Scope without Syntax

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References

## Scope without Syntax

Luke Smith

University of Arizona

December 1, 2017

# Generative syntax has an poor record with scope...

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# Generative syntax has an poor record with scope...

 Scope is often used as a metric understanding the underlying structure of a sentence (is there covert movement? phase edges? etc.)

# Generative syntax has an poor record with scope...

- Scope is often used as a metric understanding the underlying structure of a sentence (is there covert movement? phase edges? etc.)
- Despite this, there's no really systematic metric for how scope interacts with the syntax (see the literature in response to Han, Lidz, and Musolino (2007)).

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- Scope is highly sensitive to linear order. Minimalist syntacticians either have to deny this or model it as a crazy coincidence (Antisymmetry, or see works like Collins (2017)).

Background

- Scope is often used as a metric understanding the underlying structure of a sentence (is there covert movement? phase edges? etc.)
- Despite this, there's no really systematic metric for how scope interacts with the syntax (see the literature in response to Han, Lidz, and Musolino (2007)).
- Scope is highly sensitive to linear order. Minimalist syntacticians either have to deny this or model it as a crazy coincidence (Antisymmetry, or see works like Collins (2017)).
- Scope is *highly* dependent on context (Chomsky's Aphasia).

### This is a social construct!

Background

 $\forall x \exists y, eat(x, y)$ 

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$$\forall x \exists y, eat(x, y)$$

• We place quantifiers visually to the left. . .

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$$\forall x \exists y, eat(x, y)$$

- We place quantifiers visually to the left...
- Corresponding visually to "the place they take scope".

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$$\forall x \exists y, eat(x, y)$$

- We place quantifiers visually to the left...
- Corresponding visually to "the place they take scope".
- Both of these are metaphors.

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- We place quantifiers visually to the left...
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- **YET**, there's a tendency for some linguists to talk about the notation of formal logic as if it's somehow psychologically real.

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• We place quantifiers visually to the left

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- Both of these are metaphors.
- **YET**, there's a tendency for some linguists to talk about the notation of formal logic as if it's somehow psychologically real.

 $\forall x \exists v, eat(x, v)$ 

- We physically move quantifiers in our derivations to get the right "logical form".
- Linguistics Wars: does formal logic create language or vice versa?

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- This is not a new theory of syntax.
- But an account of scope without reference to syntactic structure.

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- But an account of scope without reference to syntactic structure.
- Why?

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- But an account of scope without reference to syntactic structure.
- Why?
  - It's Minimalist™.

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- But an account of scope without reference to syntactic structure.
- Why?
  - It's Minimalist™.
  - We can handle the linear order effects and the context dependence of scope.

# Typical Scope Data (English)

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#### English Data

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# Typical Scope Data (English)

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English active sentences tend to be ambiguous:

(1) a. Every arrow hit a target.  $(\forall > \exists, \exists > \forall)$ 

- a. Every arrow hit a target.  $(\forall > \exists, \exists > \forall)$ (1)
  - b. Some jackass ruins every party.  $(\forall > \exists, \exists > \forall)$

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- (1) a. Every arrow hit a target.  $(\forall > \exists, \exists > \forall)$ 
  - b. Some jackass ruins every party. ( $\forall > \exists, \exists > \forall$ )
- But their passive equivalents tend not to be...

English Data

- a. Every arrow hit a target.  $(\forall > \exists, \exists > \forall)$ (1)
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- a. Every arrow hit a target.  $(\forall > \exists, \exists > \forall)$ (1)
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- But their passive equivalents tend not to be...
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  - b. Some jackass ruins every party.  $(\forall > \exists, \exists > \forall)$
- But their passive equivalents tend not to be...
  - a. A target was hit by every arrow.  $(\exists > \forall)$ 
    - b. Every party is ruined by some jackass.  $(\forall > \exists)$
- NB: There are some differences between scopes of universals and existentials. This won't be a part of my analysis, but I'll talk about it later.

# Intuitions of the Theory

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## Intuitions of the Theory

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• In the abstract, all possible quantifier scope interpretations are possible. . .

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## Intuitions of the Theory

- In the abstract, all possible quantifier scope interpretations are possible. . .
- But, given context, the cost of communication and other pragmatic effects, we narrow down on the plausible interpretations.

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Intuitions of the Theory

- In the abstract, all possible quantifier scope interpretations are possible. . .
- But, given context, the cost of communication and other pragmatic effects, we narrow down on the plausible interpretations.
- Unambiguous sentences are those with one sensible interpretation left, while ambiguous ones have several.

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- In the abstract, *all* possible quantifier scope interpretations are possible. . .
- But, given context, the cost of communication and other pragmatic effects, we narrow down on the plausible interpretations.
- Unambiguous sentences are those with one sensible interpretation left, while ambiguous ones have several.
- Interesting empirical correlates, but we'll get into that later.

# Implementation: Game Theory

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## Implementation: Game Theory

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• I'll be using Game Theory for this analysis.

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## Implementation: Game Theory

- I'll be using Game Theory for this analysis.
- Game Theory is a way of formalizing decision-making in a game where
   players have the opportunity to choose among different strategies to achieve
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## Implementation: Game Theory

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- E.g. a game of paper-scissors-rock:

• I'll be using Game Theory for this analysis.

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### Implementation: Game Theory

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  - Two players
  - Each player has three different strategies: paper, scissors or rock.

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- E.g. a game of paper-scissors-rock:
  - Two players
  - Each player has three different strategies: paper, scissors or rock.
  - The winner gets a "payoff" to symbolize victory.

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 $\bullet$  Three players: a Speaker, a Hearer and Nature

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- Three players: a Speaker, a Hearer and Nature
- Goal: the Speaker communicates the correct message to the Hearer.

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- Three players: a Speaker, a Hearer and Nature
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- Three players: a Speaker, a Hearer and Nature
- Goal: the Speaker communicates the correct message to the Hearer.
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  - Nature has two: it (randomly) decides if the sentence the Speaker produces should have the agent scoping over the patient or *vice versa*.

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- Three players: a Speaker, a Hearer and Nature
- Goal: the Speaker communicates the correct message to the Hearer.
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  - Nature has two: it (randomly) decides if the sentence the Speaker produces should have the agent scoping over the patient or *vice versa*.
  - The Speaker, knowing what Nature has decided, decides whether to word a sentence as an Active one or a Passive one.

- Three players: a Speaker, a Hearer and *Nature*
- Goal: the Speaker communicates the correct message to the Hearer.
- Strategies (they happen in this order):
  - Nature has two: it (randomly) decides if the sentence the Speaker produces should have the agent scoping over the patient or vice versa.
  - The Speaker, knowing what Nature has decided, decides whether to word a sentence as an Active one or a Passive one.
  - Lastly, the Hearer, ignorant of Nature's choice, but knowing what the Speaker said, chooses whether to interpret the sentence with a Surface scope reading or an *Inverse* scope reading.

# Payoffs and Costs

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### Payoffs and Costs

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References

 Both the Speaker and Hearer get a payoff of c (for communication) if the Hearer ends up figuring out the right reading from the Speaker's sentence. This is the MacGuffin.

### Payoffs and Costs

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- Both the Speaker and Hearer get a payoff of *c* (for **c**ommunication) if the Hearer ends up figuring out the right reading from the Speaker's sentence. This is the MacGuffin.
- Certain constructions, like passives are marked. The Speaker's payoff is deduced by -p when he employs a passive.

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- Both the Speaker and Hearer get a payoff of c (for communication) if the Hearer ends up figuring out the right reading from the Speaker's sentence. This is the MacGuffin.
- Certain constructions, like passives are marked. The Speaker's payoff is deduced by -p when he employs a passive.
- Inverse scope is also non-preferred. When the Hearer reconstructs a sentence with inverse scope, both players lose -i.

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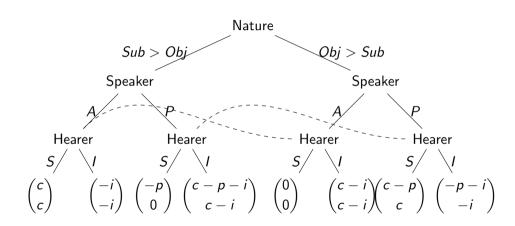
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## Meta-game Thinking

 Why would the Speaker undergo the cost of passivization unless it improved his position? (i.e. to avoid the inverse scope penalty) Passivization as signalling.

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• This would seem to indicate that if the Speaker has chosen *Passive*, Nature has chosen Obi > Sub.

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- Why would the Speaker undergo the cost of passivization unless it improved his position? (i.e. to avoid the inverse scope penalty) Passivization as signalling.
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- But if the Speaker has chosen *Active*, two hypotheses are possible:
  - This is indeed the desired scope order.
  - Inverse scope is the correct interpretation, but the Speaker doesn't mind taking -i because -p is more grave.
- Result: there's only one plausible choice if the Speaker uses a Passive, but there are two possibilities if he uses an Active (ambiguity).



# What if there's another strategy?

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## What if there's another strategy?

• Some languages have free word order, and unlike English can acheive surface scope without marked transformations/additional material.

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References

## What if there's another strategy?

- Some languages have free word order, and unlike English can acheive surface scope without marked transformations/additional material.
- These languages are nearly entirely scopally unambiguous and take only surface scope (Karimi 2003).

Scrambling

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  - (3)a. Yek dāneshju hame ketāb-i xānd. student all book-IND read "A student read every book."  $(\exists > \forall; *\forall > \exists)$

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- Some languages have free word order, and unlike English can acheive surface scope without marked transformations/additional material.
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    - b. Hame ketāb-i yek dāneshju xānd. all book-IND a student read "A student read every book."  $(\forall > \exists; *\exists > \forall)$

### In other scrambling languages as well...

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### In other scrambling languages as well...

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(4) dass eine Frau jeden liebt that a woman everybody loves

"...that everyone loves a woman" (some > every; ??every > some)

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dass eine Frau jeden liebt woman everybody loves that a

"... that everyone loves a woman"

(5) dass jeden eine Frau liebt that everybody a woman loves

"... that everyone loves a woman"

(some > every; ??every > some)

(every > some; ??some > every)

# Scramble as an alternative strategy

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• We can say that in these languages, Speakers have the additional strategy *Scramble*, which achieves a different word order without the -p cost.

Scrambling

• We can say that in these languages, Speakers have the additional strategy *Scramble.* which achieves a different word order without the -p cost.

• Let's examine the Speaker's payoffs with this new strategy:

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• We can say that in these languages, Speakers have the additional strategy *Scramble*, which achieves a different word order without the -p cost.

• Let's examine the Speaker's payoffs with this new strategy:

	Sub, S	Sub, I	$\mathit{Obj}, \mathit{S}$	$\mathit{Obj}, \mathit{I}$
Active	С	- <i>i</i>	0	с — <i>i</i>
Passive	-p	c - p - i	c - p	-p-i
Scramble	0	c-i	C	-i

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• We can say that in these languages, Speakers have the additional strategy *Scramble*, which achieves a different word order without the -p cost.

• Let's examine the Speaker's payoffs with this new strategy:

	Sub, S	Sub, I	$\mathit{Obj}, \mathit{S}$	$\mathit{Obj}, \mathit{I}$
Active	С	- <i>i</i>	0	с — <i>i</i>
Passive	-p	c - p - i	c - p	-p-i
Scramble	0	c-i	C	-i

• Scramble dominates Passive as a strategy when it is available.



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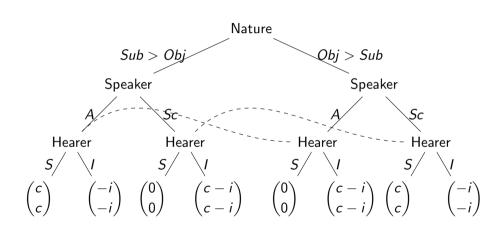
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## Meta-game Thinking

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• There are clear Schelling Points in this game: No matter what Nature chooses, the Speaker and Hearer can *always* get to *c*, *c* with no costs.

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- There are clear Schelling Points in this game: No matter what Nature chooses, the Speaker and Hearer can *always* get to *c*, *c* with no costs.
- The Speaker will want to put the Hearer on track to get to this payoff.

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• There are clear Schelling Points in this game: No matter what Nature chooses, the Speaker and Hearer can always get to c, c with no costs.

- The Speaker will want to put the Hearer on track to get to this payoff.
- And the Hearer knows no matter what, this will always be a payoff given by choosing *Surface* (since *Inverse always* yields a -i).

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### Meta-game Thinking

- There are clear Schelling Points in this game: No matter what Nature chooses, the Speaker and Hearer can always get to c, c with no costs.
- The Speaker will want to put the Hearer on track to get to this payoff.
- And the Hearer knows no matter what, this will always be a payoff given by choosing *Surface* (since *Inverse always* yields a -i).
  - Hearer: Always choose *Surface*

Scrambling

#### Meta-game Thinking

- There are clear Schelling Points in this game: No matter what Nature chooses, the Speaker and Hearer can always get to c, c with no costs.
- The Speaker will want to put the Hearer on track to get to this payoff.
- And the Hearer knows no matter what, this will always be a payoff given by choosing Surface (since Inverse always yields a -i).
  - Hearer: Always choose Surface
  - Speaker: Always choose what strategy will yield c, c when the Hearer chooses Surface

• There are clear Schelling Points in this game: No matter what Nature chooses, the Speaker and Hearer can always get to c, c with no costs.

- The Speaker will want to put the Hearer on track to get to this payoff.
- And the Hearer knows no matter what, this will always be a payoff given by choosing Surface (since Inverse always yields a -i).
  - Hearer: Always choose Surface
  - Speaker: Always choose what strategy will yield c, c when the Hearer chooses Surface
- No ambiguity ever—every sentence is unambigous and surface scope.

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#### Generalization

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• From the Game Theoretics of this we can generalize:

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- From the Game Theoretics of this we can generalize:
  - (6) Word order rigidity  $\rightarrow$  ambiguity

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- From the Game Theoretics of this we can generalize:
  - (6)Word order rigidity → ambiguity
  - Word order flexibility  $\rightarrow$  disambiguation

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• From the Game Theoretics of this we can generalize:

- (6) Word order rigidity → ambiguity
- (7) Word order flexibility  $\rightarrow$  disambiguation
- This is not just a "parameter", but a principle of order independent of formal syntactic properties of languages.

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• From the Game Theoretics of this we can generalize:

- (6) Word order rigidity → ambiguity
- (7) Word order flexibility  $\rightarrow$  disambiguation
- This is not just a "parameter", but a principle of order independent of formal syntactic properties of languages.
- The Game Theoretics should be constant across *not just* rigid/flexible languages, but across rigid/flexible constructions.



## English negation

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#### English negation

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• English negation may only appear *after* a modal:

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• English negation may only appear after a modal:

(8) Billy can not go.

$$(\neg > \mathsf{can}; \, \mathsf{can} > \neg)$$

#### English negation

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• English negation may only appear after a modal:

- (8) Billy can not go.
- (9) \* Billy not can go.

 $(\neg > \mathsf{can}; \, \mathsf{can} > \neg)$ 

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• English negation may only appear after a modal:

```
(8) Billy can not go. (\neg > can; can > \neg)
```

- (9) \* Billy not can go.
- But where there are multiple modals, there are different places the negation can appear and there is only one interpretation available, just like the scrambling data:

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• English negation may only appear after a modal:

- (8) Billy can not go.
- (9) \* Billy not can go.
- But where there are multiple modals, there are different places the negation can appear and there is only one interpretation available, just like the scrambling data:
  - (10) Billy could not have gone before we arrived. (not > have)

 $(\neg > can; can > \neg)$ 

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English negation may only appear after a modal:

```
(8) Billy can not go. (\neg > can; can > \neg)
```

- (9) \* Billy not can go.
- But where there are multiple modals, there are different places the negation can appear and there is only one interpretation available, just like the scrambling data:
  - (10) Billy could not have gone before we arrived. (not > have)
  - (11) Billy could have not gone before we arrived. (have > not)

## Chinese local rigidity

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## Persian local rigidity

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Scope without

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(16)Billy be hame shahr-i na-raft. to all city-IND not-went.

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#### Generalizations

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Rigid Constructions

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Rigid Constructions	Flexible Constructions
English main clauses	Main clauses in scrambling languages

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Rigid Constructions	Flexible Constructions
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Rigid Constructions	Flexible Constructions
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- Passives as a "bad" strategy.



## Toward a General Theory of Quantifier Scope

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• This account is incomplete. Notably it misses:

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# Toward a General Theory of Quantifier Scope

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  - The tendency for universal and existential quantifiers to behave differently.

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## Toward a General Theory of Quantifier Scope

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  - The tendency for some quantifiers of either type to prefer a certain range of scope (wide or narrow).

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- On the first point, there have been some attempts (Clark 2012) to implement this in Game Theory.
- The second point can be dealt with in Evolutionary Game Theory, that is, languages have different quantifiers and conventionalize them as preferring one scope or another. This also can tell us why different languages have "synonymous" quantifiers.
- Combine my account here with the other two pieces and you would have a phenomenologically complete theory of quantification.



#### References

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