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Syntax in Spanish-speaking children with Williams syndrome

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ABSTRACT

The syntactic skills of Spanish-speaking children with Williams syndrome (WS) were assessed in different areas (phrase structure, recursion, and bound anaphora). Children were compared to typically-developing peers matched either in chronological age (CA-TD) or in verbal age (VA-TD). In all tasks children with WS performed significantly worse than CA-TD children, but similarly to VA-TD children. However, significant differences were observed in specific domains, particularly regarding sentences with cross-serial dependencies. At the same time, children with WS were less sensitive to syntactic constraints and exhibited a poorer knowledge of some functional words (specifically, of nonreflexive pronouns). A processing bottleneck or a computational constraint may account for this outcome.

1. Introduction

Williams–Beuren syndrome (henceforth, WS) is a developmental disorder caused by a microdeletion in one copy of the chromosome 7, affecting roughly two dozen genes (Korenberg et al., 2008). The hemicygosis of these genes gives rise to diverse socio-affective, cognitive, and physical impairments (Bellugi, Korenberg & Klima, 2001; Tassabehji, 2003), although a one-to-one correlation between genes and abnormal traits cannot be easily drawn (Tassabehji, 2003).

Language deficits and strengths have been a major concern regarding the cognitive profile of people with WS. First reports suggested that their language was substantially preserved throughout development, unlike other cognitive capacities (e.g. visuospatial cognition or social abilities) (see for instance Bellugi, Marks, Bihrle & Sabo, 1988; or Bellugi, Wang & Jernigan, 1994). This unusual pattern of dissociation between cognition and language (and even between aspects of language) was then claimed to support a modular organization of the mind. Nonetheless, recent, fine-grained analyses of language deficits in WS suggest that most aspects of language knowledge, language processing, and language use are delayed or perhaps impaired in people with WS (see Karmiloff-Smith & Mills, 2006; Martens, Wilson & Reutens, 2008; Mervis & Becerra, 2007 for reviews). Because pragmatic problems are probably explained by the socio-affective profile of the disorder (see Laws & Bishop, 2004; Stojanovik, 2006), it is problems with structural components of language (i.e. morphology, syntax, etc.) that

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have gained the interest of researchers over the years. In some domains of language people with WS outscore people affected by other developmental disorders. However, they don't perform above their mental age peers (Karmiloff-Smith, 2008; Karmiloff-Smith & Mills, 2006). At the same time, their command of language is achieved in spite of deeper cognitive deficits. Importantly, language abilities improve as the child grows, pointing to cognitive compensatory mechanisms that seem to be active during development. For example, it has been claimed that working memory helps her to compensate semantic, syntactic, and pragmatic deficits (Karmiloff-Smith et al., 1998; Mervis & Becerra, 2007). Ultimately, in WS we observe "a mixture of delay, deviance, and asynchronies across the developing system" (Karmiloff-Smith & Mills, 2006: 587).

In order to characterize the linguistic profile of people with WS confidently it is important to (i) analyze their language abilities at different stages of development, looking for differences with the typically- developing (henceforth, TD) population (Karmiloff-Smith, 2008; Karmiloff-Smith & Mills, 2006; Martens et al., 2008; Mervis & Becerra, 2007); (ii) find the core deficit (if any) that may explain the observed problems in the language domain (and perhaps in other domains of cognition); and (iii) collect more cross-linguistic data that help us to examine the peaks and valleys of WS language from the broader perspective of languages that are typologically different to English.

Syntax abilities in WS are controversial. First descriptions of the condition (e.g. Bellugi, Bihrle, Neville, Jernigan & Doherty, 1992; Bellugi et al., 1988, 1994; Clahsen & Almazan, 1998) reported that ungrammaticalities were of lexical nature and that people with WS performed almost at ceiling in several syntactic indicators, both in comprehension tasks (passive sentences, negation, conditionals) and in production tasks (conditionals, nested dependencies, recursion), and also in tasks evaluating their metalinguistic knowledge. This uneven linguistic profile was then claimed to support a distinction between a computational device for language processing and a storage mechanism for lexical representations (see Ullman, 2001), that could be selectively impaired. However, recent studies suggest that syntax in WS is not spared (e.g. Grant, Valian & Karmiloff-Smith, 2002; Joffe & Varlokosta, 2007; Karmiloff-Smith et al., 1998; see also Mervis & Becerra, 2007; Udwin & Yule, 1991). However, it is still disputed whether it is just delayed or it is really deviant compared to TD population. According to several studies (e.g. Karmiloff-Smith, 2008; Karmiloff-Smith & Mills, 2006; Martens et al., 2008; Mervis & Becerra, 2007 for review) the WS syntax differs both chronologically and qualitatively from the TD syntax. According to others (e.g. Mervis, Morris, Bertrand, & Robinson, 1999) children with WS show syntactic abilities that are at the expected level for their mental age.

A related concern is whether the observed deficits are interpretable in terms of a selective breakdown of specific components of syntactic knowledge. For example, concerning syntactic dependences (e.g. passives, and binding of reflexive and non-reflexive pronouns) Perovic and Wexler (2007, 2010), Perovic and Wexler (2007) found that children with WS performed better on passives with agentive verbs, similarly to younger TD children (Hirsch & Wexler, 2006; Maratsos, Fox, Becker & Chalkley, 1985). At the same time, they had mastered the binding principle between a reflexive and its antecedent. Perovic and Wexler concluded that the capacity for forming A-chains is impaired in WS, whereas the knowledge of the binding principles involved in anaphora is spared.

We believe that this controversy around language abilities (and particularly, syntactic knowledge) in WS may benefit from a bottom-up approach. On the one hand, current neurolinguistics urges us to distil language into computational and representational primitives that are computable by the brain in real time in order to overcome the interface problems for the study of language (see Poeppel & Embick, 2005 for details). Related to this, we should expect that deficits in specific, high-level capacities result from the impairment of low-level, more generalized processes (at the same time, low level deficits may affect several cognitive abilities simultaneously). As pointed out by Karmiloff-Smith (2009: 58), "early, more general low-level processing deficits [can] affect several domains but to differing degrees and at different developmental times". Finally, we wish emphasize that similar problems with grammar are observed in different language disorders of diverse aetiology. For example, difficulties with verbal morphology are experienced by children with Down syndrome (Eadie, Fey, Douglas, & Parsons, 2002), specific language impairment (SLI) (Polite & Leonard, 2006), speech-sound disorder (SSD) (Mortimer & Rachew, 2010), autism (Roberts, Rice, & Tager-Flusberg, 2004), and WS (Clahsen & Almazan, 1998; Thomas et al., 2001). It has been claimed that the most vulnerable aspects of cognition rely on less resilient neural network and that these networks are more sensitive to damage or to ontogenetic disturbances because of their evolutionary novelty (Toro et al., 2010). All these aspects and concerns, when considered together, surely explain the observed deficits in the domain of the WS syntax.

This paper assesses in detail the syntactic abilities of a sample of Spanish-speaking participants with WS. In doing so, our aim is twofold:

First, we want to contribute to the ongoing discussion around the underlying deficit(s) in WS that emerge(s) in the form of syntactic problems. Following Fitch and Hauser (2004) we will resort to the hierarchy of formal languages known as the Chomsky Hierarchy (Chomsky, 1969), which has succeeded in capturing the computational constraints on syntactic processing in non-human primates. This Hierarchy classifies logically possible languages into sets of nested regions corresponding to patterns describable by means of grammars and with smaller regions captured by increasingly less powerful machinery. Chomsky Hierarchy has emerged as a good tool for comparative studies, because it makes use of computational primitives (non-specific to language), it avoids "theory-internal" debates and it enables cross-domain, cross-stages, and cross-species comparisons. Moreover, it has been claimed that the most computationally demanding tasks according to the Hierarchy (i.e. mildly context-sensitive computations, such as binding and control) were achieved latter in our evolutionary lineage (Balari, Benítez-Burraco, Longa, & Lorenzo, 2013). Accordingly, they rely on an enhanced computational device which resulted from gaining working memory space and that allowed us to manipulate words well beyond a strictly lineal computational regime (see Balari & Lorenzo, 2013 for details). If recently evolved neural networks are really the most sensitive to damage, as noted above, we expect that the most computationally-demanding tasks are