LOCATING THE LEARNER: INDIGENOUS LANGUAGE AND MATHEMATICS EDUCATION

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Indigenous language speaking students in remote Northern Territory schools are expected to learn mathematics in English and are assessed in English. Most teachers in these schools have little knowledge of the mathematical concepts with which their students start school. This paper reports on the initial findings of a project which is investigating spatial concepts in Iwaidja, an Indigenous language spoken in the NT. Examples of spatial frame of reference preferences in Iwaidja and related languages are compared with those taken for granted by English speakers. Implications for mathematics teaching are explored in the context of an Australian Curriculum.

Introduction

In a country such as Australian with a mobile population and a nation-wide assessment program, a national curriculum makes sense. For smaller jurisdictions, such as the Northern Territory, it will enable more access to teaching resources with explicit links to the curriculum, something that is difficult to generate for a small population. However, one danger of a national approach is that the specific needs of special groups may be overlooked. The focus of this paper is on particular needs of Indigenous Language Speaking (ILS) students in remote areas of the Northern Territory. These students make up a substantial proportion of the students in the Northern Territory and are widely represented as underachieving in numeracy.

Indigenous education strategies and policies now focus on "Closing the gap" between Indigenous and non-Indigenous numeracy outcomes (Ministerial Council on Education Employment Training and Youth Affairs [MEETYA], 2010). This study is part of an attempt to bridge another gap: teachers' understanding of the distance (Berry, 1985) between their mathematical language in English and in the Indigenous languages of their students.

First this paper will contextualise the study in terms of expectations and requirements for teaching mathematics in English that apply in a remote community such as Minjilang, the site of the study. Then it will describe spatial frame of reference from a cross-linguistic perspective and why it is relevant to the Early Years mathematics curriculum. It will describe some of the findings from the investigation of spatial frame of reference in Iwaidja, one of the languages spoken at Minjilang. It will then analyse the terminology and sequencing in the location area of the Northern Territory

Curriculum Framework and the Australian Curriculum from the perspective of spatial frame of reference.

Teaching and learning in English in a remote school

New teachers arriving at remote schools in the Northern Territory are faced with many challenges. Many of them have no formal English as a second language (ESL)[1] training and have never heard a living Indigenous Australian language spoken. Entering a classroom of ILS students, they are entering an environment of vastly different cultural expectations and traditions than their own.

At the same time, pressures on teachers in these communities have never been greater, educationally speaking. While some of the trappings of "remoteness" have decreased with improved infrastructure and electronic communication, teachers in remote Indigenous schools such as this are under increasing expectation to assist their students to achieve benchmark levels in the National Assessment Program: Literacy and Numeracy (NAPLAN). NAPLAN results of Indigenous and non-Indigenous students are frequently compared both in the media and in official reports (e.g., MEETYA, 2008). All components of NAPLAN, including numeracy assessment, are conducted in English.

Numeracy, "the capacity, confidence and disposition to use mathematics" (National Curriculum Board, 2009, p. 5), could arguably be achieved in any language, subject to the development of a mathematics register (Roberts, 1998). However there is a powerful perception that it needs to be achieved in English (Commonwealth of Australia, 2000). To this end, the Northern Territory Government's contentious *Compulsory teaching in English for the first four hours of each school day policy* (2009), was explicitly directed towards Indigenous students, banning bilingual education.

The research is being conducted at Minjilang community, on Croker Island in North West Arnhem Land. It arose out of firsthand teaching experience in the school. Traditionally a multilingual region, the main languages spoken in the community are Iwaidja, Mawng, and Kunwinjku, as well as several dialects of English (Standard Australian and Aboriginal). The language of the school is Standard Australian English, although local Indigenous assistant teachers speak to the students in local languages. The main mathematics program followed is *Count Me in Too*. There are ESL support materials for the teaching of literacy, but a lack of targeted curriculum support for teaching mathematics to ILS students from an ESL perspective.

Spatial language

The goal of the project is to investigate some aspects of mathematical language in one of the languages of the community and to make links between that and the mathematics curriculum in the Early Years. The spatial area was chosen as a focus for several reasons. Spatial thinking is a perceived strength amongst Indigenous students (Harris, 1991). Also, spatial language and thinking underpins many numerical and logical

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[1] Although most of the students in these remote communities could be more properly classified as English as an Additional Dialect or Language learners (EAD/L), I use ESL here as it is the more widely used term for a range of teaching strategies.

processes. Finally, there is a body of cross-cultural cognitive linguistic research into spatial language that allows comparison with other languages.

It was not feasible for this project to investigate all the languages spoken at Minjilang, so Iwaidja was chosen for a number of reasons, some of which were political and logistical rather than purely educational. Iwaidja is considered by the inhabitants to be the language of Croker Island, whereas Mawng and Kunwinjku have their homes elsewhere. Iwaidja is not the most frequently spoken language in the school although there are some similarities between the spatial language of Iwaidja, Mawng and Kunwinjku, as we will see.

In order to understand the role of language in mathematical learning when the language of instruction is different from the student's preferred language, Berry (1985) describes two types of difficulties. The first, most obvious, type has to do with level of fluency in the language of instruction. The second type of problem can be more subtle, and arises when there is a mismatch between the student's cognitive structure and that taken for granted by the teacher.

An example of the first type of problem can be drawn from the 2010 NAPLAN test for Years 3 and 5. One question showed a diagram of a bedroom and asked, "What is between the bed and the toy box?" Understanding the concept of 'between', which may exist in the students' home languages—in Iwaidja it is *balarra*—is different from knowing this word in English. Thus "this item is as much a test of English as it is of mapping skills" (The Australian Council of TESOL Associations [ACTA], the Applied Linguistics Association of Australia [ALAA] and the Australian Linguistic Society [ALS], 2010, p. 19). It is this type of difficulty that the *First Four Hours in English policy* was intended to address.

Frame of reference

The main focus of this project is on the second type of problem, the cognitive mismatch between the teacher and student. Spatial thinking has often been assumed to be based on a natural, innate perception of the world (e.g., Piaget & Inhelder, 1956). But the cross-linguistic research of the Cognitive Anthropology Research Group at the Max Planck Institute for Psycholinguistics [CARG] revealed unexpected differences in the ways that people talk and think about space and location. In particular this involved what is termed "spatial frame of reference"—the manner of talking about where one thing is located in relation to another in a horizontal plane. A typology was developed that described three main frames of reference: intrinsic, absolute, and relative (Pederson, Danziger, Wilkins, Levinson, Kita & Senft, 1998). Some languages, such as English, have all three frames of reference. One can variously say "the man is in front of the car"—intrinsic, using the front of the car as a reference, "the man is to the north of the car"—absolute, using a fixed system that is larger and external to the described scenario, and "the man is to the left of the car"—relative, using our own body as the reference. But although English has all these frames of reference, there are patterns of use linked to context. In small-scale space, the speakers of European languages such as English prefer the relative over the absolute and over the intrinsic (Barton, 2009; Levinson, 2003). The absolute is generally only used in large-scale spatial description, such as reading maps.

The pattern of acquisition of spatial language for English speakers reflects these preferences. Children learn first the intrinsic frame of reference such as 'in front' and 'behind', then left and right, with north, south, east and west regarded as somewhat specialised and not part of everyday speech. Mathematics curricula also reflect this. This will be discussed in more detail below, but generally early years mathematics curricula have a strong focus on the acquisition of left and right well in advance of the cardinal points.

It has long been known that in many Indigenous languages of Australia the terms for left and right can be used only about a person's body and not projected onto a scene or non-human object (Harris, 1991). It has also been known that some languages such as Warlpiri not only use cardinal directions frequently in small-scale space but that this use is compulsory in spatial description (Laughren, 1978). Some of the implications of this for mathematics teaching in schools have been previously recognised (Harris, 1991). What the CARG researchers did was move from these observations to a general typology of spatial language. They also demonstrated links between preferred frame of reference and spatial memory (Pederson et al., 1998).

This study contends that children who use different frames of reference to those preferred in English might benefit from a different sequence of mathematics teaching that more closely reflects these preferences.

Man and tree game

The ongoing project combines a cognitive linguistic approach to investigating spatial frame of reference in Iwaidja with teacher interviews, ethnographic observation, and an action research approach to improving mathematics teaching in the early years classroom.

To elicit verbal frame of reference, the "Man and Tree" game (CARG, 2003) was used, a barrier task for two participants involving photo matching. The photos show a toy man and tree that differ in spatial location and orientation. The aim of the game is for one person to choose a card and describe it and the other person to find the identical card. Gesture is not permitted. Since the cards show exactly the same objects, spatial description is necessary to distinguish them. The "Anne Senghas" set of 16 cards was used, in which the man could be in one of four orientations to the tree and one of four standing positions in relation to the tree. The cards are named Rxy, where x refers to the facing direction of the man and y to where he stands with relation to the tree. The game was conducted with four pairs of speakers.

Findings

Iwaidja

The data revealed use of all three frames of reference, with variation between speakers.

Absolute

There was extensive use of absolute terms, with common terms including *abalkbang manyij* 'east (sunrise)' and *wurrying manyij* 'west (sunset)'.

Warrkbi wakaldakan abalkbang manyij.   [1]
"The man is on the east side." (dvR_100512 25:29 AB) R43

> Ruka warrkbi ari yawukan wurrying manyij. [2]
> "This man is standing looking over west." (dvR_100513 03:34 RN) R34

Some local landmarks are also used as absolute terms, such as *mayinmul* 'headland' which refers to the headland at the north of Croker Island, and which is used as a term for north.

Relative

Unusually for Indigenous Australian languages, speakers of Iwaidja do sometimes use the terms 'left' and 'right' beyond the scope of their own bodies.

> Baraka arlirr ari maruj. [3]
> "The tree is standing on the left." (dvR_100512 00:26 AB) R12

> Warrkbi rayan nurlinurli or maruj? [4]
> "Is the man looking right or left?" (dvR_100512 43:05 DG) R11

However, this was not a popular strategy and did not often lead to the correct card being found. It was remedied with absolute or intrinsic information being added. Body parts were also used to describe the orientation of the man with respect to the speakers.

> Riki arrumbukung rtamburryak. [5]
> "This one, he gave us his chest (He's facing us)." (dvR_101115_2 13:30 CM) R12

Intrinsic

Body part descriptions were also used to describe the orientation of the man with respect to the tree, such as *rukung kirrwarda* 'he gave it his back'. More frequent was the use of the terms *wurdaka* 'in front' and *warrwak* 'behind, after'.

> Kabanayan baraka warrkbi ari wurdaka lda arlirr warrwak? [6]
> "Can you see the one where the man is standing in front and the tree is behind?" (dvR_100522 17:16 JW) R24

These terms are of particular interest and a more detailed analysis will appear in Edmonds-Wathen (2011). As with their English equivalents, these terms can have both intrinsic and relative applications. They can describe a situation where the man is in front of the tree with respect to the viewer or they can describe a situation where the man is in front of the tree by virtue of having his back to it. One of the interesting features of Iwaidja is that these terms are frequently used when from the speaker's perspective the man is to the left or right. In example (6) above, card R24 shows the man on the left side of the card with his back to the tree, which is on the right.

Other languages of Minjilang

Mawng

Mawng is another language from the Iwaidjan family. It shares some vocabulary and grammatical structures with Iwaidja, with possibly up to 70 percent coming from a shared origin (Teo, 2007). Speakers of Mawng also use a mixture of strategies in small scale spatial descriptions. Common absolute terms include *kinymalkpa muwarn* 'east (sunrise)' and *kinyuryi muwarn* 'west (sunset)' as well as landmark terms such as *matanti* 'mainland' and *wungijalk* 'deep ocean'. *Matanti* is used for south, and *wungijalk* for north. *Inyjaku* 'left' and *wurulwurul* 'right' are also used (Ruth Singer, personal communication, 18 November, 2010).

Kunwinjku

Kunwinjku is widely spoken in the community and appears to be a language gaining strength and speakers. It is one of a chain closely related, mutually intelligible dialects known variously as Bininj Kun-Wok, Mayali, or Kunwinjku. It is only distantly related to the Iwaidjan languages. In Kunwinjku, the cardinal directions are also used frequently. For example, a story in the Manyallaluk Mayali dialect about hunting freshwater crocodile describes hunters hidden in the water in a waterhole and other people hitting the water to stir up the crocodiles. When they see a crocodile, the people call out to the hunters:

"Gumeke! Walem!" gareh "gakbi!" o "goyek! Ngale gareh garri!"   [7]
" 'Over there! To the south!' or maybe 'North!' or 'East! Maybe to the west!' " (Evans p. 676)

In a similar context English speakers would be more likely to call out the relative directions "To your left!" or "Behind you!"

Child language

The next stage of the project is to further investigate children's use of frame of reference. Three pilot versions of the "Man and Tree" game have been conducted with adult-child pairs, with the children aged from seven to nine years old. There was a strong emphasis in each of these trials on which way the man was looking. One parent frequently used the absolute terms *abalkbang manyij* 'east (sunrise)' and *wurrying manyij* 'west (sunset)'. Another favoured *wurdaka* 'in front' and *warrwak* 'behind, after'. Some of the parents also used *maruj* 'left' and/or *nurlinurli* 'right'. There is not enough data yet to draw conclusions.

Cognitive effects—Animals in a Row

A non-verbal task was conducted with some of the speakers. The "Animals in a Row" task was developed by CARG to demonstrate the effect on cognition—specifically on memory—of spatial frame of reference preference (Pederson et al., 1998). It was designed to demonstrate differences between absolute and relative thinking. Participants were shown a row of three animals all facing in one direction, either to the participant's left or right. They were instructed to remember the animals. They were rotated 180 degrees and taken to another table with identical animals lying on it and instructed to "make it the same". If the stimulus showed the animals facing relative left/south, a relative response would be to lay them out facing left (which would now be facing north due to the rotation. An absolute response would be to lay them out facing south (which would now be facing right).

For the Iwaidja speakers, however, the task appeared to demonstrate a preference for intrinsic thinking. Most of the participants placed the animals facing all the same way in four or five of the five tests. That is, each time, they placed them facing south/relative left, regardless of whether the stimulus has been placed north/relative left or south/relative right. One speaker placed the animals in a row facing away from his body, at a right angle to how he had viewed the stimulus. This was definitely an intrinsic response.

Location in the early years curriculum

Northern Territory Curriculum Framework

The Northern Territory Curriculum Framework (NTCF) is an outcomes based document. These outcomes are brief. For example, the Key Growth Point 2 (school entry level) outcome for location is "describe the position of nominated everyday objects in familiar locations" (Northern Territory Department of Education and Training, 2009, p. 3).

The 2009 NTCF introduced a section of key vocabulary. This begins at Key Growth Point 2 with topographic and intrinsic concepts such as 'in', 'on top' 'beneath' and 'behind', 'in front'. The relative words 'left' and 'right' are introduced at Band 1 and compass points 'north', 'south', 'east', and 'west' at Band 2. This sequencing correlates to how English speakers are taught, acquire and use the language of location. It does not correlate to how speakers of many Australian Indigenous languages may acquire and use spatial language.

Another drawback of this type of curriculum is its size. Location is a small area of the mathematics curriculum but in this document at Key Growth Point 2 alone there are 12 separate indicators. These were not intended to be a checklist, but in practice teachers often feel that they should all be attempted and achieved.

The Australian Curriculum

The Australian Curriculum is far more concise. The location outcome at Foundation level is "Describe position and movement" (Australian Curriculum, Assessment and Reporting Authority [ACARA], 2010, p. 15). There are only two elaborations. Far fewer examples and specific terms are given than in the NTCF. 'Left', 'right', and the compass points are not specified at any stage. This is potentially more inclusive of ILS students. One of the elaborations, though, uses the phrase "everyday language of location and direction" (ACARA, 2010, p. 15). It is precisely at the Foundation level that the teacher needs to know more about the everyday language of their students if it differs from that of the teacher (Edmonds-Wathen, 2010).

Interestingly though, 'clockwise' and 'anticlockwise' are specifically identified as important in the Year 1 elaborations. Understanding these requires an understanding of 'left' and 'right'. It would be possible to "give and follow directions to familiar locations" (ACARA, 2010, p. 17) using absolute phrases such as "turn towards the sun" rather than "turn clockwise". The argument is not that ILS students should not learn 'clockwise' and 'anticlockwise', rather that it may be better to focus on achieving the early years outcomes in the frames of reference they are more familiar with, especially while they are learning basic English, and move onto those terms later.

Northern Territory Diagnostic Net

There is also the danger that the curriculum elaborations will be used in a prescriptive rather than illustrative manner. The *Northern Territory Diagnostic Net* is an attempt to define minimum standards for each year level that students must achieve to progress at school. For Year 1 minimum standards, it specifies that all students *must* "know the meaning of 'anticlockwise' and 'clockwise'" (NTDET, 2010, p. 47). This has been lifted straight out of the Australian Curriculum.

Conclusion

In the area of location, the Australian Curriculum as it stands may be more suitable than the Northern Territory Curriculum Framework for Indigenous Language Speaking students who have different frame of reference preferences. By specifying less of how teachers are to achieve outcomes, it may enable more scope for teachers to target their teaching programme to the specific needs of their students. Nevertheless, the new curriculum still makes assumptions about the sequencing of spatial learning that has been drawn primarily from the language acquisition and concept development of children from European language backgrounds. Children who are learning Indigenous languages such as Iwaidja, Mawng, and Kunwinjku are acquiring spatial language and concepts with different foci. The study of spatial frame of reference and its uses is a field that aptly demonstrates some of these differences. Further investigation is required into the actual acquisition of spatial frames of reference by the children of Minjilang community.

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