

Linguistic influences on mathematical development

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One of the cultural characteristics that may influence children's arithmetical development is the way in which numbers and arithmetical relationships are expressed in a language. The possible importance of this factor has been recognized for a very long time indeed, e.g. by John Locke and the Edgeworths, although systematic research was not carried out until quite recently.

East Asian languages such as Chinese, Japanese and Korean, have very regular counting systems. They correspond closely to written number system, and they make the relationship between units, tens and higher powers of ten very explicit. For example, in these languages the number word for 12 is the equivalent of 'ten-two'; the number word for 23 the equivalent of 'two-tens-three'. It is sometimes suggested that the relative regularity of Asian counting systems is a major contributory factor to the superior performance of Pacific Rim children in most aspects of arithmetic. There is considerable evidence (e.g. from work by Irene Miura and colleagues) that speakers of Asian languages perform better than speakers of less regular counting sequences, both in learning the counting sequence and in learning to represent tens and units. However, it is difficult to draw firm conclusions on the matter, because there are so many other cultural and educational differences between children in English-speaking Western countries and in Pacific Rim countries.

Wales has provided an unusual opportunity for research on linguistic influences on mathematics, since it is a region in which languages with both regular and irregular counting systems are used. The Welsh counting system is more regular and transparent than the English counting system. A study by Delyth Lloyd and myself aimed to test the prediction that Welsh-speaking children would perform numerical tasks better than English-speaking children. Three groups of Welsh children with varying degrees of exposure to the Welsh language were given standardized tests of arithmetic, and a more specific test of understanding representations of 2-digit numbers. The participants were 60 children: ten 6-year-olds and ten 8-year-olds from each of three schools. Children at school WW spoke Welsh both at home and at school; school WE spoke Welsh only at school; and school EE spoke only English. They were given two standardized arithmetic tests (WISC Arithmetic and BAS Number Skills); a standardized non-arithmetical cognitive test (WISC Block Design); and a Number Comparisons test of reading aloud and comparing 24 pairs of two-digit numbers. Two-way ANOVAs, with age and school as factors, revealed no significant differences in the different groups' performance on the standardized arithmetic tests, or Block Design. Both groups of Welsh speakers read and compared 2-digit numbers more accurately than monolingual English children. Eight-year-olds performed better than 6-year-olds on all raw scores; but not on age-standardized test scores.

We may conclude that there are differences between the numerical skills of children who learn mathematics in Welsh and English. Unlike Asian children, who differ from English children in both language and culture, the Welsh speakers' superiority

appears specific to tasks that directly involve the written representation of place value.