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Learning graphic symbols in two languages: Effects of monolingual teaching

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Keywords: Augmentative and alternative communication, bilingual, child, graphic symbol, transference.

Abstract

Purpose: Limited research exists to guide augmentative and alternative communication (AAC) intervention to children from multilingual backgrounds. When a graphic symbol-based AAC system is provided to children, they need to learn the meaning of the graphic symbols. This study determined the effect of teaching the association between a graphic symbol and a spoken word in one language on the ability of bilingual children without disabilities to transfer this learning to their second language.

Method: A one group pretest-posttest design was used. The ability of 30 English-Afrikaans bilingual children aged 4-5 years to provide the spoken words associated with nine graphic symbols in English and Afrikaans was evaluated before and after teaching them the symbol-word associations in English.

Result: Correct symbol-word associations in English increased from a median of 0 to 9 post teaching, while correct symbol-word associations in Afrikaans increased from a median of 0 to 6. A moderate positive relationship was identified between children's performance on symbol-word associations in Afrikaans during the posttest and their use of Afrikaans in the home.

Conclusion: Results suggest the presence of positive transference of graphic symbol-word associations learnt in one language to another known language. The implications of this finding on the provision of multilingual AAC intervention is discussed.

Keywords: Augmentative and alternative communication, bilingual, child, graphic symbol.

Introduction

Multilingualism is prevalent across the world. Estimates indicate that more than half of the world's population speak two or more languages (Grosjean, 2013; Kohnert, 2013). However, this reality seems to remain only marginally acknowledged in the field of communication disorders, with intervention practices and research focusing primarily on monolingual populations or persons using the dominant language (Kay-Raining Bird, Genesee, & Verhoeven, 2016; Paradis, 2016). When acknowledged, multilingualism is often problematised and perceived as an additional risk to communication development of children with communicating disorders. Although current research does not support this notion (Kay-Raining Bird et al., 2016), intervention efforts may still be directed at promoting monolingual language practices by the person with the communication disorder and their communication partners. Such practices do not acknowledge the sociolinguistic realities of multilingual families and communities.

In the field of augmentative and alternative communication (AAC), a similar dearth of research and intervention guidelines for multilingual populations is evident (Soto & Yu, 2014). Intervention studies focusing on supporting multilingual clients in need of AAC seem to be limited to case studies and anecdotal reports (Kempka Wagner, 2018; Stewart, 2017). Consequently, practitioners may experience uncertainties around appropriate intervention practices for multilingual clients. These may include questions about the design of aided AAC systems in two languages, and questions about the learning demands such aided systems may pose. These questions may be particularly pressing when a graphic symbol-based AAC system is recommended.

The current study aimed to understand to what extent bilingual children without disabilities can translate the words associated with graphic symbol from one spoken language into their other language. If children are able to do so, this would mean that children's

learning of symbol-word associations in one language can transfer to their other language, and that additional teaching of symbol-word associations in the other language may not be necessary. This may have implications for children who, in spite of good receptive language skills and no cognitive disabilities (the so-called expressive group according to Von Tetzchner and Martinsen, 2000), may require graphic symbols to express themselves, due to, for example, severe physical disabilities. In the sections following, children's bilingual vocabulary and their ability to translate between words in two languages will be discussed. The role of graphic symbols in AAC as well as the acquisition of graphic symbol-word associations will be considered next. The potential for children to transfer learning of a graphic symbol-word association in one language to another language will be considered as a motivation for the current study.

Bilingual vocabulary and translation in young children

Various models and theories have been proposed to explain how word meanings (semantics) are acquired in two languages (De Groot, 2013). According to the Revised Hierarchical Model (RHM; Kroll & Stewart, 1994; see also Kroll & Tokowicz, 2001, 2005; Kroll, Van Hell, Tokowicz, & Green, 2010; Sunderman & Kroll, 2006), the acquisition of new vocabulary in a second language may either take place via the vocabulary of the first language (lexical route – linking the form representation in L1 to the form representation in L2) or via direct conceptual mapping (conceptual route - linking the form representation of the L2 word directly to the conceptual representation), or via a combination (Comesaña, Perea, Piñeiro, & Fraga, 2009). Various psycholinguistic studies propose that these links exist (see Figure 1), although they are not static and change with increasing proficiency in L2 (see De Groot, 2013; and Kroll et al., 2010, for summaries of studies). How these links form in young children who are exposed to two languages at an early age and to what extent young bilingual children can flexibly access the concept or the representations via various routes

(e.g., accessing one form representation via another form representation, i.e., translation) is not well-understood. However, it is documented that translation pairs (i.e., two form representations for one concept) in the receptive and expressive (spoken) vocabulary of bilingual children without disabilities are present from an early age. Legacy et al., (2017), for example, found that the expressive vocabulary of French-English bilingual children aged 1;4 (years; months) consisted to 49% of translation pairs. This proportion increased to 61% by age 2;6. A larger and proportionally more balanced vocabulary was associated with a higher proportion of translation pairs, as was a proportionally more balanced exposure to both languages. According to Woods (2013), these translation pairs exist among different lexical categories, including adjectives. These findings support the notion that children can accommodate the existence of more than one representation for the same concept within their symbolic repertoire from an early age. In addition, anecdotal reports suggest that bilingual toddlers and preschoolers are able to translate words from one language to another language, and that translation is an innate skill of bilinguals (Harris & Sherwood, 1978). This suggests that young children are able to link the two form representations (two spoken words), although these links may not have been formally taught.

Graphic symbols

Graphic symbol-based AAC systems are typically used for individuals with complex communication needs who are not (yet) literate. Graphic symbols (also called picture symbols or line drawings) are used to represent concepts. These symbols can be selected to convey a message. Various commercially available graphic symbol libraries (e.g., Picture Communication Symbols®[1] [PCS], Metacom[2], and Symbolstix[3]) have been developed and expanded over the years. These symbol libraries are typically developed with reference to a

[1] Picture Communication Symbols are a registered trademark of Tobii Dynavox LLC of Pittsburgh, PA, https://us.tobiidynavox.com
[2] Metacom was developed by Anette Kitzinger, Oeversee, Germany, https://www.metacom-symbole.de
[3] SymbolStix is a product of n2y, LCC, https://www.n2y.com

specific spoken language, for example, English. A single PCS, for example, often corresponds to one English spoken word (e.g., 'on'). This approach works well for analytic languages such as English where most words consist of one morpheme.

Using a graphic symbol-based AAC system involves a number of cognitive and linguistic tasks or skills that need to be mastered (Thistle & Wilkinson, 2017). One of these tasks involves learning the meaning of each graphic symbol; that is, to map the graphic symbol (form representation) onto the concept it represents (conceptual representation or referent). While some symbols may be easily guessable or transparent (e.g., due to visual similarities with the referent), those that represent more abstract concepts (e.g., descriptors, pronouns, or abstract nouns) cannot exploit the potential for visual similarities between a concept and the graphic representation. The association between symbol and referent therefore has to be learnt.

Unlike the development of vocabulary in two natural languages through exposure to both in the natural environment, the acquisition of graphic symbols by children who have limited speech typically requires formal instruction, since children are hardly ever surrounded by natural competent models of the use of the graphic modality (Von Tetzchner & Stadskleiv, 2016). When children have good spoken language comprehension, the graphic symbol is often paired with the spoken word during such formal instruction. Paired associate learning and symbol explanations have been successfully used to teach children the association between a graphic symbol and a spoken word (Emms & Gardner, 2010; Schlosser and Lloyd, 1997). Symbol explanations describes a strategy whereby the relationship between the symbol and the referent is explained (Mollica, 2003). This may be especially appropriate for symbols where a logical relationship between symbol and referent is discernable, once the referent is known. For example, once explained, a graphic symbol depicting a tortoise may

logically be understood to represent the concept ‘slow’, because the tortoise is associated with slow movements.

The current study

Persons in need of AAC who are exposed to bilingual contexts would require their AAC systems to support communication in two languages. It follows that graphic symbols would be needed to represent words in two different spoken languages (see Figure 1). This may place additional learning demands on the person as they would need to learn to use graphic symbols to represent and express these two spoken languages. In order to start understanding some of the leaning demands inherent in this process, the current study aimed to investigate the extent to which a graphic symbol-word association learnt in one known language could facilitate the formation of an association between the graphic symbol and the translation equivalent word in another known language. The presence of translation pairs in the early bilingual vocabulary of young children suggests that they are able to co-ordinate more than one symbolic representation for on concept. The limited evidence on spontaneous translations by young children (Harris & Sherwood, 1978) further suggests that children seem able to link the form representation in one language to that in the other language (see Figure 1). Our hypothesis was, therefore, that children would be able to learn a graphic symbol-word association in one language, and generalise this to the word (translation equivalent) in the other language.

A number of caveats need to be noted in this work. First, the participants in this study were children without disabilities. Involving persons without disabilities in research aimed at understanding some of the underlying cognitive and linguistic processing requirements in using AAC has a longstanding history in the field (Higginbotham, 1995). This allows researchers to recruit larger and more homogenous participant groups. The assumption here is that some persons in need of AAC do not have impairments or differences in cognitive and

linguistic processing (Higginbotham & Bedrosian, 1995). However, results obtained in such studies may not apply to populations with intellectual or language impairments (Bedrosian, 1995).

Second, the study investigated nine translation pairs that were deemed to overlap in meaning to the extent that one graphic symbol could be used to represent both words. The results of this study therefore only apply to such translation pairs. Generally, languages with similar linguistic typology contain more translations pairs with considerable overlap in meaning – such languages often have a common origin (de Groot, 2013). Languages with dissimilar linguistic typology typically contain fewer of such translation pairs.

Last, although the possibility of a complex relationship between the graphic symbol, the concept, and the spoken words in both languages is acknowledged (see Figure 1), we used an expressive task as evidence of an association being formed between the graphic symbol and the spoken word. The limitations of this are discussed at the end of the article.

The questions addressed in this study are (1) What is the effect of teaching English-Afrikaans bilingual children the association between a symbol and an English word on their ability to form an association between the same symbol and the Afrikaans translation equivalent of the English word? (2) Is their performance related to their receptive language skills in English and Afrikaans, their age, and/or their use of and/or exposure to Afrikaans?

Method

Design

A quasi-experimental pretest-posttest design was used. The ability of 30 Afrikaans-English bilingual children to associate nine PCS with English and Afrikaans words was tested before they were taught the English word-symbol associations through providing them with symbol explanations, mands, and feedback. Thereafter, their ability to associate the symbols with both Afrikaans and English words was once again tested. The dependent variables in

this study were the ability to express the words associated with the graphic symbol in English and in Afrikaans.

Participants

Permission from the relevant institutional ethics board was obtained prior to the commencement of the study. The participants in the study were 30 children aged 4;0 (years;months) to 5;11 without disabilities. Children needed to comply with the following criteria: (1) receptive vocabulary knowledge as tested by standardised instruments of no more than -1 standard deviation from the norm in both languages (taking the confidence interval into consideration); (2) no parental concerns about development; (3) not receiving occupational or speech therapy to address developmental delays; (4) unable to express the Afrikaans and English word associated with at least eight of the nine PCS used in the study; (5) receptive knowledge of the nine English and Afrikaans words that were associated with the nine PCS.

They were recruited from 12 preschools within a metropolitan area in South Africa, using convenience sampling. The preschools were located in lower-middle and upper-middle income areas. Preschool teachers were required to identify children who were bilingual in Afrikaans and English. Information letters, consent forms, and biographical questionnaires were then sent to the parents/legal guardians of the children. Once parents/legal guardians had consented, children were asked for assent to participate in the study. The researcher presented the study in child-friendly language according to a script supported by pictures. Once children had assented, screening commenced. A total of 30 children met all the selection criteria and were included in the study.

Table 1 provides the mean, standard deviation and range of a number of variables related to the participants. Of the participants, 15 were exposed to both Afrikaans and English from birth. A further 15 were exposed to the second language starting from age 12-36

months. Children's exposure and use of each of the languages at home and in the preschool (as estimated by parents and teachers) ranged considerably across the sample.

Materials

Background information from parents and preschool teachers was obtained for each child via a parent and teacher questionnaire. The *Peabody Picture Vocabulary Test – Fourth Edition* (PPVT-4) (Dunn & Dunn, 2007) was used to get an impression of the participants' English receptive vocabulary skills. The *Afrikaanse Reseptiewe Woordeskattoets* (ARW - Afrikaans Receptive Vocabulary Test) (Buitendag, 1994) was used to obtain an impression of their Afrikaans receptive vocabulary skills. A customised screening tool was devised to ensure that children understood the English and Afrikaans words that were represented by the nine PCS used in the study. Three additional translation pairs representing three additional concepts were added to avoid priming (i.e., alerting the children to the target words associated with the nine symbols). Each of the twelve concepts was represented using a picture from ClipArt. The picture was color printed together with three other distractor pictures on an A4 page. An example is presented in Appendix A.

Nine PCS (see Appendix B) were used during the pre-test, the intervention, and the post-test. These symbols represent nine adjectives. Adjectives were specifically chosen as they tend to be depicted by graphic symbols that are translucent. Translucent symbols are not guessable, but one would generally be able to perceive a logical relationship between the symbol and the referent, once the referent is known (refer back to the example of the word 'slow' being depicted with a tortoise, as explained in the introduction). The symbols and their corresponding words in Afrikaans and English had been used in a pilot project (Wylie, 2017) and had been chosen with four specific criteria in mind. Firstly, symbols were chosen that were deemed to be translucent for the target group of participants. It was believed that the symbols were unlikely to be guessable. An expert panel of professionals and two English-

speaking children aged 5-6 years verified the translucency and lack of guessability of the symbols (see Wylie, 2017, for details). Secondly, symbols were chosen to represent concepts that were generally known to children aged 5-6 years. This was also verified by an expert panel. Thirdly, the English and Afrikaans words associated with each symbol are translation pairs and overlap largely in meaning. Lastly, the English and Afrikaans words associated with each symbol do not share phonological surface features to avoid cross-linguistic transference on a phonological level. Each symbol was color printed on a 4.5 X 4.5cm cardboard square.

Procedural checklists were drawn up in order to guide the researcher and research assistants in administering the testing and teaching procedures. These checklists were also used to evaluate the procedural integrity with which the testing and teaching procedures were administered.

Procedure

General

All procedures were conducted by the researcher (first author) and three trained research assistants. Research assistants had a background in psychology or education. Two were additionally enrolled for a postgraduate course in AAC. They both had over two years' experience in working with children in educational settings. The third research assistant and the researcher had over 20 years of experience in working with children in educational/therapeutic settings. Children were seen individually at their preschools. All procedures were conducted in a separate room or screened-off quiet area of the preschool. All procedures were video-recorded.

Screening

Screening always commenced in the language used predominantly at the preschool. Because all procedures were conducted at the school, it was thought that this would put

children at ease initially, as they were used to using that specific language in the context. The customised screening tool to determine understanding of the nine target concepts was administered first. The child was shown a set of four pictures and asked "Which one shows….?" or the equivalent question in Afrikaans. The procedure commenced with administering a non-target item during which the researcher or research assistant could prompt the child to respond and demonstrate the correct response. If the child pointed to the correct picture, the response was recorded as correct.

After screening the understanding of the concepts used in the study in one language, the receptive vocabulary tests (PPVT-4 and ARW) were administered – first the test that corresponded to the preschool's language, and then the test in the other language. Lastly, screening of the child's understanding of the nine target concepts in the other language was conducted in the same way as described before. Screening was conducted over the course of 1-2 days, depending on preschool schedules.

Experimental procedures

Procedures were conducted over the course of 5 days. On the first day, the pretest was administered. The pretest was always administered first in English, and then in Afrikaans. The carboard squares with the color printed PCS were presented one by one to the child, and the child was asked the question, "What does this picture mean?" or the equivalent question in Afrikaans. If child answered in the other language, they were requested to "say it in English/Afrikaans." No further prompting was provided. Responses were recorded on a recording sheet and captured on video. Responses were recorded as correct if the child provided the word (adjective) assigned to the PCS.

Teaching took place on Days 2-4 with one teaching session scheduled per day. All teaching was conducted in English. Teaching sessions ranged in length from about 5-7 min. PCS symbols were presented to the child one by one. The child was exposed to each symbol

twice during a teaching session. The order of presentation varied each day. The script for the first exposure was somewhat different to the script for the subsequent exposures. During the first exposure to the symbol on the first day of teaching, the researcher or research assistant provided an explanation of the meaning of the symbol according to a script. She named the word associated with the symbol (e.g., "This symbol means slow."), and then explained the association between the symbol and the word (e.g., "The picture shows a tortoise. A tortoise is not fast, it is very slow. That's why the picture means 'slow'."). She then requested the child to provide the word associated with the symbol ("So tell me, what does this picture mean?"). Incorrect responses were corrected ("No, this picture does not mean ___ , it means_____.") and the child was given another opportunity to respond. Correct responses were confirmed and praised. Once all nine symbols had been presented in this way, they were each presented a second time. Upon presentation, the child was asked to recall the word associated with the symbol ("Can you remember what this picture means?"). Correct responses were affirmed and a brief explanation was again added (e.g., "Yes, it means 'slow' because it shows a slow tortoise."). Incorrect responses were corrected, and the more extensive explanation given during the first exposure was provided, followed by a request to provide the word associated with the symbol, as well as correction/affirmation as during first exposure. All subsequent exposures to the symbols on Days 3 and 4 preceded in the identical fashion of this second exposure. Children were rewarded with a small token at the end of each teaching session. All teaching sessions were video-recorded.

The posttest was administered on the fifth day. Procedures were identical to the pretest.

Procedural integrity and reliability of data recording

The integrity with which the testing and teaching procedures were administered was evaluated by an independent observer, who viewed a randomly selected 20% of the video

recordings each of the pretest, posttest, as well as the teaching sessions. The observer was a speech language therapist by training with over 20 years of experience working with children in therapeutic settings. Using procedural checklists, she marked steps as correctly completed or not correctly completed. The percentage of adherence to the procedures was then calculated by dividing the number of correctly completed steps by the total number of steps and multiplying by 100. The percentage adherence was found to be 97% for the pretest, 95% for the posttest, and 99% for the teaching procedures.

The reliability with which the responses were recorded during the pretest and the posttest was evaluated by the same independent observer. She viewed a randomly selected 20% of the video recordings of the pretest and the posttest. She recorded the child's response to each request to provide the word associated with the symbol presented and scored it as correct or incorrect. These scores were then compared to those obtained by the original examiner during the session.

The percentage of agreement on response recording was 100% for the pretest, and 99% for the posttest. Discrepancies in scores were checked against the video recording and scores were corrected where necessary before statistical analysis took place.

Analysis

In order to answer the first research question, the normality of the distribution of the dependent variables (number of symbols associated with the correct Afrikaans and English words respectively) was tested using the Kolmogorov-Smirnov and Shapiro-Wilk tests. Results showed that the data were not normally distributed. For this reason, a non-parametric test, the Wilcoxon Signed Rank Test, was used to compare the pretest and posttest results.

In order to explore the second research question, the linearity of the relationship between the performance on the Afrikaans posttest and each of the receptive language, language use, and language exposure variables was explored using scatterplots. Linearity could not be

established, and therefore, a nonparametric test, namely Spearman's Correlation Coefficient, was used to test the relationships.

Results

Before answering the first research question, we needed to establish that children had indeed learnt the English words associated with the graphic symbols. We therefore used the Wilcoxon Signed Rank Test to compare the results of the English pretest to the results of the English posttest. The test revealed a statistically significant increase in correct symbol-English word associations post training, $z = 4.893$, $p < 0.001$, with a large effect size ($r = 0.63$). The median score of correct symbol-English word associations increased from 0 on the pretest to 9 on the posttest ($SD = 0.57$; range = 7-9). This confirmed that children effectively learnt to provide English words associated with the symbols. We then compared the Afrikaans pretest results to the Afrikaans posttest results in order to establish the effect of teaching the English words associated with eh symbols on children's ability to provide the Afrikaans words associated with the same symbols. The Wilcoxon Signed Rank Test showed a statistically significant increase in correct Afrikaans word-symbol associations posttraining, $z = 4.571$, $p < 0.001$, with a large effect size ($r = 0.59$). The median score of correct Afrikaans word-symbol associations increased from 0 on the pretest to 6 on the posttest ($SD = 2.39$; range = 0-9).

In order to determine whether the performance on the Afrikaans posttest was related to children's age, their Afrikaans or English receptive vocabulary scores, and/or their exposure to and use of Afrikaans in the home and in school, Spearman's Correlation coefficients were calculated. Results are presented using a correlation matrix (see Table 2). Each cell containing a correlation coefficient represents an intersection between two of the seven variables listed in the first column and in the first row. For example, the first number, .102, represents the correlation coefficient that describes the relationship between Variable 2

(Afrikaans receptive vocabulary standard score) and Variable 1 (Afrikaans posttest). Results suggest that a moderate positive relationship existed between participants' ability to provide the Afrikaans words associated with the symbols and their use of Afrikaans in the home r = .403, n = 30, $p < 0.05$, with a higher percentage of use associated with better performance on the posttest. No other variables showed a significant relationship to participants' ability to provide the Afrikaans words associated with the symbols.

Discussion

As expected, children learnt to provide the English words associated with the symbols following the training sessions, confirming previous results that found direct teaching using associations an effective training method (Emms & Gardner, 2010). Teaching children the symbol-word associations in English generally also had a positive effect on their ability to form associations between the symbol and the Afrikaans word, suggesting that they were able to establish a link between the graphic symbol and the Afrikaans translation equivalent of the English word. This is a positive finding, suggesting that, when translation pairs exist in a language, positive transference of the learnt symbol-word associations may occur from one language to the other language. This would suggest that, where translation pairs exist, formal teaching of graphic symbol-word associations in one language may suffice at times to enable learning of the associations in both languages. It is clear that this finding comes with many caveats. The children taking part in this study were relatively balanced bilinguals with relatively strong language skills in both languages. None had disabilities. Research has found that bilingual persons outperform monolinguals in learning a third language, and this has been attributed to their superior metalinguistic awareness gained through manipulating languages on an abstract level (Thomas, 1988). It is plausible that the children in this study had good metalinguistic awareness, and were therefore able to perform what technically may have amounted to a translation task.

It should be noted though, that children varied considerably in their performance on the Afrikaans posttest, with some providing correct Afrikaans words for all symbols while some did not provide any correct Afrikaans words. When exploring possible correlations between their performance and a variety of descriptive variables, only the percentage of use of Afrikaans in the home was found to have a moderate positive correlation to children's performance on the Afrikaans posttest. The three children who did not provide any of the correct Afrikaans words associated with the symbols during the posttest varied in their use of Afrikaans in the home between 0 and 20%. It has to be noted that the variation among participants on specifically age and standard scores on receptive vocabulary tests was contained as these variables were selection criteria. These variables may therefore not have shown adequate variability to detect relationships.

Previous work on translation in adolescents and adults has revealed a number of factors that influence translation speed and accuracy. Amongst others, it was found that translation from the first into the second language is more difficult than translation from the second to the first language (Kroll, Michael, Tokowicz, & Dufour, 2002). Similarly, in the current study children who spoke less Afrikaans in the home may have found it difficult to translate words from English into a language in which they had limited expressive practice. Furthermroe, Kroll, Van Hell, Tokowicz, and Green (2010) summarised research that shows that L2 leaners at early stages of learning have stronger comprehension than production skills, and that access to the concept via the L2 word (comprehension) is accomplished easily, whereas access from the concept to the word (production) is more challenging. Whether children therefore used a lexical (translation) or conceptual path to access production of the Afrikaans word, limited experience in expressing themselves in this language may have negatively influenced their Afrikaans productions.

Research on children's translation ability is surprisingly sparse (López, 2020). In one of the few studies in the field, Malakoff and Hakuta (1991) found that both proficiency in the target language of translation as well as so-called 'translation proficiency' (ability to identify a word as belonging to either of the two known languages) were positively related to the speed of translation in 9-12-year-old Spanish-English bilinguals. It has furthermore been suggested that translation is an innate skill of all bilinguals, although not all have experience with or opportunities to practice this skill (Harris & Sherwood, 1978). The results of the current study suggest that experience in production in the target language is a factor that is correlated to children's ability to translate the symbol word associations learnt in English to Afrikaans. The extent to which children had experience with informal translation between English and Afrikaans was not established in this study. This may have been another factor that could have influenced performance, and should be explored in future studies.

The positive transference between languages during graphic symbol learning is only of relevance when translation pairs of words share enough conceptual elements to be depicted by one graphic symbol. Depending on the similarity between languages, there may be more or less conceptual overlap between specific translation pairs (de Groot, 2013). Where translation pairs do not share enough conceptual overlap, different symbol may be needed to represent the concepts in different languages. This may also be the case where a word in one language may map onto more than one word in another language. For example, the word 'bank' in Afrikaans can be translated as 'bank', 'bench', or 'sofa' in English. Certain function words (i.e., words that carry limited lexical meaning but perform a grammar function) may not be translatable into another language. In such cases, graphic symbols that are unique to a specific language would be needed, and these would need to be learnt without possibilities of positive transference.

Limitations and suggestions for further research

This study investigated bilingual children's ability to translate the graphic symbol-word associations learnt in one language into another language. All children had relatively good receptive language skills in both languages and none had disabilities. Future studies may involve children with complex communication needs from bilingual backgrounds, in order to understand whether the positive language transference observed in the participants in this study is also observable among this group.

Only symbols depicting adjectives were used it the study. The extent to which results are applicable to symbols depicting other parts of speech is not known.

Participants' ability to provide the Afrikaans words associated with the symbols following teaching in English varied considerably. However, this ability was only found to be related to the percentage of use of Afrikaans in the home. It is possible that other variables not measured in this study, such as their experience in translating between languages, could have been related to their performance. A replication of the study could be considered with a larger group of participants, measuring additional possible predictor variables and performing more robust regression analyses to identify if specific factors predict children's ability to translate graphic symbol-word associations learnt in one language to another language. Furthermore, the effect of teaching graphic symbol-word associations in both languages versus only teaching graphic symbol-word associations in one language may be determined in order to understand the extent to which bilingual teaching may expedite learning as compared to monolingual teaching. The degree of maintaining the learnt graphic symbol-word associations should also be investigated in future studies.

Participants were required to express (speak) the word associated with the graphic symbol. This is not a functional task that children in need of AAC would ever engage in. The reason for choosing an expressive rather than a receptive task was that we believed that this would give more robust evidence of the existence of a link between the symbol and the

spoken word. A receptive task where children would have had to point out a target symbol (amongst foils) in response to the Afrikaans spoken word would have been made easier by the closed response set (target symbol and foils). Also, children in the expressive group require AAC for expressive rather than receptive purposes. Setting up a communication task requiring children to use the symbols to convey messages may have been considered. Future studies could investigate the effect of mono- versus multilingual intervention on children's ability to use graphic symbols to perform various communication functions (e.g. requesting, commenting, storytelling etc.) as well as on various other expressive language skills, such as producing semantic combinations and early sentences. Determining the effect of AAC system provision and intervention on not only performance in controlled environments and tasks, but on bilingual children's everyday interactions and their participation within their environment would be the ultimate aim, as increased communication and participation constitutes the envisaged outcome for all AAC intervention.

Conclusions

Providing AAC services to children from multilingual backgrounds fills many practitioners with uncertainties. When considering the provision of graphic symbols systems that give access to expression in more than one language, service providers may consider the learning demands such systems may place on children. With regards to the process of learning graphic symbol-word associations, the current study showed that children aged 4-5 can transfer the associations learnt in one language to another known language. This suggests a measure of positive transference from learning in one language to the other language. Where translation pairs exist in two languages, the association of this pair with one graphic symbol can therefore reduce learning demands. Practitioners designing and customizing bilingual graphic symbol-based AAC systems for children should therefore consider the possibility of using one symbol to represent translation equivalents where possible.

However, it is clear that many questions about children in need of AAC from bi- and multilingual backgrounds still remain unanswered. Psycholinguistically, our understanding of the relationship between concepts, words from the spoken language(s) and graphic symbols is far from complete. Studies to further our understanding are hampered by the small and heterogeneous population of children using graphic symbol-based systems. One approach is to study the communication performance of children who actually use such systems (c.f. Von Tetzchner, 2018), and both language sample analysis (Binger, Ragsdale, & Bustos, 2016) and talk-in-interaction research (David Jeffery Higginbotham & Engelke, 2013) may be methods to better understand how children from bilingual backgrounds use graphic symbols to express meaning. Of course, their performance would not be independent of the training they have received and the affordance of their AAC system. In this regard, future studies are also needed to investigate the effects of mono-versus multilingual intervention and teaching on not only symbol-word associations, but other tasks required in graphic symbol system use, such as recall of symbol location, as well as communicative use. The impact of display design and navigation options on learning to use multilingual AAC systems also requires further investigation.

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Declaration of interest

The authors declare no conflict of interest. The authors further report that they are responsible for the content and writing of the paper.

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Table 1

Descriptive Variables of Participants (Mean, Standard Deviation and Range)

Variable	M	SD	Range
Age	4;7 (years;months)	5 months	4;1 – 5;11
Age of first exposure to Afrikaans	2.5 months	8 months	0-36 months
Age of first exposure to English	10.3 months	15 months	0-36 months
PPVT4 standard score	96	13	78-119
ARW standard score	97	9	75-112
% Exposure to Afrikaans at home[a]	46%	22%	0-90%
% Exposure to English at home[a]	51%	22%	10-100%
Child's % of use of Afrikaans at home[b]	55%	27%	5-90%
Child's % of use of English at home[b]	44%	26%	10-95%
% Exposure to Afrikaans at school	47%	36%	0-100%
% Exposure to English at school	53%	36%	0-100%
Child's use of Afrikaans at school	47%	36%	0-100%
Child's use of English at school	53%	36%	0-100%

[a] Five children were also exposed to a third language in the home, ranging from 5-30% exposure. [b] Four children also used a third language in the home, ranging from 5-20% use.

Table 2

Spearman's Correlation Coefficient Between Afrikaans Post-test Results, Age, and Various Language Measures

Variable	1[a]	2	3	4	5	6	7
1. Afrikaans posttest	-						
2. Afrikaans receptive vocabulary standard score	.102	-					
3. English receptive vocabulary standard score	-.120	.057	-				
4. % exposure to Afrikaans in the home	.296	.535**	-.270	-			
5. % exposure to Afrikaans in the school	.192	.243	-.382*	.596**	-		
6. Child's % of use of Afrikaans at home	.403*	.427*	-.323	.879**	.614**	-	
7. Child's % of use of Afrikaans at school	.195	.407*	-.337	.632**	.762**	.685**	-
8. Age	-.039	-.558**	.181	-.441*	-.304	-.379*	-.246

* $p < 0.05$ (2-tailed)
** $p < 0.01$ (2-tailed)
[a] The numbers in the column spanners represent each of the seven variables as labelled in the first column. 1 = Afrikaans posttest; 2 = Afrikaans receptive vocabulary standard score; 3 = English receptive vocabulary standard score; 4 = % exposure to Afrikaans in the home; 5 = % exposure to Afrikaans in the school; 6 = child's % of use of Afrikaans at home; 7 = child's % of use of Afrikaans at school; 8 = age.

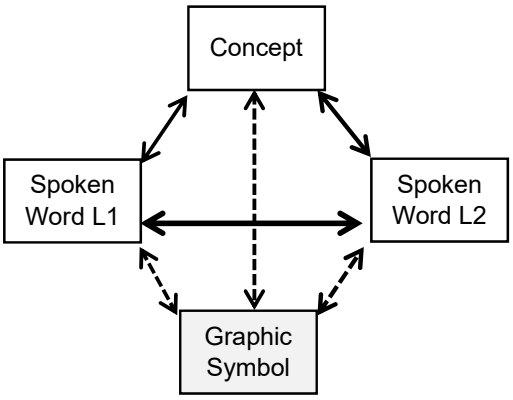


Figure 1. Possible links between spoken words, concept and graphic symbol. The shaded element and dotted lines are specific to children learning graphic symbols as representations of meaning. Adapted from Wylie, 2017.

APPENDIX A

Example of a screening item from the customised screening tool for the target word 'hot'/'warm'

1

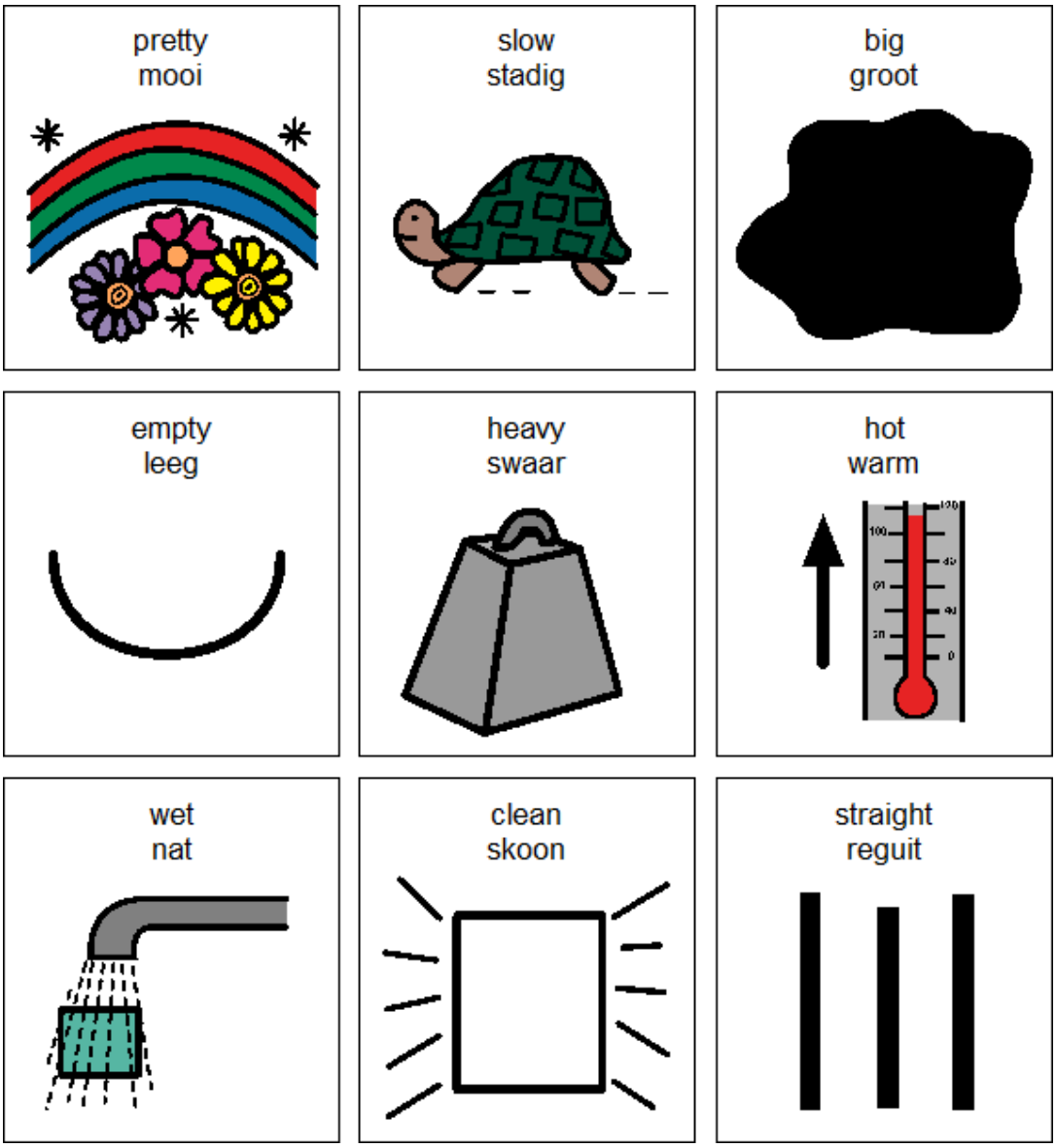
2

3

4

APPENDIX B

PCS™ used in the study



Note. For reference, English and Afrikaans word associated with each symbol are included, but these were not printed on the carboard squares presented to the children.