

Cross-categorial gradability in Logoori*

Margit Bowler
University of Manchester

John Gluckman
University of Kansas

Abstract The central empirical observation of this paper is that there are polysemous lexical items in a number of unrelated languages that have similar, not intuitively related, meanings. These meanings are ‘to arrive’/‘to reach,’ ‘to be enough,’ and ‘must.’ The central theoretical claim of this paper is based on a case study of one such polysemous lexical item in Logoori (Bantu, JE 41; Kenya). We argue that these three meanings all arise from a single semantic denotation that is sensitive to a shared gradable component in the semantics of linguistic expressions referring to spatial paths, gradable predicates, measures of plural count nouns/mass nouns, and modals. The main theoretical issue addressed in this paper is the application of ordered, abstract scales in a model of grammar. This paper is an abridged version of [Bowler & Gluckman](#), to appear.

Keywords: gradability, gradable predicates, modality, Bantu

1 Introduction

In several languages, a single lexical item can be used to express the meanings ‘to reach/arrive,’ ‘to be enough,’ and some modal meaning, most frequently necessity modality. We illustrate this polysemy in [Table 1](#), and in (1) with examples from Logoori (Bantu, JE 41).¹ Logoori has a polysemous verb, *kudoka*. In (1a), *kudoka* is translated as ‘to arrive’/‘to reach’; in (1b) and (1c), it is translated as ‘to be enough’; and in (1d), it is translated as ‘must.’ We call these spatial, degree, amount, and modal uses, respectively. In this paper, we will group the degree and amount uses together, since we show later that they have the same syntax.

* All of the data in this paper is from our own fieldwork on Logoori (with Mwabeni Indire, Walter Kigali, Bernard Chahilu, and Ben Lavussa). Thank you to our wonderful consultants! We would also like to thank Vera Hohaus, Andrew Koontz-Garboden, audience members at SALT 30, Triple A 6, the University of Manchester’s Semantics Lab, and our anonymous SALT 30 and Triple A 6 reviewers. This work has been supported in part by European Research Council Consolidator Grant ERC-2017-COG 769192.

¹ Logoori is a Bantu language in the Luhia subfamily. It is spoken by approximately 600,000 people, primarily in western Kenya, with additional speaker groups in Tanzania and Uganda. See [Nurse & Philippson 2003](#) for description of Bantu syntax and morphology.

	Spatial	Degree/ amount	Modal	
Logoori (Bantu) <i>kudoka</i>	✓	✓	✓	
Mandarin (Sino-Tibetan) <i>gou</i>	✓	✓	✓	Shuzhen Jiang, p.c.
Chickasaw (Muskogean) <i>ona</i>	✓	✓		Pam Munro, p.c.
Tatar (Turkic) <i>citergä</i>	✓	✓		Margit's fieldwork
Lusaamia (Bantu) <i>khwola</i>	✓		✓	John's fieldwork
Nyala East (Bantu) <i>okhwola</i>	✓	✓		John's fieldwork

Table 1: Similarly polysemous lexical items in other languages.

- (1) a. Sira **a-dok-i** (Nairobi)
 1Sira 1SM-DOK-FV Nairobi
 ‘Sira **arrived** (at Nairobi).’² SPATIAL USE
- b. li-boksi li-v-i na vu-angu **vu-dok-an-a**
 5NC-box 5SM-COP-FV with 14NC-lightness 14SM-DOK-PL-FV
 (ku-geng-w-a)
 15NC-lift-PASS-FV
 ‘The box is light **enough** (to be lifted).’ DEGREE USE
- c. Sira a-v-i na ma-voyo **ga-dok-an-a** (ku-romb-a
 1Sira 1SM-COP-FV with 6NC-egg 6SM-DOK-PL-FV 15NC-make-FV
 i-chai)
 9NC-tea
 ‘Sira has **enough** eggs (to make breakfast).’ AMOUNT USE
- d. (ku ma-ragoo) **ku-dok-a** Sira a-zi-e yeng’o
 to 6NC-law 15NC-DOK-FV 1Sira 1SM-go-SBJV home
 ‘(According to the law), Sira **must** go home.’ MODAL USE

We take away from this data that these superficially distinct meanings share some semantic commonality, since the same polysemy is observed across a range of languages (Table 1).

² We use the following abbreviations: 1/2/3... noun classes; AC ‘anticausative,’ CAUSE ‘causative,’ COMP ‘complementizer,’ COP ‘copula,’ FUT ‘future,’ FV ‘final vowel,’ MOD ‘modal element,’ NEG ‘negative,’ PASS ‘passive,’ REC ‘reciprocal,’ SBJV ‘subjunctive,’ SG/PL ‘singular/plural,’ and SM ‘subject marker.’ Throughout the paper, we gloss the verb root of *kudoka* as DOK. We assume the standard Logoori orthography; *ng*’ represents a phonemic velar nasal /ŋ/ and *ny* represents a phonemic palatal nasal /j/. Logoori has a two-tone system (Samuels & Paster 2015), which is not represented in this orthography.

In this paper, we provide an analysis that reflects what we argue is the shared property of all the uses of *kudoka* in (1), namely, that they can be modeled using abstract, totally ordered scales. This analysis follows a long tradition of modeling gradable predicates as scalar, using degree scales (Cresswell 1976, Kennedy 1999, a.o.). This links scalar analyses of gradable predicates to scalar analyses of spatial paths (Krifka 1998, Hohaus 2018, a.o.), as well as proposals for measure operators that apply to nouns and yield values on the scale of real numbers (Rett 2014, Cresswell 1976). This data also provides empirical support for a gradable model of modality, and suggests that the kind of scale associated with modality shares some properties with the familiar degree scale used to model gradable predicates (Lassiter 2017b, among others). At the very least, this data suggest that languages can treat all of these types of scales similarly, and demonstrates the cross-categorial applicability of abstract scales in our model of grammar.

2 Logoori data

We describe the degree and amount uses of *kudoka* in §2.1, the spatial use in §2.2, and the modal use in §2.3. In a nutshell, in all of these uses, *kudoka* relates a value on a scale to a contextually supplied “threshold” value that must be met or exceeded.

2.1 Degree and amount uses (‘to be enough’)

We begin by briefly discussing Logoori Property Concept Lexemes (PCLs). We use “PCL” (following Dixon 1982) as a lexical-category-neutral term to refer to items that lexicalize meanings that are expressed by adjectives in languages that have adjectives. Logoori has nominal, verbal, and adjectival PCLs. Degree uses of *kudoka* are only available with nominal PCLs.³

Nominal PCL predications in Logoori have the form ‘be with PCL’.⁴ Francez & Koontz-Garboden 2015, 2017 call this predication strategy “possessive predication.”

³ Logoori speakers can use the lexical item *sam* (or *samu*) to express ‘to be enough’ with verbal, adjectival, and nominal PCL predicates. *Sam* lacks the spatial and modal polysemies of *kudoka*; *sam*-expressions also have an associated value judgment that the degree of the gradable predicate is pleasant or good. *-angu* ‘light’ in (i) is an adjective.

(i) li-boksi ni li-angu {samu / *ku-dok-a / *li-duk-an-a} ku-geng-a
 5NC-box COP 5SM-light SAM / 15NC-DOK-FV / 5SM-DOK-PL-FV 15NC-lift-FV
 ‘The box is light enough to lift.’ / ‘The box is just the right weight to lift.’

⁴ These ‘be with N’ constructions are also used to express possession of referential, non-PCL nouns, e.g. ‘Sira has a car.’

- (2) Sira a-v-i na vu-tambe
 1Sira 1SM-COP-FV with 14NC-tallness
 ‘Sira is tall.’ (Lit. ‘Sira is with tallness.’)
- (3) a-v-i na zi-soni.
 1SM-COP-FV with 10NC-shame
 ‘S/he is ashamed.’ (Lit. ‘S/he is with shame.’)

In its degree use, *kudoka* occurs in a subject relative clause headed by a nominal PCL. This relationship is reflected by noun class agreement between *kudoka* and the PCL, i.e., the noun class 14 agreement in (4). A literal translation for (4) could be ‘Sira is with a/the height that reaches.’ We provide an example of a Logoori subject relative clause without *kudoka* in (5) for comparison.

- (4) Sira a-v-i na vu-tambe vu-dok-an-a
 1Sira 1SM-COP-FV with 14NC-tallness 14SM-DOK-PL-FV
 ‘Sira is tall enough.’
- (5) o-mu-ndo a-v-i na i-nzara a-ri-i ma-ndazi
 1AUG-NC-man 1SM-be-FV with 9NC-hunger 1SM-eat-FV 6NC-mandazi
 ‘The man who was hungry ate the mandazi (fried dough ball).’

An optional infinitival clause can specify the degree of height, temperature, etc. that must be reached to count as “enough.” In the absence of this infinitival clause, the threshold value is understood from the context.

- (6) li-boksi li-v-i na vu-angu vu-dok-an-a
 5NC-box 5SM-COP-FV with 14NC-lightness 14SM-DOK-PL-FV
 (ku-geng-w-a)
 15NC-lift-PASS-FV
 ‘The box is light enough (to be lifted).’

Amount uses of *kudoka* are syntactically identical to degree uses of *kudoka*: in both uses, *kudoka* occurs inside a relative clause headed by a noun. In amount uses, this can be a plural count noun (e.g. *mavoyo* ‘eggs’) or a mass noun (e.g. *amaaze* ‘water’).⁵ *Kudoka* again agrees with the noun class of this head noun. The contextual threshold value that must be reached to count as “enough” can again be optionally specified by an infinitival clause.

⁵ Count nouns in Logoori have different singular and plural forms that are marked by different noun class prefixes (*livoyo/mavoyo* ‘egg’/‘eggs’, *imbwa/zimbwa* ‘dog’/‘dogs’). Logoori mass nouns differ in that they only occur with one noun class prefix (*vuyanzi* ‘happiness’, *amaaze* ‘water’).

- (7) Sira a-v-i na ma-voyo ga-dok-an-a (ku-romb-a
 1Sira 1SM-COP-FV with 6NC-egg 6SM-DOK-PL-FV 15NC-make-FV
 i-chai)
 9NC-tea
 ‘Sira has enough eggs (to make breakfast).’
 (Lit. ‘Sira is with eggs that reach (to make tea).’)

Kudoka is unacceptable in its amount use with singular count noun subjects. Examples like (8) are felicitous only if the singular count noun is coerced into a mass noun interpretation.

- (8) * Sira a-v-i na li-voyo li-dok-an-a (ku-romb-a
 1Sira 1SM-COP-FV with 5NC-egg 5SM-DOK-PL-FV 15NC-make-FV
 i-chai)
 9NC-tea
 Intended: ‘Sira has enough egg (to make breakfast).’

2.2 Spatial use (‘to arrive’/‘to reach’)

In its spatial use, *kudoka* is translated as ‘to arrive’ or ‘to reach’, and inflects for subject marking, tense, aspect, and mood. The noun encoding the goal of motion (i.e., the threshold) is optional.

- (9) Sira a-dok-i (Nairobi)
 1Sira 1SM-DOK-FV Nairobi
 ‘Sira arrived (at Nairobi).’ / ‘Sira reached (Nairobi).’

This optional goal noun is not a direct object of *kudoka*. It cannot be passivized (10) or object marked (11). We include this data to show that the goal noun is syntactically equivalent to the other contextual thresholds in the degree, amount, and modal uses in that it is never a direct object of *kudoka*.

- | | |
|---|---|
| <p>(10) * Nairobi i-dok-w-i
 9Nairobi 9SM-DOK-PASS-FV
 Intended: ‘Nairobi was reached.’</p> | <p>(11) * Sira a-ki-dok-i
 1Sira 1SM-9OM-DOK-FV
 Intended: ‘Sira reached it.’</p> |
|---|---|

2.3 Modal use ('must')

In its modal use, *kudoka* typically occurs in its infinitival form.⁶ The infinitival form is indicated by noun class 15 marking (*ku-*) and the final vowel *-a*.⁷ Infinitival *kudoka* obligatorily embeds a subjunctive clause, which is marked by the verbal suffix *-e*. Infinitival *kudoka* may occur either clause initially or directly after the subject, but not in both places simultaneously.

- (12) (ku-dok-a) Sira (ku-dok-a) a-zi-e yeng'o
 15NC-DOK-FV 1Sira 15NC-DOK-FV 1SM-go-SBJV home
 'Sira must go home.'

Modal uses of *kudoka* are compatible with all Kratzerian flavors of necessity modality (Kratzer 1981, 1991).⁸ The source of the necessity can be overt, as in the following deontic example.

- (13) ku ma-ragoo ku-dok-a Sira a-zi-e yeng'o
 to 6NC-law 15NC-DOK-FV 1Sira 1SM-go-SBJV home
 'According to the law, Sira must go home.'

The degree and amount uses of *kudoka* both express something having to do with "sufficiency." One therefore might expect that the modal use of *kudoka* would express weak rather than strong necessity (i.e., 'should' rather than 'must'). This is not the case; Logoori uses the verb *kwenya* for weak necessity (see Gluckman & Bowler 2020 for much more information on the Logoori modal system). We discuss the modal strength of *kudoka* more in §3.4.

⁶ Modal uses of *kudoka* can also occur in an "impersonal" form in which *kudoka* takes an event pluralizer (*-an*) (Gluckman 2018) and either noun class 6 (*ga-*) or noun class 9 (*e-*) as an "expletive" subject agreement (Gluckman & Bowler 2016). We don't discuss this syntactic configuration in this paper.

- (i) ga-dok-an-a ndee a-va-rwaye va-v-e na ki-bande chi-a
 6SM-DOK-PL-FV that 2AUG-NC-patient 2SM-COP-SBJV with 7NC-card 7AGR-ASSO
 ki-vitale ku-lola mu-ahi
 7NC-identity 15NC-see 1NC-doctor
 'It's necessary that patients have an ID card to see a doctor.'

⁷ Noun class 15 has properties of both verbal and nominal syntax (Mugane 1997). We assume that the modal use of *kudoka* is verbal, rather than nominal.

⁸ Our elicitation of modal data was guided by Vander Klok 2014; see Gluckman & Bowler 2020 for a description of modality in Logoori.

3 Analysis

The conceptual starting point of our analysis of *kudoka* is that all of the uses described in §2 intuitively invoke some sort of scale. By “scale,” we refer to a set of abstract objects that are subject to an ordering; when we say that something is “gradable,” we mean that it can be modeled using such a scale. In the degree use in §2.1, the scale is an ordered degree scale, the dimension of which is lexically specified by the nominal PCL. In the amount use in §2.1, the scale is one of ordered cardinalities (measures) of plural count nouns/ordered sizes of portions of mass nouns. In the spatial use in §2.2, the scale is one of ordered locations on a path in space. In §2.3, the scale is one of ordered possible worlds relative to what is best in a given context.

We motivate the formal ingredients of our analysis in §3.1, and derive each of the uses of *kudoka* in the following subsections. For step-by-step compositional derivations of all of the following uses, see the extended version of this paper, [Bowler & Gluckman to appear](#).

3.1 Components of our analysis

The components of our analysis are: (i) *kudoka*, a type-flexible two-place predicate; (ii) a contextually supplied minimum/threshold value that *kudoka* takes as its first argument; and (iii) a maximum value that *kudoka* takes as its second argument. *Kudoka* asserts that the maximum value meets or exceeds the minimum value, and introduces a presupposition that both of its arguments are located on the same scale, which is necessary in order to compare them.

We treat *kudoka* as type-flexible. Throughout the paper, we use α to refer to a type-flexible variable of semantic type d , l , or s , where d is the type of degrees, l is the type of locations, and s is the type of possible worlds. We give a semantics for *kudoka* in (14).

$$(14) \quad \llbracket kudoka \rrbracket^c = \lambda \alpha \lambda \alpha'. \alpha' \geq \alpha \quad \text{type } \langle d, \langle d, t \rangle \rangle, \langle l, \langle l, t \rangle \rangle, \text{ or } \langle s, \langle s, t \rangle \rangle$$

Defined iff:

- a. α and α' are on the same scale Σ
- b. α is of type d , l , or s

The first argument of *kudoka* (of type α) is the contextually supplied minimum threshold that the second argument of *kudoka* must meet or exceed. This threshold argument can be realized overtly, as in *kugengwa* ‘to be lifted’ in (6), *kuromba ichai* ‘to make tea’ in (7), *Nairobi* in (9), and *ku maragoo* ‘according to the law’ in (12). We take this as evidence that this argument is present in the syntax.

We obtain the second argument of *kudoka* by movement of a constituent of type $\langle \alpha, t \rangle$ (we discuss this more in the following subsections). The remaining trace is of

type α and picks out the maximum value of the moved set. *Kudoka* combines with this trace as its second argument. *Kudoka* in (14) therefore compares a maximum value to a minimum value, both of which are located on the same (totally ordered, downward monotonic) scale, and asserts that the maximum value meets or exceeds the minimum value.

3.2 Analysis of the degree and amount uses of *kudoka* ‘to be enough’

We’ll begin with the degree use of *kudoka*, since degree scales are arguably the most familiar kind of scale from the semantic literature. Degrees (of type d) were initially posited to account for the behavior of gradable adjectives like *big* and *tall*, e.g. their ability to occur in comparative constructions and combine with degree modifiers like *very* (Cresswell 1976, Bierwisch 1989, Kennedy 1999, a.o.). Degree semantic analyses of gradable adjectives posit a downward monotonic scale consisting of a dense set of abstract objects (degrees) that are totally ordered with respect to some dimension.⁹ That is, degree scales are treated as triples $\langle D, \succ, \delta \rangle$, where D is a set of degrees, \succ is a total ordering of D , and δ is the lexically specified dimension of the adjective (e.g. height in the case of *tall/short*; temperature in the case of *hot/cold*). Being subject to a total ordering is therefore part of what it means to be a degree. Adjectives can be modeled as encoding measure functions that map individuals to degrees, as in (15) (Cresswell 1976, a.o.).

- (15) $\llbracket \text{tall} \rrbracket = \lambda d \lambda x. \mathbf{tall}(x, d)$
 (where **tall** is a measure function mapping x to degree d on a scale of height)

Recall from §2.1 that Logoori nominal PCLs form predicates through possessive predication, as in (2) (‘Sira is tall’ \approx ‘Sira is with height’/‘Sira has height’). In degree uses of *kudoka*, the nominal PCL heads a relative clause containing *kudoka*. A literal translation of (16) could be ‘The pot has heaviness that reaches breaking the table.’

- (16) i-nyingu i-v-i na vu-ritu vu-dok-an-a
 9NC-pot 9SM-COP-FV with 14NC-heaviness 14SM-DOK-PL-FV
 (ku-vunyany-a i-mesa)
 15NC-break-FV 9NC-table
 ‘The pot is heavy enough (to break the table).’

We treat Logoori nominal PCLs as denoting portions of degree scales of type $\langle d, t \rangle$, as in (17).

⁹ Downward monotonicity: If a degree d is included in a set of degrees, $d - 1$ is also included in that set. Density: For any two degrees d, d' , there exists a degree d'' that occurs between them on the scale.

(17) $\llbracket \textit{vuritu} \rrbracket = \lambda d. d$ is a degree of heaviness

We adopt an analysis of possessive predication from [Francez & Koontz-Garboden 2015](#). We locate possessive semantics in the denotation of *na* ‘with’, which is empirically motivated by the fact that *na* is also used in other possessive constructions in Logoori (see footnote 4). (This semantics is also proposed by [Bochnak 2013](#): 112 for nominal PCL predications in the Bantu language Luganda.) *Na* asserts that an individual stands in a possessive relation π with a degree of a property P .¹⁰ For more discussion of this abstract possessive relation, see [Francez & Koontz-Garboden 2015](#); [Bochnak 2013](#).

- (18) a. Sira a-v-i na vu-tambe.
 1Sira 1SM-COP-FV with 14NC-tallness
 ‘Sira is tall.’ (Lit. ‘Sira is with tallness.’)
 b. $\llbracket \textit{na} \rrbracket = \lambda P_{\langle d,t \rangle} \lambda x. \exists d [P(d) \ \& \ \pi(x)(d)]$
 (adapted from [Francez & Koontz-Garboden 2015](#): 546, 548)
 c. $\llbracket (18a) \rrbracket = 1$ iff $\exists d [d$ is a degree of tallness & $\pi(\textit{Sira})(d)]$

The first argument of *kudoka* on its degree use is a contextually supplied degree. This can only occur overtly as an infinitival clause, as in *kuvunyanya imesa* ‘to break the table’ in (16). We assume that this infinitival clause is nominal ([Mugane 1997](#)), and that this noun can be shifted to a degree, following arguments from [Heim 1987](#) that nouns can denote degrees (as in amount relatives like *It would take days to drink the champagne they spilled that evening*). In (16), this is the degree of heaviness at which the table breaks. The degree denoted by *kuvunyanya imesa* in (16) is a minimum threshold value. In the absence of an overt nonfinite clause, this threshold is contextually supplied.

We give a composition in (19) for the degree use of *kudoka* in (16), with truth conditions as in (20). *Vuritu* ‘heaviness’ undergoes movement as the head of the relative clause, leaving behind a trace of type d that picks out the maximum degree of heaviness (following the analysis of degree relatives in [Grosu & Landman 1998](#)). This maximum degree serves as the second argument of *kudoka* on its $\langle d, \langle d, t \rangle \rangle$ use. We assume following [Heim & Kratzer 1998](#) that the head of the relative clause combines with the predicate through Predicate Modification. In sum, (16) is true iff the maximum degree of heaviness possessed by the pot meets or exceeds the contextually supplied minimum degree of heaviness at which the table breaks. (For

¹⁰ [Francez & Koontz-Garboden 2015](#) treat nominal PCLs like *strength* as denoting portions of substances (analogous to the denotations of mass nouns like *water*, where mass nouns are modeled as ordered structures following [Link 1983](#)). [Francez & Koontz-Garboden 2015](#): 553-554 discuss how their analysis could be recast in terms of degrees using intervals on a scale.

readability, in this and the following derivations, we do not include the presupposition from (14) that the two arguments of *kudoka* are on the same totally ordered scale.)

(19) [*inyingu avi na* $[\langle d,t \rangle]$ *vuritu* $[\langle d,t \rangle]$ $\lambda 1 t_1$ *vudokana kuvunyanya imesa*]]

(20) [[(16)]]^c = 1 iff $\exists d$ [*d* is a degree of heaviness & $d \geq C_{break-the-table}$ & $\pi(\text{pot})(d)$]

We turn next to the amount uses of *kudoka* like (21), in which the head of the relative clause is a plural count noun or mass noun; a literal translation of (21) could be ‘Sira has eggs that reach making breakfast.’ Such nouns can be measured. Plural count nouns can be measured using numerals (*six eggs, four cats*), while mass nouns can be measured using units like *gallon* or *cup*, which can themselves combine with numerals (*six gallons of water, four cups of sand*). For space reasons, we will only give a compositional analysis of an amount use of *kudoka* with a plural count noun.

(21) Sira a-v-i na ma-voyo ga-dok-an-a (ku-romb-a
 1Sira 1SM-COP-FV with 6NC-egg 6SM-DOK-PL-FV 15NC-make-FV
 i-chai)
 9NC-tea
 ‘Sira has enough eggs (to make breakfast).’

Several authors model nominal measurements using tools from the degree literature (Cresswell 1976; Grosu & Landman 1998; Rett 2018, 2014). For instance, Rett 2014 follows Cresswell 1976 in proposing that quantities of count nouns can be measured using a measure function that combines with a plural individual and returns its cardinality. This cardinality is treated as being of type *d*. This (and other analyses) reflect the intuition that cardinality scales consisting of the set of positive real numbers share similarities with degree scales: like degree scales, cardinality scales are downward monotonic and totally ordered.

We posit such a measure operator, CARD(INALITY), in our analysis. When applied to the denotation of a plural count noun, the output of this measure operator is the cardinality of the plural individual denoted by the noun, represented as something of type *d*.¹¹ We give a denotation for CARD in (23a), and show its application to *mavoyo* ‘eggs’ in (23b).¹²

11 There is an extensive literature showing that plural count nouns and mass nouns should be modeled as having internal structure (Link 1983, among others). We assume Link 1983’s analysis of plural count nouns as denoting sums of atomic elements closed under the join operation, and mediate between *kudoka* and the denotation of the noun using a cardinality operator.

12 We assume following Francez & Koontz-Garboden 2015 that mass nouns like *amaaze* ‘water’ can be modeled as sets of portions of the relevant substance; we treat portions as being of type *e*. Following Link 1983, the portions of substances that form mass nouns (like the atoms that form plural count

- (23) a. $\llbracket \text{CARD} \rrbracket = \lambda P_{\langle e,t \rangle} \lambda d. \mu_{\text{card}}(P) = d$ type $\langle \langle e,t \rangle, \langle d,t \rangle \rangle$
 (where P is a set of plural count individuals)
 b. $\llbracket \text{mavoyo CARD} \rrbracket = \lambda d. \mu_{\text{card}}(\lambda x. \text{eggs}(x)) = d$ type $\langle d,t \rangle$

Amount uses of *kudoka* have the same relative clause syntax as degree uses, modulo the presence of the measure operator. The constituent [*mavoyo CARD*], of type $\langle d,t \rangle$, is the head of the relative clause in (21). It moves out of the relative clause, and its trace picks out the maximum of the set of degrees denoted by this moved constituent. This trace is the second argument of the amount use of *kudoka*. The first argument of *kudoka*, also of type d , is supplied contextually or by a nominal infinitival clause. The semantics of the possessive predication in (21) are as in (18b).

We give a compositional account for (21) in (24), with truth conditions as in (25). In short, (21) is true iff the cardinality of the set of eggs possessed by Sira meets or exceeds the contextually supplied minimum cardinality (of eggs) at which Sira can make breakfast.¹³

- (24) [*Sira avi na* [_{$\langle d,t \rangle$} [*mavoyo CARD*] [_{$\langle d,t \rangle$} $\lambda 1 t_1$ *gadokana kuromba ichai*]]]
 (25) $\llbracket (21) \rrbracket^c = 1$ iff $\exists d [\mu_{\text{card}}(\lambda x. \text{eggs}(x)) = d \ \& \ d \geq C_{\text{make-tea}} \ \& \ \pi(\text{Sira})(d)]$

The intuitive meanings of both (16) and (21) involve possibility modality. This was noted previously by Meier 2003 for English *enough*-expressions, which she proposes contain a covert conditional with a covert or overt possibility modal, as in (26). Hacquard 2006 also proposes that *enough* is modal.

- (26) Bertha is old enough to drive a car.
 \approx Bertha has the age such that if Bertha is that old, she is **able** to drive a car

nouns) are also ordered by the join operation. This induces a mereological part-of relation over the portions of substances, which allows the sizes of the portions to be compared. We posit a measure operator SIZE that combines with mass nouns and outputs the measure of the sizes of portions of the noun, as in (22). (See Francez & Koontz-Garboden 2015: 553 for discussion of differences between the structure of mass nouns and degree scales.)

- (22) $\llbracket \text{SIZE} \rrbracket = \lambda P_{\langle e,t \rangle} \lambda d. \mu_{\text{size}}(P) = d$ (where P is a set of portions of mass noun)

¹³ Here we encounter an issue that was previously discussed by Grosu & Landman 1998 in their analysis of English amount relatives like *We will need the rest of our lives to drink the amount of wine they spilled that evening*. Grosu & Landman 1998 argue that the amount-relative clause cannot simply denote a set of degrees, i.e. $\{d: \text{they spilled } d \text{ that evening}\}$. The denotation of the relative clause must include what is being measured, i.e. $\{d: d \text{ is an amount of wine and they spilled } d \text{ that evening}\}$. Their solution is to propose that amount relatives are internally headed, a proposal that we also follow. In our case, we have to assume that CARD (and SIZE) output measures that also encode the kind of thing they are measuring; in (23b), the scale would be one of cardinalities of sets of eggs.

However, the Logoori data suggests a non-modal analysis of the sufficiency marker, i.e., *kudoka*. The spatial use of *kudoka*, which we discuss further in the following section, clearly does not have any modal meaning. Since we want *kudoka* to have the same denotation across uses, this suggests a non-modal analysis of it on its degree and amount uses as well. We assume that covert modality in its degree/amount uses comes from the nonfinite clause providing the threshold degree (Bhatt 1999/2006), and is not part of the semantics of *kudoka* itself.

3.3 Analysis of the spatial use of *kudoka* ‘to reach’/‘to arrive’

Other authors have previously noted the semantic similarities and synchronic relationships between gradable adjectives and linguistic expressions referring to spatial paths or locations (Faller 1999; Winter 2005; Schwarzschild 2013, 2012; Hohaus 2018, 2012). Still other authors have modeled spatial paths as scalar, but without reference to the literature on gradability in adjectives (Cresswell 1978, Krifka 1998). We take the Logoori data to show that languages can and do treat gradable PCLs and spatial expressions similarly in the grammar.

We model spatial paths as sets of locations; following Hohaus 2018, we assume a semantic type l for locations. Given a set of locations L , the locations in L are ordered sequentially. l_n precedes l_{n+1} by virtue of its order in the sequence; the first location in the sequence is the starting point of the path, and the last location in the sequence is the end point of the path.¹⁴ Sets of locations (i.e., spatial paths) are therefore downward monotonic and totally ordered, like degree scales. We provide the following analogy: while gradable adjectives can relate an individual to a degree on a property scale, spatial expressions can relate an individual to a location on a spatial path.

This treatment of spatial paths is a simplification of what paths look like in physical reality. Spatial paths can be circular, in that the start and end points of a path in space can be identical. The model we assume cannot capture this, since locations are inherently sequentially ordered. This model also does not account for the directionality of the path, and is restricted to change in one dimension. As a result, it does not capture the two-dimensional changes that differentiate a path that winds and doubles back on itself from a straight path. This model therefore treats winding paths and straight paths the same.

For the purpose of our analysis, the inability of our model to distinguish between paths is a virtue, since *kudoka* is not sensitive to two- (or three-)dimensional differences in paths. It is felicitous to say (27) as long as Sira reached Nairobi, regardless

¹⁴ Another way of accomplishing this would be to treat spatial paths as consisting of location-time pairs. Since times are inherently totally ordered, location-time pairs are also totally ordered. This is like what Krifka 1998 and Cresswell 1978 propose in their analysis of paths.

of whether he took a winding path or a straight path to get there.

- (27) Sira a-dok-i Nairobi
 1Sira 1SM-DOK-FV Nairobi
 ‘Sira arrived at Nairobi.’ / ‘Sira reached Nairobi.’

As part of our analysis of spatial uses of *kudoka*, we posit a location function Λ that maps an individual to the set of their locations.¹⁵ We give a semantics for Λ in (28a), and show its application to *Sira* in (28b).

- (28) a. $\llbracket \Lambda \rrbracket^c = \lambda x \lambda l. l$ is a location of x type $\langle e, \langle l, t \rangle \rangle$
 b. $\llbracket Sira \Lambda \rrbracket^c = \lambda l. l$ is a location of Sira type $\langle l, t \rangle$

Empirical evidence for this location function in Logoori comes from the fact that locations can be predicated directly of individuals. In (29), *Sira* first combines with Λ . The location picked out by *Kenya* applies to the set of *Sira*’s locations, rather than the individual *Sira*.

- (29) Sira a-v-e Kenya i-la
 1Sira 1SM-COP-FV 9Kenya 9AGR-DEM
 ‘Sira is in Kenya.’ (Lit. ‘Sira is that Kenya.’)

The subject of the sentence in (27) is the constituent [*Sira* Λ], of type $\langle l, t \rangle$. It denotes an ordered set of locations from *Sira*’s starting point to his end point in Nairobi. This constituent undergoes movement out of the VP to subject position. Since sets of locations are downward monotonic and totally ordered, the remaining trace of type l denotes *Sira*’s maximum location on this path to Nairobi. This serves as the second the second argument of *kudoka* in its spatial use.

The first argument of *kudoka* in (27) is also of type l . In (27), it is realized overtly by *Nairobi*. We assume that this use of *Nairobi* to refer to something of type l is derived from its individual (type e) use, and is derived by a function similar to Λ that maps an individual to a location (see footnote 15). This location is a crisp threshold that varies contextually and picks out the minimum location that “counts as” being in Nairobi in the context. In some contexts, this location could be in the outskirts of the city, while in other contexts it might be the city center.

15 The domain of Λ is contextually restricted; it does not map an individual to all of their locations throughout their life, but to their locations within some contextually salient time interval.

Spatial uses of *kudoka* necessarily involve a change in location; part of the meaning of (27) is that *Sira*’s path began outside of Nairobi, and ended at or beyond Nairobi. This change in location stems from an presupposition that the set of locations output by Λ is a non-singleton set, which we omit for simplicity in our derivations here.

We give a structure for (27) in (30).¹⁶ We assume lambda-abstraction over the trace left by movement of [*Sira* Λ] to subject. The two objects of type $\langle l, t \rangle$ combine via Predicate Modification, and existential closure binds the open location variable at the top of the tree.

(30) [$\exists [\langle l, t \rangle \text{ Sira } \Lambda] [\langle l, t \rangle \lambda 1 t_1 \text{ adoki Nairobi }]]$

(31) $\llbracket (27) \rrbracket^c = 1$ iff $\exists l [l \text{ is a location of Sira } \& l \geq C_{\text{Nairobi}}]$

(27) is true iff Sira’s maximum location on a path meets or exceeds the minimum location that counts as being in Nairobi in the context. It is also possible to use *kudoka* in a context in which Sira reached Nairobi and then passed beyond it, as predicted by the use of the \geq relation in the truth conditions in (31).

(32) Sira a-dok-i Nairobi, kare ndio a-l-i Kisumu
 1Sira 1SM-DOK-FV 9Nairobi, in.fact 1SM-COP-FV 9Kisumu
 ‘Sira reached Nairobi, in fact, he’s in Kisumu.’

3.4 Analysis of the modal use of *kudoka* ‘must’

Gradability in modality has been previously discussed by Lewis 1973, Kratzer 1981, 1991, Portner 2009, Klecha 2014, and Lassiter 2017b, among many others. Empirical support for a gradable model of modality comes from data like (33). In this example, the German modal auxiliary *kann* occurs in a morphologically explicit comparative construction comparing degrees of likelihood. Kratzer 1981: 46 uses this data to motivate an ordering on possible worlds according to how many of a set of propositions (the “ordering source”) they satisfy.

(33) Der Gauzner-Michl kann eher der Mörder sein als der Kastenjagl.
 the Gauzner-Michl can rather the murderer be than the Kastenjagl.
 ‘Gauzner-Michl is more likely to be the murderer than Kastenjagl.’

Lassiter 2010, 2011, 2014, 2017a,b and Villalta 2008, among others, explicitly model modal meanings using abstract scales. We follow Lassiter 2014, 2017b and Portner & Rubenstein 2016 in proposing that sets of possible worlds can be totally ordered. This total ordering of worlds must be derived, since even when ranked according to a Kratzerian ordering source, worlds are only partially ordered: different worlds could have different propositions that are true in them that amount to the same degree on a scale of e.g. goodness according to the law, leaving open

¹⁶ We omit the morphology on *kudoka* in (27) for simplicity. We assume that agreement morphology is associated with T (since it covaries with finiteness), and that verbs undergo head-movement to T. It is likely that verbs in Logoori displace further to C.

the possibility that multiple worlds could be equally good. [Lassiter 2017b](#) derives a total ordering by mapping worlds to totally ordered values on scales, while [Portner & Rubenstein 2016](#) propose that the utterance context imposes a total ordering on worlds. It is not important to us *how* the total ordering is derived; what is crucial to our analysis is that sets of worlds *can* be treated in this way.

We propose that the total ordering on worlds is contributed by the obligatory subjunctive marking on modal uses of *kudoka*, *-e*.¹⁷ We give a semantics for the subjunctive in (34).

$$(34) \quad \llbracket \text{SBJV} \rrbracket^c = \lambda p_{\langle s,t \rangle} \lambda w. \text{VALUE}_{\Sigma,c}(p) = w$$

The function `VALUE` maps the prejacent proposition to an ordered world on a scale.¹⁸ The dimension of the scale, Σ , is contextually supplied. This dimension reflects the modal flavor and can be e.g. goodness with respect to the law (deontic modality), likelihood (epistemic modality), and so on.¹⁹

Propositions, like worlds, are not inherently ordered, since they are simply a set of worlds in which a proposition p is true. However, propositions can be compared based on how well they conform to the contextually supplied dimension (e.g., goodness with respect to the law). A proposition p may be better or worse than another proposition q relative to the law. We adopt Lewis' view of comparing propositions in that "we are comparing ϕ -at-its-best with ψ -at-its-best, and ignoring the non-best ways for ϕ and ψ to hold" ([Lewis 1973](#): 101). In Lewis' terms, this is "maximax betterness." We use the best world in the set of p -worlds to globally assign a value to p . Given our assumption of Lewis's maximax betterness, we can reconstruct orderings of propositions from ordered worlds. Given this background, it is clear how ordered worlds share properties with ordered locations and degrees. All three can be modeled as sets of totally ordered abstract objects.

Given some ordered scale of worlds, we can delimit which worlds are the most ideal along some parameter, adopting the core insights of [Lewis 1973](#) and [Kratzer 1981, 1991](#). In this model, there is some w on the scale such that this world meets

17 This is in the spirit of [Villalta 2008](#)'s observation that there is a link between subjunctive mood and gradability. In Villalta's approach, gradability is attributed to the predicates that embed a subjunctive complement. On our approach, the subjunctive introduces an ordering, and the embedding predicate (here, *kudoka*) establishes a comparison.

18 We do not posit a measure function because we do not wish to impose a mapping to the set of real numbers (or to a set of degrees). This is because it is not clear whether the ordering imposed on worlds shares the properties of real numbers/degree scales in being a) downward monotonic, and b) dense. For our analysis to work, we must minimally assume that the ordering is downward monotonic, because we invoke maximality in the interpretation of traces. However, we do not necessarily need the ordering to be dense. See discussions in [Lassiter 2017a](#); [Portner & Rubenstein 2016](#).

19 [Gluckman & Bowler 2020](#) show that Logoori modals pattern like English in only lexically specifying force, and that flavor is determined contextually.

the minimum number of requirements to be considered “ideal.” Because the scale is a total ordering, any world above w is at least as good as w . This lets us define a threshold delimiting the set of best possible worlds. We can model modal necessity as follows: if the value of the best p -world meets or exceeds the value of the sufficiently ideal world, then p is a necessity.²⁰ Reworded: a proposition p is a necessity if the best p -world is at least as good as the least best world on a given modal scale.

In our compositional analysis of modal uses of *kudoka*, we treat the threshold as something of type s that is supplied contextually and that serves as the first argument of *kudoka* in its modal use. In (35), it occurs overtly as *ku maragoo* ‘according to the law.’ This threshold is the least best world in which the law is obeyed.

- (35) (ku ma-ragoo) ku-dok-a Sira a-zi-e yeng’o
 to 6NC-law 15NC-DOK-FV 1Sira 1SM-go-SBJV home
 ‘(According to the law), Sira must go home.’

In (35), the constituent [*Sira azie yeng’o*] undergoes extraposition to the right edge of the clause. This moved constituent of type $\langle s,t \rangle$ leaves behind a trace of type s , which serves as the second argument of *kudoka*. Because we assume that the ordering imposed by SBJV is downward monotonic, this trace picks out the highest ranked world in which Sira goes home on a scale of law-abiding-ness. *Kudoka* contributes that this world meets or exceeds the contextually supplied least-best world according to the law, making it a necessity.

We again assume lambda-abstraction over the remaining trace, and combination of the two objects of type $\langle s,t \rangle$ via Predicate Modification. The open world variable at the top of the tree is bound by existential closure. We give a structure for (35) in (36), and its truth conditions in (37). (35) is true iff there exists a world in which Sira goes home, and the value of this world on a scale of law-abiding-ness meets or exceeds the value of the least best world on a scale of law-abiding-ness. That is, (35) is true iff the proposition “Sira goes home” is a necessity according to the law.

²⁰ In this approach, the difference between possibility and necessity modality stems from the value on the scale that the prejacent’s value is compared to. This threshold is lower for possibility modals than for necessity modals. Our analysis is therefore compatible with a polysemous *kudoka*-like item that contributes modal possibility, rather than necessity. This is observed for Mandarin Chinese *gou*; see Table 1.

Klecha 2014 argues that necessity modality is conceptually equivalent to superlativity, maintaining the insight from Kratzer that we can define a set of “best” possible worlds. See also Portner & Rubenstein 2016, who draw an analogy between strong necessity modals like *must* and “extreme” gradable adjectives like *huge*. Possibility modality, in contrast, can be conceptualized as comparison to a lower world-value that is merely contextually sufficient. It is similar to POS from the gradability literature (Kennedy 1999, among others): a proposition is a possibility if it exceeds some non-maximal contextual standard on a scale of likelihood /goodness/et cetera.

(36) [\exists [_(s,t) [t₁ *ku maragoo kudoka*] $\lambda 1$] [_(s,t) SBJV *Sira azie yeng'o*]]

(37) [[(35)]]^c = 1 iff $\exists w[\text{VALUE}_{\Sigma,c}(\lambda w'.\text{Sira goes home in } w') = w \ \& \ w \geq C_{\text{best-law}}$]

3.5 Recap

All of the uses of *kudoka* in §2 can be modeled using the same type-flexible semantics. In all of its uses, *kudoka* contributes a \geq relation between its two arguments, where its first argument is a contextually supplied threshold value and its second argument is a maximal value denoted by a trace. To be able to compare them, *kudoka* presupposes that both of these values are located on the same totally ordered and downward monotonic scale.

Kudoka can appear in different syntactic configurations. In its spatial use, *kudoka* occurs as a main predicate; in its degree and amount uses, it occurs in a relative clause modifying a noun; in its modal use, it is syntactically peripheral.

4 Conclusion

Linguistic expressions referring to gradable predicates, measures of plural count nouns/mass nouns, spatial paths, and modals can be treated similarly in the grammar. We demonstrated this using data from Logoori *kudoka*.

An alternative analysis of this data that we initially entertained involved shifting locations and worlds into degrees. We posited a measure function that translated locations and worlds into degrees. *Kudoka* was treated as type-inflexible, and related two degree arguments in all of its uses (type $\langle d, \langle d, t \rangle \rangle$). This analysis had some compositional problems, which we discuss in [Bowler & Gluckman to appear](#).

Conceptually, however, we felt that this degree analysis missed a larger generalization that can be made about cross-categorial gradability in grammar. Sets of locations and possible worlds are translatable into degrees *because* they share properties with sets of degrees: they can also be modeled as ordered objects on a scale. Although degrees constitute the most familiar scales in the literature, shifting everything into degrees obscures the fact that gradability also exists in other domains.

This project suggests that degree, location, and world scales can all be totally ordered. For the purpose of this paper, we also need to assume that these scales are downward monotonic to account for the interpretation of traces as picking out maximum values. We feel that this is a reasonable proposal for location scales, but would benefit from additional support for world scales.

While we show that different kinds of scales share similar properties, we do not claim that all linguistic scales are identical. The dimensions of property concept scales are lexically specified, while the dimensions of world scales are contextually

‘to arrive’ / ‘must’ / (‘to be enough’)	Language
<i>kwenyekha, khoya</i>	Lubukusu
<i>okhwola</i>	Lunyore
<i>kukhoyera</i>	Lusaamia
<i>khutukha</i>	Lutiriki
<i>okhula</i>	Luwanga

Table 2: Similarly polysemous lexical items in other Luhya languages.

specified (at least in Logoori and English). Degree scales are dense, but we do not currently have evidence for world scales being dense. Degree scales are also noted to lexically vary in having minimum and maximum values (Kennedy & McNally 2005). Lassiter 2010 argues that such distinctions in scale type are relevant to an analysis of gradable epistemic modals, though we do not discuss this in this paper.

This study has implications for semantic change and the diachronic source of threshold expressions like *kudoka*. A number of other languages in the Luhya subfamily of Bantu have similarly polysemous lexical items, listed in Table 2. All of these lexical items can express the spatial and modal meanings; degree/amount uses are available for a subset of these. Only Lutiriki *khutukha* ‘to arrive’/‘must’ is cognate with Logoori *kudoka*.

All of the lexical items in Table 2 and in Table 1 have a spatial use (‘to reach’/‘to arrive’). This suggests to us that the spatial use of these items is basic, and that the degree/amount and modal uses arose out of their spatial meaning. This accords with Hohaus 2018’s proposal for a reanalysis of spatial paths into degree scales in Samoan. It is not currently possible to definitively determine whether the modal use arose out of the degree use, or if it also arose separately from the spatial use. In any case, this data suggests a new “map” for the development of modal meanings, of the kind discussed by Bybee, Perkins & Pagliuca 1994 and van der Auwera & Plungian 1998. To our knowledge, this change from spatial meaning → (degree meaning) → modal meaning is a novel observation.

To sum up, we have shown in this paper that gradable predicates, measures of amounts, spatial expressions, and modals can be treated similarly in the grammar, as demonstrated by the Logoori verb *kudoka*. It is an open question as to why in some languages, only subsets of these meanings arise. We hypothesize that at least some of the explanation resides in lexical category and c-selectional restrictions. We hypothesize that the degree use of *kudoka* arose because (some) PCLs in Logoori are nouns, and so can act as subjects of the verb. The modal use likely developed later as the meaning of *kudoka* further bleached and c-selectional requirements were relaxed.

References

- van der Auwera, Johan & Vladimir Plungian. 1998. Modality's semantic map. *Linguistic Typology* 2. 79–124. doi:10.1515/lity.1998.2.1.79.
- Bhatt, Rajesh. 1999. *Covert Modality in Non-finite Contexts*: University of Pennsylvania PhD dissertation.
- Bhatt, Rajesh. 2006. *Covert Modality in Non-finite Contexts*. Mouton de Gruyter.
- Bierwisch, Manfred. 1989. The semantics of gradation. In Manfred Bierwisch & Ewald Lang (eds.), *Dimensional Adjectives: Grammatical Structure and Conceptual Interpretation*, 71–261. Springer Verlag.
- Bochnak, Ryan. 2013. *Cross-linguistic Variation in the Semantics of Comparatives*: University of Chicago PhD dissertation.
- Bowler, Margit & John Gluckman. to appear. Gradability across grammatical domains. *Linguistic Variation* .
- Bybee, Joan, Revere Perkins & William Pagliuca. 1994. *The Evolution of Grammar: Tense, Aspect, and Modality in the Languages of the World*. University of Chicago Press.
- Cresswell, Max. 1976. The semantics of degree. In Barbara Partee (ed.), *Montague Grammar*, 261–292. New York: Academic Press.
- Cresswell, Max. 1978. Prepositions and points of view. *Linguistics and Philosophy* 2(1). 1–41. doi:10.1007/bf00365129.
- Dixon, R.M.W. 1982. *Where Have All the Adjectives Gone? And Other Essays in Semantics and Syntax*. The Hague: Mouton.
- Faller, Martina. 1999. Dimensional adjectives and measure phrases in vector space semantics. In Stefan Kaufmann Martina Faller & Marc Pauly (eds.), *Formalizing the Dynamics of Information*, 151–170. CSLI Publications.
- Francez, Itamar & Andrew Koontz-Garboden. 2015. Semantic variation and the grammar of property concepts. *Language* 91(3). 533–563. doi:10.1353/lan.2015.0047.
- Francez, Itamar & Andrew Koontz-Garboden. 2017. *Semantics and Morphosyntactic Variation: Qualities and Grammar of Property Concepts*. Oxford University Press.
- Gluckman, John. 2018. Iterative-reciprocal polysemy in Logoori. In Ryan Bochnak (ed.), *Semantics of African, Asian and Austronesian Languages* 6, .
- Gluckman, John & Margit Bowler. 2016. Expletive agreement, evidentiality, and modality in Logooli. In *Semantics and Linguistic Theory* 26, 1063–1082.
- Gluckman, John & Margit Bowler. 2020. The expression of modality in Logoori. Forthcoming in *Journal of African Languages and Linguistics*.
- Grosu, Alexander & Fred Landman. 1998. Strange relatives of the third kind. *Natural Language Semantics* 6. 125–170. doi:10.1023/a:1008268401837.

- Hacquard, Valentine. 2006. Aspects of *too* and *enough* constructions. In *Semantics and Linguistic Theory 15*, 80–96.
- Heim, Irene. 1987. Where does the definiteness restriction apply? Evidence from the definiteness of variables. In Alice Ter Meulen & Eric Reuland (eds.), *The Representation of (In)definiteness*, 21–42. Cambridge: MIT Press.
- Heim, Irene & Angelika Kratzer. 1998. *Semantics in Generative Grammar*. Blackwell Publishers.
- Hohaus, Vera. 2012. Directed motion as comparison: Evidence from Samoan. In Elizabeth Bogal-Allbritten (ed.), *Semantics of Under-Represented Languages in the Americas 6*, 335–348.
- Hohaus, Vera. 2018. How do degrees enter the grammar? Language change in Samoan from [-DSP] to [+DSP]. In Elizabeth Bogal-Allbritten & Elizabeth Coppock (eds.), *Semantics of African, Asian and Austronesian Languages 4*, 106–120.
- Kennedy, Chris & Louise McNally. 2005. Scale structure, degree modification, and the semantics of gradable predicates. *Language* 81(2). 345–81. doi:10.1353/lan.2005.0071.
- Kennedy, Christopher. 1999. *Projecting the Adjective: The Syntax and Semantics of Gradability and Comparison*. New York: Garland.
- Klecha, Peter. 2014. *Bridging the Divide: Scalarity and Modality*: University of Chicago PhD dissertation.
- Kratzer, Angelika. 1981. The notional category of modality. In H.J. Eikmeyer & H. Rieser (eds.), *Words, Worlds, and Contexts: New Approaches in Word Semantics*, 38–74. Berlin: Mouton de Gruyter.
- Kratzer, Angelika. 1991. Modality. In Arnim von Stechow & Dieter Wunderlich (eds.), *Semantics: An International Handbook of Contemporary Research*, 639–650. Mouton de Gruyter.
- Krifka, Manfred. 1998. The origins of telicity. In *Events and Grammar*, 197–235. Dordrecht: Springer.
- Lassiter, Daniel. 2010. Gradable epistemic modals, probability, and scale structure. In *Semantics and Linguistic Theory 20*, 197–215.
- Lassiter, Daniel. 2011. *Measurement and Modality*: New York University PhD dissertation.
- Lassiter, Daniel. 2014. Modality, scale structure, and scalar reasoning. *Pacific Philosophical Quarterly* 95. 461–490. doi:10.1111/papq.12045.
- Lassiter, Daniel. 2017a. Graded modality. Manuscript, Stanford University.
- Lassiter, Daniel. 2017b. *Graded Modality: Qualitative and Quantitative Perspectives*. Oxford University Press.
- Lewis, David. 1973. *Counterfactuals*. Harvard University Press.
- Link, Godehard. 1983. The logical analysis of plurals and mass terms: A lattice-

- theoretic approach. In Paul Portner & Barbara Partee (eds.), *Formal Semantics: The Essential Readings*, 127–146. Blackwell.
- Meier, Cécile. 2003. The meaning of *too*, *enough*, and *so... that*. *Natural Language Semantics* 11. 69–107. doi:[10.1023/a:1023002608785](https://doi.org/10.1023/a:1023002608785).
- Mugane, John. 1997. *Bantu Nominalization Structures*: University of Arizona PhD dissertation.
- Nurse, Derek & Gérard Philippson (eds.). 2003. *The Bantu Languages*. Routledge.
- Portner, Paul. 2009. *Modality*. Oxford University Press.
- Portner, Paul & Aynat Rubenstein. 2016. Extreme and non-extreme deontic modals. In Nate Charlow & Matthew Chrisman (eds.), *Deontic Modality*, Oxford University Press.
- Rett, Jessica. 2014. The polysemy of measurement. *Lingua* 143. 242–266. doi:[10.1016/j.lingua.2014.02.001](https://doi.org/10.1016/j.lingua.2014.02.001).
- Rett, Jessica. 2018. The semantics of *many*, *much*, *few*, and *little*. *Language and Linguistics Compass* 12. 1–18. doi:[10.1111/lnc3.12269](https://doi.org/10.1111/lnc3.12269).
- Samuels, Alex & Mary Paster. 2015. Verbal tone in Logoori. Handout from Workshop on Luyia Bantu Languages at Annual Conference on African Linguistics 46.
- Schwarzschild, Roger. 2012. Directed scale segments. In *Semantics and Linguistic Theory* 22, 65–82.
- Schwarzschild, Roger. 2013. Degrees and segments. In *Semantics and Linguistic Theory* 23, 212–238.
- Vander Klok, Jozina. 2014. Questionnaire on modality for cross-linguistic use. [Http://www.eva.mpg.de/lingua/tools-at-lingboard/questionnaire/cross-linguistic-use.php](http://www.eva.mpg.de/lingua/tools-at-lingboard/questionnaire/cross-linguistic-use.php).
- Villalta, Elisabeth. 2008. Mood and gradability: an investigation of the subjunctive mood in Spanish. *Linguistics and Philosophy* 31. 467–522. doi:[10.1007/s10988-008-9046-x](https://doi.org/10.1007/s10988-008-9046-x).
- Winter, Yoad. 2005. Cross-categorial restrictions on measure phrase modification. *Linguistics and Philosophy* 28(2). 233–267. doi:[10.1007/s10988-004-1469-4](https://doi.org/10.1007/s10988-004-1469-4).

Margit Bowler
University of Manchester
Department of Linguistics and English Language
Oxford Road
Manchester M13 9PL
United Kingdom
margitbowler@gmail.com

John Gluckman
University of Kansas
Department of Linguistics
1541 Lilac Lane
Lawrence, KS 66045
USA
johnglu@ku.edu