of Munduruku, a language of the Tupi family from the Para state of Brazil where one can find number words only for the numbers 1 through 5. The research team collected trials in classical arithmetical tasks on a computer, including a chronometric comparison test. With such technologies they were able to test whether competence for numerical operations such as addition or comparison are present in the absence of a well-developed language for numbers (Pica et al. 2004). Later the same team enriched their fieldwork by studying core knowledge of geometry (Dehaene et al. 2006).

p. 332 The first task consisted in presenting displays of 1 to 15 dots in randomized order, and asking the people in their native language to say how many dots were present. As can be expected due to the limitation of the numerical lexicon, there was little consistency in language use above five. For instance, a response to 13 dots was: 'all the fingers on the hands and then some more'. The word for 5, which can be translated as 'one hand' or 'a handful', was used for 5 but also 6, 7, 8, 9 dots. The authors conclude: 'With the exception of the words for 1 and 2, all numerals were used in relation to a range of approximate quantities rather than to a precise number' (Pica et al. 2004: 500). Furthermore, they remark: 'This response pattern is comparable to the use of round[ed] numbers in Western languages, for instance when we say "10 people" when there are actually 8 or 12.'

This by no means indicates that these peoples are unable to achieve arithmetic operations on approximate numbers. This was established by an approximate addition task, which is thought to be independent of language in western participants. Simple animations on the laptop screen illustrated a physical addition of two large sets of dots into a can. The participants had to approximate the result and compare it to a third set. Munduruku participants had no difficulty in adding and comparing approximate numbers, with a precision identical to that of the French controls (i.e. a group of native speakers of French who were asked to do the same tests).

The question then arose of the ability of Munduruku speakers to manipulate exact numbers. An exact subtraction task was proposed to the participants, who were asked to predict the outcome of a subtraction of a set of dots from a given set (see Fig. 14.3). The displayed animation showed a set of n_1 dots entering the can and another set of n_2 dots coming out of it. The question was: how many dots remain in the can? The initial number of dots n_1, could be up to 8 dots, but the result of the subtraction $n_3 = n_1 - n_2$, was always small enough to be named. Participants responded by pointing to the correct result among three alternatives n_3, (0, 1, or 2 objects left: see Fig. 14.3). It appeared that the Munduruku were close to 100 per cent correct when the initial number was below 4, but their performance decreased sharply as the size of the initial number n_1 increased.

p. 333 The authors conclude: ↳

> Our results shed some light on the issue of the relation between language and arithmetic. They suggest that a basic distinction must be introduced between approximate and exact mental representations of number [...]. With approximate quantities, the Munduruku do not behave qualitatively differently from the French controls. They can mentally represent very large numbers of up to 80 dots, far beyond their naming range, and do not confuse number with other variables such as size and density. They also spontaneously apply concepts of addition, subtraction and comparison to these approximate representations. (p. 502)