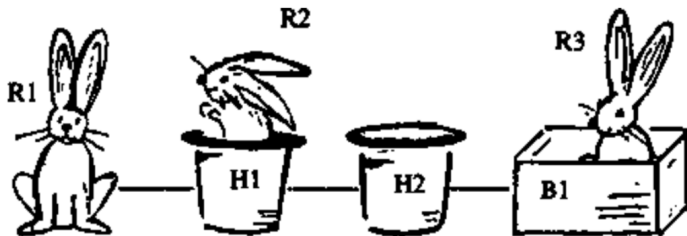


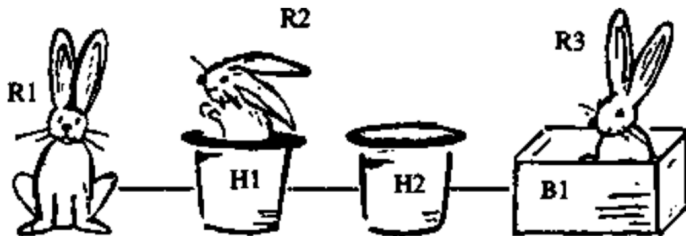
Referential garden path effects in modified Haddock descriptions

Helena Aparicio, Roger Levy, and Elizabeth Coppock

ESSLLI 2021 Workshop:
Computational and Experimental Explanations
in Semantics and Pragmatics



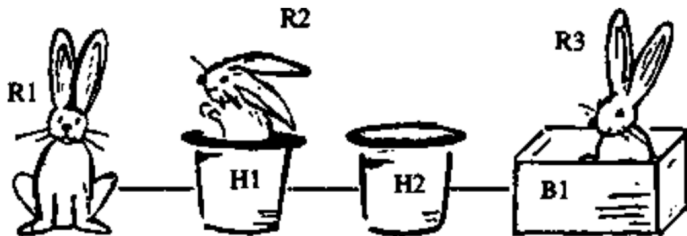
the rabbit in the hat



the rabbit in the hat

(Haddock, 1987)

The incrementalist view



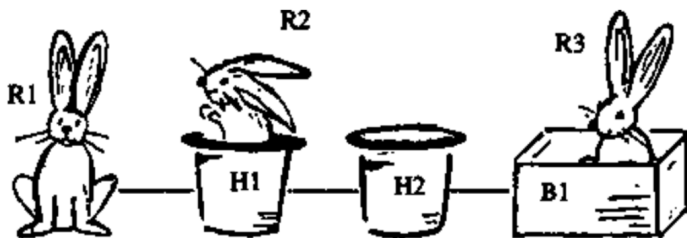
the rabbit in the hat

rabbit(x)

x R1, R2, R3

(Haddock, 1987)

The incrementalist view



the rabbit in the hat

rabbit(x) in(x ; y)

x R1, R2, R3

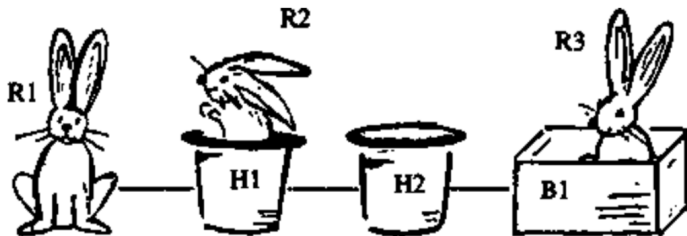
R2, R3

y

H1, B1

(Haddock, 1987)

The incrementalist view

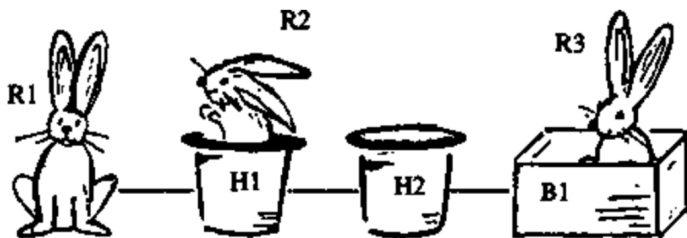


the rabbit in the hat

	rabbit(x)	in(x ; y)	hat(y)
x	R1, R2, R3	R2, R3	R2
y		H1, B1	H1

(Haddock, 1987)

The incrementalist view

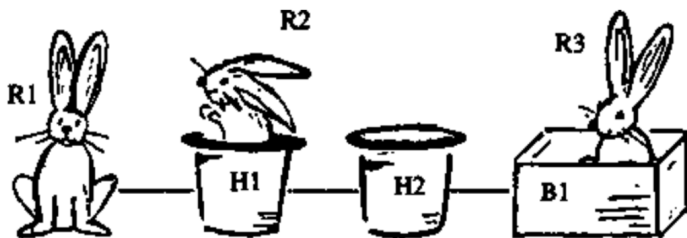


the rabbit in the hat

	rabbit(x)	in(x ; y)	hat(y)	unique(y)
x	R1, R2, R3	R2, R3	R2	R2
y		H1, B1	H1	H1

(Haddock, 1987)

The incrementalist view

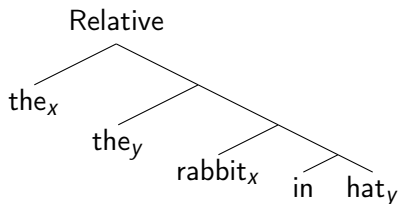
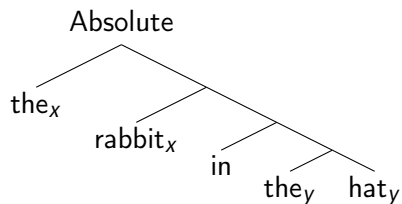


the rabbit in the hat

	rabbit(x)	in(x ; y)	hat(y)	unique(y)	unique(x)
x	R1, R2, R3	R2, R3	R2	R2	R2
y		H1, B1	H1	H1	H1

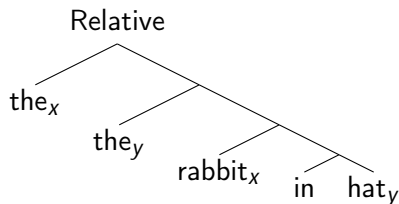
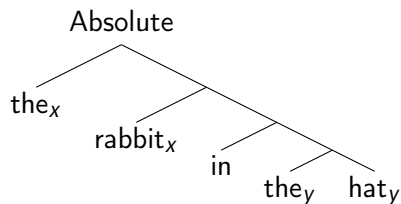
(Haddock, 1987)

The scope-based view



(Bumford, 2017)

The scope-based view



(Bumford, 2017)

Scope-based view: Absolute or relative

Incrementalist view Relative only

Our thesis:

The scope-based view is (more) right

There is such a thing as a referential garden path, where the listener temporarily settles on the wrong referent.

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Argument: It is exactly when the scope-based theory predicts referential garden paths that we observe processing penalties.

Our thesis:

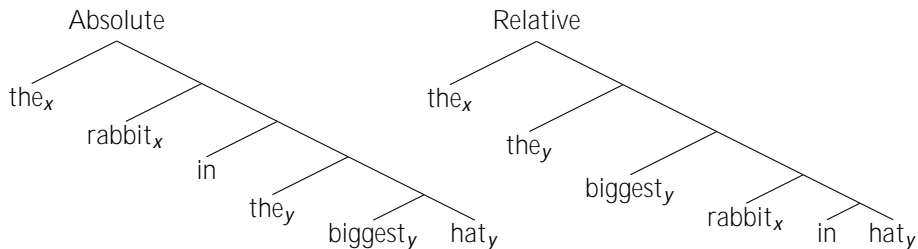
The scope-based view is (more) right

There is such a thing as a referential garden path, where the listener temporarily settles on the wrong referent.

Argument: It is exactly when the scope-based theory predicts referential garden paths that we observe processing penalties.

Data: From modified Haddock descriptions like *the rabbit in the big bag*

Scope-based analysis of relative vs. absolute superlatives



(Szabolcsi, 1986; Heim, 1999; Bumford, 2017, 2018)

Relative vs. absolute readings of comparatives

the rabbit in the bigger bag

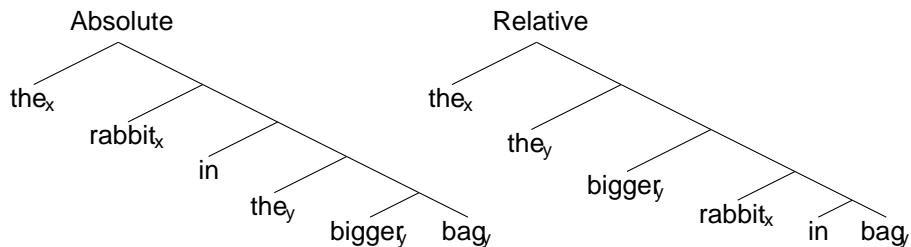
Relative vs. absolute readings of comparatives

the rabbit in the bigger bag

Absolute reading: doesn't refer

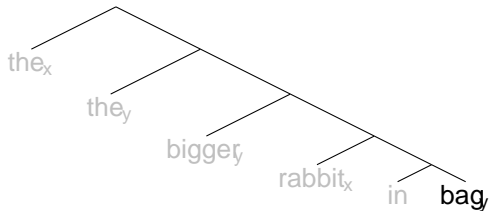
Relative reading: picks out the rabbit in the middle bag

Scope-based analysis of relative vs. absolute comparat



Relative readings of comparative adjectives

the rabbit in the bigger bag

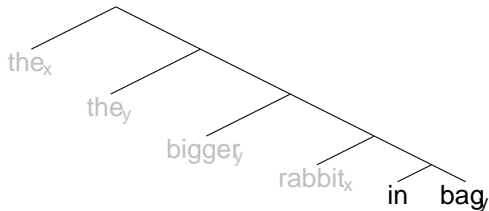


bag(y)

y:

Relative readings of comparative adjectives

the rabbit in the bigger bag

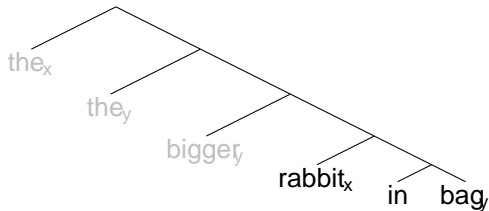


bag(y)

y:

Relative readings of comparative adjectives

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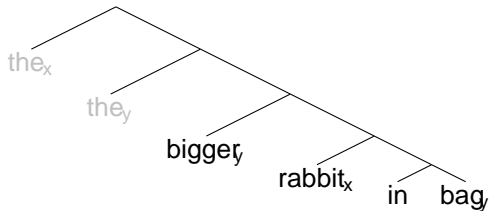
$\text{bag}(y) + \text{in}(x; y) \wedge \text{rabbit}(x)$

y:



Relative readings of comparative adjectives

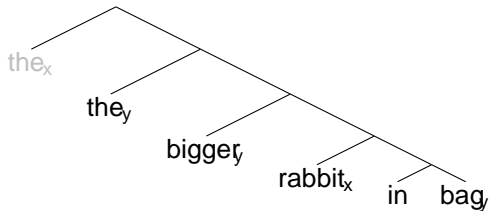
the rabbit in the bigger bag



y: bag(y) + in(x; y) ^ rabbit(x) + cmpr(y; big)

Relative readings of comparative adjectives

the rabbit in the bigger bag

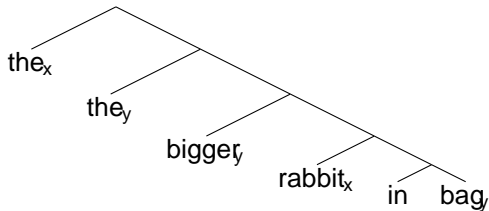


y: bag(y) + in(x; y) ^ rabbit(x) + cmpr(y; big) + uniq(y)

● ● ● ● ●

Relative readings of comparative adjectives

the rabbit in the bigger bag



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Update semantics

Meanings as updates on states (Groenendijk & Stokhof 1990)
: a set of assignments of values to variables (a state)

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if there is exactly one α for which there is $\alpha \models K$ s.t. $g(v) = k$
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Superlatives (Bumford, 2017)

$\text{Jsup}(v; A)K = \{g \in \mathcal{G} \mid \text{for all } h \in \mathcal{G} : h(v) = g(v) \text{ or } g(v) >_A h(v)\}$

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Comparatives

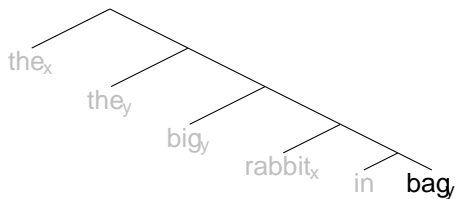
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Positives

$\text{JA}(v)K = \{g \in \mathcal{G} \mid \text{there is a } d > (A) : \langle h, j \rangle \in d; d \in I(A)\}$
 if d is a non-vacuous threshold for A relative to \mathcal{G} ; ; otherwise

Relative readings of positive adjectives

the rabbit in the big bag



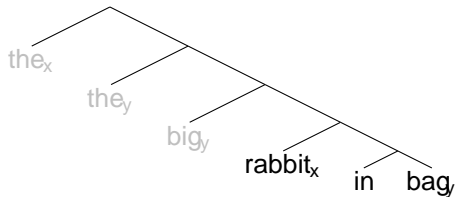
bag size: 1 2 3

bag(y)

y:

Relative readings of positive adjectives

the rabbit in the big bag



bag size: 1 2 3

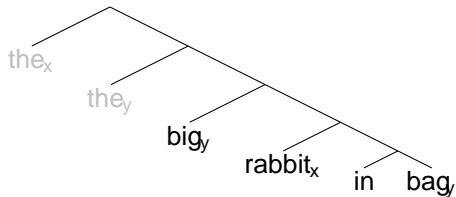
$\text{bag}(y) + \text{in}(x; y) \wedge \text{rabbit}(x)$

y:



Relative readings of positive adjectives

the rabbit in the big bag

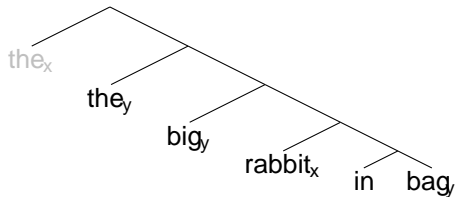


bag size: 1 2 3

$bag(y) + in(x; y) \wedge rabbit(x) + big_{=2}(y)$
 y: ● ● ●

Relative readings of positive adjectives

the rabbit in the big bag



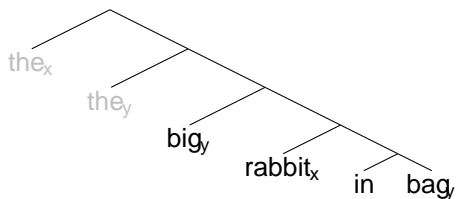
bag size: 1 2 3

y: bag(y) + in(x;y) ^ rabbit(x) + big₌₂(y) + uniq(y)

● ● ● ● ●

Relative readings of positive adjectives = (3)

the rabbit in the big bag



bag size: 1 2 3

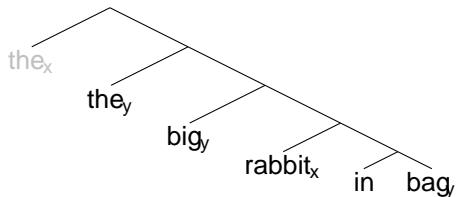
$$\text{bag}(y) + \text{in}(x; y) \wedge \text{rabbit}(x) + \text{big} =_3(y)$$

y:



Relative readings of positive adjectives = (3)

the rabbit in the big bag



bag size: 1 2 3

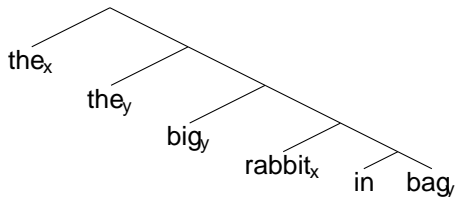
bag(y) + in(x;y) ^ rabbit(x) + big =₃(y) + uniq(y)

y:



Relative readings of positive adjectives = (3)

the rabbit in the big bag



bag size: 1 2 3

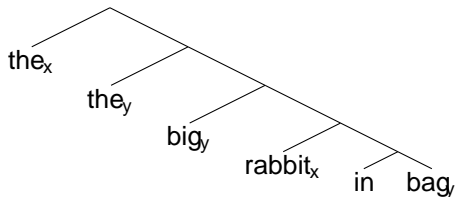
bag(y) + in(x;y) ^ rabbit(x) + big =₃(y) + uniq(y) + uniq(x)

y:



Relative readings of positive adjectives = (3)

the rabbit in the big bag



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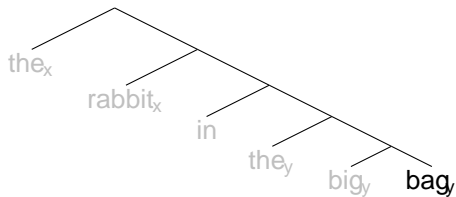
bag(y) + in(x;y) ^ rabbit(x) + big =₃(y) + uniq(y) + uniq(x) 7

y:



Absolute readings of positive adjectives (2)

the rabbit in the big bag



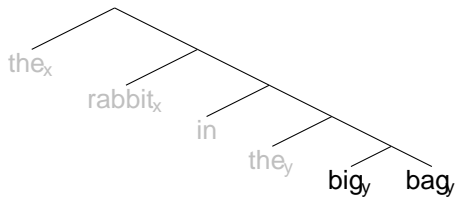
bag size: 1 2 3

bag(y)

y:

Absolute readings of positive adjectives (2)

the rabbit in the big bag

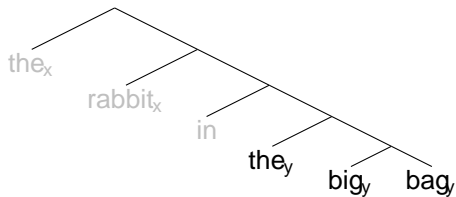


bag size: 1 2 3

y: bag(y) + big₌₂(y)
 ●

Absolute readings of positive adjectives (2)

the rabbit in the big bag



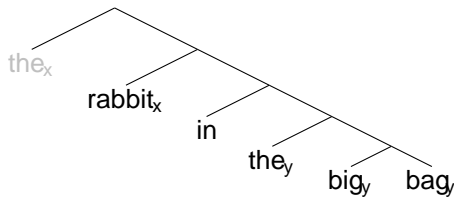
bag size: 1 2 3

y: bag(y) + big₌₂(y) + uniq(y)



Absolute readings of positive adjectives (2)

the rabbit in the big bag

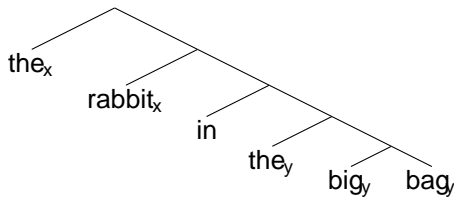


bag size: 1 2 3

$bag(y) + big_{=2}(y) + uniq(y) + in(x;y) \wedge rabbit(x)$
 y: ●

Absolute readings of positive adjectives (2)

the rabbit in the big bag

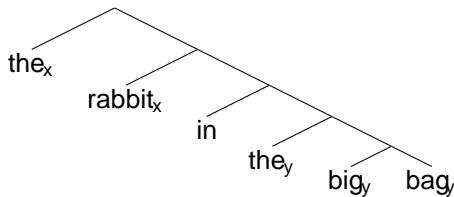


bag size: 1 2 3

$$y: \quad \text{bag}(y) + \text{big}_{=2}(y) + \text{uniq}(y) + \text{in}(x;y) \wedge \text{rabbit}(x) + \text{uniq}(x)$$

Absolute readings of positive adjectives (2)

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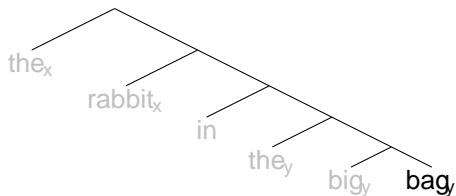


bag size: 1 2 3

$$y: \quad \text{bag}(y) + \text{big}_{=2}(y) + \text{uniq}(y) + \text{in}(x;y) \wedge \text{rabbit}(x) + \text{uniq}(x) \quad 7$$

Absolute readings of positive adjectives (3)

the rabbit in the big bag



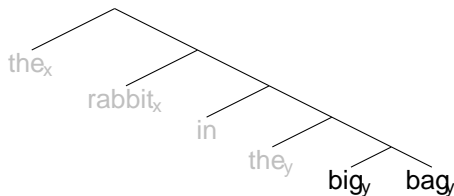
bag size: 1 2 3

bag(y)

y:

Absolute readings of positive adjectives (3)

the rabbit in the big bag

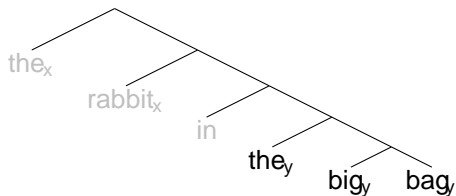


bag size: 1 2 3

y: bag(y) + big₌₃(y)
 ○○

Absolute readings of positive adjectives (3)

the rabbit in the big bag

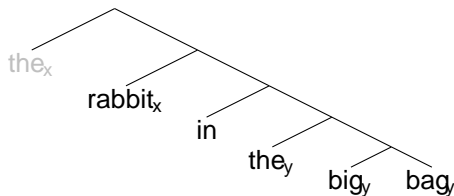


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Absolute readings of positive adjectives (3)

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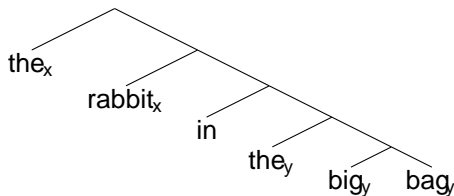


bag size: 1 2 3

$$y: \quad \text{bag}(y) + \text{big}_{=3}(y) + \text{uniq}(y) + \text{in}(x; y) \wedge \text{rabbit}(x)$$

Absolute readings of positive adjectives (3)

the rabbit in the big bag

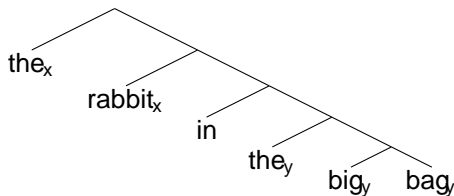


bag size: 1 2 3

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Absolute readings of positive adjectives (3)

the rabbit in the big bag



bag size: 1 2 3

$$y: \quad \text{bag}(y) + \text{big}_{=3}(y) + \text{uniq}(y) + \text{in}(x; y) \wedge \text{rabbit}(x) + \text{uniq}(x) \quad F$$

Referential garden path

A linguistic expression gives rise to a referential garden path (F) relative to a given scene if it has a reading on which the dynamic evaluation process settles temporarily on a unique referent within that scene for some variable before crashing.

Upshot

the rabbit in the _____ bag

	Absolute	Relative
big (= 2)	7	3
big (= 3)	F	7

Upshot

the rabbit in the _____ bag

	Absolute	Relative
big (= 2)	7	3
big (= 3)	F	7
bigger	7	3

Upshot

the rabbit in the _____ bag

	Absolute	Relative
big (= 2)	7	3
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bigger	7	3

Scope-based view: Absolute or relative

Incrementalist view Relative only

Upshot

the rabbit in the _____ bag

	Absolute	Relative
big (= 2)	7	3
big (= 3)	F	7
bigger	7	3

Scope-based view: Absolute or relative

Incrementalist view Relative only

So referential garden paths for big predicted only under scope-based view.

Experiment

Question: Given the challenge that absolute readings entail relative readings, is it possible to detect absolute readings?

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1. Adjectivally modified Haddock descriptions

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Experimental approach: find processing signature of absolute readings that is independent from relative readings

1. Adjectivally modified Haddock descriptions
2. Referential garden paths

Design

Design

Reference resolution task

Design

Reference resolution task

Click on the rabbit in the big [***]

Design

Reference resolution task

Click on the rabbit in the big [***]

Truncated description is ambiguous

Experimental Manipulations

Experimental Manipulations

2 adjectives (big vs. bigger)

Experimental Manipulations

2 adjectives (big vs. bigger)

Visual display:

Experimental Manipulations

2 adjectives (big vs. bigger)

Visual display:

Experimental Manipulations

2 adjectives (big vs. bigger)

Visual display:

Scene 1

Click on the rabbit in the big/ger [***]

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Click on the rabbit in the big/ger [***]

Three bags, the biggest of which contains a frog.

Scene 1

Click on the rabbit in the big/ger [***]

Three bags, the biggest of which contains a frog.

Two boxes, all of which contain rabbits.

Scene 2

Click on the rabbit in the big/ger [***]

Two bags, all of which contain rabbits.

Two boxes, only one of which contains a rabbit

Scene 3

Click on the rabbit in the big/ger [***]

Three bags, the biggest of which contains a frog.

Two boxes, only one of which contains a rabbit

Predictions:

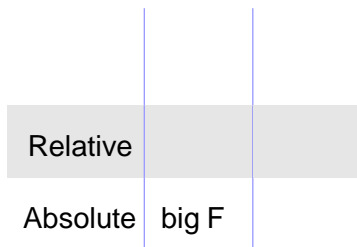
Predictions:

Referential Garden Paths negatively impact target selection rates.

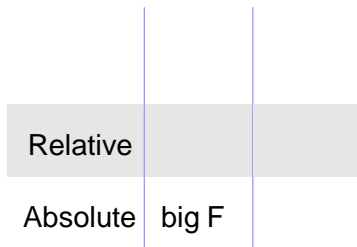
Predictions: Scene 1

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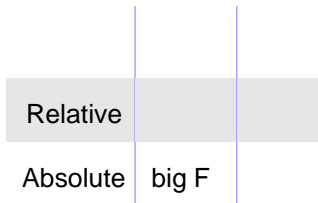
Predictions: Scene 1



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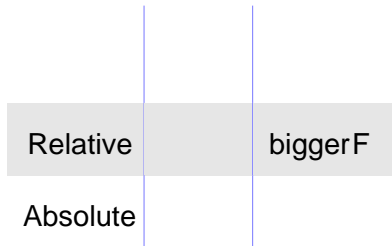


Predictions: Scene 1

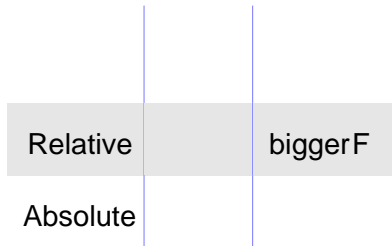


Predictions: Scene 2

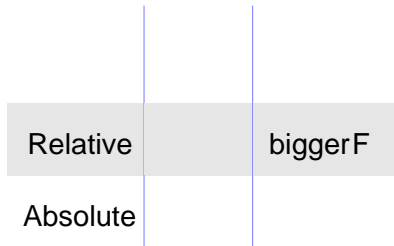
Predictions: Scene 2



Predictions: Scene 2

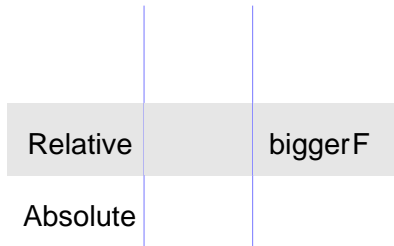


Predictions: Scene 2



$J_{\text{cmp}(v; A)}K = f g^2 \quad | \text{there is an } h^2 : g(v) >_A h(v)g$

Predictions: Scene 2



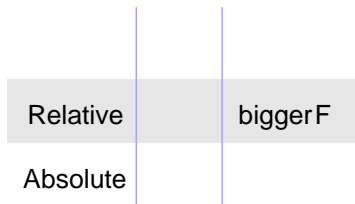
$\text{Jcmp}(v; A) = \{g \mid \exists h : g(v) >_A h(v)\}$

$\text{box}(y) + \text{in}(x; y) \wedge \text{rabbit}(x) + \text{cmp}(y; \text{big}) + \text{uniq}(y) + \text{uniq}(x) \text{ F}$

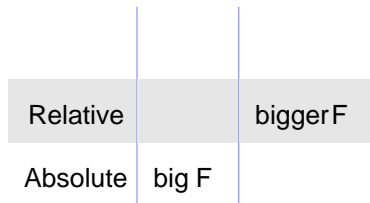
y:



Predictions: Scene 2



Predictions: Scene 3



Predictions: Summary

Predictions: Summary

Results

Results

Results

Discussion

Discussion

Discussion

Our results pattern exactly as predicted by the scope-based account

Conclusion

Our participants showed sensitivity to absolute readings that involve referential garden-paths

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Referential garden-paths as a new behavioral signature of semantic processing, opening up exciting possibilities for the study of referential communication.

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