD who attained over fifty words showed more differences in lexical content with TD children matched on vocabulary size, suggesting that differences emerge with development. Semantic organization was also investigated by Marshall, Rowley, Mason, Herman and Morgan with a unique population; namely, deaf children using British Sign Language (BSL). Two groups of school-age children using BSL were compared: some were identified as specific language impaired (SLI) and some were identified as non-impaired on grammar. Both groups showed characteristic semantic clustering effects during a fluency task, with the children with SLI differing primarily in word-finding errors and slower overall responding. Children with SLI, then, seem to manifest the same complexity of semantic organization as children with TD, while the slower responding fits with research findings with hearing children with SLI (e.g. Kail 1994).

Examples of resilient language development can also be seen in the grammatical realm. As shown previously with children with TD (e.g. Iverson & Goldin-Meadow, 2005), gesture enables propositional output at the single-clause level. Özcalişkan, Levine, and Goldin-Meadow targeted children with pre/perinatal unilateral brain lesions (PL), and investigated the intersection of their use of gesture and the onset of simple sentences. Similar to the comparison group of children with TD, the children with PL produced gesture–speech combinations that encompassed simple propositions several months before they produced those propositions entirely in speech. However, at the later-developing multi-clause level, gesture–speech combinations did not precede speech-alone in the PL group. Similarly, as shown by Levy and Eilam, children with WS and DS learning Hebrew produced a sizeable number of single-clause grammatical elements in the same developmental order (i.e. synchronously) over a two-year period as

children with TD, suggesting that these elements cohered AS A SYSTEM for all three groups.

Many of the studies we have discussed point to typicality in early language development: the first fifty words of children with ASD, the first propositional combinations of children with PL, and the synchrony of the first morphological attainments of children with DS or WS, show no differences with TD children. One possible generalization from these studies is that early language development seems to be less affected in neurodevelopmental disorders than later language development. However, as the artcile by Kerkhoff, de Bree, de Klerk, and Wijnen demonstrates, this view cannot be supported if we consider some precursors to language development, such as statistical learning. Kerkhoff and colleagues assessed learning non-adjacent dependencies in an artificial language, an aspect of statistical learning that relates to both grammatical and phonological acquisition by tapping implicit sequential learning. They tested toddlers at familial risk for dyslexia, who showed no evidence of discriminating grammatical/heard instances of these dependences vs. ungrammatical/novel instances, and hence, no evidence for sensitivity to statistics in processing the utterances. To the extent that statistical learning processes seem implicated in early grammatical development (e.g. Naigles 2002), this finding suggests that, at least in children at risk for dyslexia, early grammatical development may not proceed as for children with TD. It also open up the possibility that language development that appears to be typical at specific points in time may, in fact, be proceeding via different underlying routes/processes (Eden *et al*., 2004).

A third way that atypical language acquisition has the potential to illuminate the typical case involves the extent to which, in any given disorder and/or across disorders, systematic GRADED OR PARTIAL impairments are observed within a given area or subarea of language. Impairment in grammar but not vocabulary, for example, could be considered evidence for a 'modular' view of grammatical representation (Fodor, 1983), although Karmiloff-Smith (2009) presented a contrary view. She argued (p. 58) that even when scores in one domain are in the typical range, questions can be raised, including 'Are the cognitive processes underlying the proficient overt behavior the same as those used by typical controls?' and 'Are the brain networks underlying the proficient behavior the same as those used by typical controls?'

Theorists have recently expanded the notion of 'language-relevant representations' to include both structure and processing. For example, Ullman (2004) contrasted procedural memory, relevant for rule-based aspects of language, and declarative memory, relevant for lexicon-based aspects. To the extent that language disorders 'dissociate' along representational lines, there is support for that conception of representation.

Indeed, Ullman and his colleagues (e.g. Ullman & Pierpont, 2005; Lum, Conti-Ramsden, Page & Ullman, 2012) have proposed that individuals with SLI, in particular, manifest specific impairments in procedural but not declarative memory, such that their usage of grammar does not rely on procedural memory, as in children with TD. Findings that individuals with SLI or DS manifest more severe grammatical impairments than lexical ones may be considered evidence for a grammatical/lexical distinction in the human representation of language, and support for this is presented in the articles by Finestack *et al*. and Marshall *et al*.

Ott and Höhle also provide some support for the procedural/declarative dissociation in SLI; they demonstrate that German-learning preschoolers with SLI produced verbal inflections more consistently when the roots included high-frequency subsyllables than when they included low-frequency subsyllables. These frequency effects suggest that the children's impairment forces them to rely on declarative memory when inflecting verbs. Because children with TD matched on language showed no effects of frequency, they are presumably employing the procedural system. Once again, though, the situation is not so simple: the children with SLI did show evidence of rule use by inflecting the novel verb stimuli correctly, to a limited extent, and also by producing overgeneralization (i.e. using the incorrect allomorph) at levels comparable to the TD children. Abdalla, Aljenaie and Mahfoudhi found similar results for Kuwaiti Arabic-learning children: whereas the children with SLI produced significantly fewer correct noun inflections than a comparison group of children with TD, they nonetheless showed evidence of rule use by pluralizing novel noun stimuli correctly to a limited extent, and with a similar pattern of overgeneralization (albeit at lower frequencies of occurrence). Thus, rule use is not absent in children with SLI, although it may be disrupted. The challenge, then, for theories of typical language representation is to capture how a given area of language can appear to be rule-governed to some extent but not in total. Further investigations along these lines might directly compare the nature of the grammatical impairments of individuals with DS, WS, SLI, and ASD, among others, to see how variable or consistent are disruptions of the grammatical system (Levy & Ebstein, 2009).

METHODOLOGY MATTERS AND CONCLUDING REMARKS

Several articles in this special issue describe methods that are new to use with atypical populations of children. For example, Kerkhoff *et al*.'s article is innovative in testing statistical learning in toddlers at risk for dyslexia; only one other article we know of, Mayo and Eigsti (in press), has investigated statistical learning in an atypical population – school-age children with ASD. Extending this approach to younger children with ASD and

to children with DS and with WS would help us understand whether children with different disorders approach the language-learning task with the same toolkit. Bedford *et al.*'s study uses the innovative method of teaching novel words, which has been frequently used by researchers assessing the strategies used in word learning by children with TD, but infrequently adopted in studies of atypical language development. Finally, several statistical techniques used in these articles (e.g. discriminant function analysis (DFA), growth curve analysis) are innovative in research with language disordered populations; they illuminate how language, in particular, varies among disorders, and how the trajectories of language development might vary between typical and atypical populations. For example, Finestack *et al.* used DFA to test the extent to which a set of variables predicted DS or WS group membership, while Levy and Eilam report on curve estimations for the associations between mean length of utterance and other language variables in order to capture development patterns for young children with WS or DS.

The articles in this special issue indicate, as well, that established methods with atypical populations are still informative. Much research on language acquisition has focused on analyses of spontaneous speech. If detailed enough, these can reveal early trajectories of development, as used, for example, by Levy and Eilam. Three other articles in this issue (Ott & Höhle; Abdalla *et al.*; Marshall *et al.*) used elicited production. If the stimuli are specific enough, this method can reveal subtle abilities as well as disabilities. However, children need to be mature enough to understand the task and provide responses. Rescorla and Safyer's study used a parent checklist to reveal details of the organization of children's lexicons at the beginning of word learning. Parent checklists are commonly used to estimate vocabulary development and late language emergence, for example, to identify late talkers who are at risk for SLI. They have an advantage over direct assessment of children in that larger datasets can be obtained thereby enabling generalizations to be made.

One area that was not well represented in this special issue is the assessment of children's language comprehension. Comprehension studies have played a crucial role in our understanding of language development in the TD case (e.g. Naigles, 2002); for example, demonstrating that children typically understand a given structure developmentally prior to using it in their speech (e.g. Gertner, Fisher & Eisengart, 2006) and demonstrating how children process language in real-time, for example, dealing with ambiguity in sentences (e.g. Trueswell, Sekerina, Hill & Logrip, 1999). Such investigations need to be extended to studies of atypical populations. Moreover, the social, motor, and/or cognitive difficulties of atypically developing children may mask (relatively) intact knowledge of specific grammatical structures as well as subtle deficits in the use of word learning

principles; comprehension studies may help illuminate both of these (e.g. Goodwin, Fein & Naigles, 2012).

Finally, sample size is a methodological concern for research on language acquisition in general, and particularly so with atypical samples, especially with rare disorders such as WS. Several articles in this special isue include relatively large Ns; for example, Rescorla and Safyer included an N of 67, and so were able to use Q correlations to discover typical organization among the first fifty words in children with ASD. Relatively large Ns for research in neurodevelopmental disorders were also used by Bedford *et al.* ($N=31$) with toddlers at risk for autism, and by Kerkhoff *et al.* ($N=30$) with toddlers at risk for Dyslexia. With small samples power may be low, but it is important to keep in mind that results can still be interpreted drawing on effect sizes and confidence intervals.

One of the conclusions we can draw from the findings reported in the articles in this issue is that any given disorder seems to indicate impairment in multiple language areas, which raises challenges for theories of language impairment targeting a single area (e.g. Bellugi *et al.*, 1988; Rice, Wexler & Cleave, 1995; Tager-Flusberg & Joseph, 2003). For example, for WS, Levy and Eilam demonstrated impairments in grammar, while Plesa Skwerer *et al.* highlighted impairments in pragmatics. For DS, both the grammar and lexicon were shown to be impaired (albeit at different levels), while phonological information could be used (Levy & Eilam; Finestack *et al.*; Mengoni *et al.*). In ASD, as well as pragmatics, both word learning (Bedford *et al.*; Rescorla & Safyer) and grammar (Eigsti, Bennetto & Dadlani, 2007) have been shown to be affected. For SLI, problems in lexical access, but not organization, were shown (Marshall *et al.*); in addition, noun phrase as well as verb phrase morphology was found to be affected (Abdalla *et al.*; Ott & Höhle).

Clearly, while the articles in this special issue have provided a wealth of new information concerning language development in atypical populations – and revealed how these differ (or not) from the typical case – there is a lot of research that still needs to be done. As with the language of children with TD, there is huge variability in each of the atypical groups reported on in this issue. The chapters in this special issue have not focused on comorbidity, but comorbidity is frequently reported amongst ASD, ADHD, Dyslexia, and SLI groups, and some of the variability previously reported might be related to this factor. It is certainly an area that needs further research. Another issue is that comparing a group of children with TD and a group of children with atypical language development does not tell us about individual profiles or their developmental trajectories. In order to track development, rather than conducting individual studies with different samples of children at different ages, additional longitudinal studies are required, using similar

methodologies and assessment tools so that comparisons can be made. We will then be in a better position to track development and identify the extent to which language development in atypical and TD groups is proceeding via different underlying routes/processes. Such knowledge can be invaluable for developing appropriate intervention programs to help children achieve their potential, and for achieving a comprehensive theory of how children acquire language.

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