Research in Developmental Disabilities 32 (2011) 781–787

Contents lists available at ScienceDirect

Research in Developmental Disabilities

Contextual effect in people with Williams syndrome

Ching-Fen Hsu [a,*], Ovid J.-L. Tzeng [b]

[a] Department of Foreign Languages and Literature, Huafan University, 1 Huafan Road, Shiding, Taipei 22301, Taiwan
[b] Institute of Linguistics, Academia Sinica, 128 Academia Road, Section 2, Nankang, Taipei 115, Taiwan

ARTICLE INFO

Article history:
Received 28 September 2010
Received in revised form 25 October 2010
Accepted 3 November 2010
Available online 30 November 2010

Keywords:
Contextual effect
Williams syndrome
Semantic knowledge
Proposition integration
Developmental disorders

ABSTRACT

This study was aimed at investigating the semantic integration ability of people with WS in building up a coherent and gist theme from the context of presented sentences. Previous studies have indicated rich lexical semantic knowledge and typical semantic priming in this clinical group, but atypical brainwave patterns have been reported in studies of semantic comprehension. An integration difficulty hypothesis of merging meanings into sentences was proposed to explain the discrepancy (Tyler et al., 1997). In this study, this hypothesis was examined by means of proposition integration. Participants were presented sentences embedded with different numbers of propositions under various scenarios. Successful integration of semantically related propositions under same scenario was demonstrated by high false alarm recognition to sentences with more propositions (a maximum of four in this study). The results revealed that healthy adults showed integration ability when the number of propositions in a sentence were more than three, with increased false alarm rates and confidence ratings, whereas people with WS showed no differences in sentences with increased proposition numbers. Typically developing children controls confined recognition phenomenon to sentences carrying more than two propositions. Hence, it was concluded that contextual effects in terms of proposition integration was a gradual development from childhood into adulthood and a deviant development in people with WS.

1. Introduction

People with WS are characterized as having good linguistic ability compared to poor visuospatial performance in their cognitive profiles. Their fluent language in conversations is truly impressive, given the fact that they are mentally retarded. Studies on investigating their syntactic knowledge revealed normal performance with conditionals (Bellugi, Lichtenberger, Jones, Lai, & George, 2000) and relative clauses (Zukowski, 2001). Based on their excellent grammatical knowledge, it is inferred that people with WS understand the meanings of words and sentences as their normally developing counterparts do. However, this inference needs further confirmation. In this study, the authors aimed at investigating the ability of utilizing contextual information in semantic knowledge of people with WS.

Early studies on lexical semantics revealed extraordinary abilities of people with WS. Bellugi et al. (2000) found that people with WS produced significantly lower frequency words than healthy controls and people with Downs syndrome. In a homonym study, participants with WS were able to give definitions of both primary and secondary meanings (Bellugi et al., 2000). Previous studies also showed that behavioral evidence revealed normal performance of using contextual information in people with WS (Hsu, Karmiloff-Smith, Tzeng, Tai, & Wang, 2007; Tyler et al., 1997). In Tyler

* Corresponding author. Tel.: +886 2 2663 2102x3815; fax: +886 2 2663 2102x4952.
E-mail address: chinghsu@cc.hfu.edu.tw (C.-F. Hsu).

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doi:10.1016/j.ridd.2010.11.001

et al.'s study on semantic priming, people with WS showed typical priming effects, associating targets in synonyms (hamster-mouse) or in functional relations (broom-floor) embedded in a list of distracters. Hsu et al.'s study of conceptualized semantic formation using the memory illusion paradigm with respect to behavioral results confirmed Tyler et al.'s finding (1997). While normally developing controls formed coherent themes from a series of presented related words, participants with WS possessed the same ability in processing meanings of discrete words and integrated lexical meanings into central ideas. However, beyond building semantic network with single words, it is worth investigating whether this semantic integration ability is valid in sentential level processing in people with WS.

Contextual effect was defined as the ability of building up a coherent gist theme from presented sentences under different scenarios. To investigate this effect, a proposition integration task was employed (Bransford & Franks, 1971, 1972; Franks & Bransford, 1972, 1974a, 1974b). This task was designed to elicit participants' ability in extracting meanings from propositions embedded in sentences and integrating meanings as gist themes. This integrating ability is parallel to the central coherence theory which proposed that people process local information in a global background (Happé & Frith, 2006; Shah & Frith, 1993).

In Bransford and Franks series of studies on semantic integration with different numbers of propositions, participants were presented sentences under different scenarios with one to four propositions, first in a learning stage, and were then required to recognize those sentences afterward. In a recognition stage, half sentences from the same scenario were presented as distracted stimuli. It was hypothesized that participants would falsely recognized these related new sentences as previously heard sentences in the learning stage if they formed the gist theme from these presentations. The results confirmed the hypothesis that normally developing people misrecognized related new sentences with a higher number of propositions as sentences that were presented before, indicating an automatic buildup of semantic networks from presented sentential contexts in language processing. A similar pattern was observed in subjective confidence ratings. Hence, proposition integration task was employed in this study to preliminarily probe contextual effect in people with WS.

Two hypotheses were generated with our clinical group. If people with WS showed a similar pattern to the healthy controls, who could extract meanings from propositions in context and integrate meanings as a whole, it was determined that our clinical group possess typical semantic integration ability on a sentential level. They are able to get the gist in leading contexts. On the other hand, if people with WS showed different patterns to the healthy controls, it would be inferred that they are deviant in proposition integration in semantic knowledge.

2. Method

2.1. Participants

Thirteen children and adults with WS (10 males/3 females, mean CA in months = 214.69, SD = 60.71, from 120 to 355; mean MA in months = 106.78, SD = 29.71, from 61 to 156) matched with 13 healthy children individually in mental ages using full scale scores from WSIC-III-R and WAIS-III standardized tests (10 males/3 females, mean CA in months = 101.54, SD = 29.61, from 67 to 146; mean MA in months = 127.91, SD = 43.91, from 72 to 193) (Chen, 1997; Chen & Chen, 2002). Participants with WS were diagnosed as having missing genes on chromosome 7q11.23. No difference in the mental age between the matched groups was observed [$t(12) = 1.71$, $p = 0.11$] but a difference in the CA emerged [$t(12) = 5.65$, $p < 0.001$]. Though the p-value was less than 0.20, which was counted as low for accepting the null hypothesis (Mervis & Robinson, 2003), the authors had no choice since there were only a few participants with WS in a small country like Taiwan. Meanwhile, though the difference in mental age between the healthy children controls and the people with WS was greater than 12 months, that was because we could not ask younger children (under 6 years old) to participate in such a task. Thus, the main concern here was to recruit healthy children controls with no difference in the mental age with our clinical group.

Twenty-four college students were recruited as an adult group. Though college controls were not of interest in this study, the authors included this group as a reference because there has not been any replicated study in Chinese.

2.2. Materials and design

Three sentences with four propositions each were created as stimuli. Each sentence depicted a scenario. Under the same scenario, sentences were generated according to the combination of various numbers of propositions and then were addressed accordingly as Ones, Twos, Threes, and Fours. Thus, under the same scenario, 12 sentences were generated (see Table 1). There were 36 sentences generated as stimuli.

All propositions were familiar to WS individuals and young children. These propositions were concrete objects (cake, carrot), cartoon characters (Mickey Mouse, Snoopy), imaginable activities (playing games, eating), and familiar environments (classroom, aquarium). The thematic roles of propositions could be locations (in the forest, in the classroom, in the brushwood), actions or properties (eating carrots, cute kids) and events (the wolf caught a rabbit, kids are playing games). Stimuli were recorded with phonetic synthesized software, *Praat* in 8 bit mono sound at 44 kHz frequency. Sentences were presented in a random order without any two from the same scenario being in consecutive sequence. The experiment was conducted in a quiet room.