

**Developmental Inventories Using Illiterate Parents as Informants:
Communicative Development Inventory (CDI) adaptation for two Kenyan
Languages**

K. J. Alcock

Lancaster University, UK

K. Rimba,

Centre for Geographic Medicine-Coast, Kenya Medical Research Institute,

Kilifi, Kenya

P. Holding,

Centre for Geographic Medicine-Coast, Kenya Medical Research Institute,

Kilifi, Kenya

and International Centre for Behavioural Studies, Kenya

P. Kitsao-Wekulo,

International Centre for Behavioural Studies, Kenya and University of KwaZulu-

Natal, South Africa

A. Abubakar,

Centre for Geographic Medicine-Coast, Kenya Medical Research Institute, Kilifi,

Kenya and University of Tilburg, The Netherlands

C. R. J. C. Newton,

Centre for Geographic Medicine-Coast, Kenya Medical Research Institute, Kilifi,

Kenya and Institute of Child Health, London, UK

Address for correspondence:

K. J. Alcock, Department of Psychology, University of Lancaster, Fylde
College, Lancaster LA1 4YF, UK. Tel +44-1524-593833. Fax +44-1524-593744.
Email k.j.alcock@lancaster.ac.uk

Abstract

Communicative Development Inventories (CDIs, parent-completed language development checklists) are a helpful tool to assess language in children who are unused to interaction with unfamiliar adults. Generally CDIs are completed in written form but in developing country settings parents may have insufficient literacy to complete them alone. We designed CDIs to assess language development in children aged 8 to 30 months in two languages used in Coastal communities in Kenya. Measures of vocabulary, gestures, and grammatical constructions were developed using both interviews with parents from varying backgrounds, and vocabulary as well as grammatical constructions from recordings of children's spontaneous speech. The CDIs were then administered in interview format to over 300 families. Reliability and validity ranged from acceptable to excellent, supporting the use of CDIs when direct language testing is impractical, even when children have multiple caregivers and where respondents have low literacy levels.

Developmental Inventories Using Illiterate Parents as Informants: CDI (Communicative Development Inventories) for two Kenyan Languages

In sub-Saharan Africa the lack of appropriate methodologies to distinguish typical and atypical language development is an important issue to address (Alcock & Alibhai, 2013). The current lack of appropriate tools is associated with a dearth of systematic studies of typical development. Locally validated measures of communicative development are not only important for both educational and clinical practice, but will also advance linguistic knowledge in an area of scientific interest.

In the East African context an alternative methodology is required to monitor communicative development that avoids the use of recorded samples or direct testing (whether through structured or unstructured formats) for assessing language development. One challenge is infants' reticence with strangers (Wenger, 1989) which can alter their behaviour sufficiently to lead to an underestimation of ability (Fenson et al., 1994; Labov, 1970). In addition the use of recordings of spontaneous speech is both impractical for the collection of data from large numbers of children (MacWhinney, 2000), and is hampered by the shortage of suitably qualified personnel to complete transcriptions. The Communicative Development Inventory (CDI) provides a useful alternative methodology. Inventories in the CDI family consist of a checklist of words or statements about a child's communicative abilities through which parents can report on both receptive and expressive language. The question and answer format allows for the possibility of both a written and an orally presented format, to make the inventory accessible to a population with limited literacy. CDIs have a long history, but perhaps the best known standardised format is the MacArthur-Bates (M-BCDI) developed for US English (Fenson, et al., 1994).

A recent publication has described full or partial adaptations of the

MacArthur-Bates CDI in over 60 languages, dialects, or settings (Dale & Penfold, 2011) including European and Asian languages (Dutch: Bornstein, Putnick, & De Houwer, 2006; Basque: Garcia, 2008; Bengali: Hamadani et al., 2010; British English: Hamilton, Plunkett, & Schafer, 2000), New World variants of European languages (Brazilian Portuguese: Padovani & Teixeira, 2004; French Canadian: Poulin-Dubois, Graham, & Sippola, 1995), and signed languages (Anderson & Reilly, 2002). There are, however, no published examples in any Bantu languages, spoken by approximately 240 million people worldwide, primarily in Africa (Nurse, 2002).

Good concurrent and predictive validity of the CDI format has been reported for many adaptations (Dale, 1991; Dale, Bates, Reznick, & Morisset, 1989; Feldman et al., 2005; Reese & Read, 2000). Multiple validation methods have been applied including comparison with pre-existing transcriptions of children's speech samples (Anderson & Reilly, 2002; Berglund & Eriksson, 2000), laboratory based experimental techniques (Marchman & Martinez-Sussmann, 2002; Szagun, Steinbrink, Franik, & Stumper, 2006; Thordardottir & Ellis Weismer, 1996) home observations (Prado et al., 2010) and EEG measures of vocabulary comprehension (Mills, Coffey-Corina, & Neville, 1997; Mills, Coffey-Corina, & Neville, 1993). However, all of these methods require previous research on the target language and, where this information is not readily available, validation is either not undertaken, or has used as comparison instruments intended for other language settings (see Dale & Penfold, 2011 for information about Tamil; Hamadani, et al., 2010; Mastin & Vogt, 2011a, 2011b; Prado et al., 2011). As the assumptions of standardisation are only justifiable within the population for which the tests were originally developed (Kitsao-Wekulo, Holding, Taylor, Abubakar, & Connolly, 2013) validation against tests developed for other language groups cannot be considered best practice.

An additional challenge presents itself in settings with low literacy. Previous authors (Hamadani, et al., 2010; Vagh, Pan, & Mancilla-Martinez, 2009) have either constructed CDIs especially for use in an interview setting or have given caregivers the choice of whether to complete a CDI in interview or written format. However, no validation or comparison between written and interview formats has yet been reported.

We here describe the construction and validation of an interview form of a CDI for two related Bantu languages, Kiswahili and Kigiriana, for children from 8 months to 30 months of age. Although previous data are available on typical language development in these languages, these were not systematically collected with a view to designing an assessment instrument (Alcock, Rimba, & Newton, 2011). We now report a study to develop full versions of a CDI in these languages. The original M-BCDIs include gesture items (for younger children), vocabulary items (for all ages) and grammatical complexity items (for older children); these new CDIs follow the same format.

Characteristics of the study languages

Kigiriana and Kiswahili are very closely related Eastern Bantu languages, which share a good deal of grammatical structure and have many cognate forms, though they are not mutually comprehensible. Kigiriana has an estimated 600,000 speakers while Kiswahili has an estimated 700,000 monolingual speakers in Kenya, and about 33 million speakers across Eastern and Central Africa (Gordon, 2005). Bantu languages have multiple noun classes (up to 12), which are functionally equivalent to grammatical gender. Adjectives, verbs and many function words must agree with the noun class, and verbal morphology is also rich and extensive. Verbs are marked with a prefix for noun class and tense, and with a suffix for voice and

derived verbs.

Effectively this means that children must produce and comprehend many different forms of the same adjective and verb, as well as singular and plural forms of nouns, and multiple forms of many function words. However, considering the similarities in structure and culture across many Bantu languages, developing common techniques of construction and administration of CDIs should be relevant and valid for a variety of contexts. The rich grammatical inflections found in these Bantu languages, unlike in English, mean that we must make decisions about how to measure children's development of these inflections, as has been done in other languages where the grammatical forms children must learn are different from those learned in English. In some CDIs in other languages, for example, grammatical development inventories have concentrated on contrasting utterances with different lengths in words or morphemes (Maital, Dromi, Sagi, & Bornstein, 2000); in others, only questions about the presence or absence of inflectional morphology, but no questions about utterance length, have been asked (Kristoffersen et al., 2013), while others have used both types of questions.

Method

Study Population

The study took place in multiple communities in Coastal Kenya. Children living within our target population are generally raised in multi-generational settings, with siblings, as well as grandparents, taking part in childcare. Observations made in the recording of children's spontaneous speech samples (Alcock, et al., 2011; Deen, 2002), within this collectivist family structure, where it can be difficult to identify interlocutors, highlighted the potential threat to validity in using the CDIs with only one caregiver. Another challenge in the study area is that many parents do not have

sufficient literacy to complete a written format unaided.

Participants were drawn from the catchment area of Kilifi District Hospital (KDH), a predominantly rural area, and Kisauni location, a peri-urban neighbourhood of the city of Mombasa. Kilifi is primarily agricultural and more than half (67%) the population lives below the poverty line (Kahuthu, Muchoki, & Nyaga, 2005). Adult literacy levels are also low (44.9%), below the national average of 83.9% , and lower in women than men (UNESCO Institute for Statistics, 2011). Most rural families speak Kigiriana or a related *Mijikenda* (the larger language group to which Kigiriana belongs) dialect. However, some (primarily Muslim) villages are monolingual Kiswahili-speaking. The peri-urban site comprises mainly squatters living in informal settlements with approximately 47% below the poverty line. As the resident population is ethnically diverse Kiswahili has commonly supplanted regional vernaculars, even within the home.

Participants and Recruitment

Parents of children aged 6 to 36 months living in our designated study sites were recruited as part of a larger study developing an assessment protocol to monitor infant development in this community (Abubakar, 2008). The majority of the children were identified through a census database held at the research unit at KDH. In the metropolitan area families were identified through a snowballing method, with the aid of key neighbourhood leaders. These leaders helped identify households with children of the correct age. They then accompanied the research team for a first introductory meeting at these households, and subsequently to other households identified by the families so approached.

Prior to assessment/interview written informed consent (in the form of a signature or thumbprint) was obtained from all parents. The consent form was read

out to illiterate participants in their preferred language. Where children's participation was necessary (in validation testing) children's nonverbal assent was sought. When children became unwilling to continue, testing/recording was discontinued.

Test development underwent several stages that followed steps similar to those outlined in (Holding, Abubakar, & Kitsao-Wekulo, 2010); *Construct Definition, Item Pool Creation, Developing a Procedure, Evaluation of Test Schedule*, each of which is described below. We developed two versions for each age group, the Long Form, and the Short Form. The younger long form includes gesture as well as comprehension and production vocabulary, to evaluate both communication and vocabulary growth. In the older long form scale items covering gesture are dropped and communication growth is represented by the addition of grammar items. In the long form all vocabulary items that are in the younger scales are also included in the older scales.

Data collection occurred primarily among families that speak almost exclusively one language - Kigiriana or Kiswahili - within the home. Different groups of caregiver-infant dyads were constituted for the various forms of reliability and validity testing. In total, 126 Kigiriana-speaking mothers were interviewed to develop and validate the questionnaire for younger children (Words and Gestures – *Maneno na Ishara*). The questionnaire for older children (Words and Sentences – *Maneno na Sentensi*) was refined and validated on 139 Kigiriana-speaking and 29 Kiswahili-speaking mothers.

Construction of the Kilifi CDIs

Permission. Permission for these adaptations was sought and obtained from the CDI Advisory Board. This Board holds the global rights to grant permission for

any new CDIs and offers good research guidelines for new versions (CDI Advisory Board, 2008). These adaptations are henceforth known as the Kilifi CDIs.

Construct Definition and Item Pool Creation. The Kilifi CDIs were constructed using spontaneous speech samples collected from children in their home settings (Alcock, et al., 2011) as well as a word list from a UK version of the MacArthur-Bates CDI (the Oxford CDI: Hamilton, et al., 2000) and the gesture list from the original MacArthur-Bates CDI (Fenson, et al., 1994). In an attempt to maintain item and hence construct equivalence (Holding & Kitsao-Wekulo, 2009) all words from the original inventories were retained unless it was not possible to identify a corresponding item that was culturally relevant or familiar (e.g. snow, penguin). Substitute and additional items were obtained from the spontaneous speech samples previously referred to above (Alcock, et al., 2011), as well as through consultation with experienced researchers from the local community.

Construction of the Kigiriama and Kiswahili forms was carried out concurrently in the two languages – with the equivalent form of a word known by children acquiring one language then also included in the questionnaire in the other language. When two separate words in one language had only one form in the other the two words were included as alternatives in the first schedule, rather than as two separate items. This was a rare occurrence. Both Kiswahili and Kigiriama have extensive noun class systems and a three-value system of demonstratives; the total number of pronouns and demonstratives equivalent to the ‘Pronouns’ and ‘Quantifiers’ sections in the original M-BCDI therefore exceeded 130. At the initial stages, these were all included in the Kilifi CDIs form.

Semantic equivalence was evaluated using back-translations into English. Instructions for both administrators and respondents were also prepared to support the

administration of an interview format.

Developing a Procedure

A) Developing the Content

Piloting 1st Draft Words and Gestures. The two language versions of the Kilifi CDIs were then piloted on 10 Kigiriyama- and 10 Kiswahili-speaking mothers. Each language group consisted of five mothers of younger children (aged 12 to 18 months) and five with older children (aged 25 to 36 months). Categorical prompts such as ‘words for animals, words for things around the house, words for things he/she likes, words for things adults use, words for things he/she plays with’ were developed to help mothers recall additional words that their children could say or understand, but were not on the original list. From responses obtained, words that received no endorsement were removed from the word list, while new function words provided by mothers were added.

Piloting 2nd Draft Words and Gestures. The resulting questionnaire was piloted on a further 20 families: 10 Kigiriyama- and 10 Kiswahili-speaking mothers. Again children were selected to represent younger and older children (the sample included two groups, aged 9 to 13 months, and 19 to 25 months, respectively). A similar evaluation of responses was made, culminating in the removal of number of words and the additions of others based on the criteria outlined above.

Piloting 3rd Draft Words and Gestures. This third version of the questionnaire was administered to 68 more caregivers of younger children: 38 Kigiriyama- and 30 Kiswahili-speaking mothers. Their children were aged 8 to 20 months.

The total number of words trialled across all the three piloted versions was 765. There were also 69 questions about gestures. The total time taken to complete each of the interview schedules ranged between 28 and 112 minutes.

B) Creation of Age-Specific Forms.

In the next phase of construction, data from the previous stages was used to select items for inclusion in the long forms of the Kilifi CDIs for younger (*Maneno na Ishara – Words & Gestures*) and older children (*Maneno na Sentensi – Words & Sentences*). The words most frequently endorsed as known by younger children, 62 questions about gestures and 10 function words, were included in the final questionnaire for younger children, providing a total of 355 items.

The older version included 70 pronouns and demonstratives from all of the possible noun-class based third person pronouns and demonstratives, as well as all four first and second personal pronouns, and the most frequently endorsed words for older children – 704 vocabulary items in total.

C) Addition of Grammatical Complexity Items for older children.

Spontaneous speech samples obtained in an earlier study (Alcock, et al., 2011), were used to catalogue sentence complexity and common patterns of morphological errors. Examples of immature forms of frequently used words, consisting of omission errors of morphemes, were also documented. All of the morphological structures that were included exist in both Kiswahili and Kigiriyama. In the English M-BCDI – Words and Sentences, some more complex grammatical structures are represented by pairs of examples that contain more clauses or additional adjectives, rather than contrasts between grammatically correct and incorrect utterances; in some other language versions such contrasts have also been used (Maital, et al., 2000). Pairs of examples of this type were therefore also included in the Kilifi CDIs. In addition examples of morphemes commonly used in adult language and produced correctly in our child samples, as well as commonly used immature forms of words were included. In the final version of the long form of the

Kilifi CDIs for older children – *Maneno na Sentensi* – the following complexity sections were represented, totalling 55 items:

Section A: Small parts of words ('Word Endings' in English) – questions about general use of noun and verb prefixes and suffixes, including those representing noun classes, plurals, and past tense.

Section B: Complexity – Pairs of words or phrases, representing less and more complex forms that children may use. For example, parents were asked about the use of *koba* vs. *mkoba*, where the noun *mkoba* ('bag') consists of noun class prefix *m-* plus the root *-koba*. '*koba*' is an error and is an immature form involving omission of the noun class prefix; such errors are frequently observed in spontaneous speech.

Section C: Word combinations Parents were asked if their children were combining words into sentences, with immature examples given. If parents answered in the affirmative, Section D was also administered.

Section D: Sentence complexity – This section included examples where correct morpheme use is determined from sentence context. For example, Kiswahili-speaking parents were asked about the use of *watu mrefu* vs. *watu warefu*. The plural noun *watu* ('people') consists of the plural noun class prefix *wa-* plus the root *-tu*. This should be followed by the adjective *warefu* ('tall'), consisting of the plural noun class prefix *wa-* plus the root *-refu*, not the form *mrefu*, which consists of the singular noun class prefix *m-* plus the same root, and would apply to one person. Such examples of morpheme substitution were observed much less frequently than morpheme omission in the spontaneous speech samples (this has also been noted in other Bantu languages; Demuth, 1992). Parents were also asked about contrasts such as *nataka biskuti* vs. *nataka biskuti na maziwa* ('I want a biscuit' vs. 'I want a biscuit and milk') where both examples are grammatically correct, but one utterance is

shorter and the other longer.

D) Constructing Short Forms of the Kilifi CDIs.

Younger version for children aged 8 - 15 months of age. Frequency tables of responses to the Kigiriana version of *Maneno na Ishara* (N = 92) were used to generate a Short Form comprising 100 words, excluding gesture items. The pilot sample was arranged into age groups by month. Words that were comprehended by at least 50% at any month of age formed the initial core of the lexicon. On review it was observed that five of these words had close, or overlapping meaning, representing only two concepts between them. Three of these words were therefore dropped, and were replaced by the three highest frequency function words, a category of word otherwise unrepresented (ii – ‘this [class 9],’ iryahu – ‘that [class 9]’ and mimi – ‘me/I’), To avoid a potential ceiling effect at the older end of the age range we also replaced ten medium-frequency words with low-frequency words comprehended by only 20% of the oldest children. An additional eight words, the highest frequency words produced by these children, were then added (recall that all of the other words were selected based on children’s comprehension; these additions comprised three sound effects, as well as ‘yes’, ‘thank you’, ‘grandfather’, ‘child’ and ‘meat’). This short form has no gesture items.

Older version for children aged 16 - 30 months of age. A similar procedure was followed for the construction of the Short Form of the Kilifi CDIs for older children using data from parents who completed the Kigiriana version of *Maneno na Sentensi* (N = 100). Children were again placed into month age groups. A list of 180 words was identified that comprised words endorsed by at least 50% at any age group. These words were systematically selected to represent an even distribution across the age range, as well as the different semantic categories represented in the original M-

BCDI (see Table 2). To avoid a ceiling effect, the 20 least frequently produced words (that were known by at least 20% of children in at least one age band) were added to the list. These 200 words were then arranged according to the earliest age at which they were produced by at least 50% of the children, and divided evenly into two parallel short forms – Form A and B, each consisting of 100 words. Creating two parallel forms is helpful for longitudinal studies where a different form can be administered at two time points. This questionnaire ends with the single question about sentence use “Has your child started to join words together such as ‘Want food’ or ‘dog bite’.”

A summary of the numbers of families, content and number of items, and the age ranges involved for all versions of the Kilifi CDIs is shown in Table 1. A summary of the content of the two long forms and the three short forms (*Maneno na Ishara* long form, younger short form, *Maneno na Sentensi* long form, and older short A and short B forms) is shown in Table 2. The Kiswahili versions were constructed using the translation equivalents of the words used in the Kigiriyama short forms, since fewer data were available from Kiswahili-speaking parents.

[Tables 1 and 2 about here]

Evaluation of the Test Schedules

The Reliability, Validity and Sensitivity of the Kilifi CDIs were evaluated through a series of sub-studies. The internal consistency of the different forms was examined using Cronbach’s alpha. Other properties were examined using correlation analyses. We evaluated consistency of scores over two time-points, between parallel A and B forms and also between different modes of presentation (self- completed vs. interviews). The association between scores on different components of the Kilifi CDIs was also measured. Finally we examined the relationship between

communicative abilities as derived from parental report and other methods of eliciting communication skills, as well as the relationship of performance to age.

Reliability

Internal consistency reliability of the long form of *Maneno na Ishara* was calculated for each section (words, gestures) separately and then for the full scale (N= 103). Within-section (words and sentences) reliability was also assessed for *Maneno na Sentensi* (N = 96). These analyses were carried out on data from Kigiriyama speaking families.

Test-retest reliability was assessed by interviewing 20 Kiswahili-speaking parents using the vocabulary section of the long form of *Maneno na Ishara*. The approximate interval between the two visits was one week.

Parallel form reliability was evaluated in two ways a) Written vs. Interview presentation. Literate Kiswahili-speaking parents (N= 14) were administered *Maneno na Ishara* using both a written and an interview method. Although many parents in the study setting are illiterate, the majority of Kenyan adults have had some schooling, and literate parents are therefore representative of the local population. b) Short Form A and B of *Maneno na Sentensi* were compared (N =23). For both methods the order of presentation was reversed for 50% of respondents, and the parallel form presented after a gap of approximately one week.

Validity

Concurrent validity. For *Maneno na Ishara* we measured the degree of association between Kilifi CDI scores and

- a) Free recall score derived by summing all the words and gestures that the caregiver stated the child produced.
- b) Observed gestures

c) Performance of the child on a Naming Task

d) Performance of the child on an object selection comprehension task

Procedures. a) A free recall score was derived from mothers of Kigiriama-speaking children who were asked to recall all the words they had heard their child produce as well as the gestures the children use. Categorical prompts were used as explained above. The mothers were then interviewed using *Maneno na Ishara*. (N = 19 mothers and children aged 9 to 15 months).

b) The same dyads were used to measure the child's ability to produce gestures. For example, after the mother was asked whether or not the child could shake their head to signify 'no,' the child was asked to "Shake your head 'no'". The child received a second prompt "Can you do that?" if they failed to produce the gesture the first time, but if a child still failed to produce the gesture, it was demonstrated for them and no score was awarded.

c) The same children were then shown 10 toys or objects whose names are listed in *Maneno na Ishara* and asked to provide their names.

d) A separate group of Kiswahili speaking mother-child dyads were used to compare CDI scores with performance on an object selection task. The child was presented with 20 pairs of items (food items, small household items, items of clothing) that appear on the Short form, and asked "can you show me X?"

Presentation of some items was repeated making a total of 13 unique items. (N = 20 dyads, with children aged 12 to 15 months).

For *Maneno na Sentensi* scores on the Kilifi CDIs were compared to

e) a picture vocabulary task and

f) spontaneous speech samples were used to establish concurrent validity.

Procedures. e) A total of 23 Kigiriama-speaking children aged 24 to 30

months completed a picture vocabulary test developed within the same context (Holding et al., 2004). The score on the Kilifi-PVT was the total number of items correct out of 24.

f) Using a small recorder placed in a child-sized backpack, recordings of about 30-60 minutes were obtained from 10 Kigiriama-speaking children aged 20 to 26 months while they engaged in typical play activities in their home settings. Their spontaneous speech was transcribed by a linguistics graduate (KR) working on the project. The means (s.d.s) of the number of tokens and utterances were 204.00 (119.67) and 149.6 (51.35). Type-token ratios, mean length of utterance in words, and the proportion of utterances in which a morpheme was omitted, were calculated for all children. Mothers of children in both groups were then interviewed using *Maneno na Sentensi*.

Results

Reliability

Internal consistency. One child whose reported production vocabulary of 98/293 words at the age of 12 months, representing an outlying value, was removed from the dataset, and from subsequent analyses of the whole *Maneno na Ishara* dataset. Cronbach's alpha was high (over 0.9) for both sections (words and gestures) of *Maneno na Ishara*. As shown in Table 3, Cronbach's alpha for vocabulary and for grammatical morphemes ranged from .75 to well over .9 for *Maneno na Sentensi*. Out of 100 parents who completed *Maneno na Sentensi* four parents failed to answer sufficient vocabulary questions to obtain an alpha and three failed to answer sufficient grammar questions to obtain an alpha.

[Table 3 about here]

Test-retest reliability. One outlier, a child whose production vocabulary was

reported at Time 1 to be 7 words and at Time 2 to be 2 words (i.e. the child's production vocabulary was reported to have reduced by over 70% between the two time points) was excluded. The correlation between production vocabulary at Time 1 and Time 2 was significant, $r(17) = .54, p = .018$. For comprehension scores, test-retest reliability levels were in the moderate range, $r(17) = .69, p = .001$.

Parallel form reliability. Moderate correlations were recorded for the comprehension score on the written and interview forms, $r(12) = .69, p < .001$. Children were reported to have a very limited range of spoken words (0-6 items) and the correlation between production scores on the written and interview forms of *Maneno na Ishara* was not significant. Parents who completed the written version first reported that their child comprehended significantly fewer items in the interview (their second session) than those who completed the interview first $t(13) = 3.27, p = .006$. Correlations between scores on the older version, forms A and B were significant, $r(21) = .91, p < .001$.

Sensitivity to age. At least moderate, and significant, correlations were recorded between gesture scores, comprehension scores, production vocabulary in older children, and grammar and word combination scores on the various Kilifi CDIs (both long and short forms for both older and younger children) and age (Table 3). A weaker, but also significant, correlation was observed between production vocabulary and age on *Maneno na Ishara*. On the short form of the younger questionnaire alone, the correlation between production vocabulary and age did not reach significance. All of these data are shown in Table 4. On *Maneno na Sentensi*, there is a smaller N for this analysis because parents of children who are not yet combining words cannot answer the sentence complexity section. Two parents who answered vocabulary questions did not answer any grammar questions (even though not all grammar

questions concern word combinations), and for three further parents the answer to the complexity question was unclear meaning that for the correlations with age $N = 100$ for vocabulary, $N = 95$ for word combinations, and $N = 98$ for grammar.

[Table 4 about here]

Validity

Maneno na Ishara a) Correlations between maternal free recall of words and gestures known by their child, and that following prompts by the interviewers, were not significant, both for production or comprehension vocabulary. b) Observations of children's cued gesture production were significantly correlated with children's gesture scores from the questionnaire $r(17) = .631, p = .004$. Since children were asked verbally to produce the gestures, there was also an element of comprehension in the gesture exercise, and observed gestures also correlated significantly with children's comprehension vocabulary $r(17) = .614, p = .005$. This relationship is shown in Figure 1.

[Figure 1 about here]

c) None of the children named a single object or toy. d) There was no significant correlation between scores on the object selection task and total comprehension vocabulary, $r(17) = .119, p > .05$. The correlation between child selection and maternal report of just the 13 items included in the selection task approached significance however, $r(17) = .454, p = .051$.

Maneno na Sentensi. e) There was a significant correlation between the PVT scores and scores on the the Kilifi CDIs, $r(30) = .525, p = .01$. f) Significant correlations between maternal report and recorded spontaneous speech samples ($N = 10$) were found for type-token ratio and total grammar scores, $r(8) = .598, p = .034$, and type-token ratio and scores on the morpheme section of the grammar

questionnaire, $r(8) = .627, p = .026$. The correlation between type-token ratio and production vocabulary was moderate, although it did not reach significance, $r(8) = .538, p = .055$. The relationship between total vocabulary and type-token ratio is illustrated in Figure 2.

[Figure 2 about here]

Mean length of utterance did not significantly correlate with sentence complexity scores, $r(8) = -.233, p > .05$. There was a significant negative correlation (in the expected direction) between the proportion of children's utterances that contained a morphological error and the morpheme section of the CDI, $r(8) = -.559, p = .046$.

Discussion

We present here the first comprehensive account of the construction and validation of a parent report checklist of children's communicative abilities within a context where few parents have sufficient literacy to complete a written format. The Kilifi CDIs include vocabulary checklists for younger and older infants (long and short forms), as well as checklists to assess gesture and grammatical development, in two very closely related languages. Examination of one Short Form of the Kilifi CDIs in Kiswahili and Kigirima revealed that 92 out of the 100 words were cognate (all of which are in the same noun class in both languages), confirming our decision to adapt CDIs to both languages in parallel, and report the adaptations together.

Findings from our data

Although other researchers (Hamadani, et al., 2010; Vagh, et al., 2009) have used an interview format for a CDI before, this is the first study to carry out in-depth psychometric evaluations of tools administered in this format, assessing reliability and validity and covering key considerations in the construction of new instruments for

assessment of language development (Fenson, et al., 1994). Our data indicate achievement of moderate to good indices of reliability and validity. Noteworthy is the significant correlation between the traditional written format and the more practical interview format we created; this was not assessed in previous interview versions. Although some sample sizes in validity and reliability testing were small, the majority were at least as large as in previous CDI construction studies where similar methods have been used (Thordardottir & Ellis Weismer, 1996). Furthermore in this study we have taken the examination of reliability or validity beyond that of internal consistency (Bleses et al., 2008; Kristoffersen, et al., 2013; Maital, et al., 2000), and gone well beyond the method used to assess content validity in some previous studies (assessing the co-occurrence of vocabulary contained in CDIs and that produced by a much smaller number of different children at a different time point; Bleses, et al., 2008; Kristoffersen, et al., 2013). Our study presents advantages over all of these.

Our tools were also sensitive to maturational change, with parents reporting that children understood and produced more words as they got older. Data from our setting, reported in Abubakar, Newton, Holding, & Alcock (2013), show that the Kilifi CDIs are sensitive to the impact of biological insults, in particular HIV exposure, that are known to affect language development.

In addition maternal reports of communicative abilities using the Kilifi CDIs corresponded closely with multiple evaluations of abilities from other sources, demonstrating an understanding of the purpose of the questionnaires by parents. Both vocabulary comprehension and gesture scores obtained on the Kilifi CDIs corresponded closely to gestures produced through verbal prompts in younger children; in addition, maternal reports of vocabulary production showed substantial correlations with comprehension of vocabulary items in a forced-choice test. These

observations illustrate that mothers of infants aged below 16 months are accurate observers of their child's gesture abilities, general language comprehension abilities, overall level of vocabulary production and knowledge of specific vocabulary items.

Moreover among older children scores on the Kilifi CDIs corresponded closely with vocabulary production levels from spontaneous speech recordings, as well as with receptive vocabulary measured with a picture vocabulary test. Parents were also able to accurately report whether or not their child omitted grammatical morphemes in their everyday speech. As with other richly inflected languages, children learning Bantu languages seem to use many grammatical morphemes relatively early (Demuth, 1999). Furthermore a significant negative correlation (in the expected direction) was found between the proportion of children's utterances that contained morphological errors and the score on the morpheme section of *Maneno na Sentensi*.

In contrast to the structured interview approach we found that asking mothers to generate a list of words that their children could say or understand through free recall presented a challenge to them. Mothers either reported the names of objects their children recognised, words that their children heard frequently or for mothers of older children only mentioned extremely high frequency words that had been in their children's vocabulary for quite some time. Although it may sometimes be necessary to use parental recall of children's word knowledge as part of the construction of a measure, (Fenson, et al., 1994) have cautioned that parent recognition of children's behaviours is much more accurate than recall. Our data support the possibility that parents pay more attention to the content of the inventories in the face-to-face interviews as they were provided with an opportunity for direct interaction with the interviewer. Although the interview format is more time consuming, we have found

that parents within this cultural context are somewhat more willing to spend longer periods of time being interviewed, especially as it is not common to have an opportunity to talk to a professional about their child's development.

Research practicalities and future directions

We have produced the first set of fully validated CDIs, for two Bantu languages. The two long versions – *Maneno na Ishara* for younger children aged 8 to 15 months and *Maneno na Sentensi* for older children aged 16 to 30 months – are undesirably fairly time-consuming, taking on average between half to one-and-a-half hours to administer. However, the length of time taken to conduct interviews about a younger child's language abilities at home is comparable to, or less than, the time it would take for travel to a central location, set up and administer a testing session. With the constraints of time in mind, we have also created and validated three short forms of the Kilifi CDIs – one for younger children and two parallel versions for older children, enabling retesting in, for example, an intervention study.

It is essential in a setting with great linguistic diversity (over 40 languages are used in Kenya) that assessment instruments are easily adaptable. Obtaining comprehensive item sets is difficult in a situation where little previous data on child language use is available. In creating the Kilifi CDIs we therefore necessarily started with an English version because there was no closer language version available. Existing data available on the languages studied here, Kigiriama and Kiswahili, suggested that children are more advanced on some aspects of grammatical development (Alcock, et al., 2011; Deen, 2002) than their counterparts learning European languages, but that early vocabulary composition is similar to that in other languages, both European and non-European (Alcock, 2013). Our experience implies that there may be core universal elements to such a schedule that are shared between

language groups, but that attention should be paid to specific language contexts when constructing such instruments.

We have already collaborated with other researchers on the creation of a new short form CDI for two related languages in neighbouring Malawi (Prado, et al., 2011). We found that basing the two Malawi versions on the Kiswahili CDI (a closely related language, with many cognates and very similar inflectional morphology) was helpful. By using an English translation of the Kiswahili inventory the linguists involved in the Malawi adaptation were able to check both the intended meaning and the phonological or grammatical form of vocabulary or sentence stimuli in the Kiswahili version, before constructing a version that closely paralleled the two Malawi languages to be studied. Although the Malawi adaptation was based on the Kiswahili CDI, parallel adaptation into both Kiswahili and Kigiriyama in Kenya meant that using the same adaptation techniques in Malawi was both more flexible for the adaptation from Kiswahili to the Malawi languages, and simpler to accomplish for two languages in parallel in Malawi.

Our method is recommended for future adaptations into similar Bantu languages, even those that are not mutually comprehensible. For sub-Saharan African languages that are not very closely related to the two languages studied here, both the instructions and vocabulary items may translate more directly than those of tools developed in other cultural settings, as underlying concepts in vocabulary development are likely to be more similar.

Many families in coastal Kenya (particularly outside the main rural study area) use more than one language on a day-to-day basis. Previous research (Mancilla-Martinez, Pan, & Vagh, 2011) suggests that integrating scores from two languages is valid and useful with bilingual infants and toddlers. It would therefore be important

to include translated equivalents of items in both languages to create CDIs that can be used with bilingual families.

In summary, we have created two CDIs that are valid and reliable for these languages and this setting. We have also initiated the construction of CDIs for the region and, in particular, for Bantu languages, providing a useful method for CDI construction and validation.

Table 1

Versions of the Kilifi CDIs

Version	Number of families involved in piloting	Number of items	Age range
First pilot <i>Maneno na Ishara</i>	20		10 12-18 months, 10 25-36 months
Second pilot <i>Maneno na Ishara</i>	20		10 9-13 months, 10 19-25 months
Third pilot <i>Maneno na Ishara</i>	68	765 words 69 gestures across all pilot versions	8-20 months
Final long version of <i>Maneno na Ishara</i>		293 words, 69 gestures	8-15 months
Final long version of <i>Maneno na Sentensi</i>		704 words, 55 grammatical complexity items	16-30 months
Short version for 8-15 month olds	Constructed based on responses from 92	100 words	8-15 months

	families		
Short versions for 16-30 month olds	Constructed based on responses from 100 families	200 words (100 on version A and 100 on version B) plus question about combining words	16-30 months

Table 2

Numbers of words in each semantic category on each form of the Kilifi CDIs

<i>Category</i>	<i>6-15 months</i>		<i>16-30 months</i>		
	<i>Long - Mane no na Ishara</i>	<i>Short</i>	<i>Long - Mane no na Sente nsi</i>	<i>Short</i> <i>A B</i>	
Sound effects	15	6	18	3	2
Animals	15	7	38	6	6
Transport	5	2	13	2	3
Toys/play things	10	3	18	4	3
Foods	39	14	76	12	13
Clothes	14	5	37	7	6
Body parts	15	1	24	4	3
Household objects	34	11	55	10	12
Furniture	11	2	21	3	3
Outdoors	18	4	26	6	4
Places to go	10	2	17	3	3
People	14	9	30	2	3
Games and routines	12	6	24	4	6
Verbs	56	19	107	13	13
Adjectives	15	6	51	4	4
Function words (combined section)	10	3	-	-	-
Words about time	-	-	11	2	2
Pronouns and demonstratives	-	-	93	9	6
Question words	-	-	9	1	2
Prepositions	-	-	16	3	4
Quantifiers	-	-	12	1	1
Conjunctions	-	-	8	1	1

Total	293	100	704	100	100
-------	-----	-----	-----	-----	-----

Table 3

Internal consistency for long forms of the Kilifi CDIs

<i>Section</i>	<i>N</i>	<i>Number of variables</i>	<i>Cronbach's Alpha</i>
<i>Maneno na Ishara</i> words	104	293	.987
<i>Maneno na Ishara</i> gestures	104	62	.954
<i>Maneno na Sentensi</i> words – Sound effects through Outdoors	98	326	.993
<i>Maneno na Sentensi</i> words – Places to go through Conjunctions	97	378	.996
<i>Maneno na Sentensi</i> Grammatical Morphemes	95	12	.750

Table 4

Sensitivity to age of components of the long and short forms of the Kilifi CDIs

Measure	N	<i>r</i>
<i>Maneno na Ishara</i> production vocabulary	104	.363**
<i>Maneno na Ishara</i> total vocabulary (comprehended and/or produced)	104	.507**
<i>Maneno na Ishara</i> gestures	104	.675**
<i>Maneno na Sentensi</i> total vocabulary	100	.680**
<i>Maneno na Sentensi</i> total score for grammatical morphemes	66	.465**
<i>Maneno na Sentensi</i> sentence complexity score	25	.485*
<i>Maneno na Sentensi</i> word combining score	95	.645**
Short form 8-15 months production vocabulary	19	.402
Short form 8-15 months total vocabulary	19	.490*
Short form 16-30 months total vocabulary	23	.508*

Note: * $p < .05$; ** $p < .01$

Figure 1

Scatterplot of comprehension vocabulary (Maneno na Ishara) and cued gestures

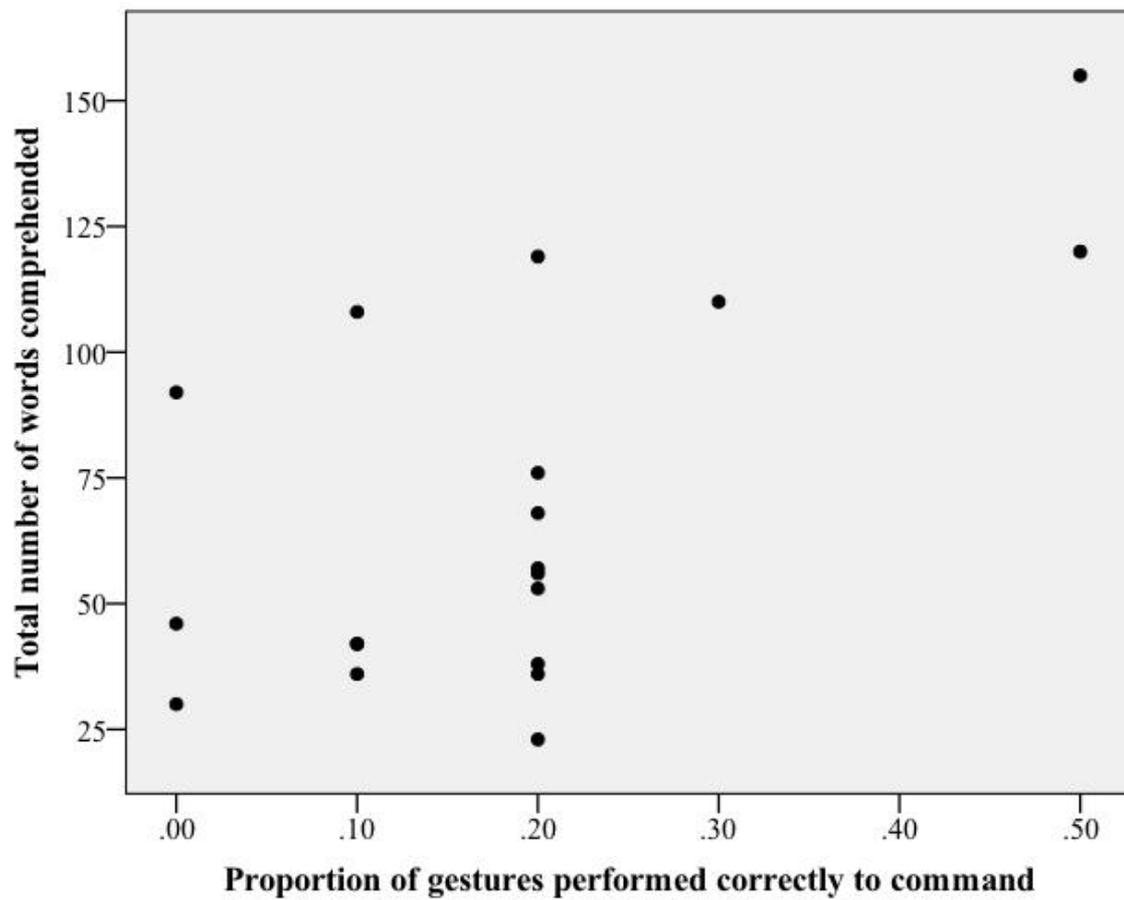
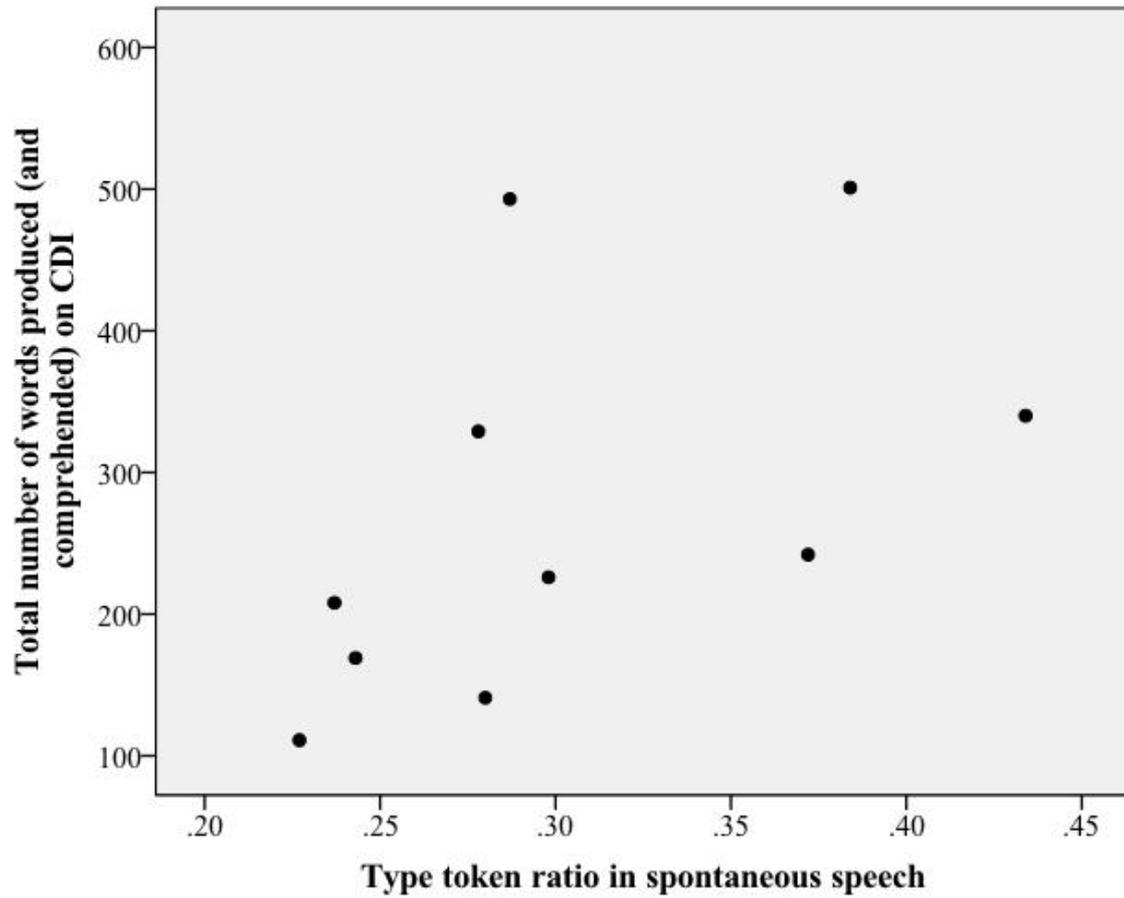


Figure 2

Scatterplot of total vocabulary (Maneno na Sentensi) against type-token ratio



References

- Abubakar, A. (2008). *Infant-Toddler Development in a Multiple Risk Environment in Kenya*. PhD, Tilburg University, Tilburg.
- Abubakar, A., Newton, C. R. J. C., Holding, P. A., & Alcock, K. J. (2013). *Language Outcomes of Prenatal HIV Exposure in Kenyan Children*. Manuscript submitted for publication.
- Alcock, K. J. (2013). *Early word production is not representative of early word knowledge — Data from two East African languages* [Manuscript submitted for publication].
- Alcock, K. J., & Alibhai, N. (2013). Language development in sub-Saharan Africa. In M. Boivin (Ed.), *Neuropsychology of Children in Africa: Risk and Resilience* (pp. 155-180). New York: Springer.
- Alcock, K. J., Rimba, K., & Newton, C. R. J. C. (2011). Early production of the passive in two Eastern Bantu languages. *First Language, 32*(4), 459-478.
- Anderson, D., & Reilly, J. (2002). The MacArthur Communicative Development Inventory: Normative data for American Sign Language. *Journal of Deaf Studies and Deaf Education, 7*(2), 83-106.
- Berglund, E., & Eriksson, M. (2000). Reliability and content validity of a new instrument for assessment of communicative skills and language abilities in young Swedish children. *Logopedics Phoniatics Vocology, 25*(4), 176-185.
- Bleses, D., Vach, W., Slott, M., Wehberg, S., Thomsen, P., Madsen, T. O., & Basboll, H. (2008). The Danish Communicative Developmental Inventories: Validity and main developmental trends. *Journal of Child Language, 35*(3), 651-669.
- Bornstein, M. H., Putnick, D. L., & De Houwer, A. (2006). Child vocabulary across the second year: Stability and continuity for reporter comparisons and a

- cumulative score. *First Language*, 26(3), 299-316.
- Dale, P. S. (1991). The validity of a parent report measure of vocabulary and syntax at 24 months. *Journal of Speech and Hearing Research*, 34(3), 565-571.
- Dale, P. S., Bates, E., Reznick, J. S., & Morisset, C. (1989). The validity of a parent report instrument of child language at twenty months. *Journal of Child Language*, 16(2), 239-249.
- Dale, P. S., & Penfold, M. (2011). Adaptations of the MacArthur-Bates CDI Into Non-U.S. English Languages. Retrieved from Retrieved from www.sci.sdsu.edu/cdi/documents/AdaptationsSurvey7-5-11Web.pdf
- Deen, K. u. (2002). *Inflectional prefixes, mood and null subjects: The acquisition of Swahili verbal morphology*. PhD PhD, UCLA, Los Angeles. Retrieved from <http://www2.hawaii.edu/~kamil/dissertation.htm>
- Demuth, K. (1992). The Acquisition of Sesotho. In D. I. Slobin (Ed.), *The Crosslinguistic Study of Language Acquisition* (pp. 557-637). Hillsdale, NJ: LEA.
- Demuth, K. (1999). The acquisition of Bantu languages. In D. Nurse & G. Philippon (Eds.), *The Bantu Languages* (pp. 209-222). Surrey: Curzon Press.
- Feldman, H. M., Dale, P. S., Campbell, T. F., Colborn, D. K., Kurs-Lasky, M., Rockette, H. E., & Paradise, J. L. (2005). Concurrent and Predictive Validity of Parent Reports of Child Language at Ages 2 and 3 Years. *Child Development*, 76(4), 856-868. doi: doi:10.1111/j.1467-8624.2005.00882.x
- Fenson, L., Dale, P. S., Reznick, J. S., Bates, E., Thal, D., & Pethick, S. (1994). Variability in early communicative development. *Monographs of the Society for Research in Child Development*, 59(5).
- Garcia, I. (2008). Influence of the Linguistic Environment on the Development of the

Lexicon and Grammar of Basque Bilingual Children *A portrait of the young in the new multilingual Spain* (Vol. 9, pp. 86-110).

Gordon, R. G. (2005). *Ethnologue: Languages of the world* (15th ed.). Dallas, TX: SIL International.

Hamadani, J. D., Baker-Henningham, H., Tofail, F., Mehrin, F., Huda, S. N., & Grantham-McGregor, S. M. (2010). Validity and reliability of mothers' reports of language development in 1-year-old children in a large-scale survey in Bangladesh. *Food and Nutrition Bulletin*, 31(2), S198-S206.

Hamilton, A., Plunkett, K., & Schafer, G. (2000). Infant vocabulary development assessed with a British communicative development inventory. *Journal of Child Language*, 27(3), 689-705.

Holding, P. A., Abubakar, A., & Kitsao-Wekulo, P. K. (2010). Where there are no tests: A Systematic Approach to Test Adaptation In M. Landow (Ed.), *Cognitive Impairment: Causes, Diagnosis and Treatments*. Hauppauge NY: Nova Science Publishers, Inc. .

Holding, P. A., & Kitsao-Wekulo, P. (2009). Is assessing participation in daily activities a suitable approach for measuring the impact of disease on child development in African children? *Journal of Child & Adolescent Mental Health*, 21(2), 127-138. doi: 10.2989/jcamh.2009.21.2.4.1012

Holding, P. A., Taylor, H. G., Kazungu, S. D., Mkala, T., Gona, J., Mwamuye, B., . . . Stevenson, J. (2004). Assessing cognitive outcomes in a rural African population: Development of a neuropsychological battery in Kilifi District, Kenya. *Journal of the International Neuropsychological Society*, 10(2), 246-260.

Kahuthu, R., Muchoki, T., & Nyaga, C. (2005). Kilifi District Strategic Plan 2005-

2010 for Implementation of the National Population Policy for Sustainable Development. . Nairobi: National Coordination Agency for Population and Development.

Kitsao-Wekulo, P. K., Holding, P. A., Taylor, H. G., Abubakar, A., & Connolly, K. (2013). Neuropsychological Testing in a Rural African School-Age Population Evaluating Contributions to Variability in Test Performance. *Assessment*, 20(6), 776-784.

Kristoffersen, K. E., Simonsen, H. G., Bleses, D., Wehberg, S., Jørgensen, R. N., Eiesland, E. A., & Henriksen, L. Y. (2013). The use of the Internet in collecting CDI data—an example from Norway. *Journal of Child Language*, 40(03), 567-585.

Labov, W. (1970). The logic of nonstandard English. . In J. E. Alatis (Ed.), *20th Annual Round Table* (pp. 1-43). Washington, DC: Georgetown University Press.

MacWhinney, B. (2000). *The CHILDES project: tools for analyzing talk* (3rd ed.). Mahwah, N.J.: Lawrence Erlbaum.

Maital, S. L., Dromi, E., Sagi, A., & Bornstein, M. H. (2000). The Hebrew Communicative Development Inventory: language specific properties and cross-linguistic generalizations. *Journal of Child Language*, 27(1), 43-67.

Mancilla-Martinez, J., Pan, B. A., & Vagh, S. B. (2011). Assessing the productive vocabulary of Spanish/English bilingual toddlers from low-income families. *Applied Psycholinguistics*, 32(02), 333-357.

Marchman, V. A., & Martinez-Sussmann, C. (2002). Concurrent validity of caregiver/parent report measures of language for children who are learning both English and Spanish. *Journal of Speech Language and Hearing*

Research, 45(5), 983-997.

Mastin, D., & Vogt, P. (2011a). *Joint Engagement and Vocabulary Development: Re-defining data collection, categorization and analysis*. Paper presented at the

International Association for the Study of Child Language, Montreal.

Mastin, D., & Vogt, P. (2011b). *Variation in frequencies of multimodal gesture usage and vocabulary development*. Paper presented at the Acquisition

Dysfonctionnements Langues Oral Cognition, Paris.

Mills, D. L., Coffey-Corina, S., & Neville, H. J. (1997). Language comprehension and cerebral specialization from 13 to 20 months. *Developmental*

Neuropsychology, 13(3), 397-445.

Mills, D. L., Coffey-Corina, S. A., & Neville, H. J. (1993). Language acquisition and cerebral specialization in 20-month-old infants. *Journal of Cognitive*

Neuroscience, 5(3), 317-334.

Nurse, D. (2002). A Survey Report for the Bantu Languages *SIL Electronic Survey Reports*.

Padovani, C. M. A., & Teixeira, E. R. (2004). Using the Macarthur Communicative Development Inventories (CDI'S) to Assess the Lexical Development of

Cochlear Implanted Children. *Revista de Actualizacao Cientifica*, 16(2), 217-224.

Poulin-Dubois, D., Graham, S., & Sippola, L. (1995). Early lexical development: The contribution of parental labelling and infants' categorization abilities. *Journal*

of Child Language, 22(2), 325-343.

Prado, E. L., Alcock, K. J., Ullman, M. T., Phuka, J., Yakes, B., Arimond, M., . . .

Dewey, K. (2011). *Assessing child development in the context of nutrition trials in developing countries: Principles for test selection, adaptation, and*

- evaluation*. Paper presented at the Lipid-Based Nutrient Supplements Research Network Meeting, Washington DC.
- Prado, E. L., Hartini, S., Rahmawati, A., Ismayani, E., Hidayati, A., Hikmah, N., . . . Alcock, K. J. (2010). Test Selection, Adaptation, and Evaluation: Three Critical Steps to Assess Nutritional Influences on Child Development in Developing Countries. *British Journal of Educational Psychology*, *80*(1), 31-53.
- Reese, E., & Read, S. (2000). Predictive validity of the New Zealand MacArthur Communicative Development Inventory: Words and sentences. *Journal of Child Language*, *27*(2), 255-266.
- Szagan, G., Steinbrink, C., Franik, M., & Stumper, B. (2006). Development of vocabulary and grammar in young German-speaking children assessed with a German language development inventory. *First Language*, *26*(3), 259-280. doi: 10.1177/0142723706056475
- Thordardottir, E. T., & Ellis Weismer, S. (1996). Language assessment via parent report: Development of a screening instrument for Icelandic children. *First Language*, *16*(48), 265-285.
- UNESCO Institute for Statistics. (2011). Education (all levels) profile - Kenya. UIS Statistics in brief. .
- Vagh, S. B., Pan, B. A., & Mancilla-Martinez, J. (2009). Measuring growth in bilingual and monolingual children's English productive vocabulary development: The utility of combining parent and teacher report. *Child Development*, *80*(5), 1545-1563.
- Wenger, M. (1989). Work, play, and social relationships among children in a Giriama community. In D. Belle (Ed.), *Children's social networks and social supports*

(pp. 96–104). New York: Wiley.