

QUANTIFIER SCOPE AMBIGUITIES IN AKAN

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Abstract

Quantifier scope ambiguities have received a lot of attention in theoretical linguistics. However, the majority of the data that feed into these theories are based on introspective judgments from a relatively small set of languages. This is a problem considering that previous research has shown that there are large cross-linguistic differences, varying partly with particular grammatical properties of the languages, but partly also due to yet unknown reasons. Further, previous experimental work has shown that even speakers of the same language show large variability in their judgments of doubly-quantified sentences, which is why purely introspective judgments can be problematic. Our goal with this paper is to contribute to research aiming at filling this gap. We present an experiment on quantifier scope interpretations in transitive sentences of the Asante Twi dialect of Akan (Kwa, Niger-Congo), a language in which no such research has been conducted before. We will provide evidence that inverse readings are in fact available in Asante Twi but are nevertheless clearly dispreferred. This result is of particular relevance to the theory that languages with strict word order, such as Akan/Asante Twi, should be very permissive with inverse readings. Our findings also suggest that relative clause boundaries do not completely block inverse readings in Asante Twi. This contradicts popular assumptions on quantifier scope but is in line with recent experimental work from other languages. Thus, our findings provide additional insights into the cross-linguistic phenomenon of quantifier scope ambiguities and the respective theories in this field.

Keywords: Quantifier, quantifier scope ambiguities, inverse reading

Anim muabɔsem

Nnipa bebreɛ a wɔyɛ kasa mu nhwehwɛmu atwere nsem pii afa nsemfua a yede kyere dodoo wɔ okasamu mu. Nanso nhwehwɛmu no bebreɛ no ara gyina kasa ahodoɔ ketewa bi so. Ena eno nso mpo gyina nnipa kakra bi nteaseɛ so. Nhwehwɛmu saa no nsi pi, esiane sɛ nhwehwɛmu bebreɛ akyere sɛ nsonsonoyɛ wɔ kasa ahodoɔ mu, te sɛ kasahodoɔ ene deɛ ekeka ho a yennim. Ebiom, won a wode mfidie ahwehwɛ kasa mu no akyere sɛ nsonsonoyɛ kaseɛ da nnipa a woka kasa baako mpo ntem sɛ eba no won atemmuo fa okasamu a nsemfua a wode kyere dodoo mmienɛ wɔ mu no ho a. Enti na nhwehwɛmu a ehwe obaakofoɔ nkoa nsi pi no. Yebotae ne sɛ yebewehwɛ saa nneema yi mu na ama nhwehwɛmu a ewo ho deda no asi pi. Yenhwehwɛmu no fa mfidie mu nhwehwɛmu a yeaye wɔ nsemfua a yede kyere dodoo wɔ Akan kasa mu (a ewo Kwa, Niger-Congo kasa abusua no mu). Na saa nhwehwɛmu yi, obiara nnya nyee bi wɔ Akan kasa mu. Yebekyere sɛ nsemfua a yede kyere dodoo nteaseɛ no tumi dane wɔ Akan kasa mu, nanso bebreɛ no ara mpe. Saa aba yi ho hia ma nsusuyɛ a efa kasa ahodoɔ a wosesa senea wɔhyehyɛ nsemfua, te sɛ Akan. Yenhwehwɛmu yi siane kyere sɛ nsemfua a ekasa fa nsemfua foforo ho no wɔ Akan kasa mu no nsi nsemfua a yede kyere dodoo nteaseɛ a etumi dane no ho kwan. Saa aba yi ne nhwehwɛmu a ewo ho deda no bo abira, na mmom efoa mfidie mu nhwehwɛmu a afoforo aye wɔ kasa ahodoɔ mu no so. Enti, yenhwehwɛmu yi de nhunumu foforo fa nsemfua a yede kyere dodoo nteaseɛ ho aba.

Nsemfua atitire: okasamu, dodoo nteaseɛ, kasamu nteaseɛ nnaneɛ

1. Introduction

Quantifier scope ambiguities arise when two or more quantificational expressions interact with one another. An example is given in (1), which contains an existential and a universal quantifier, thereby giving rise to two different readings. Under the surface reading, the first quantifier takes scope over the second quantifier, resulting in an interpretation as in (1a). Under the inverse reading, the second quantifier takes scope over the first quantifier, resulting in an interpretation as in (1b). The scope-taking quantifier is said to take wide scope, the other quantifier takes narrow scope.

- (1) [A clown] scared [every child].

- a. Surface reading $\exists > \forall: \exists x[\text{clown}(x) \wedge \forall y[\text{child}(y) \rightarrow \text{scare}(y,x)]]$
 $\approx$ There is a single clown that scared all the children.

- b. Inverse reading $\forall > \exists: \forall y[\text{child}(y) \rightarrow \exists x[\text{clown}(x) \wedge \text{scare}(y,x)]]$
 $\approx$ For every child there is a (potentially) different clown that scares it.

An important point to keep in mind about scope readings is that only the surface constellation $\exists\forall$, but not $\forall\exists$, allows for accurate assessment of true inverse readings (Reinhart 1976). When the existential occurs in a position below the universal, as in (2), the inverse reading is entailed in the surface reading. The surface reading is both compatible with the existence of a single or multiple children that are scared by the clowns. That makes it impossible to tell if we are dealing with a true inverse reading or if the apparent inverse reading is only a sub-case of the surface reading. In (1), on the other hand, only a true inverse reading can give rise to the interpretation that there is more than one clown that scared children.

(2) [Every clown] scared [a child].

- a. Surface reading $\forall > \exists: \forall y[\text{clown}(y) \rightarrow \exists x[\text{child}(x) \wedge \text{scare}(y,x)]]$
 $\approx$ For every clown there is a (potentially) different child that they scare.
- b. Inverse reading $\exists > \forall: \exists x[\text{child}(x) \wedge \forall y[\text{clown}(y) \rightarrow \text{scare}(y,x)]]$
 $\approx$ There is a single child that all the clowns scared.

Usually, the surface reading is preferred over the inverse reading. However, there are a plethora of factors that influence the particular interpretation of doubly quantified sentences, including prosody (e.g., Jackendoff 1972, Kitagawa 1994, Krifka 1998, Sugawara et al. 2018), information structure (e.g., Kempson & Cormack 1981, Ionin 2001, Bobaljik & Wurmbrand 2012, Oikonomou et al. 2020), choice of quantifiers, predicate, or nouns (e.g., Ioup 1975, Micham et al. 1980, Kurtzman & MacDonald 1993), grammatical function (e.g., Ioup 1975, Gillen 1991, Kurtzman & MacDonald 1993, Tunstall 1998), syntactic environment (e.g., Chomsky 1975, May 1977, Liu 1990, Huang 1995), and context or general world knowledge (e.g., Saba & Corriveau 1997, Anderson 2004, Srinivasan & Yates 2009, Philipp & Zimmermann 2023). Additionally, there are also differences between languages. While some languages allow for inverse readings quite readily and in a wide range of contexts, such as English (e.g., Fodor 1982, Kurtzman & MacDonald 1993, Anderson 2004), other languages seem to be more resistant, such as German (e.g., Frey 1993, Bobaljik & Wurmbrand 2012, Radó & Bott 2012, 2018, Philipp & Zimmermann 2023) or Russian (e.g., Ionin et al. 2014, Ionin & Luchkina 2015, Antonyuk 2015), and some languages seem to be completely scope-rigid, like Mandarin Chinese (e.g., Huang 1982, Liu 1990, Tsai et al. 2014).

Due to this highly variable behaviour, scope ambiguities are an interesting and fruitful field of research. However, they play an important role beyond these observational aspects as well. In contrast to typical syntactic or lexical ambiguities, it is much more difficult to determine, how exactly scope ambiguities arise in the first place. A number of different accounts have been put forward to explain their nature, where they are variable classified as underlyingly syntactic (e.g., May 1977, 1985, Aoun & Li 1989, Hornstein 1995), lexical (e.g., Hendriks 1988, 1993, Jacobson 1992, Shan & Barker 2006), or a different type altogether (e.g., Barker & Shan 2014, Kiselyov & Shan 2014). The most popular approach is Quantifier Raising (QR), which was put forward by May (1977, 1985). This approach is based on ideas from the Government and Binding Theory and experienced further development in the Phase Theory of Minimalism (Chomsky 1991, 1995). In this framework, any expression has two levels of representation: Phonetic Form (PF), which is the expression's surface form, i.e. its pronunciation, and Logical Form (LF), which is the expression's mental representation, i.e. its semantic interpretation. The advantage of having these two separate levels is that ambiguities can readily be explained: At the level of PF, there is only one representation, but at the level of LF, there are two. Quantifier scope ambiguities are treated as a syntactic ambiguity in this approach. The idea is that the

hierarchical order of quantifiers at the level of LF determines quantifier scope. For the inverse reading to arise, the second quantifier needs to move covertly to a position above the first quantifier as exemplified in (3).

- (3) Inverse reading $\forall > \exists$: [[NP every child]_j [[NP a clown]_k [_____k [VP scared _____j]]]]

The QR approach makes an important prediction: Overt A-bar-movement is restricted by islands boundaries. As a covert form of A-bar-movement, QR should be subject to the same restrictions. Indeed, it is usually claimed that inverse readings are blocked when an island boundary intervenes between the second and the first quantifier, as in (4). This was taken as important evidence in favour of QR as the mechanism behind quantifier scope ambiguities and as such is often used as a diagnostic for other linguistic phenomena. However, the assumption that inverse readings are strictly island-bound has sometimes been questioned in the literature (e.g., Reinhart 1997, Hulsey & Sauerland 2006, Szabolcsi 2010), and received stronger criticism in the more recent time (Barker 2021, Philipp 2023, Philipp & Zimmermann 2023).

- (4) The circus hired a clown that scared every child.

Importantly, a lot of the literature on scope ambiguities is based on a relatively small set of languages, most of which are Indo-European, like English, German or Russian, along with some Asian languages like Japanese or Mandarin Chinese. This is problematic considering the highly variable behaviour that we observe with these ambiguities both within and between languages. Further, a lot of the research heavily relies on introspective judgments. Experimental research is restricted to an even smaller set of languages. This is also problematic, as previous research has shown that there are also large differences between speakers of the same language in the extent to which they accept inverse readings. Thus, while there is a large body of literature on quantifier scope ambiguities, most of it relies on introspective judgments from a small set of speakers of a small set of languages.

The current paper aims to contribute to fill this gap by providing experimental data on quantifier scope interpretations in the Asante Twi dialect of Akan (Kwa, Niger-Congo), which has not been done before. The motivation for this experiment is threefold: (i) Data from less researched languages such as Akan can broaden the perspective and improve the understanding of quantifier scope ambiguities in general; (ii) Data on quantifier scope ambiguities in Akan can increase the understanding of the language itself; (iii) The particular grammatical properties of Akan can serve as interesting test case for a number of predictions made by theories on quantifier scope.

In the following section, we will present some background on quantifier scope in Akan/Asante Twi and how general theories of scope ambiguities apply to it.

2. Quantifier scope in Akan

Previous research on quantifier scope in Akan is scarce. Most of it is indirect research whereby the phenomenon is merely used as a diagnostic tool for other phenomena, with the exception of Philipp (2023), which focussed solely on the Asante Twi dialect of Akan. In order to keep our experiment comparable to previous research, we also decided to focus on the Asante Twi dialect. Asante Twi is also the most widely spoken dialect, which makes it easier to test a large group of participants. Therefore, in the following, we will only speak about Asante Twi. However, many of the background information applies to Akan more generally and we have in fact no reason to assume that other dialects of Akan deviate in their availability of scope ambiguities due to the commonalities in grammatical features such as word order and the respective quantifiers.

Asante Twi has an overt indefinite article *bi* (= ‘a’/‘some’), but it also makes use of the bare noun to express indefiniteness. The overt article is typically used for specific interpretation, while the bare noun is used for a non-specific interpretation (Amfo 2010a, Arkoh 2011, a.o.). There is some debate around the way this overt article should

be analysed semantically (Amfo 2010a, Arkoh 2011, Bombi et al. 2019, Owusu 2020, Philipp 2023), which goes beyond the scope of this paper. It has been observed, though, that *bi* has a strong tendency to take wide scope over any other quantificational expressions, due to its inherent specificity (Amfo 2010b, Arkoh 2011). However, later research has shown that *bi* can take narrow scope in the c-command domain of certain other operators (Bombi et al. 2019, Owusu 2020, Philipp 2023). Nevertheless, it seems either impossible (Owusu 2020) or very difficult (Philipp 2023) for *bi* to take narrow scope when it is structurally higher than another quantifier, as in (5). Note that this is exactly the relevant configuration if we want to test the possibility of true inverse readings in a language, as discussed in the introduction.

- (5) **Ɔbaa bi kane-e nhoma biara.**
woman IND read-PAST book every
 ‘A (certain) woman read every book.’

(adapted from Owusu, 2020, p. 65)

The bare noun, on the other hand, is claimed to only take narrow scope when it is preceded by another quantifier or operator (Arkoh 2011). When the order is reversed, the inverse reading arises readily in constellations such as double-object constructions or inverse linking constructions (Philipp 2023). However, it is difficult to test the same in simple transitive sentences, since the bare noun is usually unacceptable in subject position (Philipp 2023).

It is also possible to use a numeral as existential quantifier, such as *baako* (= ‘one’) in Asante Twi. Cross-linguistically, though, there seems to be a preference to interpret such a numeral with wide scope (Tsai et al. 2014, Philipp 2023). Previous elicitation data indicates that inverse readings might be acceptable in transitive clauses both with the indefinite article as well as with the numeral, as in (6).

- (6) **Adeɛ huhuuhu [bi / baako] hunahuna-a akwadaa biara.**
thing scary IND / one terrify-PAST child every
 ‘A certain/One creepy thing scared every child.’

(Philipp 2023, p. 200)

As for universal quantifiers, Asante Twi has both a distributive universal *biara*¹ (= ‘every’/‘each’) and a collective universal *no nyinaa* (= ‘all’). As expected, distributive inverse readings are usually only observed with the former (Philipp 2023).

Interestingly, Philipp (2023) also reports that clause boundaries in general and island boundaries in particular do not fully block inverse readings, as would be expected under a movement-based approach like QR, see section 1. This has been reported to exceptionally apply to some other languages as well, see section 1. However, Asante Twi is a particularly interesting case in this regard, as even overt movement² seems to be acceptable across island boundaries³ (Saah 1994, Saah & Goodluck 1995, Korsah 2017, Bombi et al. 2019, Philipp 2023).

Overall, we see that there is little previous work on quantifier scope in Asante Twi. There is some evidence from elicited data that inverse readings might be dispreferred

¹ The expression *biara* can also be interpreted as free choice item or negative polarity item, depending on the environment it occurs in (Amfo 2010b, Owusu 2019, Philipp 2023). However, for the types of sentences we investigate here, these interpretations do not play any role.

² Note that some researchers analyse wh-questions and the parallel focus construction as base-generated, i.e. not involving any movement in the first place (Saah 1988, Saah 1994, Saah 2010, Ofori 2011). However, other researchers maintain that these constructions are created by movement and provide different types of evidence for it (Boadi 1974, Korsah 2017, Korsah & Murphy 2020).

³ However, there are differences between individual speakers in the extent to which they accept overt movement, as observed in Saah (1994), Saah & Goodluck (1995), Philipp (2023).

but available in Asante Twi in a number of different constellations, including between subject and object (Philipp 2023). Inverse readings seem to be triggered most easily with a bare noun, followed by the numeral *baako* and the indefinite article *bi*. However, in the case of the indefinite article, there are also claims that inverse readings should be blocked altogether (Owusu 2020). There is also some indication from elicited data that inverse readings might not be completely blocked by island boundaries (Philipp 2023).

3. Experiment

In the following experiment, we will investigate the interpretation of doubly quantified transitive sentences with an existential subject and a universal object in the Asante Twi dialect of Akan. The goal is to test if inverse readings are available at all and if so, whether or not a relative clause boundary can block these inverse readings.

3.1 Methods

3.1.1 Materials

The experiment employed a 2x2x2 factorial design with the factors - ‘determiner’, ‘embedding’, and ‘picture type’. For the factor ‘determiner’, there was either the distributive universal quantifier *biara* (=‘every’/‘each’) or the definite article *no* (=‘the’). For the existential subject, we used the numeral *baako* (=‘one’). In the case of the factor ‘embedding’, there was either an unembedded sentence (0-emb) or an embedding into a relative clause (‘1-emb’). An example for the target sentences is given in (7). The target sentences were always preceded by a short context about a plan, expectation, or prediction, introducing the NPs used in the target sentences. This was done to control for potentially confounding factors that influence scope interpretation such as information structure, see section 1. Finally, the factor ‘picture type’ represented the two types of pictures that were shown in the truth-value-judgment task following the stimuli. These pictures either showed a one-to-many mapping, corresponding to the surface reading for the target items, or a one-to-one mapping, corresponding to the inverse reading for the target items. An example of these pictures for the sentences in (7) is provided in figure 1. The group description on the left always corresponded to the first NP of the stimuli and the group description on the right to the second NP. There were 24 target sentences in total. The items were distributed via a Latin Square design such that no participant saw any target item in more than one condition, resulting in eight lists.

(7) Context:

ɛhaa maame no sɛ ebia nkwadaa no bɛsuro nneɛma huhuuhu wɔ nhyiamu no ase.

‘The mother worried that the children could fear creepy things at the parade.’

a. Universal/unembedded:

Na ampara nso, adeɛ huhuuhu baako hunahuna-a akwadaa biara.
and indeed thing creepy one scare-PAST child.SG every
‘And then, in fact, one creepy thing scared every child.’

b. Definite/unembedded:

Na ampara nso, adeɛ huhuuhu baako hunahuna-a nkwadaa no.
and indeed thing creepy one scare-PAST child.PL DEF
‘And then, in fact, one creepy thing scared the children.’

c. *Universal/RC-embedding:*

Na ampara nso, adeε huhuuhu baako wɔ hɔ aa ε-hunahuna-a
 and indeed thing creepy one at there RC RES-scared-PAST
akwadaa biara.
 child.SG every
 ‘And then, in fact, there was one creepy thing that scared every child.’

d. *Definite/RC-embedding:*

Na ampara nso, adeε huhuuhu baako wɔ hɔ aa ε-hunahuna-a
 and indeed thing creepy one at there RC RES-scared-PAST
nkwadaa no.
 child.PL DEF
 ‘And then, in fact, there was one creepy thing that scared the children.’

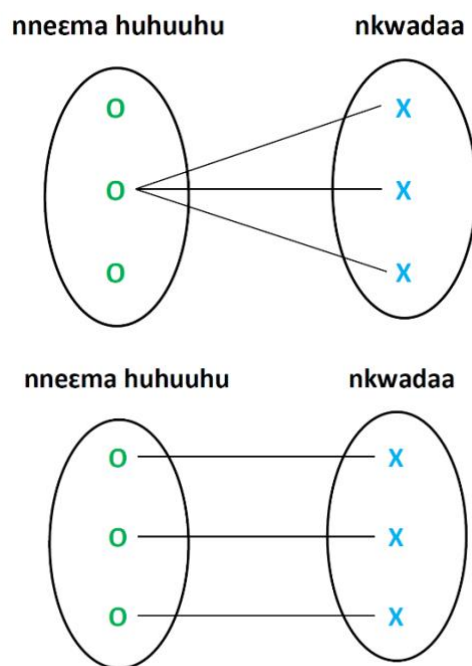


Figure 1: Examples of picture types one-to-many/surface (left) and one-to-one/inverse (right) for the stimulus in (7).

In addition to the target sentences, there were 24 fillers, divided into four types. They were either fully unambiguous or strongly biasing towards one of the picture types. Two of them favoured the first picture type (8-9) and the other two favoured the second picture type (10-11).

(8) *Specific + all (one-to-many):*

Apolisifoɔ no bɔɔ kaseε sε wɔde mfonyintwa mfidie besisi Kasoa
kwantempɔn no so.
 ‘The police announced that they would install cameras on the Kasoa road.’

Na ampara nso, polisini baako bi hyehyεε mfonyintwa mfidie no nyinaa.
 ‘And then, in fact, a certain one police officer installed all the cameras.’

- (9) *Specific + all + RC (one-to-many):*
Nnamfoɔ no hwɛɛ anim sɛ nnua no bɛkata nkonnwa no so.
'The friends hoped that the trees would shade the seats.'

Na ampara nso, dua baako bi wɔ hɔ aa ɛkataa nkonnwa no nyinaa so.
'And then, in fact, there was a certain one tree that shaded all the seats.'
- (10) *Universal first (one-to-one):*
Adwumapanin no hyɛɛ bɔ sɛ adwumayɛfoɔ no bɛnya mmoa afiri adesuafoɔ no hɔ.
'The boss promised that the apprentices would help the workers.'

Na ampara nso, adesuani biara boaa odwumayɛni baako.
'And then, in fact, every apprentice helped one worker.'
- (11) *Each (one-to-one):*
ɔfareni no ka kyere adwumayɛfoɔ no sɛ wɔngu asau no.
'The fisherman told the workers to cast the nets.'

Na ampara nso, wɔn mu biara guu asau baako.
'And then, in fact, each of them cast a net.'

3.1.2 Participants

Data collection took place at the University of Ghana Legon in Accra, Ghana. All participants were students at the University of Ghana and were contacted through the participant pool of the linguistics department⁴. They received 120 Cedis (~10€) for their participation in this experiment and a second experiment, unrelated to the one presented here⁵. All participants were pre-screened to make sure they were native speakers of the Asante Twi dialect of Akan. All of them indicated that they spoke at least one further language besides Akan. There were 56 participants overall (f: 23, m: 33). The data of one participant had to be excluded due to technical issues. They were between 18-27 years old with a mean age of 22⁶.

3.1.3 Procedure

Participants were tested in person at the University of Ghana. They were seated in front of a screen and listened to audio recordings of the items through over-ear headphones. They read the experiment instructions on their own, but had the option to ask clarification questions before starting the experiment. They were instructed to make a judgment if the picture represents a possible interpretation of what actually happened in the end (i.e., only with respect to the target sentence, not the context). They were

⁴ A special thanks goes to Reginald Akuoko Duah from the University of Ghana, without whom we could not have conducted this experiment.

⁵ One reviewer criticized that this is a relatively high payment. However, participants had to do two experiments in a row, which took between 1.5 to 2 hours and due to the limited equipment, most of them had to wait before they could start. Considering their travelling time in top, we deem this a fair payment.

⁶ One reviewer pointed out that older participants from more rural areas might have been a better group to test, since there is less interference from languages such as English. This is indeed a fair point. The reason why we chose that age group was mainly for reasons of practicalities: In order to conduct an experiment with a sufficient number of data points to detect finer grammatical differences with statistical analysis, a large number of participants needs to be tested. With the resources we had, this could only be done through the large, preexisting participant pool at the University of Ghana. An additional advantage with using this participant pool is that participants go through strict pre-screening processes for quality assurance.

further instructed to accept the picture even if they could think of yet another way to interpret the sentence and only reject the picture if it was impossible to interpret the sentence in that way. They were also told that there were no right or wrong answers and that they should only follow their intuition as native speakers of Asante Twi. They could initiate the audio recordings at their own pace and listen to them as many times as they wanted. The judgment task was already displayed while they were listening to the recordings. Once they accepted or rejected the presented picture with *aane* (= ‘yes’) or *dabi* (= ‘no’), the next item appeared automatically. The whole experiment including instructions and the subsequent background questionnaire took about 35 minutes.

3.2 Predictions

As discussed in section 1, languages differ in the extent to which they permit inverse readings in various contexts. While it is not always obvious why a particular language permits or prohibits inverse readings, Bobaljik & Wurmbrand (2012) provide a cross-linguistic approach to explain these patterns. Bobaljik & Wurmbrand’s approach is based on the operation of Quantifier Raising. They suggest that it is available in all languages and is the universal mechanism to create inverse readings. Further, they assume that inverse readings are restricted by the soft (= violable) constraint Scope Transparency (ScoT), which expresses that the order of quantifiers at the surface Phonological Form (PF) should be parallel to the order of quantifiers at the abstract Logical Form (LF). If ScoT is in opposition to another constraint, it may be violated. Their account makes a strong cross-linguistic prediction with respect to word order freedom: Languages with stricter word order should be more permissive in scope possibilities compared to languages with less strict word order. The reason is that ScoT enforces overt over covert movement whenever possible. In languages with strict word order, where the order of quantifiers cannot simply be changed through overt movement, ScoT needs to be violated in order to express the reverse scope constellation. Bobaljik & Wurmbrand used this account to explain why German, which allows for scrambling, is more restrictive in inverse interpretations than English, where scrambling is not an option. In that regard, Asante Twi is more similar to English, as it is an SVO language with very strict word order. There is only one possibility of changing the order of quantifiers overtly, which is via left-dislocated structures, such as the focus or topic construction. However, they involve a certain type of cleft-construction and are both syntactically complex and pragmatically marked. For similar reasons, Bobaljik & Wurmbrand (2012) consider neither passive voice nor the cleft-construction or other left-dislocated structures in English viable alternatives that could satisfy ScoT. Based on this line of reasoning, we would therefore expect inverse readings to be readily available between subject and object in Asante Twi.

Turning to the case of relative clauses, any approach that is based on QR – including the one presented by Bobaljik & Wurmbrand – predicts inverse readings to be completely blocked. However, there is some indication from other languages that this is not in fact true in such a strict sense, see section 1. Further, as discussed in section 2, Akan has been claimed to even allow for overt extraction in certain island environments such as relative clauses (Saah 1994). Therefore, inverse readings might be available in Akan relative clauses as well. On the other hand, QR is usually not only assumed to be blocked by island boundaries but by all clause boundaries, even those, where overt movement is licensed (Chomsky 1975). Thus, inverse readings should be blocked across all types of embedding and the possibility of overt island violations might not in fact be reflected in scope possibilities.

In light of these considerations, we expect the following pattern for our experiment: Both the unembedded and the embedded condition with the definite article to be at floor level, since the definite article is not quantificational and therefore cannot interact scopally with the existential quantifier. Based on the discussion on Bobaljik & Wurmbrand (2012), we expect relatively high acceptance rates for the IR-picture in the universal/unembedded condition – at least as high as acceptance rates for English in previous experiments. However, previous elicitation studies have found inverse readings to be available but rather difficult to obtain for Asante Twi speakers (Philipp 2023). But since speakers of the same language may vary greatly in their acceptance of

scope inversion, results from a small number of speakers cannot necessarily be generalized to a larger population. Nevertheless, if these elicitation result could be replicated in our experiment, acceptance rates might in fact be more similar to languages like German or Russian. As for the embedded condition, there are several conceivable outcomes: As predicted by QR-accounts, inverse readings might be blocked altogether. On the other hand, if the results for Asante Twi pattern with recent research on embedding in other languages (Tsai et al. 2014, Tanaka 2015, Barker 2021, Philipp 2023, Philipp & Zimmermann 2023), inverse readings should be reduced compared to the unembedded condition but still marginally available. Finally, if the fact that overt movement across island boundaries seems to be possible in Asante Twi is reflected in scope-taking, inverse interpretations might be just as high in the embedded condition compared to the unembedded condition. Philipp (2023) provides some support from elicitation data that inverse readings are indeed not completely blocked, but due to the small number of consulted speakers a numerical comparison to unembedded sentences is not possible.

3.3 Results

The results for the one-to-many/surface picture type are visualized in figure 2 and for the one-to-one/inverse picture type in figure 3.

When presented with the one-to-many/surface picture type, participants clicked ‘yes’ in 90.9% with the universal determiner and in 92.7% with the definite article in the unembedded condition. In the embedded condition, they clicked ‘yes’ in 94.5% with the universal determiner and in 95.8% with the definite article.

When presented with the one-to-one/inverse picture type, participants clicked ‘yes’ in 32.1% with the universal determiner and in 17.6% with the definite article in the unembedded condition. In the embedded condition, they clicked ‘yes’ in 22.4% with the universal determiner and in 13.9% with the definite article.

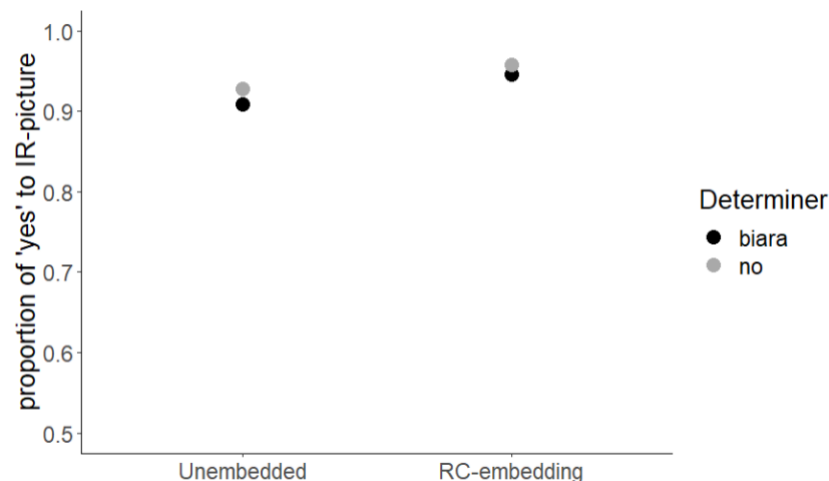


Figure 2: Results for one-to-many/surface picture type.

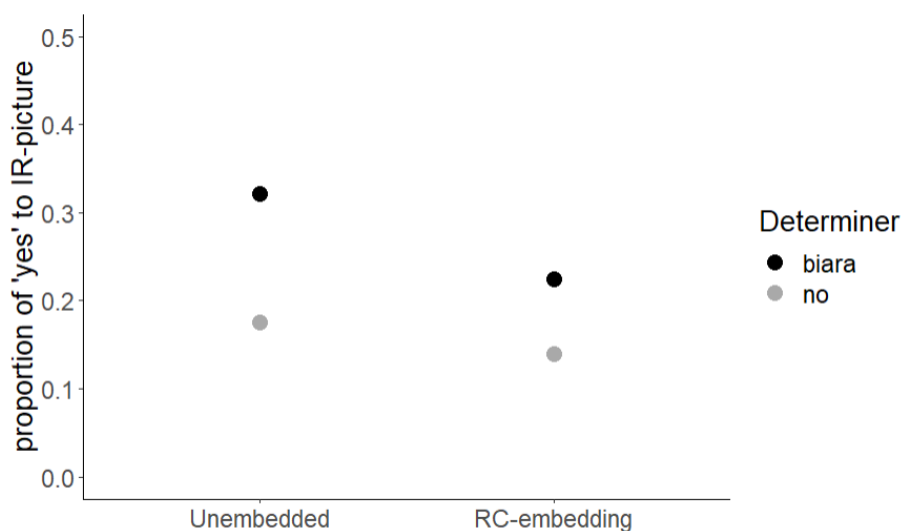


Figure 3: Results for one-to-one/inverse picture type.

The results were analysed using the free software R (version 3.6.1; R Core Team 2019) with a generalized linear mixed model fit by maximum likelihood using the package lme4 (Bates et al. 2015). There was a significant main effect of determiner ($p = 0.027$), embedding ($p = 0.028$), and picture type ($p < 0.001$). There was also a significant interaction of embedding $\times$ picture type ($p = 0.023$). No other interaction was significant. The results for the filler items are shown in Table 1.

	Spec + all	Spec + all + RC	Universal first	Each
Picture: one-to-many	0.99	0.99	0.08	0.11
Picture: one-to-one	0.11	0.11	0.96	0.98

Table 1: Results for filler items.

4. Discussion

The filler conditions showed the expected outcome and are thus reassuring that the experimental design worked successfully and that participants understood the task well and paid attention throughout the whole experiment. The expected picture type was accepted in 96-99% of the cases. The unexpected picture type was accepted in 8-11% of the cases. The experiment provides evidence that inverse readings are in fact available in Asante Twi.

This is because we found a significant main effect of determiner in the expected direction. The increased acceptance of the IR-picture in the case of the universal quantifier compared to the definite article can only be explained by true inverse interpretations due to a scopal interaction of the two quantifiers. The acceptance rates are also clearly higher than the filler items, which were designed to be unambiguous or strongly biasing towards one picture. These results are also not driven by a few extreme outliers among the participants, as can be seen in figure 3. The x-axis shows the number of times the IR-picture was accepted out of the six items each participant was exposed to. The y-axis shows the number of participants who accepted the IR-picture to the extent shown on the x-axis. It can be seen that most participants either reject the inverse readings in all cases or they accept them in one or two out of the six cases. Only a small group of participants accept them three times or more.

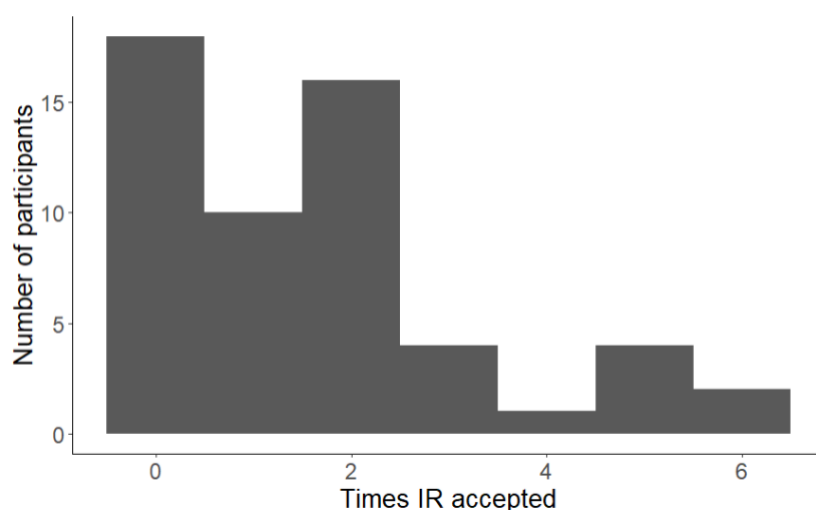


Figure 4: Individual participant data for the universal quantifier condition.

While inverse readings could be observed, they were clearly dispreferred, while the surface reading is strongly preferred. The acceptance rates of the one-to-many/SR-picture type were almost at ceiling for all four target conditions (90.9-95.8%). Thus, inverse readings in this experiment on Asante Twi were not as readily available as in previous experiments for other strict word order languages like English (e.g., Kurtzman & MacDonald 1993, Anderson 2004, Philipp & Zimmermann 2023). Instead, they were more similar to results for German (e.g., Fanselow et al. 2022). This is unexpected under the approach presented in Bobaljik & Wurmbrand (2012). According to this approach, inverse readings should be easily available in Asante Twi due to its strict word order. Note, however, that Akan/Asante Twi is not the only language which does not fully pattern with the predictions made in Bobaljik & Wurmbrand (2012). Mandarin Chinese, for example, is highly resistant against inverse readings despite lacking scrambling (Huang 1982, Lee 1986, Aoun & Li 1989, Tsai et al. 2014). Conversely, other languages are more permissive than would be predicted by Bobaljik & Wurmbrand's account. Experiments on German have shown that inverse readings are available in sentences where they should be blocked (Radó & Bott 2018, Fanselow et al. 2022, Philipp 2023, Philipp & Zimmermann 2023). The same is true for Russian (Antonyuk 2015, 2019, Ionin & Luchkina 2018). Greek has been shown to readily permit inverse readings, potentially to an even higher degree than English (Varkanitsa et al. 2016, Oikonomou et al. 2020), despite being a free word order language. Thus, while it cannot be excluded that a broad cross-linguistic correlation of word order freedom and availability of inverse readings could be observed, the strict wording of

ScoT as provided in Bobaljik & Wurmbrand (2012) cannot be correct based on data like Asante Twi and other languages mentioned above.

As for the case of embedding, our experiment provides evidence that inverse readings are not fully blocked when a relative clause boundary intervenes between the two quantifiers. The IR-picture was accepted in 22.4% in the embedded condition with the universal quantifier. This is clearly higher than the filler conditions, which were around 8-11%. This finding is in line with previous data in Philipp (2023). Nevertheless, the significant drop in acceptance from 32.1% to 22.4% indicates that the island embedding still reduces availability of inverse readings and that they can only be considered marginally available. This is further supported by the fact that the number of participants who reject the IR-picture across the board is higher in the unembedded compared to the embedded condition. This pattern is similar to what has been found in similar experiments on relative clauses in German, where the embedding condition reduced, but did not block inverse readings (Philipp 2023, Philipp & Zimmermann 2023). For English, there is introspective, experimental, and corpus data to suggest that inverse readings are at least marginally available in relative clauses as well as other types of embedding (Tsai et al. 2014, Tanaka 2015, Barker 2021, Philipp 2023, Philipp & Zimmermann 2023). The data on Asante Twi thus further challenges the assumption that inverse readings are derived by a covert movement mechanism. A further indication that scope ambiguities are unrelated to movement comes from the observation that despite the acceptability of overt movement in relative clauses and other islands in Akan/Asante Twi (e.g., Saah 1994), inverse readings are not attested to a higher degree in Asante Twi than in the other languages discussed here, which do not exhibit such island insensitivity with overt movement. Further, Philipp (2023) points out that in Asante Twi the pattern of acceptability rates across different types of islands is different from the pattern of inverse scope availability across the same islands. If the same underlying mechanism was at play, we would expect parallel patterns. Thus, overall, our results provide important evidence against a QR-account of inverse readings.

There were also some unexpected results with respect to the definite article. Acceptance rates for the two target conditions with the definite article were still slightly higher than for the filler conditions (17.6/13.9% vs. 8-11%). Further, there was no significant interaction between embedding and determiner. These results are in contradiction to our predicted floor effect for this condition. We can only speculate that there is an additional factor at play here besides scopal interaction. For instance, the mere presence of a plural set (*nkwadaa no* = 'the children') might have led some participants to erroneously respond with 'yes'. We also find 11% of such responses in the two filler conditions 'Spec + all' and 'Spec + all + RC'. Here, too there is a plural set (*nkwadaa no nyinaa* = 'all the children'). The rates might be slightly higher in the definite target compared to these filler conditions because the existential used for the latter (*baako bi* = 'a particular one') is inherently strongly specific, which is not the case for the existential in the target conditions (*baako* = 'one'). Either way, the observation that the 'yes'-responses to the IR-picture were still boosted in the condition with the universal quantifier compared to the baseline condition with the definite article can only be due to actual inverse interpretations. Therefore, this unexpected result does not harm the conclusions we can draw for the case of scope interaction between quantifiers.

In the experiment presented in here, we chose the numeral *baako* as existential quantifier, based on the considerations in section 2. Future work could provide a more accurate and general assessment for inverse readings in Akan/Asante Twi by also testing the same sentences with the indefinite article *bi* and, if possible, the bare noun. Further, testing inverse readings in other environments, such as in other types of embedding or between two objects, might provide further insight. Some initial elicitation research on these topics is presented in Philipp (2023). A particularly interesting case could be serial verb constructions, which do not exist in other languages that scope interpretations have been experimentally tested in. Finally, experimental research on inverse readings in a broader set of languages with more variable

grammatical properties could generally sharpen our understanding of this cross-linguistic phenomenon.

5. Summary

In this paper, we presented an experiment on interpretations of quantifier scope ambiguities in Asante Twi. As such, it is the first of its kind and provides novel insights into an underresearched phenomenon in the language. It also extends the field of quantifier scope research by adding experimental data of a language outside of the usual spectrum. We found evidence that inverse readings are available in transitive sentences in Asante Twi, as previously hypothesized in Philipp (2023). However, inverse readings were clearly dispreferred. Considering the strict word order in Asante Twi, this is surprising under the popular hypothesis that languages with stricter word order are more permissive in inverse interpretations (Bobaljik & Wurmbrand 2012). While our results do not completely contradict such a theory, they indicate that the cross-linguistic picture is a lot more complex. We further found partial evidence that inverse readings are not completely blocked by relative clause islands in Asante Twi. This is in contrast to common assumptions on inverse scope readings. Along with recent experimental data from other languages (Tsai et al. 2014, Philipp & Zimmermann 2023), these results pose a challenge to the popular approach of Quantifier Raising as the underlying mechanism of inverse readings.

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