Proceedings of the ESSLLI 2018 Student Session

30th European Summer School in Logic, Language & Information

Preface

These proceedings contain the papers presented at the Student Session of the 30th European Summer School in Logic, Language and Information (ESSLLI 2018), which was held at Sofia University "St. Kl. Ohridski" in Sofia, Bulgaria from August 6th to 17th, 2018. The Student Session is part of the ESSLLI tradition and was organized for the 30th time this year. It is an excellent venue for students to present their work on a diverse range of topics at the interface of logic, language and information, and to receive valuable feedback from renowned experts in their respective fields. The ESSLLI Student Session accepts submissions for three different tracks: Language and Computation (LaCo), Logic and Computation (LoCo), and Logic and Language (LoLa). The Student Session attracted submissions this year from all over Europe and beyond for each of the above tracks. As in previous years, the submissions were of high quality and acceptance decisions were hard to make. Of the submissions, 16 were presented as talks and 8 submissions were presented in form of a poster. Due to a special request by the author, one of the papers was not included in the online proceedings.

Four area experts, renowned in their respective fields, agreed to help in the reviewing process and support the student co-chairs of each track. We are deeply grateful for their support and help. We would also like to thank the ESSLLI Organizing Committee, especially Petya Osenova and Kiril Simov for organizing the entire summer school and supporting the Student Session in numerous ways, as well as the Program Committee chair Laura Kallmeyer. Thanks go to the chairs of the previous Student Sessions, in particular to Johannes Wahle and Karoliina Lohiniva for providing us with many of the materials from the previous years and for their advice. As in previous years, Springer has generously offered prizes for the Best Paper and Best Poster Award, and for this we are very grateful. This year we introduced an additional prize, the Axioms Award, for innovation in the fields of logic/mathematics. This award was generously provided by the Axioms Journal. Most importantly, we would like to thank all those who submitted to the Student Session, for you are the ones that make the Student Session such an exciting event to organize and attend.

Jennifer Sikos
Editor, 2018 ESSLLI Student Session Proceedings
6 August 2018

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Student Session Program

1st week	Monday	Tuesday	Wednesday	Thursday	Friday
	6th	7th	8th	9th	10th
	LoCo	LoLa	LaCo	LoLa	
15:50-16:20	*Social Choice and the Problem of Recommending Essential Readings* Silvan Hungerbühler, Haukur Páll Jóhnsson, Grzegorz Lisowski, Max Rapp	*Conservativeness, Language, and Deflationary Metaontology* Jonas Raab	*Playing with Information Source* Velislava Todorova	*Compositionality in privative adjectives: extending Dual Content Semantics* Joshua Martin	Beth prize talk
16:20-16:50	*Rule-based Reasoners in Epistemic Logic* Anthia Solaki	*Disjunction under Deontic Modals: Experimental Data* Ying Liu	*D3 as a 2-MCFL* Konstantinos Kogkalidis, Orestis Melkonian	*Definiteness in Shan* Mary Moroney	
Poster flash	*Explainability of irrational argument labelings* Grzegorz Lisowski	*Metafictional anaphora: A comparison of different accounts* Merel Semeijn	*Incorporating Chinese Radicals Into Neural Machine Translation: Deeper Than Character Level* Lifeng Han, Shaohui Kuang	*Free relatives, feature recycling, and reprojection in Minimalist Grammars* Richard Stockwell	

2nd week	Monday	Tuesday	Wednesday	Thursday	Friday
	13th	14th	15th	16th	17th
	LoLa	LaCo	LoLa	Laco/LoCo	
15:50-16:20	*Fighting for a share of the covers: Accounting for inaccessible readings of plural predicates* Kurt Erbach	*Classifying Estonian Web Texts* Kristiina Vaik	*Interpreting Intensifiers for Relative Adjectives: Comparing Models and Theories* Zhuoye Zhao	*The Limitations of Cross-language Word Embeddings Evaluation* Amir Bakarov	Posters
16:20-16:50	*"First things First": an Inquisitive Plausibility-Urgency Model* Zhuoye Zhao, Paul Seip	*The Challenge of Natural Language Understanding - what can Humans teach Machines about Language?* Lenka Bajčetić	*Representing Scalar Implicatures in Distributional Semantics* Maxime Corbeil	*Harrop: A new tool in the kitchen of intuitionistic logic* Andrea Condoluci, Matteo Manighetti	
Poster flash	*Towards an analysis of agent-oriented manner adverbials in German* Ekaterina Gabrovska	*Towards a Cognitive Model of the Semantics of Spatial Prepositions* Adam Richard-Bollans	*Perspective blending in graphic media* Sofia Bimpikou	*Simulating the No Alternatives Argument in a Social Setting* Lauren Edlin	Awards

Table of Contents

Language & Computation

Logic & Computation

Logic & Language

Fighting for a share of the covers: Accounting for inaccessible readings of plural predicates

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Abstract. This paper presents novel empirical data that motivates an analysis of plural predicates in which the predicates have a basic, "double cover" interpretation from which all other interpretations are derived. The data presented in this paper are the results of a truth-value judgment task designed to test whether intermediate cover readings of plural predicates (i) can be made available or indexed in context as argued by Gillon [3] and Schwarzschild [9], or (ii) are never available as argued by Lasersohn [7], [8]. The results show that neither intermediate cover readings, nor collective and distributive readings are initially available in ambiguous contexts that contain minimal negative evidence. To account for the empirical data, this paper presents an analysis in which the basic reading of certain transitive constructions with two plural NPs is a Landman [6] inspired double cover reading that has been modified with a Schwarzschild [9] style approach to indexing minimal cover readings.

Keywords: Plural Predicates · Minimal Covers · Collectivity · Distributivity · Cumulativity.

1 Introduction

The interpretation of plural predicates is a still unsettled topic that draws on traditional semantic methods to motivate analyses. For example, Gillon [2] argues that plurals are ambiguous rather than vague or indeterminate in respect to readings that correspond to minimal covers of the plural noun phrase. (Gillon [2] defines a minimal cover as a set that (i) is a subset of the power-set of a set being covered, (ii) contains all of the same individuals as the set being covered, and (iii) contains no set that is a subset of another.) Lasersohn [7], however, argues that such an approach requires too many readings to be available in certain cases, and that an approach in which plural predicates are ambiguous between collective and distributive interpretations is more sound. Subsequent analyses of plural predicates fall between these two approaches, arguing for somewhere between two and (sometimes infinitely) many interpretations, e.g. [3], [4], [9], [5], [6], [8]. While there is support for each position, none of these formal analyses are informed by empirical data. In this paper, I introduce empirical data from a truth-value judgment task to motivate a new analysis of plural predicates, namely that plural predicates have a single interpretation rather than being ambiguous between two or more interpretations.

2 Background

This paper is focused on constructions like (1), in which there are two plural NPs in a transitive construction that could be interpreted as collective or distributive.

(1) Alex, Billy, and Charlie wrote songs.

(1) can be interpreted as collective, in which case Alex, Billy, and Charlie all co-wrote the same songs, and (1) can be interpreted as distributive in which case Alex, Billy, and Charlie each wrote their own songs. It is often argued that plural predicates like that in (1) are straightforwardly ambiguous between the collective and distributive readings, e.g. [7], [8], [9].

The collective and distributive readings of (1) are not the only possible interpretations, however. In addition to these interpretations, there are over 100 different combinations, or **covers** of Alex, Billy, and Charlie that could have written songs. In respect to (1), a cover is any set of sets of Alex, Billy, and Charlie, whose sum is equal to Alex, Billy, and Charlie. More formally, a cover is a subset of the the closure under sum of a set, which is equal to the supremum of the atoms of the subset.

(2) A covers B iff $A \subseteq {}^*(B) \wedge AT(\sqcup A) = B$

For example, a cover could be as complex as one in which Alex and Billy wrote songs together, while Charlie wrote songs both individually and with Alex and Billy respectively ($a \sqcup b$, c, $c \sqcup a$, $c \sqcup b$). However, while such a reading is theoretically possible, no one argues that this is part of the basic interpretation of a sentence like (1). Instead, such a sentence is argued to have a more restricted set of possible interpretations.

Gillon [2] argues that sentences like (1) are ambiguous in respect to their truth conditions, which is a set of minimal covers—i.e. sets of subsets of pluralities, in which none of the subsets overlap with the union of the others, and the union of all subsets is equal to the plurality itself (3).

(3) A minimally covers B iff A covers $B \wedge \neg\exists X(X \subseteq A \wedge \sqcup(A\text{-}X)$ covers B)

In other words, (1) has eight possible interpretations which correspond to the minimal covers of the subject NP. For example, *The men wrote musicals* is true of Rogers, Hammerstein, and Hart because, though they did not individually or collectively write musicals, the plural predicate is minimally covered by the fact that Rogers and Hammerstein wrote musicals together as did Rogers and Hart.

Lasersohn [7] criticizes the analysis of Gillon [2], claiming that certain minimal cover readings are non-existent, and that covers-based analyses are untenable because they require sentences to have unfathomably large numbers of readings. What seems to be the underlying issue for Lasersohn [7] is the distinction between *interpretation* in the sense of on-line processing of language users versus the sense of logically possible readings. For example, under Gillon's [2] analysis, (4) is predicted to be a true statement when John, Mary, and Bill are teaching assistants (TAs) who each made exactly $7,000 last year.

(4) The TAs were paid exactly $14,000 last year. [7, p. 131]

Lasersohn [7] argues that in the given context the predicted truth of this sentence is untenable. Furthermore, he argues that NPs like *the real numbers* would require infinite minimal covers and that it is unlikely that the grammar of a language would assign an infinite number of readings or set an upper limit on the number of possible readings. As an alternative to Gillon's [2] analysis, Lasersohn [7], points to analyses like Dowty [1], in which verbs are ambiguous between collective and distributive readings.

Responding to Lasersohn, Gillon [4] agrees that at least collective and distributive readings are available, but he insists that context can make available intermediate minimal cover readings—i.e. minimal cover readings other than collective and distributive. Gillon [4] gives (5-a) as an example of a context that makes intermediate cover interpretations available.

(5) a. A chemistry department has two teaching assistants for each of its courses, one for the recitation section and one for the lab section. The department has more than two teaching assistants and it has set aside $14,000 for each course with teaching assistants. The total amount of money disbursed for them, then is greater than $14,000. At the same time, since the workload for teaching a course's section can vary from one section to another, the department permits each team of assistants for a course to decide for itself how to divide the $14,000 the team is to receive.

b. The T.A.'s were paid their $14,000 last year. [4, p. 483].

While (5-a) does not explicitly point to which minimal cover is true, it nevertheless gives the context necessary to know that distributive or collective interpretations of (5-b) are not sufficient truth making conditions, and that a derivation of minimal covers is necessary.

Schwarzschild [9] also argues for a context based analysis, analyzing plural predicates as having a single meaning that can be indexed to any cover reading in the appropriate context (which solves the problem of potentially infinite covers [8]). According to Schwarzschild, [9], "whether or not a certain intermediate reading is available seems to have to do with the context not with the semantics of particular lexical items" (p. 66). He therefore proposes the following generalization to account for cover readings:

(6) $[_{S}\mathrm{NP}_{\mathrm{plural}}$ VP] is true in some context Q iff there is a cover C of the plurality P denoted by NP which is salient in Q and VP is true for every element in C.

This generalization for distributive readings is formalized in (7), where Part is the one place distributivity operator and Cov is free variable over sets of sets of the whole domain of quantification, the value of which is determined by the linguistic and non-linguistic context.

(7) x ∈ ‖Part(Cov)(α)‖if and only if ∀y[(y∈ ‖Cov‖∧y⊆x) →y∈ ‖α‖] [9, p. 71]

Schwarzschild [9] specifies the translation rule in (8) which means that a plural predicate is indexed to a particular cover reading.

(8) Plural VP rule:
If α is a singular VP with translation α', then for any index i, $\text{Part}(\text{Cov}_i)(\alpha')$ is a translation for the corresponding plural VP.

These rules allow any cover reading to be indexed given the right context. (9-a), for example, therefore has the logical form in (9-b), where the two-place Part operation distributes the predicate to the subsets of the indexed cover, Cov_i.

(9) a. The musicians wrote songs.
b. $(\text{Part}(\text{Cov}_i)(\text{wrote'}))(\text{songs'})(\text{the-musicians'})$

Schwarzschild [9] concludes that the absence or presence of a given cover interpretation depends, to some extent, on the same sorts of things that other pragmatic phenomena depend on, like salience. In an ambiguous context, collective and distributive readings are made salient by the plural noun phrase.

Lasersohn [8] revisits these issues and further argues for the unavailability of intermediate cover readings, motivating an analysis where plural predicates are ambiguous between collective and distributive interpretations. While Lasersohn [7] convincingly argues that certain intermediate cover readings are never salient, it is nevertheless the case that they are logically possible interpretations.

Landman [6] takes an approach in which cover interpretations are neither one of several basic interpretations nor are they indexable via context. For Landman [6] cover interpretations are the result of a special contextual mechanism that weakens the interpretations of verbs. In respect to a plural argument like *the musicians* that denotes three individuals Alex, Billy, and Charlie or a⊔b⊔c, a minimal cover like Alex and Charlie, and Billie and Charlie (a⊔c,b⊔c in (11)), can be the agent of a plural predicate, e.g. (12)[1], so long as one has a definition of cover roles (13), a definition of covers (14), and a type shifting principle for verbs that allows verbs with plural roles to be turned into cover roles (15).

$$\begin{aligned} &\{\text{a} \sqcup \text{c}, \text{b} \sqcup \text{c}\} \in {}^*\text{MUSICIAN} \\ &[\![\text{the musicians}]\!] = \sigma({}^*\text{MUSICIAN}) = \sqcup\{\text{a} \sqcup \text{c}, \text{b} \sqcup \text{c}\} = \text{a} \sqcup \text{b} \sqcup \text{c} \end{aligned} \tag{11}$$

$$[\![\textit{The musicians wrote songs}]\!] = \begin{cases} \exists e \in {}^*\text{WRITE}: \\ a \sqcup b \sqcup c = \sigma({}^*\text{MUSICIAN}) \wedge \\ {}^C\text{Ag(e)} = \uparrow (a \sqcup b \sqcup c) \wedge \\ \exists y \in {}^*\text{SONG} \wedge {}^C\text{Th(e)} = \uparrow (y) \end{cases} \tag{12}$$

[1] AT(d) is the set of atoms below d: if d ∈ D then AT(d) = {a∈AT:a⊒d}

Let R be a thematic role

^{C}R, the cover role based on R,

is the partial function from D_e to D_d defined by: (13)

^{C}R(e) = a iff a ∈ ATOM ∧ ⊔({↓ (d) ∈ SUM: d ∈ AT(*R(e))}) = ↓(a)

undefined otherwise [6, p. 210]

group β is a subgroup of α iff ↓ $(\beta) \sqsupseteq$ ↓ (α).

Let X be a set of subgroups in group α. (14)

X covers α iff ⊔ {↓ (x) ∈ X} =↓ (α) [6, p. 211]

$\lambda x_n ... \lambda x ... \lambda x_1$.{e ∈ *V:...*R(e)=x...} →

$\lambda x_n ... \lambda x ... \lambda x_1$.{e ∈ *V:...^{C}R(e)=x...} [6, p. 211] (15)

For Landman [6], cover readings are those in which there are plural agents of sums of events. Such readings are made possible by cover roles, which are defined in (13). If the plural role R has atoms d, and those atoms can be type-shifted down with the operation ↓, and we can take the sum of those type-shifted individuals, and that sum of type-shifted individuals is equal to the plural individual made from the group a, then a is a cover role. More plainly, if the agent of an event is a sum of groups, then that agent is a cover role. This is exactly what occurs when a sentence like (16-a) is used to describe the event that is described in (16-b)—i.e. an event in which $a \sqcup c$ and $b \sqcup c$ are the agents of separate song writing events.

(16) a. The musicians wrote songs.
b. Alex and Charlie wrote songs together, and Billie and Charlie wrote songs together.

In order to derive the interpretation in (12) from that of (16-b), the following must occur: ↑ $(a \sqcup c)$ and ↑ $(b \sqcup c)$ must be group atoms (made via the type shifting operation ↑[2]) that are the agents of events e and f respectively (17).

(17) ↑ $(a \sqcup c)$ = Ag(e)
↑ $(b \sqcup c)$ = Ag(f).

The plural agent of the sum of events e and f is equivalent to the sum of the groups ↑ $(a \sqcup c)$ and ↑ $(b \sqcup c)$:

(18) *Ag(e⊔f) = ↑ $(a \sqcup c)$⊔↑ $(b \sqcup c)$ [6, p. 212]

The set of atoms below the plural agent in (18) is the set containing the two groups ↑ $(a \sqcup c)$ and ↑ $(b \sqcup c)$:

[2] one function of the type shifting operation ↑ is to turn plural individuals into group atoms; see [6] for details

(19) $\text{AT}(*\text{Ag}(\text{e}\sqcup\text{f})) = \{\uparrow (a \sqcup c), \uparrow (b \sqcup c)\}$ [6, p. 212]

Given the definition of cover roles, (13), it is possible to take the closure under sum of the set of atoms below the plural agent, and therefore get the supremum of the groups of agents ((20)), which upshifted, is equivalent to the plural agent of events e and f ((21)).

(20) $\sqcup\{\downarrow(\text{d}) \colon \text{d} \in \text{AT}(*\text{Ag}(\text{e} \sqcup \text{f}))\} = \sqcup\{a \sqcup c, b \sqcup c\} = a \sqcup b \sqcup c$

(21) $*\text{Ag}(\text{e} \sqcup \text{f}) = \uparrow (a \sqcup b \sqcup c)$

The type-shifting principle for verbs, (15), allows the basic meaning of the verb *write* to be shifted cover interpretations:

(22) $\textit{write} \rightarrow \lambda y \lambda x.\{\text{e} \in *\text{WRITE}: {}^{C}\text{Ag}(\text{e})=\text{x} \wedge {}^{C}\ \text{Th}(\text{e})=\text{y}\}$

This derivation provides a cover agent for the interpretation of (12) from the interpretation of (16-b).

While Landman [6] provides this mechanism for building plural predicates from covers, he argues that these are special cases that are not part of the basic interpretation of the verb. Instead, he argues there are four scopeless readings (double collective, collective-distributive, distributive-collective, and double-distributive–i.e. cumulative) if plural noun phrases fill the roles of the verb, and five other readings are available depending on how a particular scope mechanism is invoked. The cumulative interpretation is relational–i.e. it is not a statement about each individual denoted by the arguments of a transitive verb, and it is not about a predicate and one argument: it is about the relation between the predicate and its arguments. The cumulative reading (16-a) indicates that (i) there is a set of musicians, (ii) there is a set of songs, (iii) every one of the musicians wrote at least one of the songs, and (iv) every song was written by one or more of the musicians. The cumulative interpretation can be type-shifted to the "double cover interpretation", from which minimal cover interpretations can be derived, meaning that a relation between subgroups is expressed rather than a relation between individuals.

Among all of the arguments for one analysis or another, it seems that no empirical investigation into readings of plural predicates has been undertaken. Given there is no consensus among theories, it is an open question whether (i) cover readings might not be initially available but can be made available by context [4], [9], [6] or (ii) certain cover readings are never available [7],[8].

3 Main Data

In addition to distributive and collective readings of plural predicates, lexical modifiers like *each* have a distributive effect, and modifiers like *together* have a collectivizing effect [3], [9], [10]. These lexical modifiers can therefore be used to restrict the possible interpretations to distributive, (23-a), or collective, (23-b).

(23) a. Alex and Billie wrote songs individually.

b. Alex and Billie wrote songs together.

If plural predicates like *wrote songs* have all minimal cover readings available as argued by Gillon [2], then (1) should be equally ambiguous in respect to the combinations of song-writers listed in (24).

(1) Alex, Billie, and Charlie wrote songs.

(24)
a. $a \sqcup b \sqcup c$
b. $a \sqcup c, b \sqcup c$
c. $a \sqcup b, b \sqcup c$
d. $a \sqcup b, a \sqcup c$
e. $c, a \sqcup b$
f. $b, a \sqcup c$
g. $a, b \sqcup c$
h. a, b, c

If all minimal cover readings are equally available, then it should be possible to refer to a subset of the minimal covers by adding lexical modifications. For example, (25-a) is true of a set of minimal covers, and (25-b) is true of a subset of those minimal covers.

(25) a. Alex, Billie, and Charlie went to the music studio. The musicians wrote songs.
b. Alex and Billie didn't write songs individually.

The set of minimal covers that could be true of both (25-a) and (25-b) are all of those in which the predicate does not distribute to either Alex or Billie individually. The only available interpretations would be those in which Alex and Billie are part of a collective interpretation. The potentially true minimal covers are listed in (26), along with the false minimal covers, which are crossed out.

(26)
a. $a \sqcup b \sqcup c$
b. $a \sqcup c, b \sqcup c$
c. $a \sqcup b, b \sqcup c$
d. $a \sqcup b, a \sqcup c$
e. $c, a \sqcup b$
f. ~~$b, a \sqcup c$~~
g. ~~$a, b \sqcup c$~~
h. ~~a, b, c~~

It is also possible to use modifiers to eliminate collective interpretations for particular individuals. In (27) for example, the use of *together* in (27-b) negates the scenarios in which Alex and Billie are predicated over collectively.

(27) a. Alex, Billie, and Charlie went to the music studio. The musicians wrote songs.
b. Alex and Billie didn't write songs together.

The set true and false minimal covers for (27-a) and (27-b) are listed in (28)[3].

[3] though $p \sqcup q$ is only a subpart of $p \sqcup q \sqcup r$, this reading is assumed to be canceled via implicature

(28)
a.	~~$a \sqcup b \sqcup c$~~	e.	~~$c, a \sqcup b$~~
b.	$a \sqcup c, b \sqcup c$	f.	$b, a \sqcup c$
c.	~~$a \sqcup b, b \sqcup c$~~	g.	$a, b \sqcup c$
d.	~~$a \sqcup b, a \sqcup c$~~	h.	a, b, c

Taking these modifications one step further, only a single minimal cover is available as the truth-making condition when using both *each* and *together* in the same sentence. For example, given (29-a) as a context, (29-b) negates all minimal covers in which *wrote songs* gets a collective or distributive interpretation in respect to Alex and Billie.

(29) a. Alex, Billie, and Charlie went to the music studio. The musicians wrote songs.
b. Alex and Billie didn't write songs individually or together.

Both (29-a) and (29-b) are true if Alex and Charlie wrote songs together and Billie and Charlie also wrote songs together. The true and false minimal covers of these two sentences are listed in (30).

(30)
a.	~~$a \sqcup b \sqcup c$~~	e.	~~$c, a \sqcup b$~~
b.	$a \sqcup c, b \sqcup c$	f.	~~$b, a \sqcup c$~~
c.	~~$a \sqcup b, b \sqcup c$~~	g.	~~$a, b \sqcup c$~~
d.	~~$a \sqcup b, a \sqcup c$~~	h.	~~a, b, c~~

Given the interpretation of plural predicates is an open question, there are five ways in which the pairs of sentences in (25), (27), and (29) are likely to be interpreted. If all of these follow-up sentences are judged to be possibly true, then it could be the case that the plural predicates are straightforwardly ambiguous between all minimal cover interpretations as argued in Gillon's [2], [3] earlier work, or it could be the case that plural predicates are ambiguous between collective and distributive interpretations, and that context makes the minimal covers available as argued by Gillon [4] and Schwarzschild [9], and implied by Landman [6]. Second, if (25) and (27) are judged to be possibly true, and (29) is judged to be necessarily false, then it could be the case that plural predicates are ambiguous between distributive and collective interpretations but intermediate cover interpretations are not available, as argued by Lasersohn [8]. Third, if (25) is judged to be possibly true while (27) and (29) are judged to be necessarily false, then it would be the case that a collective interpretation is basic and all other interpretations are derived. Fourth, if (27) is judged to be possibly true while (25) and (29) are necessarily false, then the distributive interpretation is basic and all other interpretations are derived. Lastly if all follow-up sentences are judged to be false, then it is the case that there is a single general interpretation that is basic, and all other interpretations are derived or indexed.

Experimental Design. An empirical study was designed to test determine the interpretations of the pairs of sentences, like those in (25), (27), and (29). A truth-value-judgment survey was conducted with 32 native English speakers through Prolific.ac. The participants were presented with 45 test items containing

a context like (29-a) and a follow-up like (29-b). Participants were told to judge whether the follow-up sentence could be true or must be false in respect to the context preceding it[4]. The 45 test items exemplified one of the three conditions in (25), (27), and (29): 15 test follow-up items contained *individually*, 15 contained *together*, and 15 contained both *individually* and *together*. Participants were also asked to judged the truth value of 45 filler items that could be true or must be false depending on their lexical modifiers. The total number of items expected to be true or false was equal.

Results. The results of the study show that there is a significant difference in the way that the truth of sentences with both *individually* and *together* are judged relative to sentences with only one of the two lexical modifiers. Using a binary logistic regression model (lme4 package in R), and the conditions and judgments as arguments, the judgments of test condition with both *individually* and *together* were found to be significantly different ($p<0.001$) than judgments of the condition in which sentences only contained *together* as a lexical modifier. Sentences that only contained *individually* as a lexical modifier were found to be judged no differently ($p=0.282$) than those that only contained *together*. These results show that despite the fact that each follow up sentence is true in respect to its preceding context, speakers do not judge sentences in the test condition to be true at the same rate at which they judge sentences in the other conditions to be true.

The average percentage of true and false judgments for sentences in each condition is presented in Figure 1. This graph shows that follow up sentences with

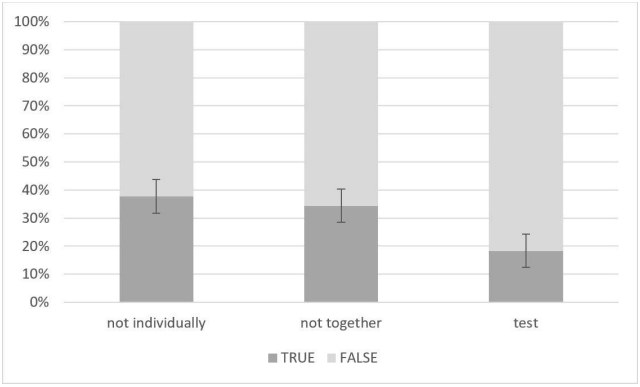

Fig. 1. Average percentage of true and false judgments by condition

only one of the two lexical modifiers are judged as necessarily false a majority of the time, while follow up sentences with both lexical modifiers are judged

[4] While these directions were written above every pair of sentences, the options the participants clicked on were simply labeled *True* and *False*.

as false an even larger majority of the time. In other words, negated follow up sentences that restrict the set of true minimal covers with the lexical modifiers *individually* or *together* are generally judged to be false. This is a surprising result given the plural predicates are said to have both collective and distributive readings, yet neither reading seems to be available when the subjects were asked to interpret the possible truth of follow-up sentences. If the collective reading was available, then the follow-up sentences negating the distributive reading should all have been true. Furthermore, if the distributive reading was available, then the follow-up sentences negating the collective reading should have been true.

Discussion. The fact that the follow-up sentences were judged to be false means that the plural predicate they follow is not straightforwardly ambiguous between all minimal covers as argued for by Gillon's earlier work [2],[3]. It also cannot be the case that they are ambiguous between collective and distributive interpretations argued by Lasersohn [8], Schwarzschild [9] and Gillon's later work [4]. The results also suggest that the follow-up sentences in the study are insufficient context to make the set of true cover readings available. Instead of any of the aforementioned analyses, the empirical data seems to point toward an analysis in which neither the distributive, collective, nor intermediate cover readings are part of the basic meaning.

4 Analysis

Building on the idea of Schwarzschild [9] that a plural predicate has one meaning that can index cover interpretations, and also the idea from Landman [6] that cover readings are derived from a double cover interpretation, I motivate an analysis in which plural predicates have a single, general interpretation from which all cover interpretations are indexed. The double cover reading from Landman [6] provides a weak, general meaning for the plural predicate, and by adding indexing, specific interpretations can be salient. The required translation entails the following rule.

(31) If α is a singular transitive verb phrase with translation A, then for any index i, $\exists e \in {}^*\mathrm{A} : {}^{C_i}\mathrm{Ag(e)} = x \wedge {}^{C_i}\mathrm{Th(e)} = (y)$ is the translation for the corresponding plural transitive verb phrase.

If a particular cover is not indexed in the context–i.e. the index is left unspecified as i–then the plural predicate is straightforwardly interpreted as a dual cover reading. The reading indicates (i) that there is a sum of writing events, (ii) a sum of groups of musicians (Alex, Billie, and Charlie in (25), (27), and (29)) as a plural agent, (iii) there is a sum of groups of songs as a plural theme:

$$[\![\textit{The musicians wrote songs}]\!] = \begin{cases} \exists e \in {}^*\mathrm{WRITE} : \\ a \sqcup b \sqcup c = \sigma({}^*\mathrm{MUSICIAN}) \wedge \\ {}^{C_i}\mathrm{Ag(e)} = \ \uparrow (a \sqcup b \sqcup c) \wedge \\ \exists y \in {}^*\mathrm{SONG} \wedge {}^{C_i}\mathrm{Th(e)} = \ \uparrow (y) \end{cases} \tag{33}$$

While this seems very similar to a distributive interpretation (and in Landman's [6] framework, the double cover interpretation is a type-shifted double-distributive (cumulative) interpretation), without indexing a particular cover, it is impossible to tell exactly which (covers of) musicians wrote exactly which (covers of) songs. It is therefore distinct from Landman's [6] scoped distributive readings where the set of musicians would necessarily distribute to either distinct sets of songs, or the same set of songs.

The proposed analysis, provides a plausible explanation for why each condition was judged to be necessarily false in the empirical study. The ambiguous context in which the plural predicate was presented did not index any minimal cover despite the fact that it informed the participants that every atomic part of the song writing event had a group of musicians as the agent and a group of songs as the theme. The ambiguous context did not index even the strictly collective or distributive interpretation of the agent or the theme, so no specific interpretation from the set of minimal covers was available. At the same time, the follow-up sentences were interpreted as negated collective, distributive, and both collective and distributive readings respectively, these readings being indexed by the use of the lexical modifiers *together* and *individually*. Crucially, these indexed readings in the follow-up sentences were for an agent that was subset of the agent in the context sentences. Because no specific cover was indexed in the context sentences, the intersection of the context sentence and the follow-up sentence was the empty set. It seems that the participants in this study judged the follow-up sentences to be necessarily false because the follow-up sentences did not contain information that could straightforwardly index a particular cover reading of the the preceding context. In other words, the sort of context that can index a particular cover interpretation is positive evidence. The negative evidence in this study's follow-up sentences is not sufficient for indexing cover interpretations of the preceding contexts: Given Alex and Billy are part of the double cover interpretation of the context, the follow up sentences were generally judged to be false.

The fact that follow-up sentences with both *individually* and *together* were judged false significantly more frequently than those with only *individually* or *together*, is a phenomenon that must be accounted for. It might suggest that collective and distributive readings are more simple to derive than intermediate cover readings, which corresponds to the claim supported by many that these are basic readings—e.g. [3], [6], [7], [9]. However, given these readings cannot be taken to be basic readings in light of the evidence found in this study, the following question remains open: Why are collective and distributive readings more simple to get than intermediate cover readings?

One possible explanation for the difference in judgments is the respective frequencies of overtly collective, distributive, and intermediate cover readings. Both the number of lexical modifiers that specify collective or distributive readings and their frequency of use lend to the intuition that these two minimal cover readings are more salient than intermediate covers. After all, it seems there are no lexical modifiers that index specific intermediate covers, and situations in which intermediate covers are salient are likely to be less frequent than situations in

which collective or distributive interpretations are salient. A corpus study looking for the relative frequencies of these readings could validate this hypothesis.

5 Conclusion

While it is possible for plural predicates to have collective or distributive interpretations, their basic interpretation is more general. The results of the empirical study in this paper suggest that neither Gillon [3], Landman [6], Lasersohn [8], nor Schwarzschild [9] is correct in concluding that the collective and distributive interpretations are part of the basic interpretation of plural predicates. At the same time, the study also suggests that Lasersohn [8] is correct in arguing that certain intermediate cover readings are never available, that is if they are never made contextually salient. I propose a basic reading, inspired by Landman's [6] double cover reading and Schwarzschild's [9] indexing, that can index cover readings when they are contextually salient. Given this contradicts the common view, further empirical research is necessary to substantiate these claims.

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