Clashing Constraints: Scope Economy and Scope Parallelism in Verb Phrase Ellipsis

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Introduction: Previous research has shown that calculating scope relations when processing quantifiers incurs a cost **[1-4]**. This observed cost is often discussed with reference to economy conditions on Quantifier Raising (QR), which prevent QR from being freely applied **[1-6]**. There are two primary formulations of this constraint called Scope Economy. Processing Scope Economy (PSE) contends that the parser seeks to avoid performing QR whenever possible, and thus only raises structures when grammatical and contextually supported **[1-2]**. In Grammatical Scope Economy (GSE), QR is only licensed when the raised structure provides a new interpretation relative to the pre-raising structure **[6]**. GSE requires a comparison between two structures to be evaluated, thus the parser must perform QR to determine if it is grammatical. PSE and GSE make different predictions about the nature of cost, and when it should appear. Under PSE, cost is assumed to be a feature of QR application, and the parser avoids raising whenever possible to avoid this cost. Under GSE, performing QR is unavoidable as it is required for comparison, and an additional cost occurs when a QR application fails to provide a new interpretation. In a Maze reading experiment, we use materials, shown in (1), with multiple quantifying Noun Phrases and Verb Phrase Ellipsis to observe when costs are incurred **[7-9]**. We find that costs occur when performing QR is ungrammatical, rather than in conditions where QR is contextually and grammatically supported. We take this as evidence that the parser builds rich structural representations and implements a parsing solution for the calculation of GSE.

Experiment 1: In this Experiment we use Scope Parallelism under VPE as a probe to determine the parser's implementation of constraints on QR. Scope Parallelism is a constraint which requires representational isomorphism between conjoined clauses and ellipsis sites, such that both are interpreted with the same scope structure **[5,10-12]**. In our items, 24 total, we use a 2x2 design, depicted (1), which manipulates the availability of inverse scope in each conjunct. The alternation of first clause *At least one NP* and *That NP* toggles between a quantifier which prefers inverse scope or a demonstrative which only permits surface scope. The manipulation of the second clause between *some* and *the* similarly toggles the availability of inverse scope.

(1) $\left\{ \begin{array}{c} \textbf{\textit{At least one}} \\ \textbf{\textit{That very traditional}} \end{array} \right\}$ stylist will take each measurement, and $\left\{ \begin{array}{c} \textbf{\textit{some}} \\ \textbf{\textit{the}} \end{array} \right\}$ tailors will too because the fabric is extremely expensive.

In our items (1) the critical position is the ellipsis site which contains the wide-scope preferring element *each*. Under PSE, we would only expect QR and its associated cost in the *At least* X *some* condition, as this is the only condition where QR is grammatical and QR in all other conditions should be avoided. Under GSE, we would anticipate raising in all conditions with enhanced costs for *the* conditions which violate GSE.

Results and Conclusions: Reading time data can be seen in Figure 1, with regions of theoretical and statistical note reported in Table 1. At our primary region of interest, the ellipsis site marked by *too*, we find a main effect of second conjunct *the* slowing reading times. In the spillover region for the ellipsis site, *because*, we also find a weak interaction for the *at least* X *the* condition. These suggest that at the ellipsis site a penalty is faced only in the conditions in which raising is prohibited, *the* conditions, and this cost is persists longer when the first conjunct prompts inverse scope, *at least*. We also observe effects at earlier quantifier regions, such that the matrix object is read slower when the subject blocks inverse scope, *that*, and an interaction at the second conjunct subject resulting in slower reading times when the first conjunct blocks inverse scope and the second does not *that* and *some*. Taken together, these results indicate the parser builds rich structural representations and performs QR even in cases where the ultimate result violates economy, as predicted by a grammatical theory of Scope Economy.

References: [1] Anderson, C. (2004); **[2]** Wurmbrand, S. 2018; **[3]** Pritchett, B. & Whitman, J. (1995); **[4]** Tanaka, M. (2015); **[5]** May, R. (1977); **[6]** Fox, D. (1995) ; **[7]** Boyce, V. & Futrell, R. & Levy R. P. (2020); **[8]** Forster, K. I. & Guerrera, C. & Elliot L. (2009); **[9]** Witzel, N. & Witzel, J. & Forster K. I. (2012); **[10]** Sag, I. A. (1976); **[11]** Johnson, K. (2001); **[12]** Merchant, J. (2001); **[13]** Chung, S. & Ladusaw, W. A. & McCloskey, J. (1995)

Figure 1: *Reading Times for the full sentence with regions of theoretical and statistical note marked by points on the line.*
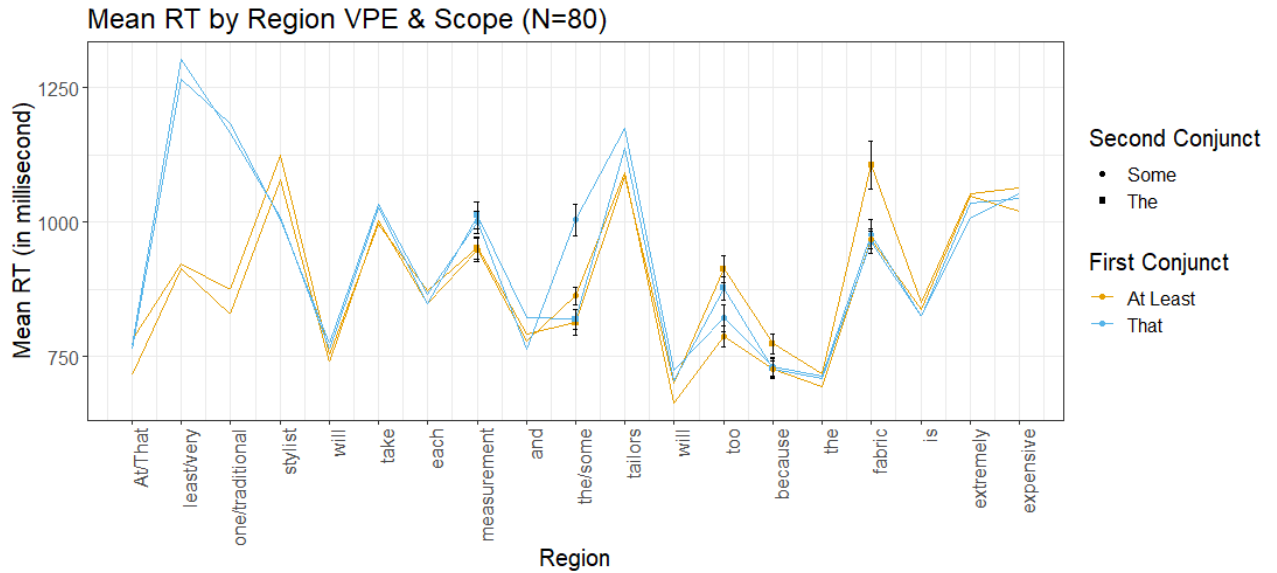

Table 1: *Fixed effect $\hat{\beta}$ and p-values for mixed effects linear regression models for each region of interest, fit to log reaction time in milliseconds. Each model employed contrast coding such that **That NP** was weighted 0.5 and **At least NP** was weighted -0.5, and **The NP** was weighted 0.5 and **Some NP** was weighted -0.5. Each region also fit maximum converging random slopes/intercepts by subject and item.*

Fixed Effects	measurement $\hat{\beta}$	p	the/some $\hat{\beta}$	p	too $\hat{\beta}$	p	because $\hat{\beta}$	
That/At least	**0.037**	**<0.05**	**0.068**	**<.001**	-0.000	>0.05	**0.030**	**<0.05**
The/Some	-0.004	>0.05	**-0.142**	**<.001**	**0.087**	**<.001**	0.010	>0.05
Interaction	0.000	>0.05	**-0.070**	**<0.05**	-0.050	>0.05	**-0.053**	**<0.10**