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# The emergence of quantifier scope\*

Stephen Matthews and Virginia Yip

## Quantifier scope as the holy grail

Emergentist explanations have already penetrated deep into areas such as lexicon, morphology, argument structure and other syntactic phenomena. O'Grady's article attacks an area which has previously been a showpiece for generative approaches (Crain & Thornton, 1998) but has remained largely off-limits to alternative approaches. The stakes are high since if emergentist accounts can succeed in this domain, there would seem to be no limit on their application to the deepest problems in the acquisition of grammar. In this sense, to pursue an emergentist account of quantifier scope is to seek the holy grail.<sup>1</sup>

What makes quantifier scope especially complex is the relationship between syntax (the positions of quantifiers and other operators) and semantic interpretation (scope of quantifiers and other operators with respect to each other). Scope has been argued to be determined not only by linear precedence, but also by hierarchical structure in the form of *c*-command. Thus the Scope Principle proposed by Aoun and Li (1993: 71) states that "a quantifier A has scope over a quantifier B in case A *c*-commands a member of the chain containing B".

In O'Grady's account, the preferred scope interpretations for each language 'emerge' from experience in processing sentences containing quantifiers. The close relationship between scope and linear order results from setting up semantic representations for constituents incrementally as they are parsed. This readily accounts for "isomorphic" scope readings where the linear order of quantifiers matches their scope as reflected in logical form. Thus in Korean (1a), the quantifier *motun* 'all' precedes the negative morpheme *an* 'not'; incremental parsing will set up a semantic representation involving a universally quantified object before the negated verb is encountered, giving the preferred reading  $\forall > \text{not}$  ('None of the cookies were eaten').

- (1) a. Mike-ka motun kwaca-lul an mekessta.  
 Mike-NOM all/every cookie-ACC not ate  
 'Mike didn't eat any of the cookies.'  
 b. Mike didn't eat all the cookies.

In English (1b), the negated auxiliary *didn't* precedes the quantifier *all*; processing the negated verb before the quantifier results in a semantic representation with a negated predicate and a universally quantified object. In O'Grady's model this representation allows either the reading  $not > \forall$  or  $\forall > not$ , so that the preferred reading ( $not > \forall$ ) must be learnt from experience. This is supported by studies indicating that children acquiring English initially allow both scope interpretations (Musolino & Lidz, 2006).

To the extent that a language has isomorphic scope, the challenge for acquisition and theories thereof is relatively straightforward. An incremental processor such as that proposed by O'Grady can set up a semantic representation from which the scope of operators will follow naturally. A more challenging task is to explain the emergence of non-isomorphic scope readings, which in generative treatments have widely been attributed to c-command relations applying at Logical Form (LF: Aoun & Li, 1993). Thus in cases such as (2) and (3), negation is assumed to raise to a higher position at LF so that the negation precedes the subject *all*.

- (2) All that glitters is not gold.  
 'Not everything glitters is gold.'  
 (3) All the students did not come.  
 'Not all the students came.'

The logical problem is further exacerbated by the fact that utterances containing interacting quantifiers are relatively rare in the input to children, as shown by O'Grady's Table 1: for example, in the input recorded in the Timmy corpus (Yip & Matthews, 2007), the pattern [*not*  $\forall$  *all/every*...] does not occur at all. Nevertheless, the combination is attested in the child's speech production with the correct scope as early as 3;04:

- (4) You didn't eat all (Timmy 3;04;15)

Consistent with the order (and with adult English), the intended interpretation is clearly  $not > \forall$ , i.e. 'You are not eating all of it', since the reference is to a partially eaten apple.

Chinese poses similar challenges: although scope is mostly isomorphic with syntax, as in (5), a subset of cases allow 'inverse scope', i.e. the scope of the quantifiers is the reverse of that predicted by their linear ordering. For some speakers, at

least, passive sentences such as (6) are ambiguous with respect to the scope of the universal quantifier *meigeren* ‘everyone’ (Aoun & Li, 1993: 54):

- (5) *Meigeren dou zhuazou yige nuren.* (unambiguous)  
 everyone all arrest one woman  
 ‘Everyone arrests a woman.’
- (6) *Meigeren dou bei yige nuren zhuazou.* (ambiguous)  
 everyone all PASS one woman arrest  
 ‘Everyone is arrested by a woman.’

Crucially, in Aoun and Li’s account the inverse scope reading is explained by reference to movement: the subject *meigeren* ‘everyone’ has been moved from object position, leaving a trace [t] with which it forms a chain as in (7):

- (7) *Meigeren<sub>i</sub> dou bei yige nuren zhuazou t<sub>i</sub>*  
  
 NP-movement

In accordance with the Scope Principle as defined above, the indefinite NP *yige nuren* c-commands a member of the chain containing the subject *meigeren*, namely the trace left by NP-movement.<sup>2</sup> In an emergentist account such an explanation is not available and the ambiguity of (6) will need to be explained by other means. We suggest that the contrast between (5) and (6) may be attributed to incremental processing: in the active SVO sentence (5) the predicate *zhuazhou* ‘arrest’ is processed before the quantifier *yige nuren* ‘a woman’, whereas in the passive (6) both quantified arguments are processed before the predicate.

### Transfer in SLA

Having shown how incremental processing accounts for the ‘emergence’ of scope readings, O’Grady proceeds to adopt a ‘strong emergentist’ approach to transfer in SLA. Under this view, ‘transfer reflects an entirely processor-centered strategy’ (p. 271): a processing routine can undergo transfer, but will be dispreferred if it proves to be less efficient in a second language than in the first. The prediction is supported by the fact that Korean learners of English initially prefer the  $\forall > \textit{not}$  interpretation as in Korean, while more advanced learners do acquire the preferred  $\textit{not} > \textit{all}$  reading. The question is how they achieve this. Do they learn through finding their interpretations are incompatible with the contexts for the utterances that they encounter, or do they develop a left to right processing strategy for English? The findings suggest that L2 learners with Korean as L1 initially transfer

their processing strategies, leading to the  $\forall > \text{not}$  interpretation. Experience in incremental processing of English leads them to develop the  $\text{not} > \forall$  interpretation.

The acquisition of English scope interpretation by Chinese speakers offers another test case. English and Chinese contrast in that scope in Chinese is largely isomorphic, with the scope of operators matching the linear order (Lee, Yip & Wang, 1999; Liu, 1997). English by contrast is notoriously ambiguous, with non-isomorphic readings commonly available as seen in (2)–(3) above. Under the Amelioration Hypothesis, the isomorphic readings in Chinese should develop straightforwardly through incremental processing. Thus, in (8), the universally quantified object is processed before the negated verb, deriving the  $\forall > \text{not}$  interpretation as in Korean:

- (8) Ta suoyou de dongxi dou bu chi  
 he all poss thing also not eat  
 'He doesn't eat anything.'

Whether this interpretation is subject to transfer in second language learners remains to be investigated. A similar transfer hypothesis was, however, tested in Lee et al. (1999) who investigated the interpretation of English quantifiers by Chinese learners. In (9), the object *every museum* can have scope over the subject *some tourists*, that is, inverse scope is allowed; whereas in the Mandarin Chinese counterpart (10), *yixie youke* 'some tourists' must take scope over *bowuguan* 'museum'.

- (9) Some tourists visited every museum.  
 (10) You yixie youke canguan-le mei ge bowuguan  
 exist some tourist visit-ASP every CL museum  
 'Some tourists visited every museum'

It was found that the second language learners accepted inverse scope readings for English sentences such as (9) almost as readily as native speakers did. There was thus no evidence of transfer in this study. Since the learners concerned were at intermediate and advanced level, they may have had sufficient experience to develop the necessary processing routine to derive inverse scope, like the advanced learners in Lee (2009).

### Is language acquisition an illusion?

O'Grady's proposal that quantifier scope can be learnt through processing routines marks a significant step forward in the quest to show that key properties of grammar are emergent. We have raised some challenges posed by the acquisition

of Chinese, and suggested that inverse scope interpretations could be derived through incremental processing as per the Amelioration Hypothesis.

To what extent can our received wisdom concerning what it means to acquire a language be reformulated in terms of purely processing-based strategies without appealing to grammatical mechanisms? By tackling the ‘acquisition’ of quantifier scope, O’Grady has raised the stakes in the debate. If this approach to quantification can be made to work, the Scope Principle will not be needed as part of Universal Grammar. This would be a significant gain in parsimony, and a step towards replacing acquisition with emergence: if the model works for quantifier scope, it may work for much of grammar.

## Notes

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1. The holy grail, believed to contain the blood of Christ, was the object of quests in Medieval Europe. The quest for the holy grail came to stand for the ultimate prize of errant knights, alchemists, and scientists.
2. Similarly, in the structure assumed for Korean in O’Grady’s example (11), the quantified object has undergone raising. The Scope Principle predicts that such sentences should be ambiguous since the negation *c*-commands the trace of the quantified object. Consistent with this prediction, O’Grady reports that some Korean speakers do allow the *not* >  $\forall$  interpretation.

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