Limited variable-force modals and the interaction of scal{ar,eless} implicatures

I show that exhaustification-based accounts of scalar implicatures, when combined with domain-restriction accounts of weak necessity modals, to directly and freely account for an otherwise puzzling and subtle pattern of variable-force modals in Kinande (Bantu J, DRC) without the need for additional stipulations within the semantic system.

Limited variable-force   Depending on its context, the Kinande modal prefix *anga* can be interpreted as a possibility modal or as a weak necessity one, but never as a strong necessity modal (translations below from epistemic contexts):

(1)   Kabunga a-**anga**-na-sya   oko   kalhasi ko   munabwire
      Kabunga 3SG-MOD-T-come PREP class   PREP today
      "Kabunga might come to class today"
      "Kambale should be coming to class today"
      #"Kabunga must be coming to class today"

Variable-force modals are previously attested in the Salish (Rullmann et al., 2008), Sahaptian (Deal, 2011), and Tukanoan (Jeretič, 2020) language families, among others; but this is the first attestation of a language with **limited** variable-force: Kinande *anga* does not span the entire scale of possibility to necessity, like the modals in prior accounts do, but instead it only spans a part of that scale, from possibility to weak necessity. Strong necessity is typically expressed with the modal verb *paswa* ('must'). The pattern of ambiguity persists under downward entailing operators, except for clausemate negation.

This pattern is puzzling on prior analyses for a variety of reasons: If the modal variation is from domain restriction (e.g., Rullmann et al.), we would expect *anga* to remain ambiguous under clausemate negation, and perhaps also be compatible with strong necessity interpretations. If we analyze *anga* as an underlyingly weak modal and interpret the stronger readings as a lack of scalar implicature due to a missing stronger modal (e.g., Deal), then the ambiguity under most downward entailing operators is unexpected. If we take a grammaticalized approach to scalar implicatures (Chierchia et al., 2010), as in Jeretič (2020) and Bowler (2014), exhaustifying over the subdomain alternatives of the modal base, a puzzle arises with regard to *anga*'s interaction with *paswa*: the presence of a strong necessity modal should create a scalar implicature and prevent any strengthening of *anga* via exhaustification; alternatively, if we exclude *paswa* from the scalar alternatives of *anga*, exhaustification would then strengthen *anga* all the way to a strong necessity interpretation, which is unacceptable. Instead we only see strengthening to weak necessity.

Exhaustification gets us partway   A (potentially recursive) exhaustification operator over *anga*'s subdomain alternatives (the possible subsets of the accessible worlds), if *paswa* ('must') weren't a scalar alternative, would account for most of *anga*'s distribution. Briefly, recursively exhaustifying over the subdomain alternatives of a weak expression that has no scalar alternatives derives a kind of strengthening: if we apply *exh* twice to $(p \lor q)$, if there is no scalar alternatives of $(p \land q)$, we derive scalar implicatures (or rather, scaleless implicatures) of "not just p, and not just q", and concatenated with the original proposition, this evaluates to the logical equivalent $(p \land q)$ (Bowler, 2014). Similarly, such exhaustification over the subdomain alternatives of a modal that lacks a strong alternative will result in the logical equivalent of a universal quantifier over the same domain of modals (Jeretič, 2020). If the *exh* operator is taken to optionally applied at clause boundaries, then we derive the ambiguity of these expressions even in downward-entailing environments.

But this kind of exhaustification analysis fails to account for Kinande's pattern: Kinande has a strong necessity modal *paswa* that appears to limit how far strengthening *anga* can go. Since *paswa* provides a true scalar alternative, we shouldn't see any strengthening of *anga* from "can" to "should". The only scalar implicature we should draw is one of "not have to", but we see both such a scalar implicature and a scaleless implicature strengthening *anga* partway up the scale. Exhaustifying *anga*'s subdomain alternatives should strengthen *anga*-expressions directly to strong necessity (universal quantification over the domain of accessible worlds), or *anga* should remain a weak existential quantifying modal; we do not expect this partial strengthening.

Domain restriction Looking to the literature on weak necessity modals presents a solution: von Fintel & Iatridou (2008) and others have analyzed weak necessity modals like *ought* and *should* as universal quantifiers over an extra-restricted set of accessible worlds as compared to their strong necessity counterparts. While Kinande has neither a dedicated weak necessity modal nor one derived from strong necessity, *anga* does acquire a meaning much like this when it is strengthened. Note also that domain restriction of an existential quantifier/possibility modal does not result in a weakened reading, and in general is largely indiscernible in context; if the set of permissable worlds is very small and some p is still true in at least one of those worlds, we are not much closer to saying that p is obligatory; rather is it simply a very innocuous proposition. As a result, if we restrict *anga*'s domain we will only see any effect when *anga* is behaving as a universal quantifier, but not when it acts as an existential one.

Taking all this together, I define *paswa* as a strong necessity modal, and *anga* as a domain-restricted possibility modal, here following von Fintel & Iatridou in using multiple ordering source variables:

(2) $[\![anga(p)(w)]\!] = \exists w'[Best(O_2(Best(O_1(MB(w)))))(w') \ \& \ p(w')]$

(3) $[\![paswa(p)(w)]\!] = \forall w'[Best(O_1(MB(w)))(w') \to p(w')]$

Putting it together Given the definitions above, exhaustifying (either recursively or exhaustifying once with Innocent Inclusion as in Bar-Lev & Fox, 2020) over an *anga*-expression behaves exactly in line with what we see empirically: We draw a scalar implicature negating the *paswa* version of the expression via Innocent Exclusion, and then Innocent Inclusion on the subdomain alternatives of *anga* strengthens *anga* from an existential quantifier to a universal with a restricted domain, keeping it weaker than *paswa*.

(4) a. $Best(O_1(MB(w))) = \{w_1, w_2, w_3\}$ $Best(O_2(Best(O_1(MB(w))))) = \{w_1, w_2\}$

b. $exh(anga(p)) = \exists w'[w' \in \{w_1, w_2\} \ \& \ p(w')] \ \& \neg \forall w'[w' \in \{w_1, w_2, w_3\} \to p(w')]$

c. $exh(exh(anga(p))) = exh(anga(p)) \ \&$
$\exists w'[w' \in \{w_1\} \ \& \ p(w')] \ \& \ \exists w'[w' \in \{w_2\} \ \& \ p(w')]$
$= \forall w'[w' \in \{w_1, w_2\} \to p(w')] \ \& \ \neg \forall w'[w' \in \{w_1, w_2, w_3\} \to p(w')]$

This result falls out naturally from our existing mechanisms for scalar implicature and weak necessity modals, coupled with the fact that Kinande lacks a dedicated weak necessity modal. The empirical and typological facts are accounted for, and a gap in the typology of variable-force modals is filled without overgenerating.

References: Bar-Lev & Fox (2020). "Free choice, simplification, and Innocent Inclusion". *Natural Langauge Semantics.* **Bowler** (2014). **Chierchia et al.** (2012). "The grammatical view of scalar imlpicatuers and the relationship between semantics and pragmatics". *Semantics.* **Deal** (2011). "Modals without scales." *Language.* **von Fintel & Iatridou** (2008). "How to say *ought* in foreign". *Time and modality.* **Jeretič** (2020). "Modal strengthening in Ecuadorian Siona and the typology of scaleless implicatures". GLOW presentation. **Rullmann et al.** (2008). "Modals as distributive indefinites". *Natural Language Semantics.*