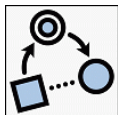


One reading to rule them all: Basic readings of plural predicates

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Introduction

Constructions like (1-a) are typically assumed to be ambiguous between at least collective, (1-b), and distributive, (1-c), readings.

- (1)
 - a. The men wrote musicals.
 - b. The men wrote musicals together.
 - c. The men wrote musicals individually.

Gillon (1990b) and Schwarzschild (1996) argue that context can make intermediate readings available.

- ▶ i.e. readings that are not fully collective or distributive
- ▶ e.g. when (1-a) has the same truth conditions as (2)

- (2) Rodgers and Hammerstein wrote musicals together, and Rodgers and Hart wrote musicals together.

Lasersohn (1989, 2013): some intermediate readings are never available.

- ▶ (3) would not be judged true for an intermediate reading akin to (2)

- (3) The TAs were paid exactly \$14,000 last year.

Introduction

Opposition:

What readings are logically possible versus which are plausible?

Open question:

Are intermediate readings available given context (Gillon, 1990b; Schwarzschild, 1996), or are they never available (Laserson, 1989, 2013)?

Empirical study:

Goal: to test what readings are available using truth-value judgments?

Results:

Neither intermediate, collective, nor distributive readings are available.

Analysis:

Plural predicates have a single, general interpretation that may index more specific (collective, distributive, or intermediate) readings when salient.

Table of Contents

Background

Empirical Study

Analysis

Conclusion

Background: Cover Interpretations

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

There are over 100 different combinations, or **covers**, (5), of Alex, Billy, and Charlie that could have written songs in (4).

(5) A covers B iff $A \subseteq *B \wedge \sqcup A = \sqcup B$

A cover of (4) is any set of sets of Alex, Billy, and Charlie, whose sum is equal to Alex, Billy, and Charlie.

(6) (4) is covered by $\left\{ \begin{array}{l} \text{Alex and Billy wrote songs together} \\ \text{Alex and Charlie wrote songs together} \\ \text{Billy and Charlie wrote songs together} \\ \text{Charlie wrote songs individually} \end{array} \right.$

No one argues that sentences like (4) are straightforwardly ambiguous between all cover interpretations.

Background: Minimal Covers

Gillon (1987) argues that sentences like (4) are ambiguous in respect to their truth conditions, which is a set of minimal covers, (7)

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

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

A minimal cover is a cover that cannot have any of its subparts removed and still be a cover.

- ▶ (6) is not a minimal cover because it has subparts (e.g. Charlie) that overlap with the other subparts, which together are a still cover.

(6) (4) is covered by $\left\{ \begin{array}{l} \text{Alex and Billy wrote songs together} \\ \text{Alex and Charlie wrote songs together} \\ \text{Billy and Charlie wrote songs together} \\ \text{Charlie wrote songs individually} \end{array} \right.$

There are eight minimal covers of the agent in (4).

- (8)
- | | | | |
|----|--------------------------|----|-----------------|
| 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 |

Background: Available Interpretations I

Lasersohn (1989): A minimal covers-based analysis is untenable

- Some covers are not available.
 - ▶ (9) is predicted to be a true under Gillon's (1987) analysis.

- (9)
- a. John, Mary, and Bill are teaching assistants (TAs) who each made exactly \$7,000 last year.
 - b. The TAs were paid exactly \$14,000 last year.
(Lasersohn, 1989, p. 131)

- NPs like *the real numbers* would require an infinite number of minimal covers.
- It is unlikely that the grammar of a language would assign infinite readings or set an upper limit on the number of possible readings.
- Verbs are ambiguous between collective and distributive readings (Dowty, 1987).

Background: Available Interpretations II

Gillon (1990b): At least collective and distributive readings are available.

- Context can make available intermediate minimal cover readings.

i.e. readings other than collective and distributive.

- (10) 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.

(Gillon, 1990b, p. 483).

- There is enough context in (10-a) to know that distributive or collective interpretations of (10-b) are not sufficient, and that minimal covers are necessary.

Background: Available Interpretations III

Schwarzschild (1996): Plural predicates have a single meaning that can be indexed to any cover reading in the appropriate context.

- ▶ “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” (Schwarzschild, 1996, p. 66).
- ▶ This solves the problem of infinite covers (Lasersohn, 2013).
- ▶ The translation rule in (11) means a plural predicate is indexed to a particular cover reading.

(11) 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.

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

In an ambiguous context, collective and distributive readings are made salient by the plural noun phrase.

Background: Available Interpretations IV

Landman (2000):

(13) Three boys invited four girls.

There are nine readings

- ▶ four scopeless readings
 - ▶ double collective
 - ▶ collective-distributive
 - ▶ distributive-collective
 - ▶ double-distributive—i.e. cumulative
- ▶ four scoped readings
 - ▶ Ds(Co): group object in situ, quantify-in sum subject
 - ▶ Do(Cs): group subject in situ, quantify-in sum object
 - ▶ Ds(Do): sum object in situ, quantify-in sum subject
 - ▶ Do(Ds): sum subject, quantify-in sum object

Background: Available Interpretations IV

Cover interpretations are the result of a special contextual mechanism that weakens the interpretations of verbs to a “double cover interpretation”.

- The “double cover interpretation” is a type-shifted cumulative interpretation
 - ▶ The cumulative interpretation is relational.
For “The men wrote musicals”, it indicates
 1. there is a set of men
 2. there is a set of musicals
 3. every one of the men wrote at least one of the musicals
 4. every musical was written by one or more of the men
- The “double cover interpretation” expresses a relation between subgroups rather than a relation between individuals.

Background: Available Interpretations IV

(13)

$$\llbracket \textit{The musicians wrote songs} \rrbracket = \begin{cases} \exists e \in *WRITE : \\ \exists x \in *MUSICIAN \wedge {}^C Ag(e) = \uparrow(x) \\ \exists y \in *SONG \wedge {}^C Th(e) = \uparrow(y) \end{cases}$$

(14)

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:

$${}^C R(e) = a \text{ iff } a \in ATOM \wedge \sqcup(\{\downarrow(d) \in SUM : d \in AT(*R(e))\}) = \downarrow(a) \\ \text{undefined otherwise} \quad (\text{Landman, 2000; p. 210})$$

$$(15) \quad \lambda x_n \dots \lambda x_1. \{e \in *V : \dots *R(e) = x \dots\} \rightarrow \\ \lambda x_n \dots \lambda x_1. \{e \in *V : \dots {}^C R(e) = x \dots\} \quad (\text{Landman, 2000; p. 211})$$

Interim Summary

- Analyses all argue for collective and distributive readings.
- Some analyses also argue for indexable/derivable cover readings.

Open question:

Are intermediate readings available given context (Gillon, 1990b; Schwarzschild, 1996; Landman, 2000), or are certain cover readings never available (Laserson, 1989, 2013)?

Table of Contents

Background

Empirical Study

Analysis

Conclusion

Empirical Study

- truth-value-judgment survey was conducted through Prolific.ac
- 32 native English speakers
- 45 test items, each containing a context and a follow-up
 - ▶ 15 follow-up items excluded a collective interpretation
 - ▶ 15 follow-up items excluded a distributive interpretation
 - ▶ 15 follow-up items allowed only one intermediate-cover interpretation
- 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.
- Instructions: Judge whether the follow-up sentence could be true or must be false in respect to the context preceding it¹

¹While these directions were written above every pair of sentences, the options the participants clicked on were simply labeled *True* and *False*.

Empirical Study

Collective and distributive effects from lexical modifiers

- ▶ Gillon (1990a); Schwarzschild (1996); Syrett and Musolino (2013) among others
- ▶ collective, (16-a), distributive, (16-b)

- (16) a. Alex and Billie wrote songs together.
b. Alex and Billie wrote songs individually.

Excluding a distributive Interpretation

(17) Alex, Billie, and Charlie went to the music studio. The musicians wrote songs.

(18) Alex and Billie didn't write songs individually.

- (19) 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~~

Empirical Study

Excluding a collective Interpretation

- (17) Alex, Billie, and Charlie went to the music studio. The musicians wrote songs.
- (20) Alex and Billie didn't write songs together.
- (21)
- | | | | |
|----|--------------------------|----|----------------------------|
| a. | $a \sqcup b \sqcup c$ | e. | $\overline{c}, a \sqcup b$ |
| 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 |

Intermediate cover Interpretation

- (17) a. ...
- (22) Alex and Billie didn't write songs individually or together.
- (23)
- | | | | |
|----|--------------------------|----|----------------------------|
| a. | $a \sqcup b \sqcup c$ | e. | $\overline{c}, a \sqcup b$ |
| 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 |

Empirical Study

- (17) Alex, Billie, and Charlie went to the music studio. The musicians wrote songs.
- (18) Alex and Billie didn't write songs individually.
- (20) Alex and Billie didn't write songs together.
- (22) Alex and Billie didn't write songs individually or together.

Potential results

1. All of these follow-up sentences are judged to be possibly true
 - context makes intermediate covers available
2. (18) and (20) are true, and (22) is false
 - intermediate covers are not available
3. (18) is true while (20) and (22) are false
 - collective interpretation is favored
4. (20) is true while (18) and (22) are false
 - the distributive interpretation is favored
5. all follow-up sentences are judged to be false
 - a general interpretation is favored

Results

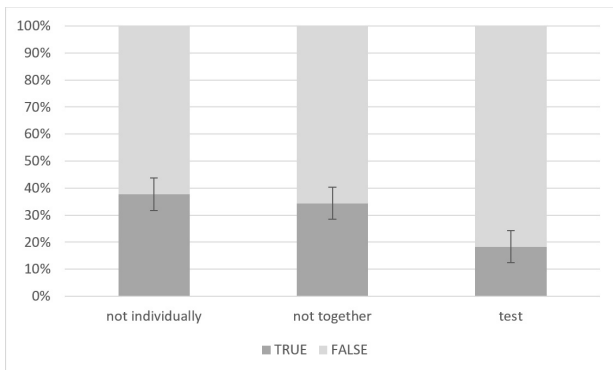


Fig.: Average percentage of true and false judgments by condition

- *not individually* and *not together* conditions are significantly different ($p < 0.001$) than intermediate cover condition.
 - ▶ binary logistic regression model (lme4 package in R)
- Each follow up sentence can be true, but speakers generally judge them to be false, though at different rates.

Discussion

- The results do not straightforwardly support any of the previous analyses.
- The follow-up sentences in the study are insufficient context to make the set of true cover readings available.
- Possibilities
 - ▶ Intermediate covers are not available; Lasersohn (2013)
 - ▶ Minimal cover interpretations are indexed; Schwarzschild (1996)
- 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.

Table of Contents

Background

Empirical Study

Analysis

Conclusion

Analysis

Plural predicates have a single, general interpretation.

- Schwarzschild (1996): A plural predicate has one meaning that can index cover interpretations.
- Landman (2000): Cover readings are derived from a double cover interpretation.

Translation rule:

- (24) If α is a singular transitive verb phrase with translation A , then for any index i , $\exists e \in {}^*A : {}^{C_i}Ag(e) = x \wedge {}^{C_i}Th(e) = y$ 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 interpreted as a dual cover reading.

Analysis

The dual-cover reading of *The musicians wrote songs* indicates

1. there is a sum of writing events
2. there is a sum of groups of musicians as a plural agent
3. there is a sum of groups of songs as a plural theme

(24)

$$\llbracket \textit{The musicians wrote songs} \rrbracket = \left\{ \begin{array}{l} \exists e \in \textit{*WRITE} : \\ a \sqcup b \sqcup c = \sigma(\textit{*MUSICIAN}) \wedge \\ {}^{C_i}\text{Ag}(e) = \uparrow(a \sqcup b \sqcup c) \wedge \\ \exists y \in \textit{*SONG} \wedge {}^{C_i}\text{Th}(e) = \uparrow(y) \end{array} \right.$$

Without indexing a particular cover, it is impossible to tell exactly which (covers of) musicians wrote exactly which (covers of) songs.

Analysis

Explaining the results

- The intersection of indexed readings between the context and the follow-up contains no possibly true covers.
- The ambiguous context did not index any minimal cover.
- The follow-up sentences indexed minimal covers and negated them.
- Given Alex and Billy are part of the double cover interpretation of the context, the follow up sentences were generally judged to be false.

Explaining the difference between conditions

- **Hypothesis:** Collective and distributive readings are more salient because such events occur more frequently.
 - ▶ There are lexical modifiers for collective and distributive, but not for intermediate cover readings.

Table of Contents

Background

Empirical Study

Analysis

Conclusion

Conclusion

Plural predicates have an un-ambiguous, general interpretation

- ▶ Ambiguity between specific readings arises from and is resolved by context.

The opposition between logically possible and plausible readings:

- ▶ Not all readings are available in a given context (Lasersohn, 1989).
- ▶ Models of language use should reflect such behavior.
 - ▶ Previous analyses would not predict the findings here.
- ▶ Much work is needed to continue to unpack the notion of context.
 - ▶ What exactly makes a particular reading salient?

What sort of knowledge is needed for resolving ambiguity? And how can the interaction between knowledge and resolution be modeled?

- ▶ Resolving ambiguity requires knowing which salient covers are true and which are false.
- ▶ Resolution takes place in the Immediate Common Ground. The definition of covers, which can be used to identify covers, is in the General Common Ground (Erbach and Berio, 2018)

Thanks for listening!

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