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Research report

Cognitive neuropsychological and regional cerebral blood flow study of a Japanese–English bilingual girl with specific language impairment (SLI)

Akira Uno[a,*,1], Taeko N. Wydell[b,1], Motoichiro Kato[c], Kanae Itoh[d] and Fumihiro Yoshino[e]

[a]University of Tsukuba, Tsukuba, Japan
[b]Brunel University, Uxbridge, Middlesex, UK
[c]Keio University Medical School, Tokyo, Japan
[d]National Institute of Mental Health, Chiba, Japan
[e]Tokyo Dental College, Chiba, Japan

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ABSTRACT

We report here on an investigation into the possible factors which might have contributed to language impairment (LI) in EM, a 14-year-old Japanese–English bilingual girl. EM was born in the UK to Japanese parents with no other siblings, and used English to communicate with all other people except for her parents. A delay in her English language development was identified at primary school in the UK, which was attributed to her bilingualism. The deficiency in her English language skills persisted into her adolescence despite more than adequate educational opportunities (including additional language support). At the start of her secondary education, language ability/literacy attainment tests were conducted in both English and Japanese, and the results suggested specific language impairment (SLI) in both languages. Further, her brain Single Photon Emission Computed Tomography (SPECT) revealed significantly lower Regional Cerebral Blood Flow(rCBF) in the left temporo-parietal area, which is also similar to the area of dysfunction often found among Japanese individuals with SLI.

1. Introduction

Approximately half the children in the world are exposed to more than one language (e.g., De Houwer, 1995). However, the literature on bilingual development is very limited in comparison to the literature on second language learning in terms of both the number of studies reported and the number of subjects per study (Hoff-Ginsberg, 1997). An often addressed question on bilingual development is whether bilingual children demonstrate a developmental delay in each language compared with monolingual children. Some studies have supported the idea that there is a significant developmental

* *Corresponding author*. Graduate School of Comprehensive Sciences, University of Tsukuba, 1-1-1, Tennohdai, Tsukuba, Ibaraki 305-8577, Japan.
E-mail address: uno@human.tsukuba.ac.jp (A. Uno).
[1] Both authors contributed equally.
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language delay in bilingual children (e.g., Rosenblum and Pinker, 1983; Umbel et al., 1992). For example, Rosenblum and Pinker (1983) found that bilingual children aged five and over had smaller comprehension vocabularies in each of their languages than age-matched monolingual children. However, Pearson et al.'s (1993) longitudinal study following bilingual and monolingual children from the age of 8 months to 30 months revealed that the bilingual children had comprehension vocabularies in each language comparable to that of monolinguals. Hoff-Ginsberg (1997) therefore argued that bilingual development might cause some delay in the development of each language but not so much as to cause these children to be outside the normal range of variation in the rate of language development.

Bishop (1997) has extensively discussed abnormal monolingual language development, in particular children with specific language impairment (SLI). In brief, SLI is defined as a disorder in the development of language despite adequate educational opportunities and normal intelligence. It requires a significant discrepancy between the child's verbal and nonverbal abilities in the absence of any additional disorders (e.g., mental retardation or autism) (e.g., Bishop, 2001; Williams et al., 2000; Botting and Conti-Ramsden, 2003). Most children with SLI are poor at acquiring new vocabulary, which is reflected in their performance on tests for receptive vocabulary. For example, research on incidental learning of word meanings revealed that children with SLI understood fewer new words than age-matched normal controls after a few brief exposures to the new words in the naturalistic context of a television program (Oetting et al., 1995). Gleitman (1994) postulated the following process for the acquisition of new vocabulary in children: (1) the acquisition of knowledge of the concepts that words express, (2) the extraction of phonological patterns from incoming speech, and (3) the mapping of (1) and (2), that is, mapping each concept to a phonological pattern. Conceivably, poor word learning in children with SLI may be linked with a deficit at one of these processing stages. Bishop (1997) argued that deficient vocabulary learning in children with SLI is not attributable to abnormal conceptual development or lack of symbolic representation. Rather, it is attributable to poor phonological perception and memory in these children. This is because vocabulary acquisition depends on the setting up of long-term phonological representations in the lexicons, and phonological representations in these children's lexicon may be under-specified.

More recently, research into language impairment (LI) or SLI in bilingual children started to emerge, although the numbers are still few. Hakansson et al. (2003) revealed for example that Swedish–Arabic children with LI developed both languages "in the same implicational way" (Salameh et al., 2004, p. 66) as those bilingual children without LI, but showed slower development in both languages. Salameh et al. (2004) in their longitudinal study followed the grammatical development of Swedish–Arabic bilingual children with LI and normal children (aged between four and seven) for 12 months. Their results also confirmed that their children both with and without LI developed grammatical structures in both languages in the same implicational way. However, it was found that the children with LI seemed to be more vulnerable to language exposure. They were more affected by lack of the language exposure than the bilingual children without LI. Moreover, Paradis et al. (2003) compared French–English bilingual SLI children (mean age = 6:11) with age-matched monolingual French and English SLI children, and found that these bilingual and monolingual children both showed a difficulty in processing grammatical morphology to the same extent. Paradis et al. (2003, p. 123) therefore concluded that "their dual language knowledge was not causing them to have different patterns in this domain of morphosyntax than monolinguals".

Further, Bishop (1997) also discussed etiological factors in SLI (albeit in monolinguals), including the language environment, genetics and neurobiology. She argued that genetic factors have been strongly implicated in the etiology of SLI. For example, the concordance of SLI among monozygotic twins is said to be almost 100% (Bishop et al., 1995). Similarly, Plante (1991) argued that developmental language disorders such as SLI are biologically transmittable, as her study revealed family aggregations of SLI.

Ors et al. (2005) considered identifying neurobiological features for SLI as one of the main lines of SLI research and cited studies of morphometric analyses of magnetic resonance imaging (MRI) (e.g., Plante, 1991; Plante et al., 1991) or studies using functional imaging techniques such as single photon emission computed tomography (SPECT) and positron emission tomography (PET) (e.g., Saper et al., 2000). For example, Plante et al.'s (1991) morphometric study with MRI revealed an atypical perisylvian asymmetry in SLI children – the asymmetry was seen by an atypically larger right perisylvian area compared to normal controls, while the left perisylvian area was of the same size as that of the normal controls. Plante (1991) further stated that for the majority of normal controls the asymmetry was seen with the left perisylvian area it being greater than that of the right. Plante et al. (1991, p. 63) thus argued that the atypical perisylvian asymmetry in the SLI children might be due to the brain's "overproliferation of neurons that migrate out to the cerebral surface" during its development, and a possible "failure of regressive events which occur late relative to the prenatal developmental course of the affected region".

In SPECT/PET studies, it has been shown that there is a linear relationship between local changes in the cerebral blood flow (CBF) and glucose consumption, thus indicating local neuronal activity (Saper et al., 2000). Ors et al. therefore argued that there are morphological and functional differences in children with SLI compared to children without SLI.

Ors et al. (2005) using SPECT compared the regional cerebral blood flow (rCBF) of children with SLI and children with attention deficit hyperactivity disorder (ADHD), and found that the SLI children had symmetrical rCBF values in the left and right temporal areas whereas the ADHD children showed a typical asymmetry with the left temporal region predominant. Further, SLI children showed lower rCBF values in the right parietal as well as the subcortical regions, while the ADHD children showed symmetrical rCBF values in these areas. Both ADHD and SLI children, however, revealed lower rCBF values in the right frontal area compared to the left frontal area.

Researchers in Japan have also investigated these neurobiological abnormalities in Japanese SLI children using SPECT