Symmetry and Symmetrical Predicates

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1. Introduction: Our topic, issues, goals.

- Symmetry is a property that plays a role in many domains of human cognition and in nature. The familiar logical definition of symmetry as a property of binary relations is given in (1).

(1) A relation R is *symmetrical* iff for all x, y: if R(x,y), then R(y,x).

- In English (not only), there is a kind of two-part litmus test for the symmetricals: If they surface in intransitive structures such as (2a), then (i) the sentential subject has to be plural (compare (2b)) and (ii) the reading, or interpretation, is roughly reciprocal.

(2) The Litmus Test (Gleitman et al 1996)

a. John and Bill are similar/match/hug. (Plural subject, reciprocal)

b.* John is similar/matches/hugs. (Singular subject infelicitous)

Introduction, *cont'd*

- Here we want to look at real and apparent mismatches among
  (a) the logical definition,
  (b) the linguistic litmus test, and
  (c) judgments offered by native speakers.

- Our goal is to diagnose the mismatches, and in trying to explain them, to get a better handle on the interplay of lexical meaning, syntactic structure, context, and the pragmatic effects of a speaker's choosing to use one syntactic structure rather than another.

Introduction, *cont'd*

- One big problem came from Amos Tversky, who argued in a 1977 paper that *similar* is not symmetrical, on the grounds of a significant difference in subjects' degrees of agreement with the following two statements:

(3) a. North Korea is similar to Red China.
b. Red China is similar to North Korea.

- Gleitman et al (1996) showed how the judgments about (3a-b) arise from a **symmetrical** lexical item *similar* being put into an asymmetrical syntactic structure.

Introduction, *cont'd*

- Extending that work and other work since then, we first argue for classing predicates (verbs, nouns, adjectives, prepositions) by a combination of logical and linguistic criteria.
- The "pure symmetricals" are those that are symmetrical by the tests of both (1) and (2): *equal*, *similar, match, cousin*.
- An interesting class, the "mixed symmetricals", behave linguistically like symmetricals by the litmus test of (2), but logically have both symmetrical and asymmetrical "instances": *love, hug*, *friend*.
- And by synthesizing logical and linguistic perspectives, and identifying both lexical and syntactic contributions to inferences, we may contribute to a possible resolution of a range of further puzzles about symmetrical predicates.
- We close with a brief look at some striking findings about symmetrical predicates in an emerging sign language, Nicaraguan Sign Language (Gleitman et al 2019).

2. Logical definitions, and extensions

- The standard logical definitions of *symmetrical, asymmetrical, and non-symmetrical* are given in (4) (Partee et al, 1990)

(4) a. A relation R is symmetrical iff for all x, y: if R(x,y), then R(y,x).

b. A relation R is asymmetrical iff for all x, y: if R(x,y), then ¬ R(y,x).

c. A relation R is non-symmetrical iff it is not symmetrical.

- On this definition, *non-symmetrical* simply means "not symmetrical", and the three classes are not a partition − the asymmetrical relations are a subclass of the non-symmetrical ones, and there is no standard name for the "middle" or "+/-" class of relations that are neither symmetrical nor asymmetrical.

Logical definitions, and extensions, *cont'd.*

- An alternative definition (Lemmon 1965) defines *non-symmetrical* as "neither symmetrical nor asymmetrical".
- On that definition, *non-symmetrical* picks out exactly the middle (+/-) class, the relations that are neither symmetrical nor asymmetrical, *love, hug, friend*.
- There are competing advantages to the two definitions. But only the alternative choice gives a three-way partition of relations into exhaustive and non-overlapping classes of symmetrical, asymmetrical, and the middle (+/-) class.
- For our purposes, the alternative definition of *non-symmetrical* is more useful linguistically (and probably more natural conceptually) than the definition in (4).
- To avoid confusion, we will use the more mnemonic terms *middle class* or *+/- class* in what follows, without departing from the standard definitions in (4) of (logically) *symmetrical, non-symmetrical* and *asymmetrical*.

Extending the logical definitions.

- When talking about a +/- relation like *love*, it's tempting to say "sometimes it's symmetrical and sometimes it's asymmetrical." Or "it has both symmetrical and asymmetrical instances."
- But according to the definitions, *symmetrical* and *asymmetrical* are properties of *relations*, with a universal quantifier built into their definitions, and it shouldn't make sense to apply those terms to *instances*, or to say that a relation has such a property "sometimes". Yet it's clear what is meant by those locutions.
- We can give supplementary definitions to extend the terminology in these useful ways.

(5) a. A *symmetrical instance* of a relation R is a pair a,b such that aRb and bRa. An *asymmetrical instance* is a pair a,b such that aRb and not bRa.

b. "Sometimes love is symmetrical" and "Love has symmetrical instances" can both be defined as follows: there are pairs a,b such that a loves b and b loves a.

Extending the logical definitions, *cont'd.*

- As (Partee 2009) observed, with definitions of symmetrical and asymmetrical instances, symmetry could be treated as a ***graded*** property: one relation can be more symmetrical than another.
- Gleitman et al (1996) treated *symmetrical* and *asymmetrical* as sharp concepts (as they are under the standard logical definitions, as well as by the litmus test), but also showed experimentally that subjects readily gave rankings of 'how symmetrical' various relational predicates were.
- In Section 4 we consider the usefulness of 'graded symmetry' in semantically classifying predicates, and suggest that there may rather be several discrete subclasses of predicates with respect to symmetry properties, rather than simple gradedness.
- All these considerations suggest that the standard logical definitions of *symmetrical* and its relatives are by themselves too limited for linguists' needs. Common usage offers clues to further notions that are descriptively and perhaps explanatorily valuable.

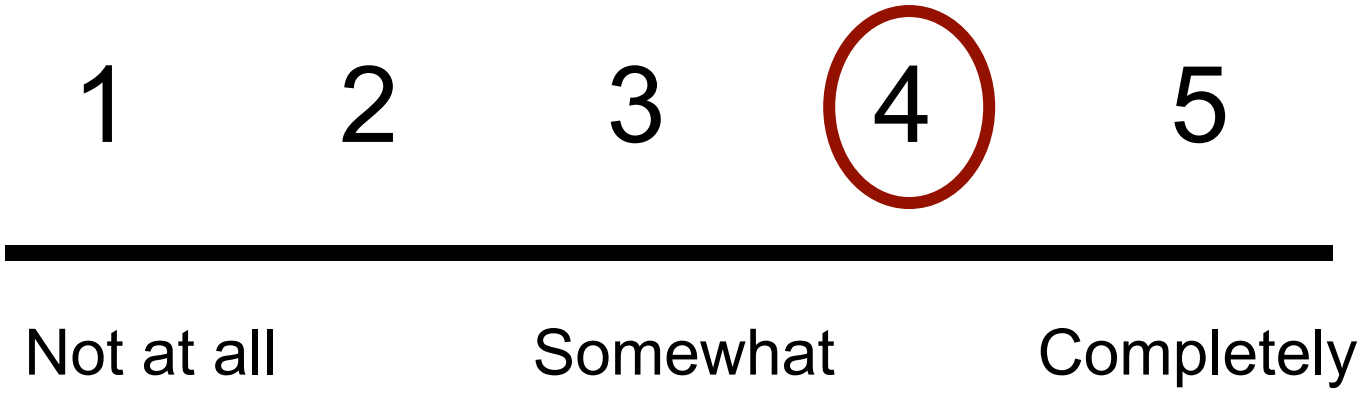
3. Apparent mismatches: Are *similar* and *near* really symmetrical?

- What if it turned out very generally that with respect to words formally characterized as symmetrical according to the definition in (1), our usage of those words in natural language does not actually appear to respect the entailment stated in that definition?
- If a core symmetrical predicate such as *similar* violates (1), that would be serious trouble, suggesting a deep disconnect between the abstract logical definitions and the notions needed in the study of language and cognition.
- The heart of the challenge raised in (Tversky 1977) was that in judgments about similarity statements, laboratory participants appear to violate the definition of logical symmetry.
- His conclusion was that SIMILAR is not a psychologically symmetrical concept.

Tversky's experiment (Tversky, 1977)

Assess the degree to which:

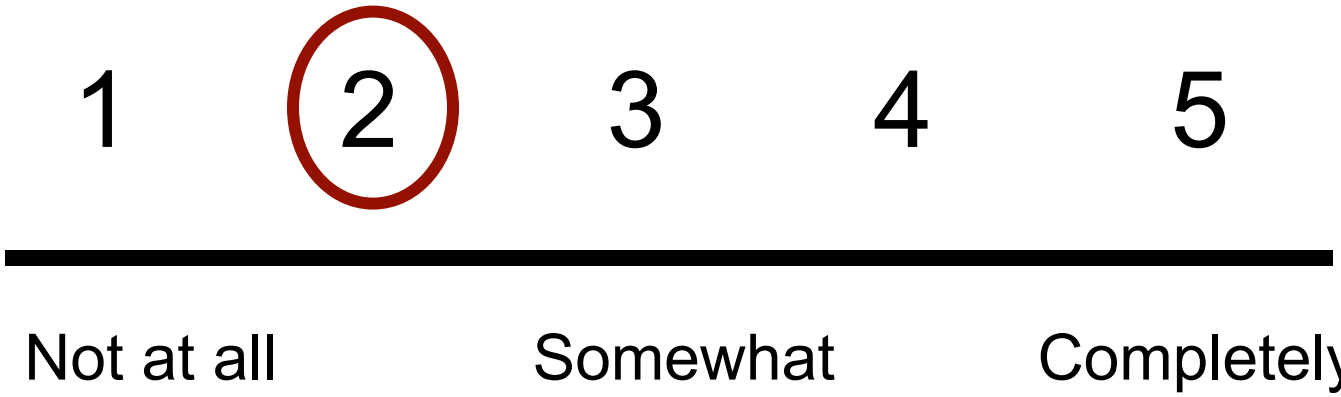
(a) North Korea is similar to Red China.



Assess the degree to which:

(a) North Korea is similar to Red China.

(b) Red China is similar to North Korea.



X is more similar to Y than Y is to X

The Tversky Model

- Objects a and b are each characterized by a set of features A, B.
- S(*a, b*), the similarity of *a* to *b,* is a weighted function of:

  A ∩ B (all shared features),

  A – B (features of *a* not shared by *b*), and

  B – A (features of *b* not shared by *a*).

$$S(a, b) = \theta f(A \cap B) - \alpha f(A - B) - \beta f(B - A) \quad \text{where } \theta, \alpha, \beta \geqslant 0.$$

- Tversky, in his Contrast Model, held that featural descriptions organized any nominal concept, including North Korea and Red China.
- Similarity was taken to involve comparison of these feature descriptions. Not necessarily symmetrical, since parameters α and β can differ.
  - And the more of the central features, or the more features altogether, a concept embodied, the more likely that it would preferentially take “second position” in a similarity predication.
- And now a generation or more of psychologists believes that ‘similar’ is not a symmetrical concept.

A More General Phenomenon

Talmy, 1978; Burroughs & Sadalla, 1979

The bicycle is near the building.

Pink is like red.

My sister met Meryl Streep.

The button matched the shirt.

True of *All* Symmetricals

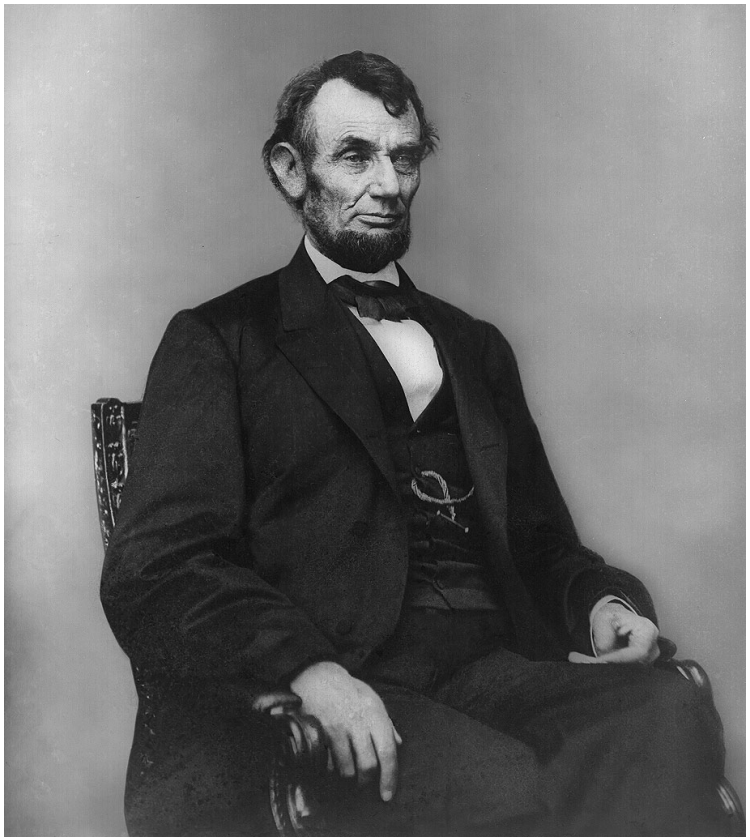
Assess the degree to which:

(a) The least of the citizens is **equal** to the president.

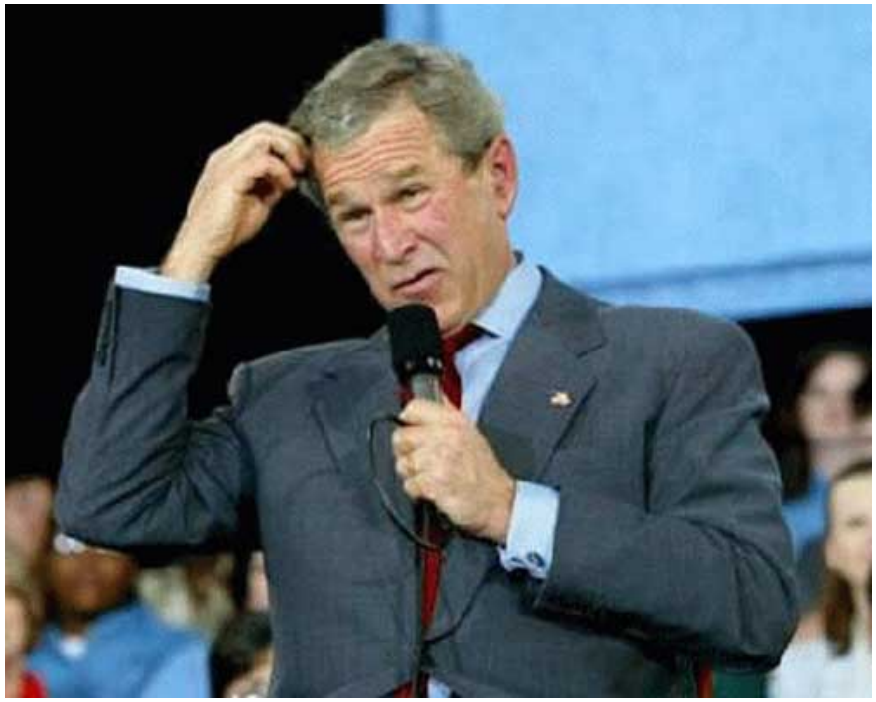
1 2 3 4 5

Not at all Somewhat Completely

(a) The least of the citizens is **equal** to the president.



(b) The president is **equal** to the least of the citizens.



Not wrong, just different

The social significance of figure-ground

Chestnut and Markman 2018

(6) (a) Girls are as smart as boys.

(b) Boys are as smart as girls.

The bicycle is next to the building.

Talmy 1975

The building is next to the bicycle.

Human Subjects Interpret Structure

- When would you say:
- *The garage is next to the bicycle*?
- "If you have a big statue of a bicycle and a little garage on wheels going round it"
- "I parked my bicycle somewhere and somebody built a garage next to it while I was gone"

Gleitman et al., 1996

The man is tied to the tree.

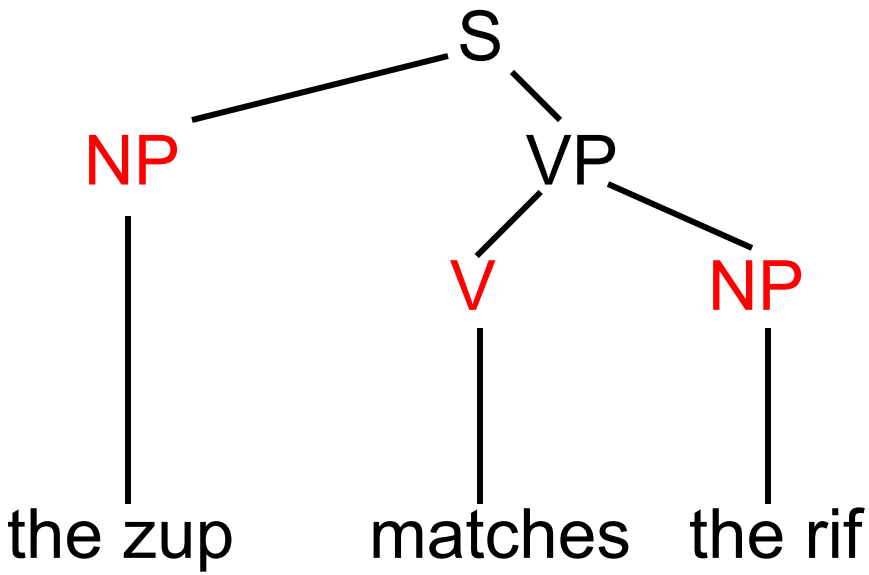
The man is tied to the tree.

The tree is tied to the man.

The tree is tied to the man.

Illustrations courtesy Henry Gleitman

The Asymmetry of Syntactic Structure



…expresses category ‘dominance’.

Causal Role of the Syntax

The zup **is similar to/ married/ met** the rif.

	the zup	the rif	Same	Irrelevant
Older/ younger				
Less/more famous				
Bigger/ smaller				
Less/more mobile				
More/less familiar				

"The zup is similar to the rif."

Gleitman, Gleitman, Miller & Ostrin, 1996

Which is more ____, the rif or the zup?

(zup = -1, rif = +1)

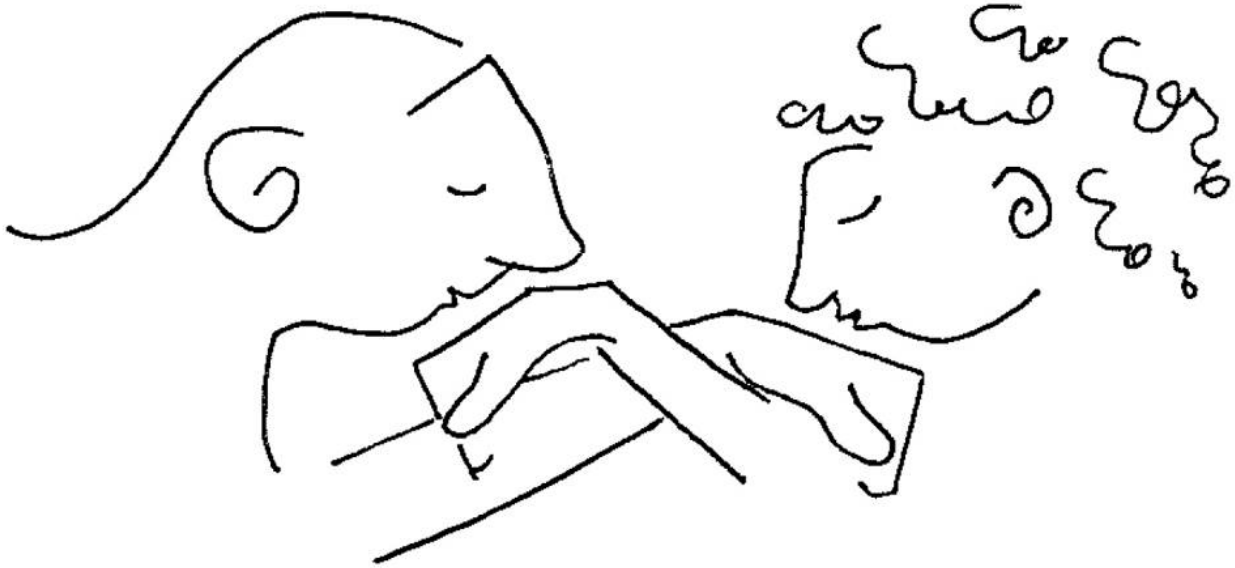
**p < .01, *p < .05

Property	"zup"	"rif"	Preference	t(df)=19
important		✔	+0.45	7.3**
famous		✔	+0.38	5.1**
old		✔	+0.41	6.3**
big		✔	+0.38	5.8**
immobile		✔	+0.15	2.6*

Symmetrical Kissing: One Event

John and Mary kiss.

Reciprocal Kissing: Two Events



John and Mary kiss each other.

Takes two to "shake hands"…

…but a "hug" may be unrequited

Conclusions about the apparent mismatches

- The experiment with nonsense words showed that subjects "know" something about *zup* and *rif*, which previously had no meaning, from where they were in the structure of the sentence.
- The *rif*, in complement position, where it is understood as the "ground" or "reference point", is more often judged larger, older, more prominent, more famous, etc.
- In sum, what GGMO found was that the appearance of non-symmetry in Tversky's findings was an illusion, that it was a matter of putting a symmetric predicate into an asymmetric syntactic frame.
- Notice that, as usual, language design as we know it is profoundly efficient, exhibiting the ability to express more than one kind of information with the same structure. The positioning of noun phrases tells us who bears what relation to whom, and at the same time conveys the different sort of "dominance" among members of a category expressed by figure-ground perspective.

4. Synthesizing logical and linguistic perspectives on symmetry

- The logical definitions of *symmetrical* and *asymmetrical* relations in Section 1 and the linguistic "litmus test" in (2) for classifying lexical predicates as symmetrical or not do not make identical distinctions.
- *Meet, similar, sibling* are symmetrical on both counts.
- *Kiss, hug, opposed to, friend* pass the litmus test but are in the +/- logical class, having both symmetrical and asymmetrical 'instances'.
- The logical definitions have roots in mathematics and their value is generally measured in terms of their mathematical applications.
- The litmus test rests on a combination of morphological, syntactic, and semantic properties of an intransitive variant of a two-place predicate; its value is measured by its linguistic explanatory power.
- Our ambition is to forge a perspective on these notions that draws on both approaches, and to show that this enriched perspective can be useful in shedding light on the_role of symmetry in linguistic and conceptual structure.

Synthesizing, *cont'd.*

- Initially restricting attention to English, consider the behavior of verbs and other predicates on two kinds of criteria. Logically, are they symmetrical, asymmetrical, or in the "mixed" +/- class? And linguistically, do they pass the linguistic litmus test in (2) for "symmetricals" or not?
- In principle, there could be six classes (3 x 2), but no predicate is both logically symmetrical and linguistically asymmetrical (except the recalcitrant verb *resemble*) or vice versa, so there are actually only four classes.
- We've mentioned the two subclasses of 'linguistic symmetricals', the *meet, similar, sibling* class and the *kiss, hug, friend* class.
- The 'linguistic asymmetricals', which fail the litmus test, are also of two kinds logically: some, like *supportive of, admirer* are +/-, while others, like *father, taller*, are logically asymmetrical.
- The next slide shows our resulting classification.

Synthesizing, *cont'd.* Table 1.

Name of class	Linguistic Property (Litmus test)	Logical Property	Examples
Pure symmetricals	Symmetrical	Symmetrical	*meet,, match, similar, equal, sibling, near*
Mixed symmetricals	Symmetrical	Mixed: +/-	*kiss, hug, fight, opposed to, friend, foe*
Mixed asymmetricals	Asymmetrical	Mixed: +/-	*love, drown, hit, supportive of, admirer*
Pure asymmetricals	Asymmetrical	Asymmetrical	*outrank, contain, father, taller, below*

Synthesizing, *cont'd.*

- One tricky issue that arises when one considers the properties of eventive verbs in our chart like *meet, marry, kiss, hug, drown, hit, outrun* is the question of how many events there are asserted to be in the case of different constructions with different verbs.
- We'll briefly state our hypotheses without much argument.
- With pure symmetricals like *marry,* an event of Pat marrying Chris is always an event of Chris marrying Pat, so *Pat and Chris married each other* entails *Pat and Chris married*. The construction doesn't; it's a lexical entailment.
- Mixed symmetricals like *kiss, hug,* don't have that entailment, as we saw in the pictures. (7a) asserts the existence of a single event; (7b) can, and typically does, assert a sum of asymmetrical kissings.

(7) a. Chris and Pat kissed.

b. Chris and Pat kissed each other.

- Note that "on different days" is fine with (7b), but not with *married.*

Synthesizing, *cont'd.*

- What do we say about the "mixed asymmetricals" *drown, kill, hit*? By the litmus test, they are asymmetrical, but logically, when we test them in full sentences, they are +/-. And an explicit reciprocal sentence is ok, expressing a "symmetrical instance".

(8) John and Bill drowned each other.

- But an 'act of A drowning B' seems to generally be conceived as an 'asymmetrical act' (GGMO). Does the possibility of a "symmetrical instance" arise only at the level of the sentence?
- An analysis offered in (Champollion 2015) helps make good sense of the situation: a lexical verb such as *drown* predicates of a situation that there is an event of drowning in it. So the verb itself is not asymmetrical, but +/-, since a situation that contains an event of *John drowning Bill* can also contain an event of *Bill drowning John.* These can be two subevents of a larger event, much as entities denoted by *John* and *Bill* can be parts of a plural entity denoted by *John and Bill*.

Synthesizing, *cont'd.*

- With a pure asymmetrical like *outrun*, a reciprocal sentence is grammatical, but can only be possibly true if it's understood as interpreted as referring to different events, e.g. in (9), to different races.

(9) Chris and Pat outran each other.

- ***Graded judgments?***
- Although we are not invoking a graded notion of lexical symmetry, there remains the question of the gradedness of judgments of symmetry among participants in GGMO's pre-test on which people were simply asked to rate on a 5-point scale how symmetrical a given predicate was. (Table 2 from GGMO (next slide))
- The results in that table do correlate with linguistically symmetrical behavior and with the four classes in Table I. All 20 of the predicates ranked below the midline in Table 2 are indeed linguistically asymmetrical; all 20 above are linguistically symmetrical.

Graded judgments: Gleitman *et al* 1996, Table 2 - Pretest.

Pretest: symmetry ratings of 40 predicates (with 1 = minimum and 5 = maximum symmetry)

Predicate		Symmetry score	Predicate		Symmetry score
equal	S	4.89	love	A	2.44
identical	S	4.89	copy	A/S	2.22
marry	A	4.78	safe	S	2.00
far	P	4.22	see	A	1.89
match	S	4.17	hit	A	1.89
divorce	A	4.11	bounce	A	1.67
resemble	S	4.11	unpleasant	S	1.61
meet	A	4.00	lecture	A	1.56
similar	S	3.94	hurry	A	1.56
across	P	3.94	applaud	A	1.39
near	P	3.94	follow	A	1.33
different	S	3.94	inside	P	1.28
separate	A/S	3.94	eat	A	1.28
combine	A	3.83	drown	A	1.28
collide	A	3.50	choke	A	1.24
attach	A	3.22	inferior	S	1.22
argue	A	3.11	below	P	1.22
embrace	A	3.00	behind	P	1.22
kiss	A	2.89	better	S	1.22
compare	A	2.88	less	S	1.17

S = stative; A = active; P = preposition.

Synthesizing, *cont'd.*

- We note that one can distinguish *necessarily symmetrical* predicates from *empirically symmetrical* ones, and likewise for the asymmetricals, by saying that a relation is *necessarily symmetrical* iff its symmetry follows from a formally statable definition or axiomatization of the relation.
- Then it can be seen that the two predicates in Table 2 that are necessarily symmetrical, *equal* and *identical*, are rated highest of all, and the two predicates that are necessarily asymmetrical, *better* and *less*, are rated among the very lowest.

5. Integrating contributions of lexicon and syntax

- The logical definition of symmetry in (1) and the linguistic litmus test in (2) give different partitions of English predicates; Section 4 established a finer-grained classification of those predicates by combining the two systems.
- This section argues that interpreting full sentences also requires synthesizing contributions from different sources: the compositional interpretation of truth-conditional meaning on the one hand, and the further influence of syntactic structure, or the choice of one syntactic structure over alternatives, on other aspects of interpretation.
- We do not so far have an actual formal account. The ideas we describe here are influenced by a number of sources, including GGMO (Gleitman et al 1996), (Dowty 1991) on thematic proto-roles, Winter (2018) on hard and soft entailments, Rubinstein (2009) on groups in the semantics of symmetricals, and others.
- We illustrate our ideas by working through an interesting challenge to compositionality from (Landau and Gleitman 2015).

Integrating lexicon and syntax, *cont'd.*

- "If two bodies collide, then the first of them collides with the second, the second collides with the first, and they collide with each other. Surprisingly, assenting to these mutual entailments does not imply that these sentence forms are semantically equivalent, at least in a court of law. For if a scooter collides with a bus then the scooter's insurance company pays, and the reverse obtains if the bus collides with the scooter. Although any collision must be a single event, the asymmetry of syntactic structure in these cases imparts a further semantic element to the interpretation. Of course, if the bus and the scooter collide (or the scooter and the bus collide), that is simply a tragic accident and money doesn't change hands. This set of syntactic structures is a striking case whereby even a single symmetrical motion event (colliding) can be linguistically framed so as to alter the relative prominence of the participants, resulting in additional interpretive values of path direction and even—as in the present case—attributions of instigation and cause." [Landau and Gleitman 2015, p. 187]

The *collide* puzzle, *cont'd.*

- On the one hand, we agree with those observations, and they provide a good example of relevant "further aspects of meaning".
- On the other hand, we seem dangerously close to inconsistency.
- Let's label the key example sentences for reference:

(10) a. The scooter collides with the bus. ("SCOOTER")

b. The bus collides with the scooter. ("BUS")

c. The bus and the scooter collide. ("BUS & SCOOTER")

- How can one reconcile the following assumptions, which Landau and Gleitman make and which we have also been making?

(11) Assumptions:

a. The word *collide* has the same meaning in (10a-c).

b. The intransitive variant (10c) entails the conjunction of (10a) and (10b).

c. The two transitive variants (10a) and (10b) are not semantically equivalent to each other or to the intransitive variant (10c).

The *collide* puzzle, *cont'd.*

- What's the problem? Well, given the stated difference in culpability in cases (10a) and (10b), it would seem that when the first sentence is true, the second is not -- these seem to be truth-conditional differences, given the consequences in a court of law.
- But if the two transitive sentences are truth-conditionally incompatible, how can the symmetrical sentence entail both? That is, how can we make good on Gleitman and Landau's statement that "assenting to these mutual entailments does not imply that these sentence forms are semantically equivalent"?
- We offer a solution building on GGMO and a modification of Dowty's ideas about thematic proto-roles and argument selection.
- Dowty rejects the idea that there is a fixed set of distinct thematic roles, and instead identifies a set of "Proto-Agent properties" (volition, sentience, causation, movement) and "Proto-Patient properties" (change of state, incremental theme, causally affected, relatively stationary).

The *collide* puzzle, *cont'd.*

(12) Dowty's Subject Selection Principle: The argument for which the verb entails the greater number of Proto-Agent properties will be lexicalized the as subject.

- Dowty observes that with stative pure symmetricals (our term) like *rhyme, intersect, be similar*, neither argument has any Proto-Agent properties.
- For mixed symmetricals *hug, kiss*, he notes that only the intransitive collective entails that both parties were volitionally involved.
- He observes, in contrast, that for the non-stative pure symmetricals in (13), both arguments even of the transitive variant have Proto-Agent properties: both must be actively and volitionally involved.

(13) married / played chess / debated / discussed the matter

- In this case, the lexical semantics of the verbs requires the two arguments even in the transitive case to have equal Proto-Agent properties.

The *collide* puzzle, *cont'd.*

- Dowty also discusses the verb *collide*, for which the judgments he assumes are that in the intransitive collective form, both of the conjoined subjects must be in motion, whereas in the transitive form, motion is entailed only for the subject. Neither volition nor causation is entailed for either argument.
- "A different situation is presented by (36):

(36) a. The truck collided with the lamppost.

b. (#)The truck and the lamppost collided.

- Ex. (36b) might seem like a bizarre sentence, but in fact it would be perfectly natural to describe a situation where a new lamppost was being carried to the top of a hill, came loose from its moorings, rolled down the hill, and intersected the path of a moving truck at the bottom.
- Thus the difference here is that (36a) entails only that the truck was in motion in the event of collision, while (36b) entails that both the truck and the lamppost were in motion." (Dowty 1991, p.586)

The *collide* puzzle, *cont'd.*

- Dowty assumes polysemy: transitive and intransitive *hug* are two different but related verbs. We follow GGMO in treating transitive and intransitive *hug* as one underspecified lexical item which can fit into two syntactic frames, with the choice of syntactic structure sometimes resulting in further semantic and/or pragmatic content.
- An important ingredient in both Dowty's work and GGMO: A given aspect of meaning, such as "this participant is in motion" or "this participant plays a causal role in the event", may arise either from the semantics of the verb or indirectly as a result of the choice of one syntactic structure or another.
- Example: Compare "Volitional" component of meaning in (14-15):

(14) a. John and Mary hugged. (both must be volitional)

b. Mary hugged John. (only Mary must be)

(15) a. Fred and Ginger tangoed. (both must be)

b. Ginger tangoed with Fred. (both must be)

- Note that the effect of syntax on meaning is greater for the +/- *hug*.

The *collide* puzzle, *cont'd.*

- Now we can solve the *collide* puzzle.
- Let's say, with Dowty, that the core meaning common to all (literal, physical) uses of *collide* says a *collide* event involves the impact (sudden forceful contact) of two objects (or more, but let us restrict attention to the case of two), at least one of which was moving. The core lexical meaning says nothing about causation or volition.
- The symmetrical construction requires that the conjoined NPs have the same proto-Agent properties, hence both in motion. It may say no more than that.
- The transitive construction prefers that the subject has more proto-Agent properties than the complement. Hence either the complement wasn't moving, or both were moving and the subject was the causer. In either case, the subject is 'at fault'.
- The *use* of one or the other construction in any setting where the differences could matter will give rise to an implicature that such a difference was intended. A court of law is such a setting.

The *collide* puzzle, *cont'd.*

- The first sentence in the Landau and Gleitman passage is in the context of logic, the two thousand-year tradition about what it is for a predicate to be symmetrical. There is universal quantification over all instantiations of the given predications, and no particular event is being described; hence only what all such events have in common is relevant. One abstracts away from the language user, and hence from pragmatics, when one explicates the logical properties of symmetrical predicates, including the principle that the collective intransitive entails the two transitive variants.
- But then in the context of the court of law, where the choice of how the event is described is deliberate, the syntax of the three different sentences (10a-c) makes contributions to the enriched meaning, contributions of the kind described by *GGMO*, made more specific in this case with elements of Dowty's proto-role ideas.
- Work remains to make the relevant principles more precise, and to work out the division of labor between semantics and pragmatics.

6. Evidence from emerging languages

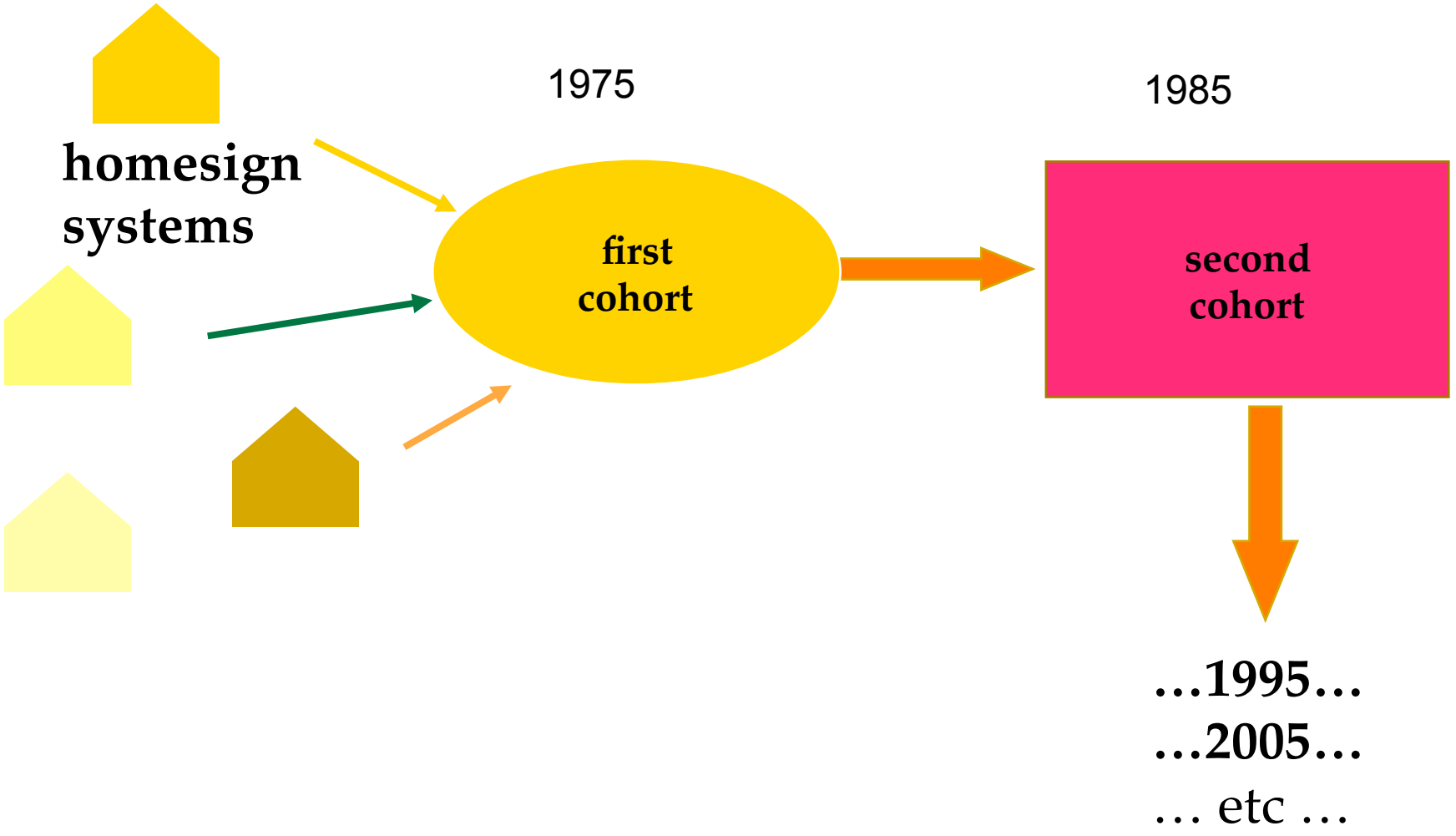
- In this section, we ask how semantic properties such as symmetry arise, in the life of languages and their learner-users.
- For this kind of conceptual category, the puzzle of acquisition is particularly acute. Bad enough, for example, that concrete words such as *doggie* are often uttered in the absence of dogs and sometimes are un-uttered in their presence. But at least the child may get some help from perception for *doggie*, whereas for abstract words like *fair* and *not*, there is nothing to perceive.
- Syntax can provide important constraints and clues for the learner in the typical language-learning situation; but what happens if a child is not surrounded by a received language?

Nicaraguan Sign Language

Kegl, 2002; Senghas et al. 2005

History of the Nicaraguan signing community

Senghas (1997)



Why look here?

- This language, evolved by children, is suggestive for the unlearned character of form-meaning mappings.

- NSL displays event structure in a particularly revealing way relevant to our question.

Animacy Hierarchy in NSL

Senghas, Coppola, Newport & Supalla, 2007

- A woman hit a ball
- *A ball hit a woman
- *A man hit a woman
- Man hit woman got-hit
- Man woman hit got-hit : see video

  (SOV)

Simple Punch

Stimulus Videos presented to NSL signers

Gleitman, Senghas, Flaherty, Coppola & Goldin-Meadow (2019)

Reciprocal

Symmetrical

Reciprocity in NSL

Gleitman, Senghas, Flaherty, Coppola & Goldin-Meadow (2019)

- English:
  - A woman and a man punch each other.
- NSL:
  - Woman man cross-punch got punched got punched.

Punch Each Other with "Recoil"

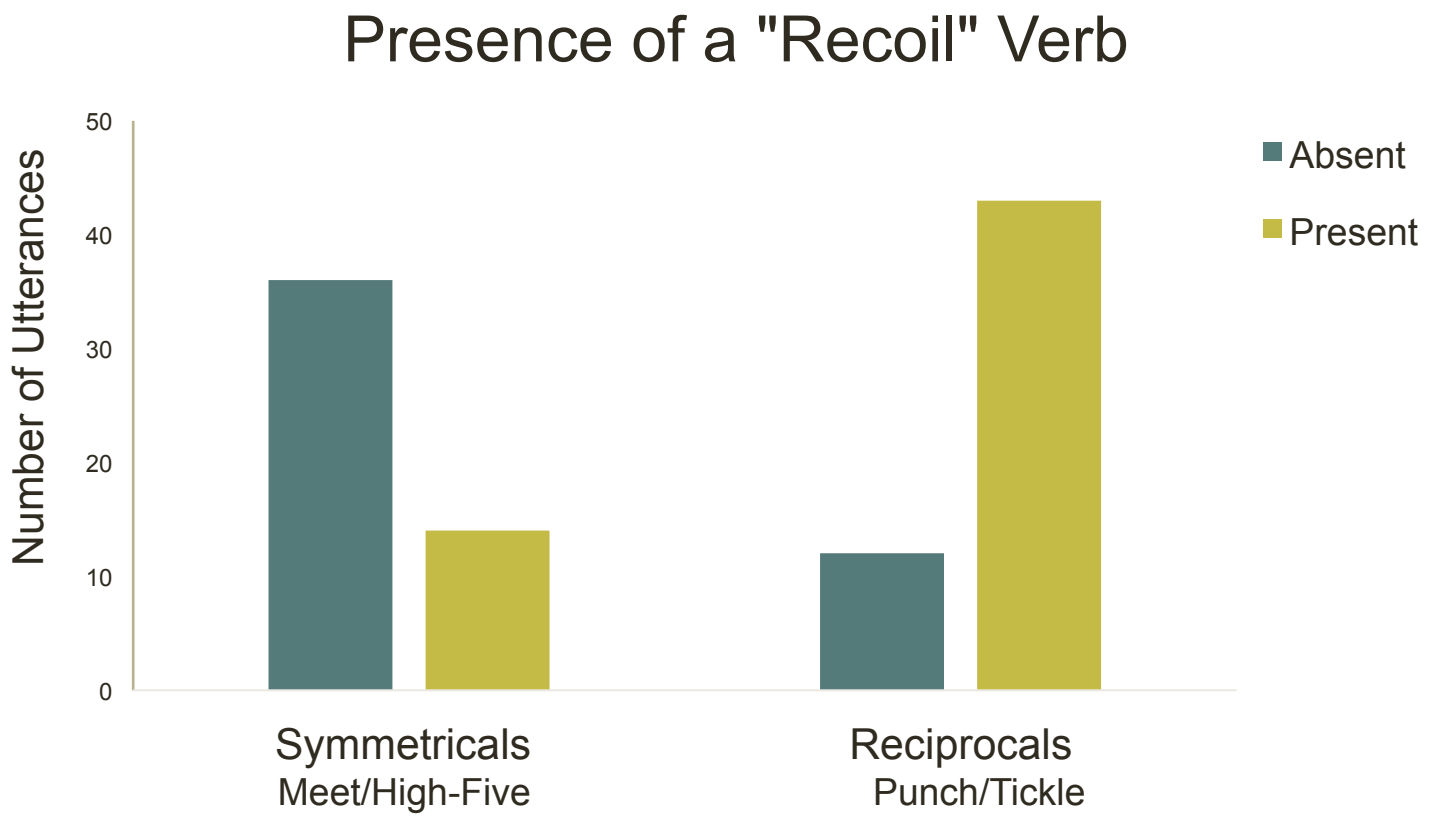
Symmetry in NSL

- English:
  - A man and a woman meet.
- NSL:
  - Man woman meet.

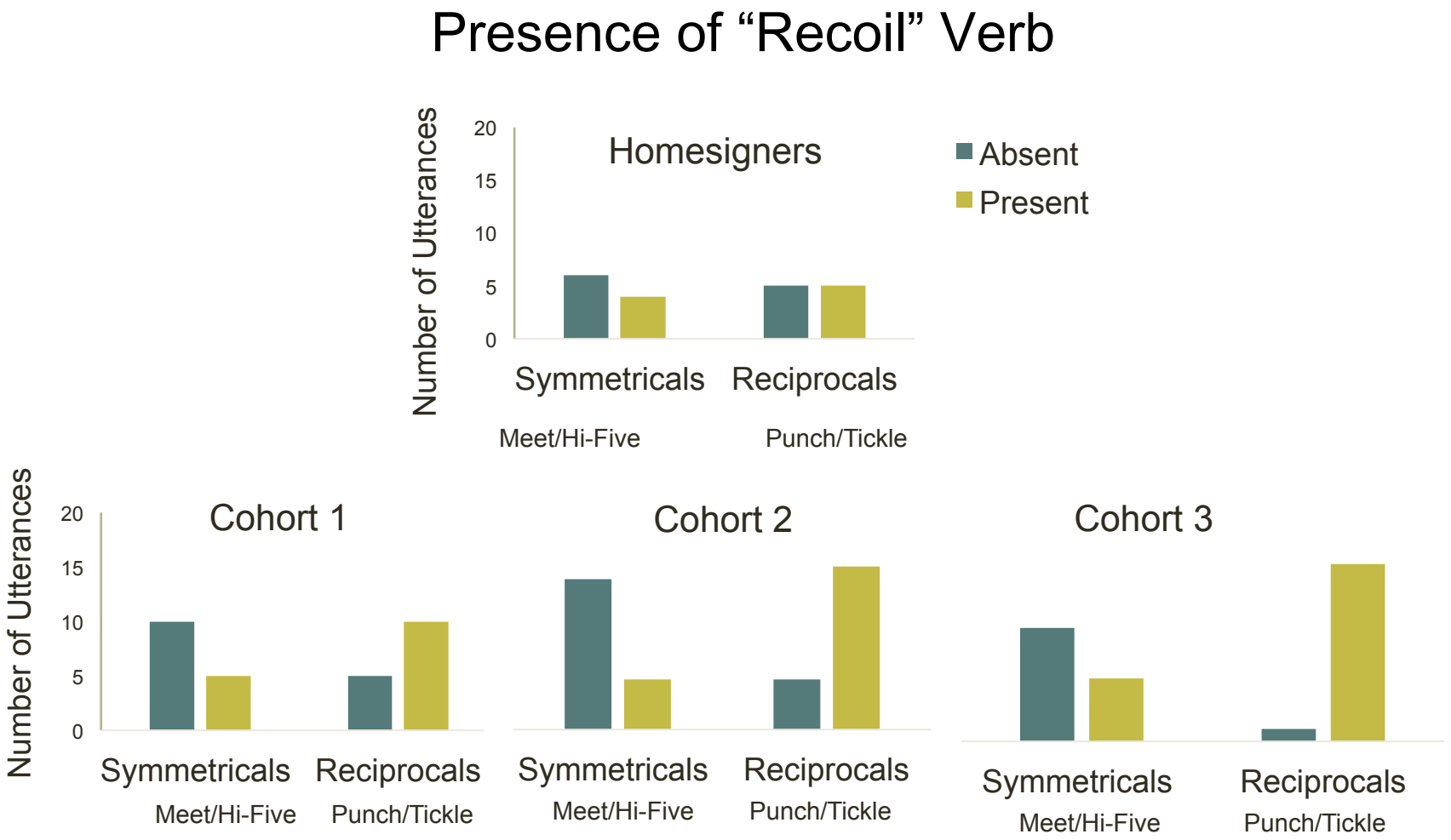
Meet

Symmetricals Expressed with Single Verb (no recoil)

Gleitman, Senghas, Flaherty, Coppola & Goldin-Meadow (2019)



…and they always were.



*No reliable interactions with Cohort

What NSL tells us

- The results showed that not all symmetrical-looking bidirectional events are represented using mirroring. When two people punch each other, the event can look symmetrical. Nevertheless, the mirrored form was used primarily for events that are abstractly construed as symmetrical—a single event in which two participants act as one—*not* for two simultaneous reciprocal events.
- All signers, even homesigners, have this intuition and thus make a distinction between symmetrical and reciprocal construals of events at the word level.
- At the sentence level, verbs describing bidirectional events with *punch* or *tickle* are produced with serial verb constructions, which are transitive constructions for NSL signers. And verbs describing symmetrical events (*high-five, meet*) are rarely produced in serial verb constructions, signaling that they are *not* typically construed as transitive. Signers no matter what their year of entry into the Deaf community displayed this pattern.

What NSL tells us, *cont'd.*

- In summary Gleitman et al (2019) note the remarkable fact that both English-speakers and NSL-signers distinguish between symmetricals (one event involving a collective agent, described by one non-transitive clause) and reciprocals (two events involving two agents, described by two transitive clauses).
- These findings, taken together, suggest a common core of conceptual distinctions and grammatical means for the foundational formal property of symmetry.
- The fact that this sameness is found under radically different input conditions highlights that unlearned forces are at work in the design of language.
- Perhaps we have failed to discover how this distinction is "learned" by children owing to the fact that it was there from the beginning, prefigured in the conceptual underpinnings that make language acquisition possible.

In Conclusion

- The arguments of this paper all have a common core, consisting of the following two observations:
- First, that the logical characterization of symmetry in (1) has wide application and presumably reflects the laws of thought, and natural languages do not violate that logic.
- And second, that human languages have evolved so as to render, remarkably efficiently, an enormous panoply of further distinctions, reflected both in vocabulary and in syntax.
- Both formalisms and patriotism are satisfied when we declare that *all humans are created equal*, but something more is communicated when we remark that *the least of the citizens is equal to the President*, or the reverse. Symmetry is part of the lexical semantics of many predicates, but is never the only part. And the syntactic structure of sentences can make its own contributions.

In Conclusion, *cont'd.*

- So the solutions proposed here to the puzzles posed by symmetricals, while still very incomplete, all have the form of integrating the contributions to meaning of lexicon and syntax.
- A given aspect of meaning may come from either, since a lexical predicate in a given language may be specified or unspecified for some semantic feature or property that an asymmetric syntactic structure can in principle contribute.
- Syntax contributes the structure that supports semantic composition, and also the structure that determines asymmetrical "prominence" among the arguments of a predicate.
- Symmetry in language, and notably in the emergent language NSL, supports the view that the learning or language-creating child must go beyond perception to structural features of language to discover or invent unobservable aspects of word meaning and understand how those meanings are enriched by the syntactic structures in which they occur.

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Appendix 1: The *brothers* puzzle.

- There are a few non-symmetrical (+/-) nouns that act linguistically symmetrical: *brother* is one.
- *Brother* is non-symmetrical on the domain of humans, and symmetrical only when restricted to the domain of males. (Actually it's also symmetrical on the domain of females, where it's empty.)
- Yet it patterns with the fully symmetrical *sibling* and *cousin* and the nearly symmetrical *friend,* and unlike the fully asymmetrical *mother,* in forming plurals as in (A1).

(A1) *Pat and Chris are brothers.* (cf. *Pat and Chris are mothers.*)

- This puzzle was solved independently by Schwarz (2006) and Champollion (p.c. 2008).
- The solution uses the notion of *Strawson-entailment*, advocated in other contexts by Kai von Fintel (1999).

Appendix 1: The *brothers* puzzle, *cont'd.*

- Why does nonsymmetrical *brother* pattern with symmetrical nouns?
- The solution by Schwarz (2006) and Champillon (p.c. 2008) uses the notion of *Strawson-entailment*, advocated in other contexts by Kai von Fintel (1999).

(A2) **Definition:** A set P of premises **Strawson-entails** q if P plus the presuppositions of q entails q.

- Assume that *X is a brother of Y* presupposes that *X* is male and asserts that they are siblings.
- Then *X is a brother of Y* Strawson-entails that *Y is a brother of X.* (It also Strawson-entails that *Y is a sister of X.*
- So linguists should better use a revised definition of *symmetry*:

(A3) A relation R is Strawson-symmetrical iff for all x, y: R(x,y) Strawson-entails R(y,x).

Appendix 1: The *brothers* puzzle, *cont'd.*

- *Brother* and *sister* are among the few English nouns that are Strawson-symmetrical but not classically symmetrical.
- But there are more in languages with grammatical gender, e.g. French *cousin – cousine* (cousin, m – f).
- Among kinship vocabulary systems, there are some languages that have a distinct word for brother-of-a-male vs. brother-of-a female.
- At least one language has a word for same-sex sibling; see Lichtenberk (2007) on the Austronesian language To'aba'ita.
- See also the interesting work by Peter Staroverov (2007) on sentences like (A4) and their relation to sentences with *are brothers.*

(A4) *Pat and Chris are brother and sister.*

- Staroverov gives a compositional semantics for (A4) using a notion of Strawson-reciprocal exactly analogous to Strawson-symmetrical.