Article

Matjarr Djuyal: How Using Gesture in Teaching Gathang Helps Preschoolers Learn Nouns

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Abstract: There are important efforts being made to revitalise Aboriginal languages in Australia, which are both pedagogically and culturally appropriate. This research seeks to expand the current knowledge of the effectiveness of gesturing as a teaching strategy for young children learning the Gathang language. An experimental method was used to investigate the effectiveness of gesture by employing a context in which other variables (e.g., other teaching pedagogies) could be held constant. Participants, age range 4–5.2 years, were taught Gathang nouns with gesture and without gesture, alongside verbal and pictorial instruction. After the teaching sessions, each child was assessed for their receptive and expressive knowledge of the Gathang nouns, at two time points, two days after instruction (post-test 1) and one week after (post-test 2). At post-test 2, children had stronger receptive knowledge for words they had learned with gesture than without. These findings contribute to a growing body of research attesting to the effectiveness of gesture for improving knowledge acquisition amongst learners. In the context of Aboriginal language revitalisation, gesture also aligns with traditional teaching practices and offers a relatively low-cost strategy for helping teachers assist their students in acquiring Aboriginal languages.

Keywords: Aboriginal languages; teaching; language acquisition; gesture; language revitalisation

1. Introduction

1.1. Background

Upon the invasion of Australia by the British, there were approximately 250 individual Aboriginal languages spoken (Power 2013). Gathang, the language of the Birrbay, Warrimay and Gurigay, is one of thirty-five Aboriginal languages spoken in New South Wales (NSW). Gathang belongs to the Pama-Nyungan family of Australian languages and many grammatical relations are expressed through the use of suffixes (Lissarrague 2010). Aboriginal languages in NSW were severely impacted as NSW was one of the first parts of Australia to be colonised (Lowe and Walsh 2009). Over time, English became the predominant language in NSW, as Aboriginal people were forbidden from speaking their languages (Lissarrague 2010).

Currently, there are significant efforts being made to revitalise Aboriginal languages in Australia (Hobson et al. 2010). In 2010, Muurrbay Aboriginal Language and Cultural Co-operative (Muurrbay) launched the Gathang Dictionary to support the revitalisation of the language. While at the time of the publication of the dictionary there were no longer any fluent Gathang speakers, there is now a body of language activists/teachers/learners, *Djuyalgu Wakulda* 'to speak as one' group, that are working together to revive Gathang. Although Gathang has not been incorporated into any local school curriculum, there has been a surge of interest to use Gathang on signage and to use basic words in everyday life, for example *wiyabu* 'hi', *marrungbu* 'thank you', and *gapu* 'goodbye'. However, there is a need for more Gathang teachers, the development of more Gathang teaching resources and a stronger evidence base around effective teaching strategies in language revitalisation, to

expand language learning within the schools and community. The research discussed in this article aims to make a practical contribution to developing the teaching and learning of Gathang through an investigation of the effectiveness of gesture or *matjarr djuyal*[1] as a strategy to promote the learning of Gathang nouns in a pre-school context. The present research study advances the field in three ways. First, learning nouns is an early and vital step in any language revitalisation or revival effort; in fact, the very challenges it presents in an Aboriginal revitalisation setting with few resources make the acquisition of vocabulary an important test case from a research angle that can inform the teaching of Aboriginal languages other than Gathang. Second, the present research study seeks evidence for how to maximise success in language revitalisation with young preschool learners, to capitalise on their language learning abilities. Gesture has rarely been researched in formal language contexts with very young (preschool) learners; this research contributes to addressing that relative gap. Finally, although gesture has long been part of how Aboriginal languages have been taught and communicated, there is an absence of research by Aboriginal researchers examining the efficacy of gesture in facilitating the acquisition and retention of Aboriginal languages in a revitalisation setting. An Aboriginal researcher can bring the insider out and the outsider in to broaden the scope of the study through embedding Aboriginal ways of thinking; for further details on this last point, see Radley et al. (2021).

1.2. Gesture and Non-Verbal Communication

The use of body language or kinesics is an intrinsic part of human communication, although strategies vary from one culture to another (Brown 2007). There is clear evidence of the existence of a continuing strong relationship between sign language or hand talk and spoken language in Aboriginal communities across Australia. Research from central Australia, for example, indicates that a complex system of sign language has been and still is consistently used daily in parallel with speech or to replace the spoken language specifically in specific settings such as hunting, initiation, mourning and some everyday communication (Power 2013; Green 2014; Kendon 2015).

Gesture is an important mechanism in both first and second language acquisition as a precursor to spoken language (Cartmill et al. 2014; Gullberg 2014; Macedonia and von Kriegstein 2012), and the use of gesture in the field of language revitalisation is expanding (Borgia 2014; Gardner and Ciotti 2018). Gesture is part of traditional Aboriginal teaching methods to convey the meaning of spoken words (Power 2013), for example, a movement of the hand toward self, directing a person to come, or whole-body movements in storytelling to enhance the meaning of the story. Non-verbal behaviours can be utilised as a tool to learn a second language and support verbal communication, as they offer a way for learners to explore techniques to send and receive language without using words (Brown 2007). Non-verbal learning is one of the eight key elements in Yunkaporta's Eight Ways pedagogical framework representing a 'synergy' of important Aboriginal and Western ways of learning (Yunkaporta 2009). From this perspective, gesture is both a strategy to avoid English translation as well as a means of conveying deeper cultural knowledge associated with the target language: 'The Aboriginal teacher uses facial expressions, body position, mime and gesture to communicate the meaning of language words and phrases, and this ensures that students are linking their language not to an English translation, but to their own cultural and personal meaning' (p. 43).

1.3. The Role of Gesture in Language Learning

Evolutionary theories propose that spoken language has motor origins and that gesture served as the forerunner in the development of spoken language (De Stefani and De Marco 2019). This is important from an embodied cognition perspective which posits that bodily actions can influence cognition. It is believed that the acquisition of semantic knowledge is intimately connected to sensory-motor systems in the human

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[1] In Gathang, *matjarr djuyal* means to gesture or use the hands to "talk".

body (De Stefani and De Marco 2019), and it has been shown that words are represented in the brain as a network incorporating linguistic, sensory, motor and emotional features (Macedonia and von Kriegstein 2012). Multimodal teaching methods involving, for example, verbal and pictorial instructions are thought to lead to richer more complex representations of knowledge suggesting that the addition of gesture could play a part in deepening and enriching this network. The use of hand gesture can also focus the visual attention of students more acutely on the instructional material, as well as providing additional encoding and retrieval cues (Korbach et al. 2020).

According to David Geary's theory of evolutionary educational psychology, knowledge can be categorised as biologically primary knowledge or biological secondary knowledge (Geary 2007, 2008, 2012). Primary knowledge refers to categories of knowledge that we have evolved to acquire such as the languages of the communities in which we are reared, including the dominant languages spoken in the community and the heritage languages spoken at home (Scontras et al. 2015), as well as non-verbal behaviours and facial cues. The acquisition of primary knowledge usually occurs through immersion in society, requiring minimal conscious processing and generally very little, if any, explicit instruction (Geary 2012; Sweller et al. 2011). In terms of language acquisition, some people acquire primary knowledge from both the dominant language spoken by the community in which they are reared and the language that is spoken at home (heritage language). During their pre-school years, these heritage speakers can develop language skills in both the dominant language of the community and their heritage language. However, over time, heritage speakers tend to socialize with others in the dominant language which then often results in a weakening of their heritage language skills (Scontras et al. 2015).

In contrast to primary knowledge, secondary knowledge refers to the knowledge that has been generated and passed on through generations via cultural advancements. Examples include complex writing systems, algebra, chemistry, amongst others. This category of knowledge is cognitively demanding and requires many years of formal instruction in order for learners to demonstrate proficiency. Second language learning, particularly when bound to a formal classroom setting, can arguably be classified into the secondary knowledge category.

Notably, it is argued that primary forms of knowledge can assist in the acquisition of secondary knowledge and alleviate some of the cognitive demands of secondary knowledge (Korbach et al. 2020). Gesturing is considered to be biologically primary knowledge and when incorporated in second language acquisition can offset some of the cognitive demands associated with language learning. In their review of current behavioural and neuroscientific research into the impact of gesture on the learning of lexical items, Macedonia and von Kriegstein (2012) suggest that gesture can enhance the acquisition and retention of words and phrases. Wakefield and James (2015) demonstrated that the use of gesture can help children learn a new concept when they are at a point in their development where they can benefit from instruction. Ping and Goldin-Meadow (2010) provide more specific evidence that gesture is effective in lightening cognitive load, therefore, supporting learning and the retrieval of information among second and third grade students. Studies analysing the use of gesture and speech suggest that gesturing can promote language learning in vocabulary development (Rowe and Goldin-Meadow 2009) and increases learning of mathematics (Church et al. 2004). Other studies have also highlighted the importance of speech and gesture as an interconnected system used for second language learning (Gullberg 2014) and in language development in early childhood (Cartmill et al. 2014). In language revitalisation, there are, however, with the exception of Borgia (2014), very few previous studies examining the utility of gestures with very young learners, despite the popularity of revitalisation approaches targeting this age group (e.g., language nests).

1.4. Gesture as a Teaching Strategy

As gesture is a common human complement to speech, it is very likely to form a part of a language teacher's interaction with learners. However, there are few language

teaching methods that incorporate the systematic use of gesture as a teaching strategy. Total Physical Response (TPR) is a second language teaching methodology developed in the 1960s. TPR provides one example that seeks to use gesture as a teaching strategy. The learners listen to a command and then physically enact it, enforcing the language instruction and avoiding the need for translation (Asher and Price 1967). The method relies on listening and responding to support learning, although the focus on commands and comprehension makes learning past the beginner's stage difficult (Suhendan 2013). More recently, other language teaching methods have been developed with an explicit focus on gesture, such as the Accelerated Integration Method (AIM) (Arnott 2011) and the 'Where are your keys' (WAYK) method (Gardner and Ciotti 2018).

The bodily movement associated with TPR typically involves the learner enacting a command, for example, 'Go to the door'. However, more symbolic gesture could equally be used to simulate or represent an action, for example, 'drinking' (Macedonia and von Kriegstein 2012). These gestures can either be drawn from the repertoire of gestures recognised and used within a specific culture (emblematic) or they can be more idiosyncratic, reflecting an individual conception of the target word or phrase which might be more or less closely tied to the semantics of the action through the use of more universal iconic imagery (Church et al. 2004). Church et al. (2004) give the example of the gesture where thumb and index finger form a circle (which means 'OK' in some cultures) as an emblematic gesture and making a large circular gesture to represent the statement 'It was big and round' as a 'representational' gesture. Unlike TPR, the AIM and WAYAK methods incorporate both emblematic and representational gestures.

McNeill (1992) divides gestures into four major categories: iconic, metaphoric, deictic (pointing) and beat (related to the rhythm of speaking). It has been shown that iconic gesture alongside speech (speech–gesture matches) reduces the load on the working memory more than speech–gesture mismatches (Goldin-Meadow 1993); hence, to maximise learner success, in this research, we have used iconic gesture matched with concrete objects. The gesture used for the experiment was either borrowed from existing gesture systems, such as Auslan, or Australian Aboriginal hand talk, if the gesture was judged to be iconic, or developed specifically for this research by the lead researcher. Three parameters were used to construct iconic gesture—hand shape, hand position in relation to the user's body and path of movement.

2. Method

2.1. Research Hypothesis

Based on the empirical findings and cultural and theoretical backgrounds discussed above, this study tests the hypothesis that the use of iconic gesture to teach Gathang nouns (alongside verbal and pictorial instruction) will result in higher scores for children in subsequent testing of receptive and expressive knowledge of Gathang nouns compared to instruction without gesture. We included both receptive and expressive testing because it is well established that receptive knowledge typically precedes expressive language skills, in first and second language learning. Although it was expected that oral production of Gathang nouns was likely to be a difficult task for pre-schoolers, it was not clear in advance the exact difficulty level that the learning would pose, particularly given individual learner variation. We therefore included both receptive and expressive testing in case of ceiling or floor effects (if the task was too easy or too hard, respectively). Participants were tested for acquisition 'post-test 1' (two days after the last learning session) and retention 'post-test 2' (seven days after the last learning session). Retention testing was included as there are long standing findings in memory research (see McGaugh 2000) that memories are consolidated slowly over time. One of the consequences of this is that knowledge and skills can improve when there is a gap between initial acquisition and follow-up testing, even in the absence of active rehearsal (Stafford and Haasnoot 2017). In the context of this study, this means that experimentally it might be only possible to measure learning—and

so assess the effectiveness of gesture use—after a period of time had elapsed (i.e., in the post-test 2).

2.2. Ethics Considerations

In conducting the research, the lead author, a proud Goori[2] woman, language activist, teacher/learner and Aboriginal Elder, is under specific ethical requirements to meet local Aboriginal protocols as an Aboriginal researcher. As a Gathang teacher and community elder supporting decolonisation through the revival of Gathang, she is an insider (Smith 2012). As an observer testing a research hypothesis, she is stepping into an outsider role. Bonner and Tolhurst (2002) describe the research insider as holding a greater understanding of the specific culture studied, keeping a flow between the social interaction of the researcher and respondent, and having an existing or established level of intimacy promoting truth-telling within the research process. Both roles require critical thinking about actions and processes; however, the insider is accountable to the community in a way the outsider is not (Smith 2012). In recognition of this, before beginning the research, cultural protocol obligations were observed, and discussions were held with all relevant local Aboriginal organisations and communities. These practices are consistent with the Guidelines for Ethical Research in Indigenous Studies (AIATSIS 2020) for working with communities on language projects.

As preschool-aged children are the focus of this research, the research design draws on the 'Ethical Research Involving Children (ERIC) project' approach which views children as individuals with agency (Graham 2015, p. 26). ERIC positions children as capable of providing informed consent when given age-appropriate information about the study. A tiered model of consent was introduced, where, in addition to parental consent, informed consent of the child was also sought. The children were individually asked if they wanted to participate in the language lessons and the testing task, and educators who knew them were present to support any who wished to opt out. It was the case that some children opted out. Ethics approval for the project was granted by the Western Sydney University Human Research Ethics Committee (H13060).

2.3. Experimental Approach

The experimental research method is used to test the effectiveness and impact of an intervention in controlled conditions where factors of interest (i.e., independent variables) are manipulated to assess impact on one or more dependent variables (Cohen et al. 2000). In this study, the main independent variable was iconic gesture use in teaching and learning.

2.4. Participants

The study was conducted in the context of a preschool centre. In support of Gathang language revival, the local Community Preschool Centre offered their service to provide a cohort and facility for the study. Forty children attending the preschool aged between 4 and 5.2 years participated in the study.

The children had already, as part of regular teaching, been placed by the Community Preschool Centre within two class groupings, classroom Wati (A) and classroom Buna (B). The considerations for placement had included sibling relationships, peer groupings, special needs and days of enrolment. In both class groupings, there was a small number of children who spoke, or were exposed to, a language other than English at home. One child with Birrbay heritage in the Buna group had had previous exposure to Gathang at home. However, checks made with his family confirmed that Gathang nouns introduced within the teaching program were not known to him. Although there were other children of Aboriginal origin in the study, their families were not from Gathang speaking nations. Discussions with parents and educators indicated that no other child had exposure to Gathang outside of the community pre-school environment and had no knowledge of

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2   Australian First Nations people on the Mid Coast, NSW, use the term 'Goori' to identify themselves as Aboriginal people from this region.

the Gathang nouns used in the study. All families were in support of their children participating in the experiment.

As shown in Table 1, the participants (*N* = 40) had an age range of 4–5.2 years. The class groups were broadly similar in demographic makeup. There were more boys than girls in both class groups. The children were predominantly from non-Aboriginal families (not of Australian Aboriginal origins) in both class groups. The children with special needs were already distributed across the two groups prior to the research, as were the children from non-English-speaking backgrounds.

Table 1. Characteristics of child participants.

Class Grouping	n	Number of Girls	Number of Boys	Age (in Years)			Aboriginal Children	Children with Special Needs	Children from Non-English-Speaking Backgrounds
				M	**S.D.**	**Range**			
Buna	19	7	12	4.6	0.39	4.1–5.2	4	2	3
Wati	21	8	13	4.6	0.31	4–5.2	3	4	3

2.5. Materials and Procedures

The learning materials comprised ten nouns in Gathang; five to be taught with gesture, and five without. The pairing of the two sets with and without gesture was counterbalanced across the Buna and Wati class groups. In this way, the children acted as their own controls in that each child was taught half the Gathang nouns with and half without gesture.

The number of ten nouns was chosen as an achievable target for the preschool class lessons. The rationale for the selection of nouns was based on each set containing semantically similar items: language names for people, creatures and tangible objects whose semantics are relatively well known to the learners. It was important that the items could be easily associated with iconic gesture and pictorial (image) support. We also balanced each set to have a similar phonological difficulty level (e.g., word length in syllables, phonotactics). Figure 1 shows the nouns together with the associated images used in teaching. The nouns are in two sets (set 1 and set 2), and there are five items in each set.

The experiment involved a learning phase, followed by a testing phase. The lead researcher taught all phases, with classroom support from the children's regular educators. Each class group was taught one of the noun sets with gesture and one without gesture in two 35–40 min lessons. As there were two sets of nouns, the counterbalancing across class groups allowed the researchers to assess the effect of gesture use independent of the actual word set learned. The testing phase began two days after the last lesson. Children were tested individually to see whether they had learnt the Gathang nouns (post-test 1) and then tested five days later (post-test 2). In both of these tests, there were two components: the child was asked to respond to verbal language (receptive) and to speak language (expressive).

The teaching program was created in consultation with the Community Preschool staff. Table 2 provides details of the schedule.

Table 2. Teaching program.

Set 1—Nouns	Group Wati—With Gesture	Group Buna—Without Gesture
Lesson 1 (40 min)	18 March 2019 Monday	18 March 2019 Monday
Lesson 2 (30 min)	20 March 2019 Wednesday	20 March 2019 Wednesday
Post-test 1 (individual)	22 March 2019 Friday	22 March 2019 Friday
Post-test 2 (individual)	27 March 2019 Wednesday	27 March 2019 Wednesday
Set 2—Nouns	Group Buna—With Gesture	Group Wati—Without Gesture
Lesson 1 (40 min)	1 April 2019 Monday	1 April 2019 Monday
Lesson 2 (30 min)	3 April 2019 Wednesday	3 March 2019 Wednesday
Post-test 1 (individual)	5 April 2019 Friday	5 April 2019 Friday
Post-test 2 (individual)	10 April 2019 Wednesday	10 April 19 Wednesday

Figure 1. Noun sets.

2.6. Learning Phase

The lessons for each of the noun sets were two days apart. The first lesson was to present/practise new content, and the second lesson was to revise/consolidate content. Each group received the same learning program. For the lessons that were taught with gesture, an iconic gesture was used to introduce each noun in the set (see Appendix A) and the same gesture was used thereafter throughout the two lessons.

Children were encouraged to use the gesture in these lessons (as well as to say the words verbally, as in the without-gesture condition). The lesson design enabled the children to explore the language in different ways using an interactive approach. Short activities throughout the lessons were used to introduce and/or consolidate the children's language learning. These activities included: Call and Response—children say the words loudly gradually becoming softer (turn up and down volume) and then using different kinds of voice (deep, squeaky, growly); Rhythm and Beat—children clap and say the words,

breaking the words into syllables (e.g., *Mi tji gan*); Memory Game—children find matching picture cards and say the Gathang words for the card. The activities allowed the children to hear and respond repetitively to each noun set shown in Figure 1.

2.7. Testing Phase

Each child was tested for acquisition in 'post-test 1' two days after the final learning session and then five days later for retention in 'post-test 2' for each set 1 and set 2—that is nouns learnt with and without gesture. The children were tested individually by the researcher with whom they had become familiar over the course of the teaching sessions. Testing took place in a small private room in the centre. Post-test 1 and Post-test 2 both comprised a receptive and an expressive task. First, the child was given a receptive task. This tested the child's ability to match an image with a spoken Gathang word. The child was given a sheet with four images, one of which matched the Gathang word. The researcher said a word in Gathang and the child was asked to stamp the image that represented the word. The children were familiar with this kind of activity from the learning sessions. The images used in the testing were different from those used in the learning sessions to ensure that real semantic learning had taken place, not just associative learning of the noun and a particular image. Second, the child was given an expressive task. The child was asked to say the Gathang word represented by an image. The researcher showed the child an image representing one of the Gathang nouns and said *Minya yii?* ('What is this?'); *yii* ('this is . . . .'). The child was familiar with these phrases from the learning sessions and understood that they should say the Gathang word represented by the image. All five nouns in the set were tested, resulting in a score out of five. One point was awarded for each word the researcher judged had been pronounced correctly. At the end of the testing sessions, the children were not given any feedback on their results other than receiving praise for their efforts. This reduces concerns of practice effects in post-test 2, as the children did not know whether they had answered correctly. The same testing sequence and pictures were used for post-test 1 and post-test 2.

2.8. Data Analysis

The overall design involved a single independent (treatment) variable, gesture, which had two levels (with gesture and without gesture). Gesture was a within-participants' variable. The effect of gesture was assessed for each child at two time points (post-test1/post-test 2) across two modes at each time point (receptive/expressive). The data analysis focused on inferential analysis of the test scores, which were recorded for each child at two time points: post-test 1 (two days after the last learning session) and post-test 2 (seven days after the last learning session). The scores were noted during testing on paper and then transcribed into a spreadsheet. Overall, each child received eight scores in testing, four per noun set: two scores for post-test 1 testing (receptive and expressive) with gesture; two scores for post-test 1 testing (receptive and expressive) without gesture; two scores for post-test 2 testing (receptive and expressive) with gesture, and two scores for post-test 2 testing (receptive and expressive) without gesture. If a child did not attend a testing session, there was no score recorded.

To test the hypothesis that the use of gesture alongside verbal and pictorial instruction for Gathang nouns would result in higher accuracy scores for children in subsequent testing (receptive and expressive testing), four paired-samples t-tests were conducted. There was one paired-samples t-test for each of receptive post-test 1, receptive post-test 2, expressive post-test 1, and expressive post-test 2. The paired-samples t-tests were one-way t-tests given the directional hypothesis that gesture would benefit children's learning of the Gathang nouns.

3. Results

Across the time point x mode conditions, children's scores for words learned with vs. without gesture are shown in Figure 2. The maximum score in all cases was five.

Descriptively, it is clear that children tended to score higher in receptive testing than expressive testing, as would be expected in language learning. Note that it is not possible to read Figure 2 for the effect of gesture across time point and mode conditions, as each child acted as their own control, and there was wide individual variation in how hard the task was for the participants. Figure 2 also illustrates how children's scores tend to be higher for words they have learned with gesture, in the post-test 2 conditions but not in the post-test 1 conditions.
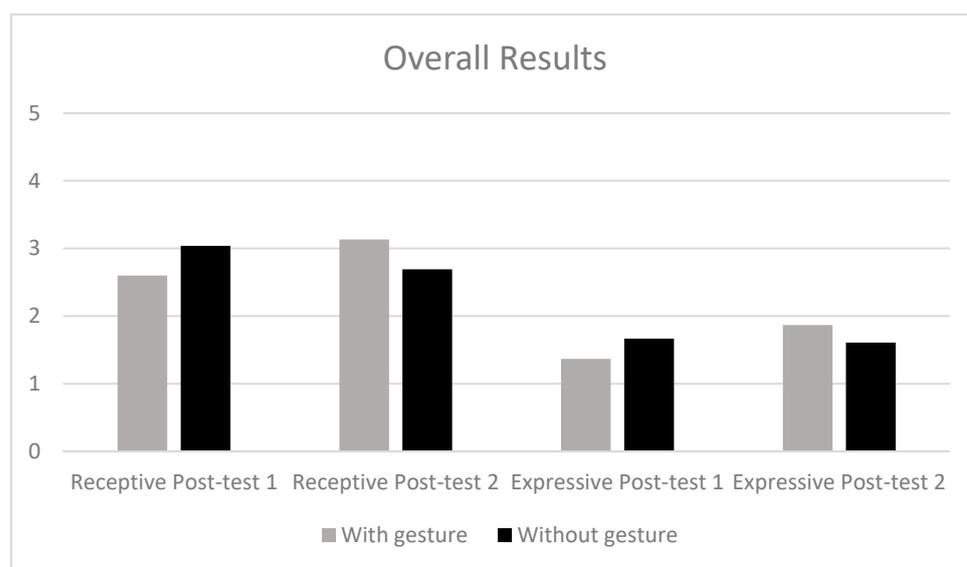
Figure 2. Mean accuracy scores by timepoint x mode conditions, with and without gesture.

Next, we present detailed results for the effectiveness of gesture by mode and time point. For each mode × time point, the results are presented with paired *t*-test statistics, a plot of individual results and a box plot. The box-plot graph is a summary of a data set based on quartiles of the data (splits data into four groups) with each quartile containing 25% of the measurements. The whiskers represent the ranges for the bottom 25% and the top 25% of the data values. The median (middle quartile) marks the middle score in the data and is shown by the line that divides the box into two parts. Half the scores are greater than or equal to this value and half are less. The middle "box" represents the middle 50% of scores for the group.

3.1. Receptive Post-Test 1

In the receptive post-test 1 condition, assumptions of normality were met; the difference scores (i.e., score without gesture—score with gesture) for receptive post-test 1 appeared to be normally distributed since the Shapiro–Wilk statistic was not statistically significant ($W = 0.932$, $p = 0.111$). Children's scores for words learned with gesture ($M = 2.6$, $SD = 1.8$) were not higher than for words learned without gesture ($M = 3.0$, $SD = 1.5$), $t(23) = -1.415$, $p = 0.915$. The mean of the differences (With Gesture vs. Without) was -0.46.

Figure 3 shows that the median score was 3 (with middle 50% range 2–4) for words learned without gesture and 3 (with middle 50% range 1–4) for words learned with gesture.
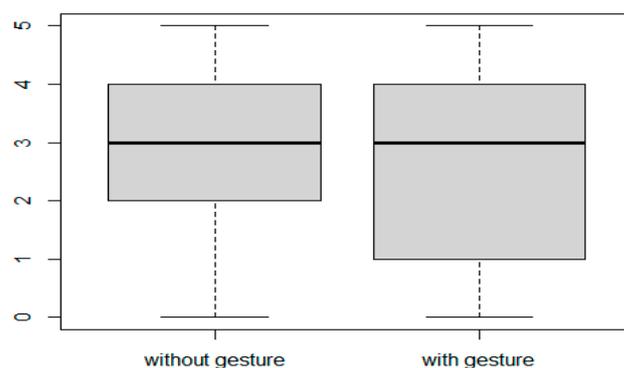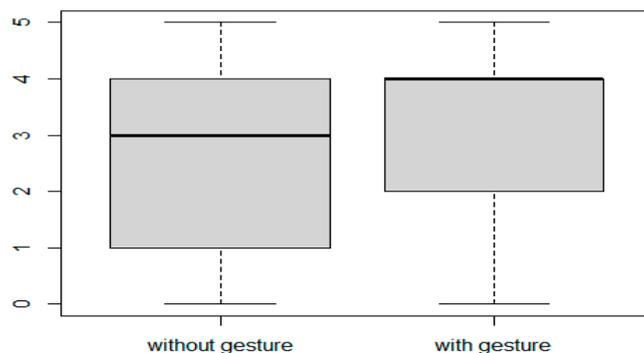
Figure 3. Box plot for testing results in Receptive Post-Test 1 condition.

3.2. Receptive Post-Test 2

In the receptive post-test 2 condition, assumptions of normality were met; the difference scores (i.e., score with gesture—score without gesture) for Receptive post-test 2 were considered to be normally distributed since the Shapiro–Wilk statistic was not significant (W = 0.946, p = 0.286). Children's scores for words learned with gesture (M = 3.1, SD = 1.6) were higher than for words learned without gesture (M = 2.76, SD = 1.7), $t(20)$ = −1.925, p = 0.034. The mean of the differences (With Gesture vs. Without) was −0.76. The effect size (Cohen's d) is 0.42, i.e., a medium effect size.

Figure 4 shows that the median score was 3 (with middle 50% range 1–4) for words learned without gesture and 4 (with middle 50% range 2–4) for words learned with gesture.

Figure 4. Box plot for testing results in the Receptive Post-Test 2 condition.

3.3. Expressive Post-Test 1

In the expressive post-test 1 condition, assumptions of normality were met; the difference scores (i.e., score with gesture—score without gesture) for expressive post-test 1 were considered to be normally distributed since the Shapiro–Wilk statistic was not significant (W = 0.937, p = 0.142). Children's scores for words learned with gesture (M = 1.4, SD = 1.5) were not higher than for words learned without gesture (M = 1.7, SD = 1.5), $t(23)$ = −1.053, p = 0.848. The mean of the differences (With Gesture vs. Without) was −0.33.

Figure 5 shows that the median score was 1 (with middle 50% range 0–3) for words learned without gesture and 1 (with middle 50% range 0–2) for words learned with gesture.
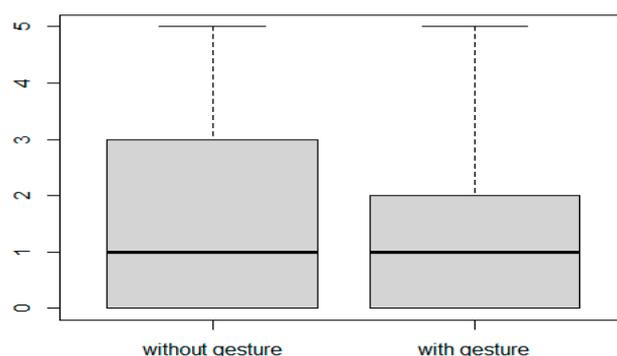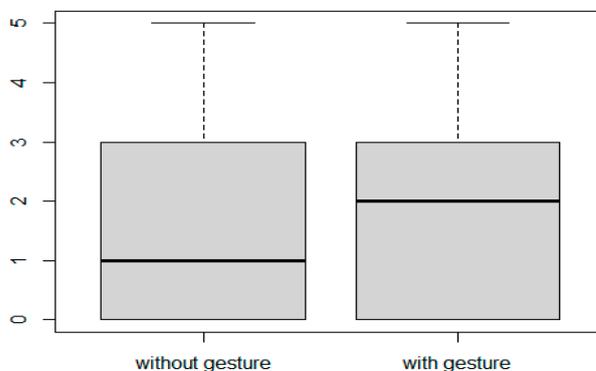
Figure 5. Box plot for testing results in the Expressive Post-Test 1 condition.

3.4. Expressive Post-Test 2

In the expressive post-test 2 condition, assumptions of normality were met; the difference scores (i.e., score with gesture—score without gesture) for expressive post-test 2 were considered to be normally distributed as the Shapiro–Wilk statistic was not significant (W = 0.944, *p* = 0.264). Children's scores for words learned with gesture (M = 1.9, SD = 1.7) were not higher than for words learned without gesture (M = 1.6, SD = 1.6), *t*(20) = −1.446, *p* = 0.082, although the fact that the *p*-value approaches 0.05 indicates that there was possibly a tendency towards a benefit from gesture. The mean of the differences (With Gesture vs. Without) was 0.62.

Figure 6 shows that the median score was 1 (with middle 50% range 0–3) for words learned without gesture and was 2 (with middle 50% range 0–3) for words learned with gesture.

Figure 6. Box plot for testing results in the Expressive Post-Test 2 conditions.

4. Discussion

This study used a classroom-based experiment to test the usefulness of iconic gesture alongside spoken instruction and pictorial image to support pre-schoolers learning Gathang. The experimental results supported the hypothesis that the use of gesture benefits the learning of nouns in Gathang, at least for the post-test 2 condition (i.e., seven days after the last learning session). At post-test 2, the benefit for gesture reached significance in receptive knowledge testing and approached significance in expressive knowledge testing. For the post-test 1 (i.e., two days after the last learning session), there was no effect of gesture on receptive or expressive knowledge of the Gathang nouns.

Overall, the findings provide empirical evidence for the use of gesture to teach the Gathang language, and the results can be interpreted within several theoretical models. The findings are consistent with dual coding theories and align with previous empirical research with that framework (e.g., Korbach et al. 2020). The visual focus of gesture may help the learners attend, and the incorporation and encouragement of body movement in the lessons provide additional sensorimotor encoding. In practical terms, teachers

and parents of preschoolers recognise that young preliterate learners are often physically highly energetic and have relatively short attention spans. According to dual coding theories, memories are stronger when encoded in more than one sensory mode. At this age, when (most) children are not literate and so cannot encode visually via spelling, using gesture harnesses a visual and gross motor encoding alongside the auditory and oral-motor encoding of spoken language.

The findings are also supportive of other theoretical models. Perspectives from evolutionary educational psychology suggest that the use of biological primary knowledge (gesture) can offset some cognitive demands in secondary knowledge acquisition (here, second language learning). The results are consistent with this viewpoint. From an educational psychology perspective, it was also expected that learning would take time and require consolidation, which was why we tested at both acquisition 'Post-test 1' (2-day) and retention 'Post-test 2' (7-day) time lags. The finding that the beneficial effect of gesture was detectable at retention but not acquisition was somewhat surprising; however, it may point to the complexity of language learning and its need for consolidation. The finding also suggests that future research in language learning might usefully employ more delayed testing to pick up more subtle traces of learning progress, alongside the immediate testing that seems more common in the literature (Norris and Ortega 2000).

The lead researcher as an Aboriginal language activist/teacher researcher brings other specific perspectives to the evaluation of this study, and the prospects of future research. She has an insider role being a Gathang language teacher and community Elder supporting decolonisation through the revival of the Gathang language and an outsider role as an observer to test the hypothesis and manage the research study. Her experience doing this study using a Western scientific approach is that it is an important first step, but it raises further questions. The reduction in variables required for a controlled experimental approach in a preschool classroom environment reduced the scope to embed Aboriginal pedagogies, for example, 'Aboriginal ways that include connection to land, community and stories' (Yunkaporta 2009), which gives broader terms of reference to engage with language learners. It is clear, however, that having demonstrated benefit from gesture use in the controlled context of this study, there is every reason to imagine that these results can be translated to richer educational approaches (i.e., that gesture will help learners in those richer contexts). Therefore, the study will also contribute to the efforts made toward the revitalisation of the Gathang language.

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Appendix A

Table A1. Iconic gestures used in the study.

burray 'boy', right hand is closed around the chin moving in downward motion to hip level (as for gesture for man), then hand is open and turns on a 90-degree angle to arm and positioned at the side of the body continuing on a downward motion (gesture for 'little')	*mitjigan* 'girl', using the right hand to flick the hair away from away from the head	*guying* 'bird', holding the right hand to the side of the face close to the lips, index and thumb fingers, opening and closing together to mimicking the bird beak	*bikan* 'platypus', bringing two hands together to each side of the body, waist level, moving hands in a paddling motion	*butjin* 'basket', bending arm from the elbow, raising arm up and down in short motions, as in carrying a bag
guri 'man', right hand is closed around the chin moving in downward motion to hip level	*galbaan* 'woman', both hands are cupped under breasts	*mirri* 'dog', hitting the top of leg in continuous motion as if calling the dog	*gunggang* 'frog', holding the hand at the front of throat, moving the hand to and from the throat area	bakan 'rock', bringing two hands together in a closed fist moving one hand on top of the other in an upward and downward motion

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