Broca's Aphasia and Plurality Inferences

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Object of investigation

- Plurality Inferences in Broca's aphasia
- Compared to typical adults and children

Object of investigation

(1) Emily fed pig**s**

-> Emily fed more than one pig

Preview

- Plural inferences are regarded as a type of SI
- Our previous experiment suggests that BAs can compute SIs
- **Expectation**: They will compute PIs too

Preview

- Our findings suggest that indeed they do compute PIs (74%) and showed sensitivity to monotonicity

The bigger picture

- It is not the case that BAs can compute *all* semantic/pragmatic inferences

Roadmap

- Background
- Previous experiment
- Current Experiment
- Main findings
- The ‘bigger picture’
- Conclusions
- Future research

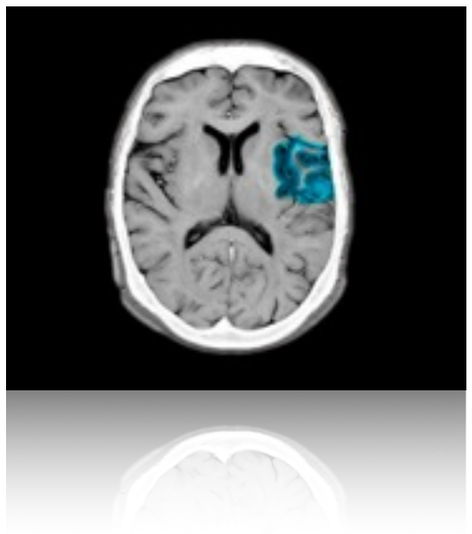
Background

Broca's aphasia

- Difficulties in comprehension *and* production

- **Comprehension**: difficulty with 'complex' syntactic constructions

- e.g. passives, object relatives, object clefts, pronominal binding *(e.g. Grodzinsky 2000, Avrutin 2006, Vasic et al. 2006)*



Broca’s Aphasia

- **Difficulties with ‘processing’**: Slowed lexical access and delayed priming effects *(Swinney et al. 1996, Swinney and Zurif 2001, Swinney et al. 2006)*

Acquisition and Aphasia

- (At least) superficial similarities in linguistic profiles
- **A regression?**
    - Later acquired=most vulnerable in BA
- Mostly syntax and more recently, syntax-discourse interface *(e.g. Avrutin 2000, 2004, Vasic 2006)*

Beyond syntax

- **Novelty**: looking at phenomena outside syntax that are:
    - Hard to process for typical adults
    - Acquired later by children

Beyond syntax

- Can help us further characterise the '*processing limitation*' in Broca's aphasia

Semantic/pragmatic inferences

- **Scalar implicatures**

- The prototypical example of a type of inference we draw from utterances

- Extensively studied

Semantic/pragmatic inferences

- **Scalar implicatures**

(1) **Some** giraffes have a scarf

↝ ***Not all*** *giraffes have a scarf*

(2) **Not all** giraffes have a scarf

↝ ***Some*** *giraffes have a scarf*

Hard to process

- Evidence suggests that SIs arise with a delay in typical adults *(e.g. Huang and Snedeker 2009, Bott et al. 2012, Cremers and Chemla 2013)*

Acquired later

- Children compute SIs less often than adults (e.g. *Chierchia et al. 2001, Gualmini et al. 2001, Papafragou and Musolino 2003*)

In sum

- Processing limitation in Broca's aphasia
- Parallels in linguistic profiles in acquisition and aphasia

- SIs are **harder to process** for typical adults and are **acquired later** by children

Expectation: SIs will be hard for BAs

Previous experiment

Kennedy, Bill, Romoli, Schwarz, Crain and Folli (2014)

Bill et al. (2014)

- Scalar implicatures vs presuppositions
- Adults *vs* children
- Difference between the two groups on scalar implicatures and presuppositions

Scalar Implicatures in BA

- Adding to Bill et al. (2014)
- Comparison of:

  Scalar implicatures and Presuppositions

- Adults vs children vs **BAs**

The Experiment

- **Participants**:
  - Adults with Broca's aphasia (n=9)
  - Typical adults (n=22)
  - 7 yr old children (n=14)
- BAs showed difficulty processing 'complex syntactic constructions' on language screening

Design

- We compared our 3 groups (BAs vs 7yo children vs typical adults) on ‘classical’ scalar implicatures

  - Some giraffes have a scarf↝*Not all giraffes have a scarf*

  - Not all giraffes have a scarf↝*Some giraffes have a scarf*

Methods and Materials

- Sentence to picture matching task *(e.g. Huang et al. 2013, Romoli and Schwarz 2014)*

Some - target

Literal interpretation minus inference

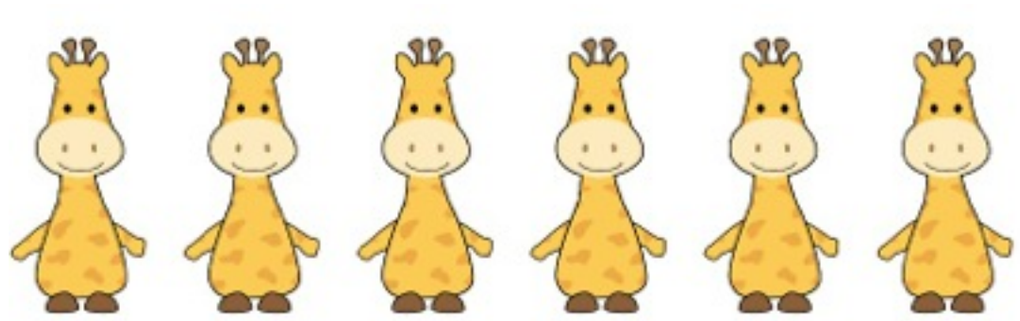
‘*<u>Some or all</u> giraffes have a scarf*’

Some - target

Inference interpretation

‘*<u>Some but not all</u> giraffes have a scarf*’

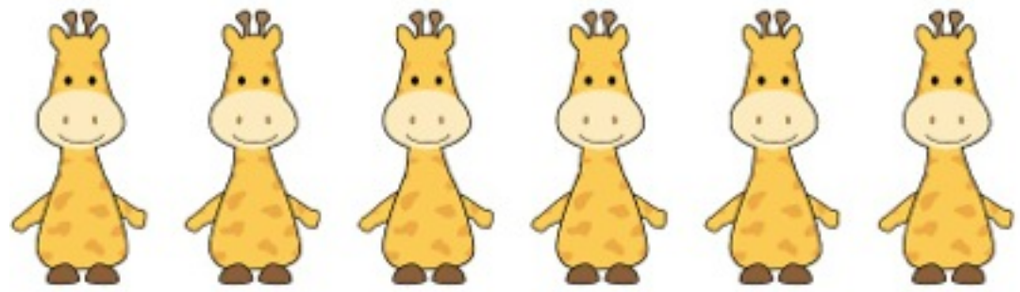
not all - target



Literal interpretation minus inference

‘*<u>not all or no</u> giraffes have a scarf*’

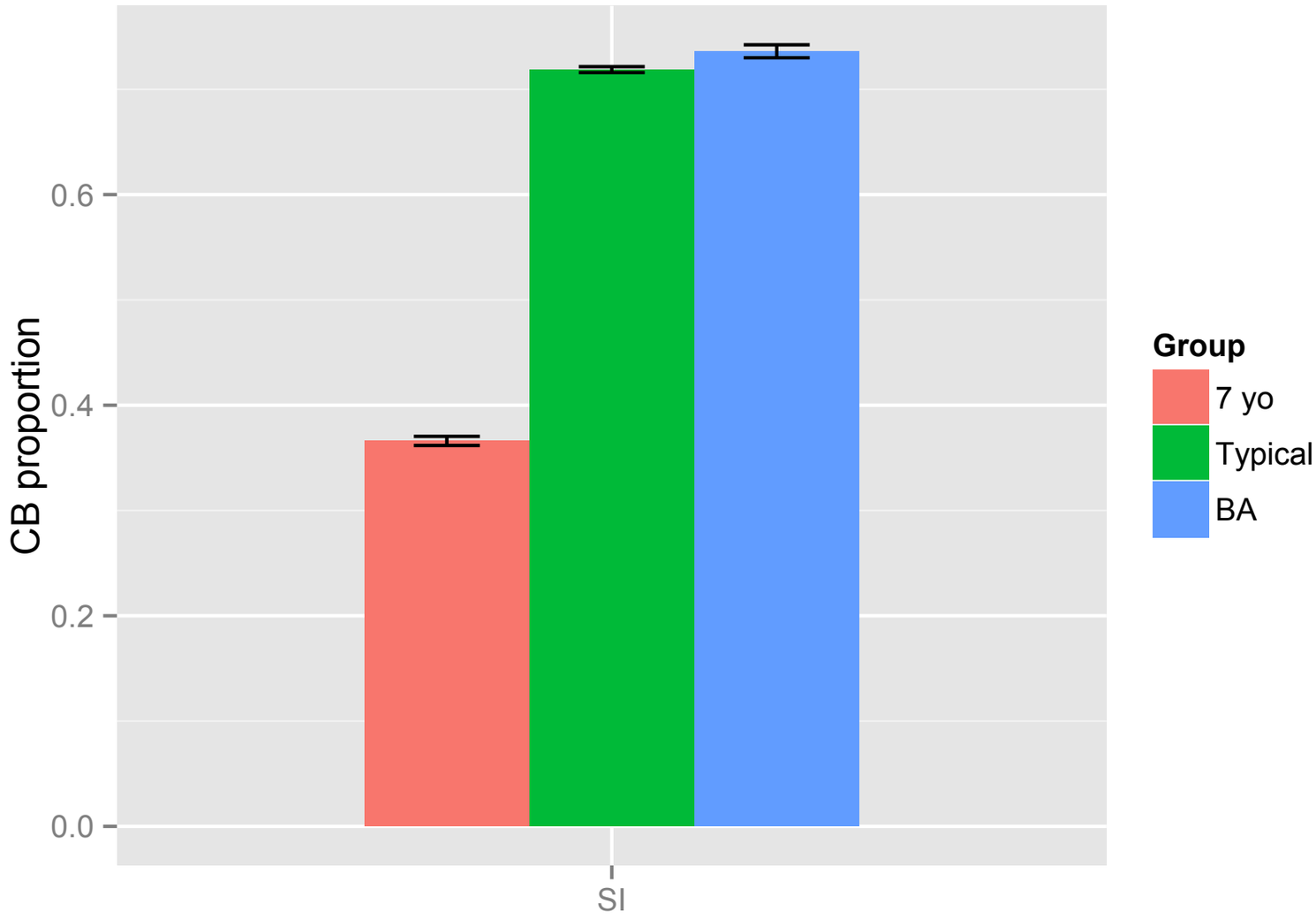
not all - target



Inference interpretation

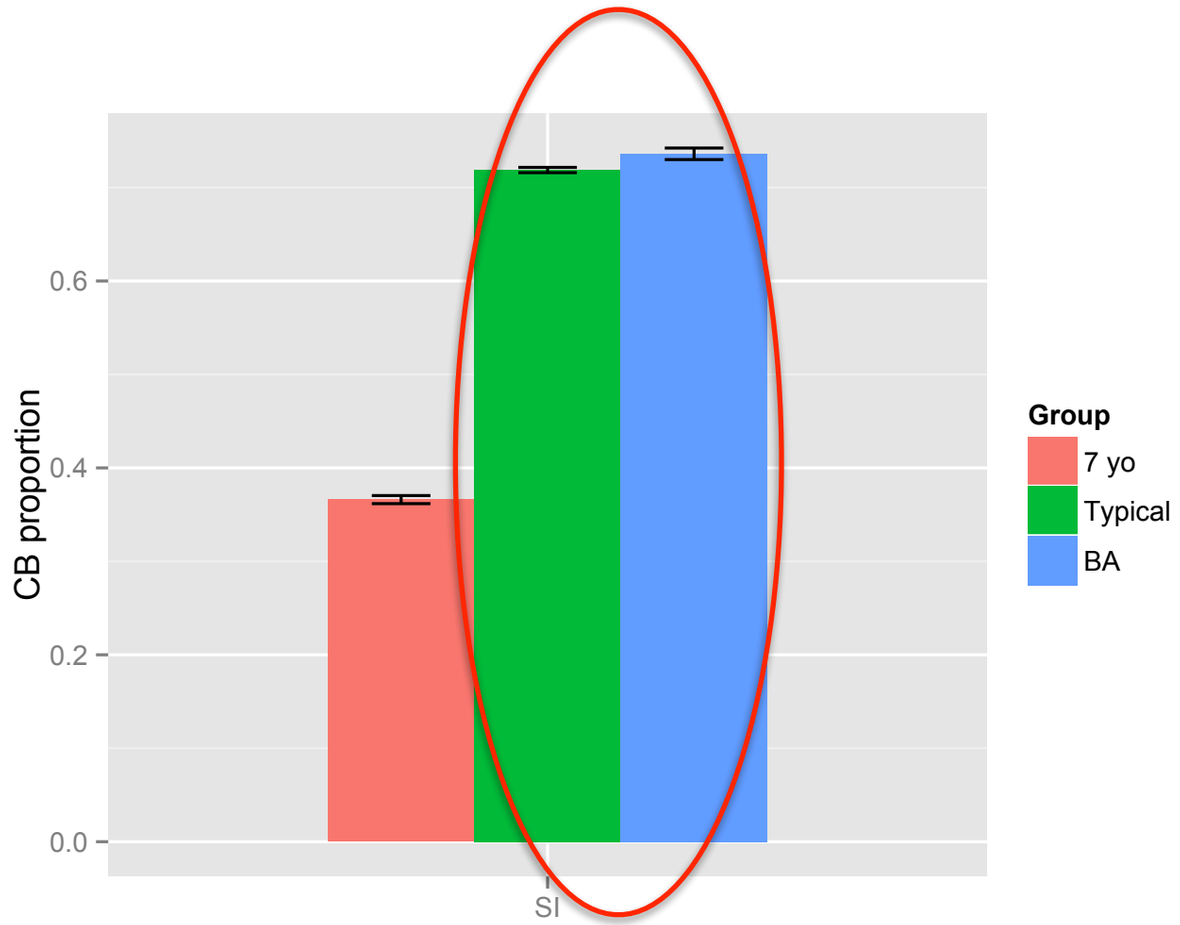
‘*<u>some</u> giraffes have a scarf*’

Results



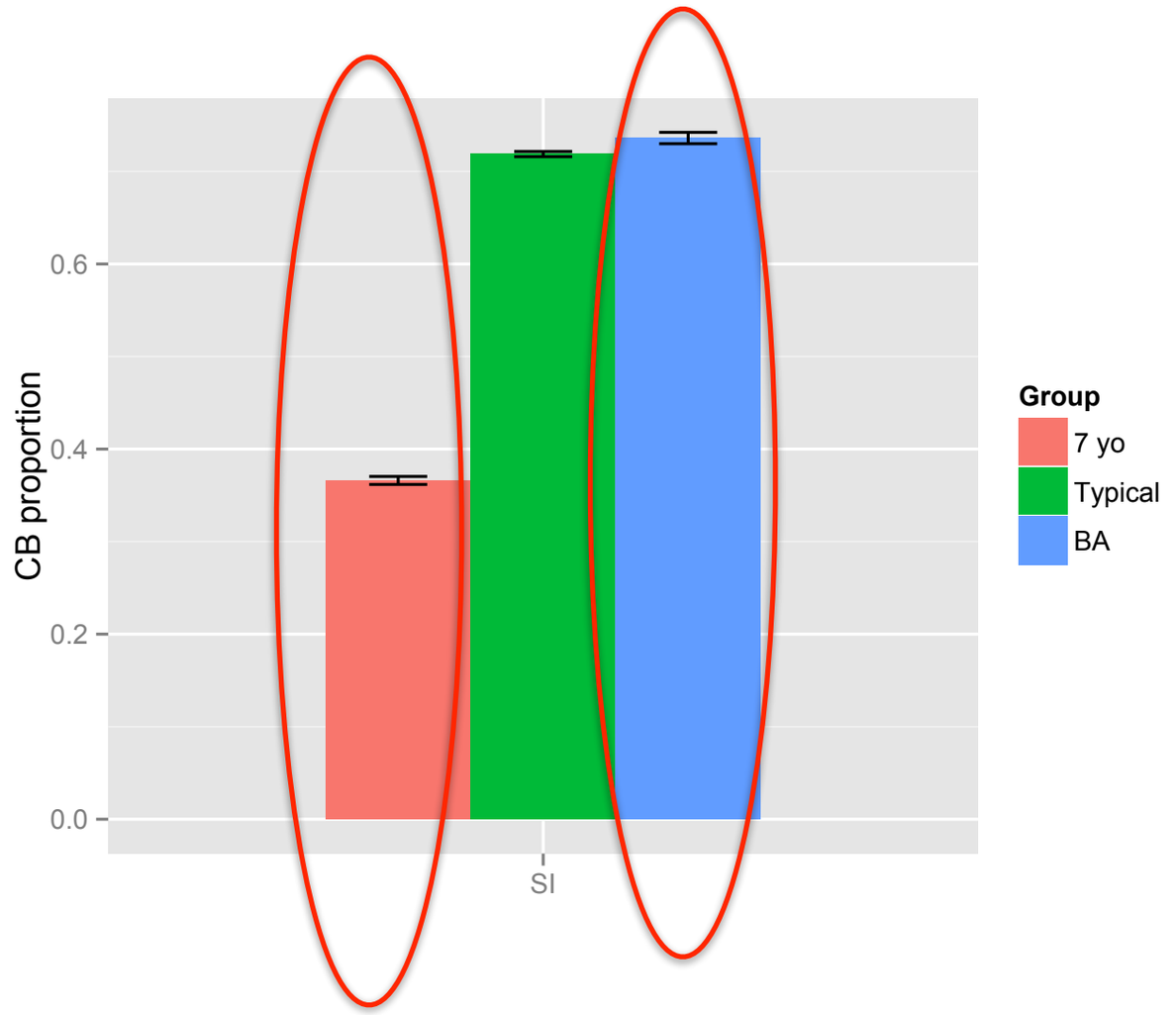
CB choice=inference interpretation

Results



- **Adults vs BA**: No significant difference on SIs

Results



- **BAs vs children**: Significant difference on SIs

Results

Main finding:

- Adults with BA= typical adults on SIs and different from children

BAs compute SIs

Current experiment

Motivation

- BAs can compute classical scalar implicatures
- Recent arguments to suggest plurality inferences are a type of scalar implicature (Sauerland 2003, Spector 2007)

->**Expectation**: BAs should compute PIs

Arguments for a scalar implicature approach

- Plural morphology triggers a '*more than one*' inference in positive sentences

(1) Sue picked apple**s**

(2) Sue picked **more than one** apple

Plurality Inferences

- This inference generally disappears under negation (and DE contexts more generally)

- (3) Sue didn't pick apple**s**

  -/-> *Sue didn't pick <u>more than one</u> apple*

  -> *Sue didn't pick <u>a single</u> apple*

Plurality Inferences

- The disappearance of inferences in DE contexts is the hallmark of SIs

- Treating PIs as a kind of SI can account for this very naturally

SI approach to plurality inferences

- Moreover, the SI approach can successfully account for a second property of PIs

- A marked “more than one” reading of the plural can be forced in DE contexts

- *Emily didn’t feed pigs, she fed only one!*

SI approach to plurality inferences

- This is again similar to SIs more generally

In sum

- Two arguments for a SI approach to PIs
  - The pattern in UE vs DE contexts
  - The possibility of forcing a marked reading in DE contexts

Further support from acquisition

- **Prediction**: The acquisition profile of PIs should mirror that of other SIs

- **Experimental support**: Sauerland et al. (2005), Tieu et al. (2014)

Tieu et al. (2014)

- Comprehension of plural and singular sentences in upward entailing (UE) and downward entailing (DE) contexts

- Children *vs* typical adults

- **Prediction tested**:

  - If **PIs= SIs** then they should be difficult for children

Tieu et al. (2014)

- **Prediction borne out**
  - Children computed PIs significantly less than adults **(42% vs 92%)**

Plurality inferences and Broca's aphasia

- Comprehension of plural morphology in UE and DE contexts by typical adults *vs* children ***vs*** **Individuals with BA**

Expectation

- BAs can compute SIs
- PIs are a type of SI
- BAs should compute PIs

The Experiment

- **Participants:**
  - Adults with Broca's aphasia (n=9)
  - Typical adults (n=22)
  - Children (n=14)

Design

- **3x2** with group (typical *vs* BAs *vs* children) and monotonicity (UE vs DE) as factors

- Truth Value Judgement task

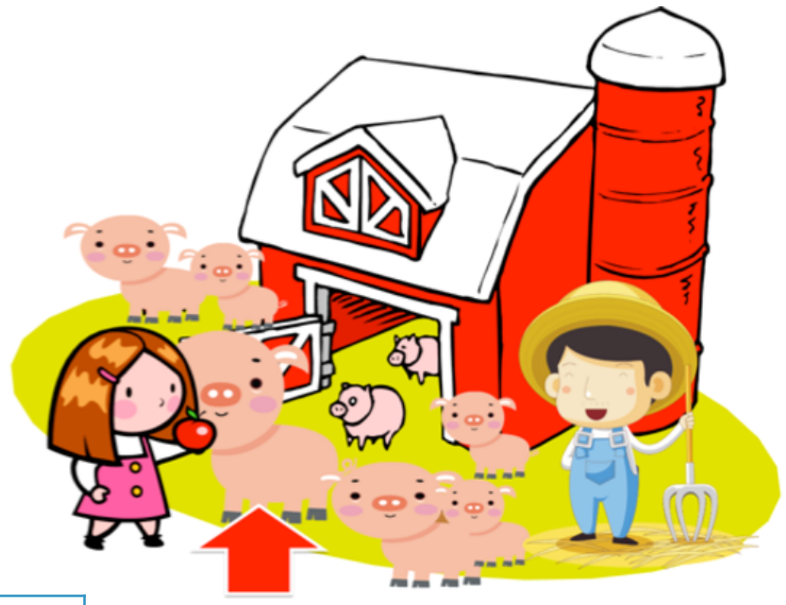
Design

- **2 training items**
- **6 test items** (3 UE, 3 DE)
- **8 control items:** positive (x2) and negative indefinites (x2) and negation (x4)

Test items: UE context

‘Emily fed pigs’

Positive (UE) contexts



'Emily fed pigs'

Response	**Interpretation**
NO!	**+PI** '*Emily fed* ***more than one*** *pig*'
YES!	**-PI** '*Emily fed* ***one or more*** *pigs*'

Test items: DE contexts

‘Emily didn’t feed giraffes’

Negative (DE) contexts

'Emily didn't feed giraffes'

Response	**Interpretation**
NO!	**-PI** 'Emily didn't feed **a single giraffe**'
YES!	**+PI** '*Emily didn't feed giraffe**s**, she only fed one!*'

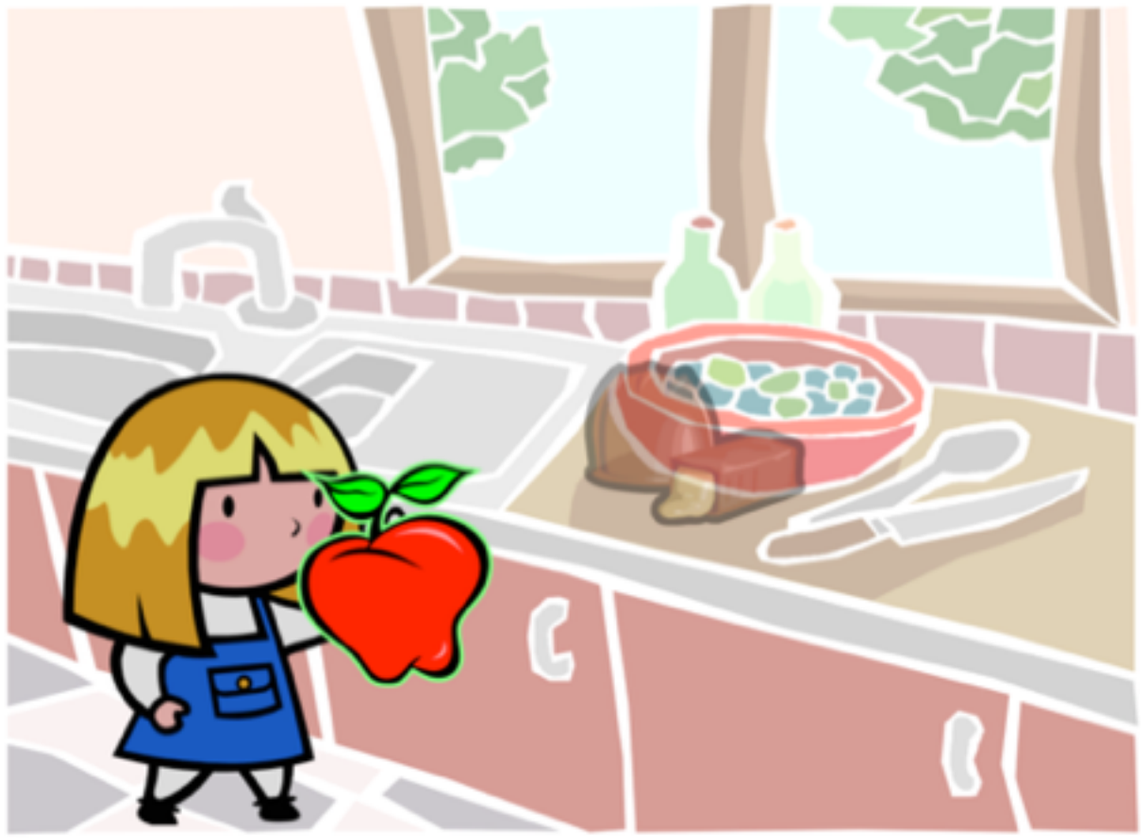
Control items

‘Sammy painted birds’ (YES)

Control items

‘Sammy didn’t draw dogs’ (YES)

Control items



(i) ’Emily didn’t eat the apple’ (Target: **NO**)

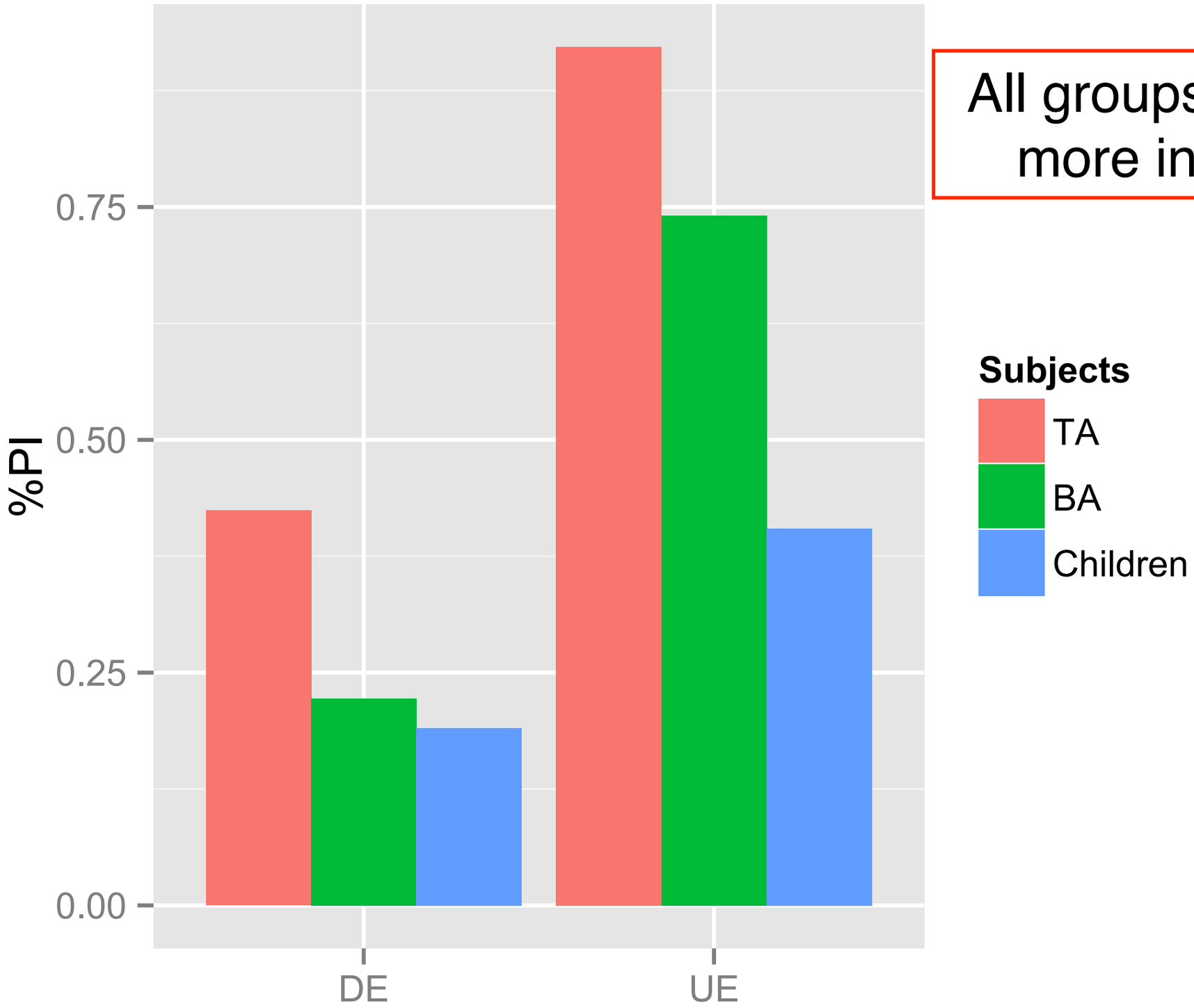
(ii) ‘Emily didn’t eat the chocolate’ (Target: **YES**)

Remember expectation

BAs will compute PIs:

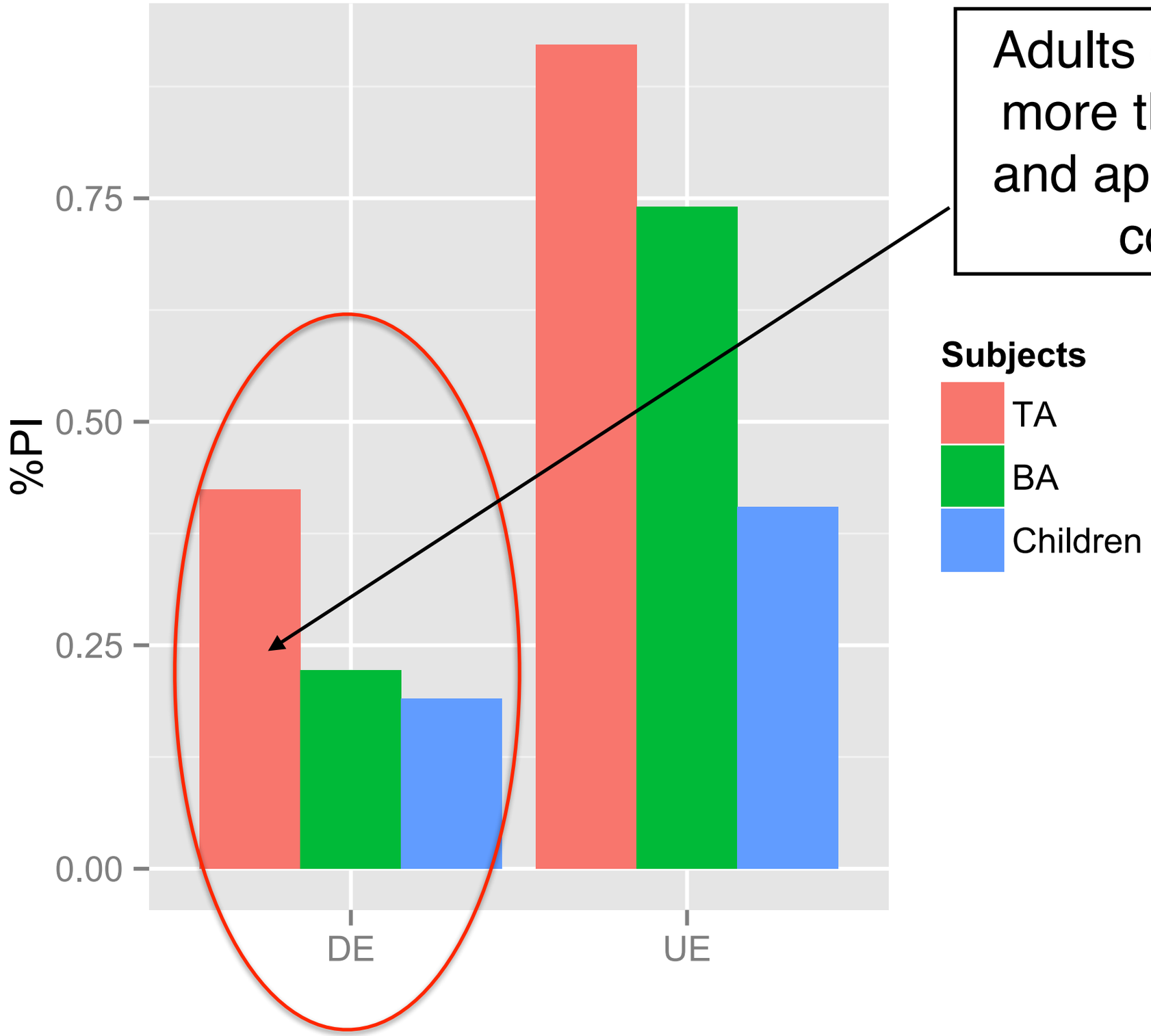
- On par with typical adults
- Different from children

Results



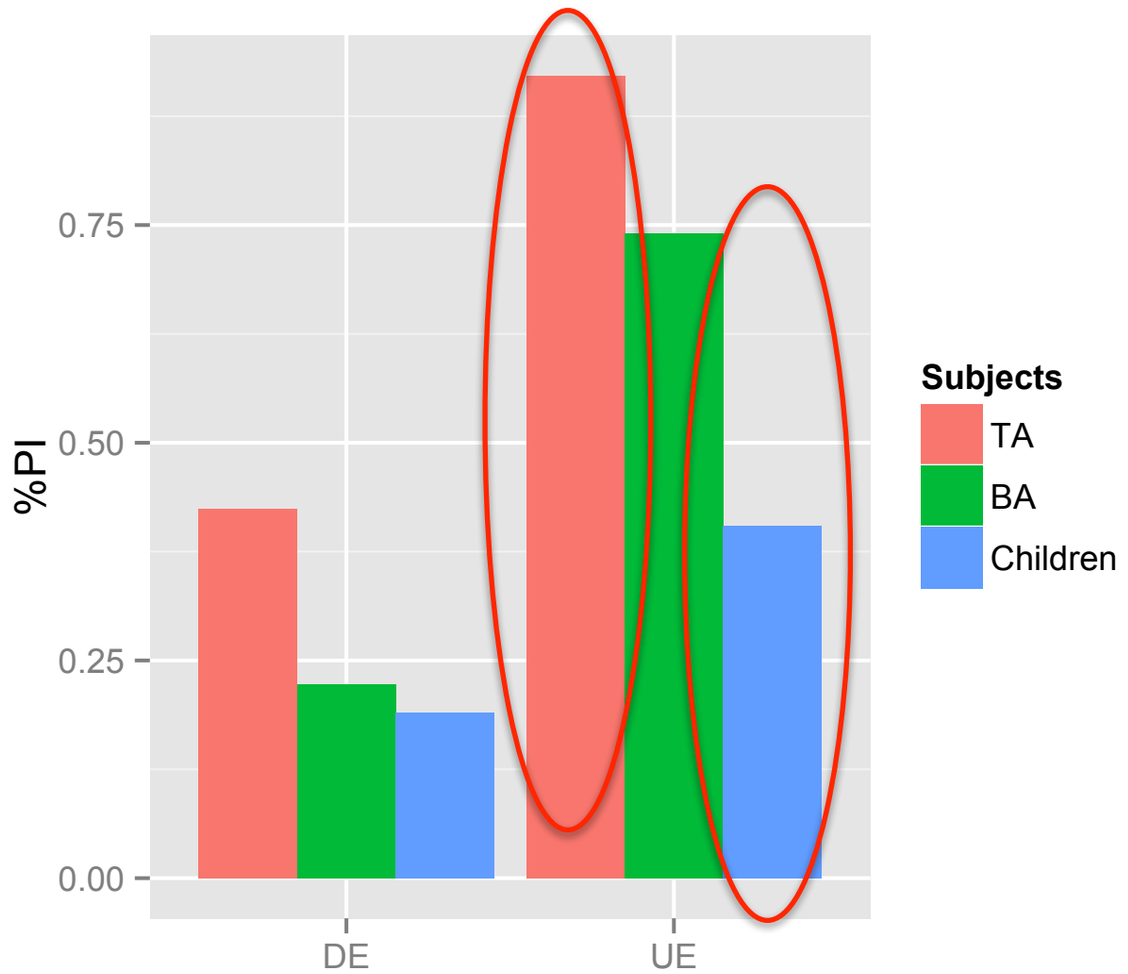
All groups computed PIs more in UE contexts

Results



Adults compute PIs more than children and aphasics in DE contexts

Results
(Tieu et al)

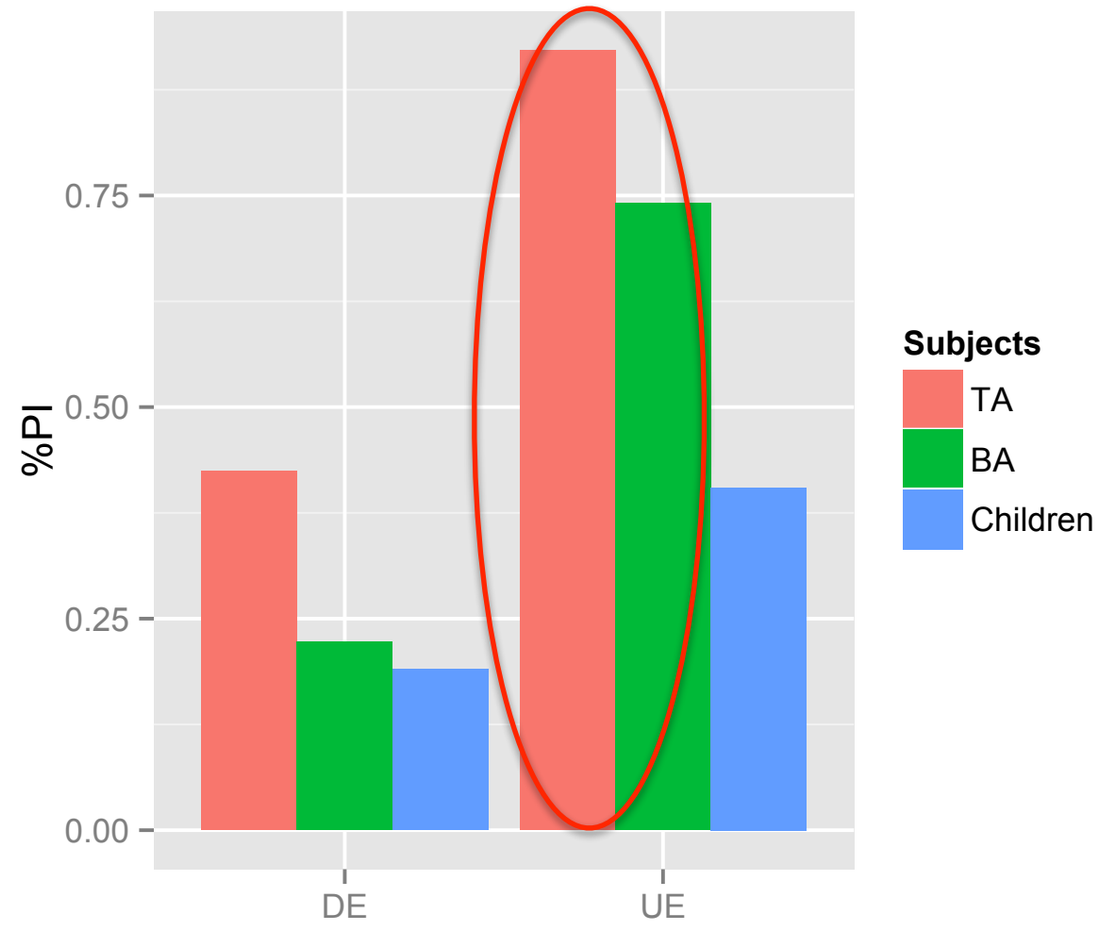


Typical adults vs children

- Typical adults computed PIs significantly more often than children (42% vs 92%)

- Main effect of group *(p<.01)*

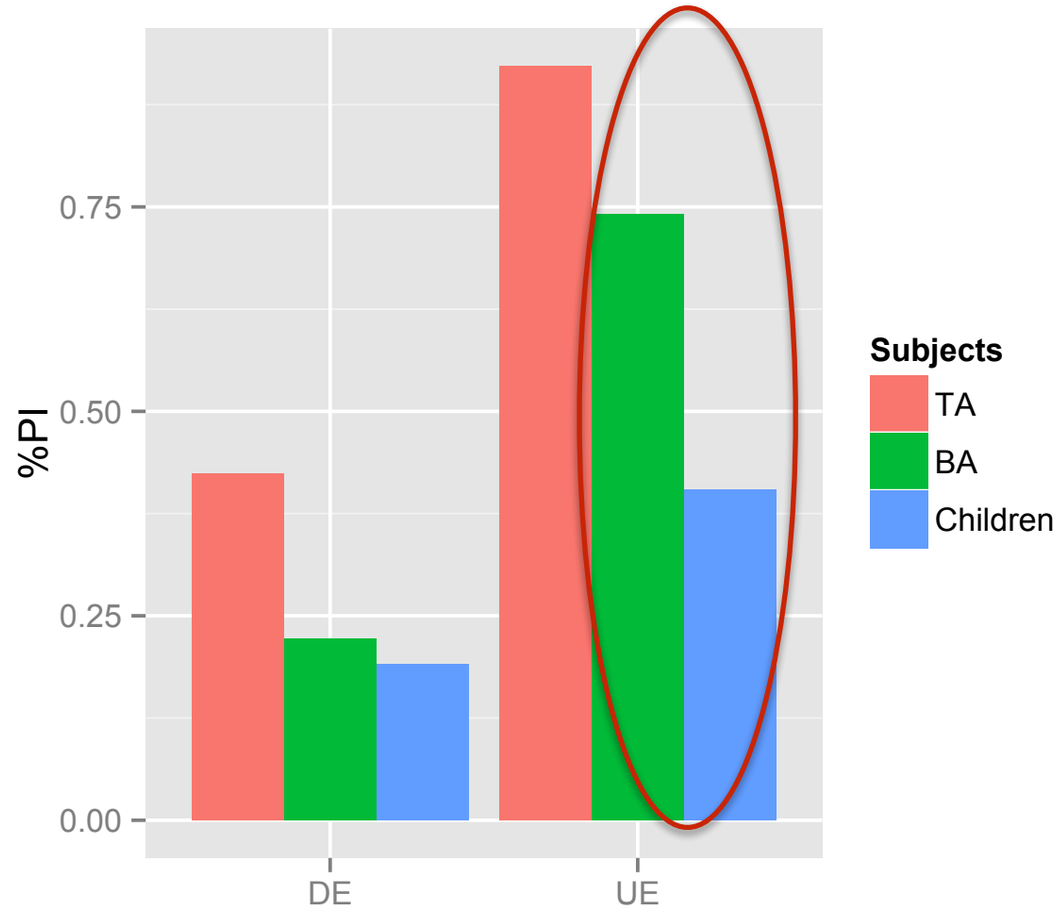
Our results



BAs vs typical adults

- BAs successfully computed PIs (74%)
- However not quite as often as adults (92%)
- Marginal main effect of group *(p=.054)*

Our results



2x2 BAs vs children

- BAs computed PIs more often than children
- Marginal main effect of group *(p=.074)*

Main findings

- BAs successfully computed PIs and showed sensitivity to monotonicity

Main findings

- Performance was in line with performance on classical SIs

BAs compute SIs

Main findings

- They did not compute PIs as often as adults but did so more than children

BAs performance was ‘in between’ typical adults and children

The ‘bigger picture’

Beyond Syntax

- Part of a larger project on semantic/pragmatic inferences in BA

Beyond Syntax

- Refine the picture of what is spared/retained in BA

- Tell us more about the nature of semantic/ pragmatic inferences and how they are processed

- Help us to better understand the similarities/ differences between acquisition and aphasia

The bigger picture

- We found that BAs can compute classical SIs and PIs
- Can we conclude that they will be universally successful with all semantic/pragmatic inferences?

The bigger picture

- No!

- **Evidence:** Previous study on SIs also included comparison with **presuppositions** in BA

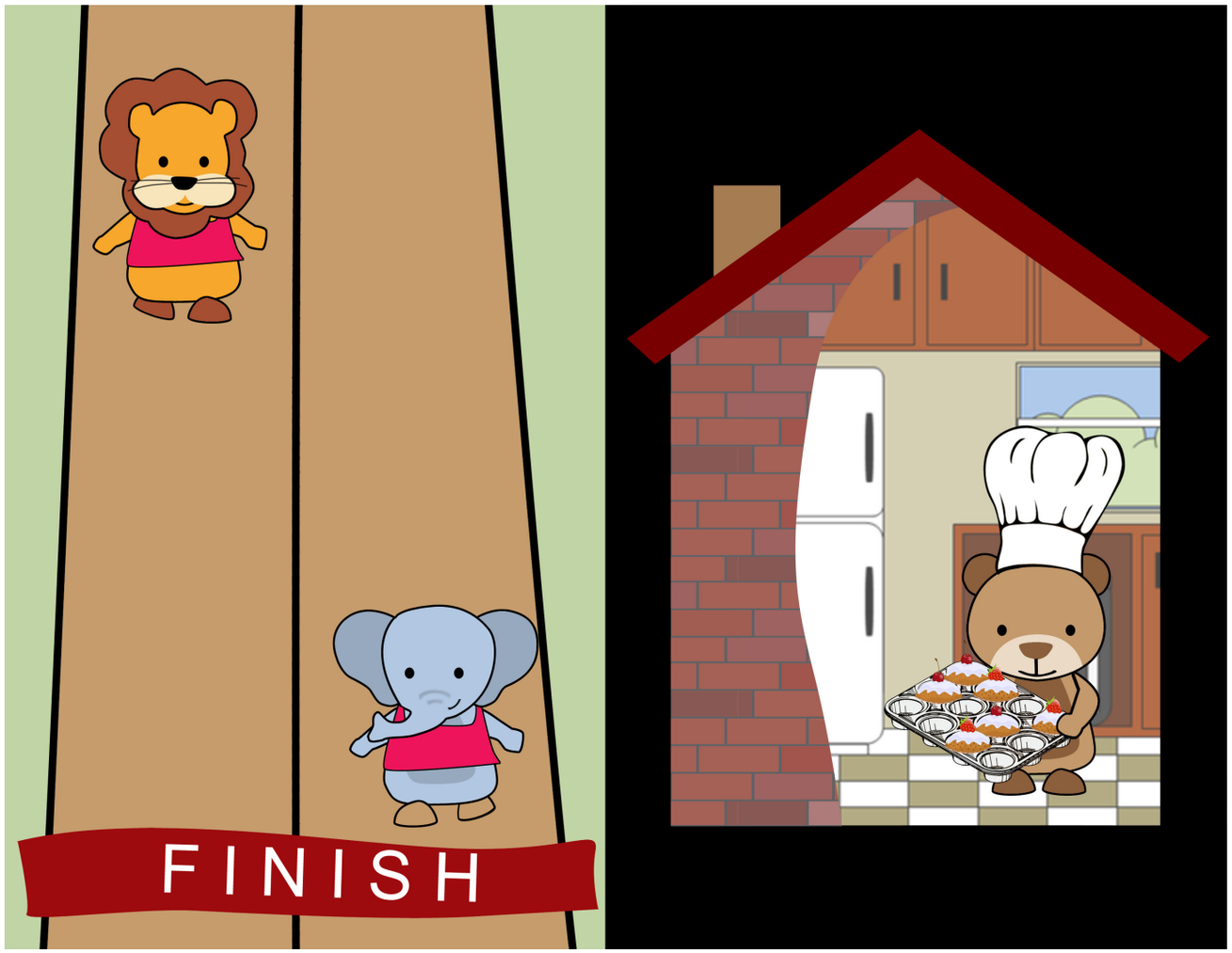
Presuppositions

- Another type of inference
- Difference between children and adults *(e.g. Bill et al. 2014)*

- '*The bear didn't win the race*'

  -> The bear participated in the race

Presuppositions in literal contexts



‘The bear didn’t win the race’

Presuppositions in BA

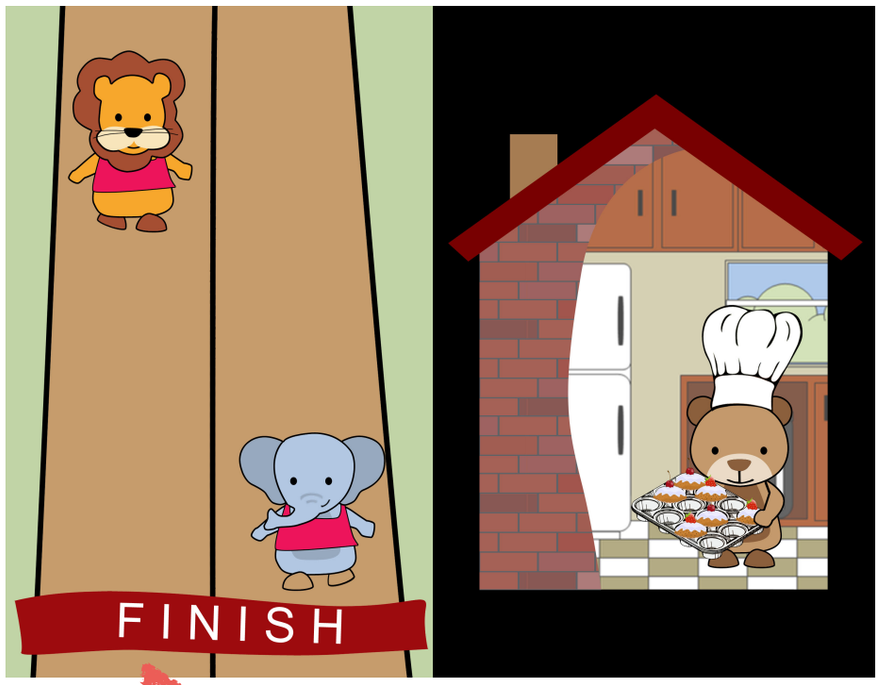
- Presuppositions in literal contexts are hard *(e.g. Chemla and Bott 2012, Romoli and Schwarz 2014)*
- Acceptance requires suspending the presupposition
- In traditional approaches to presuppositions, this involves *an extra mechanism*

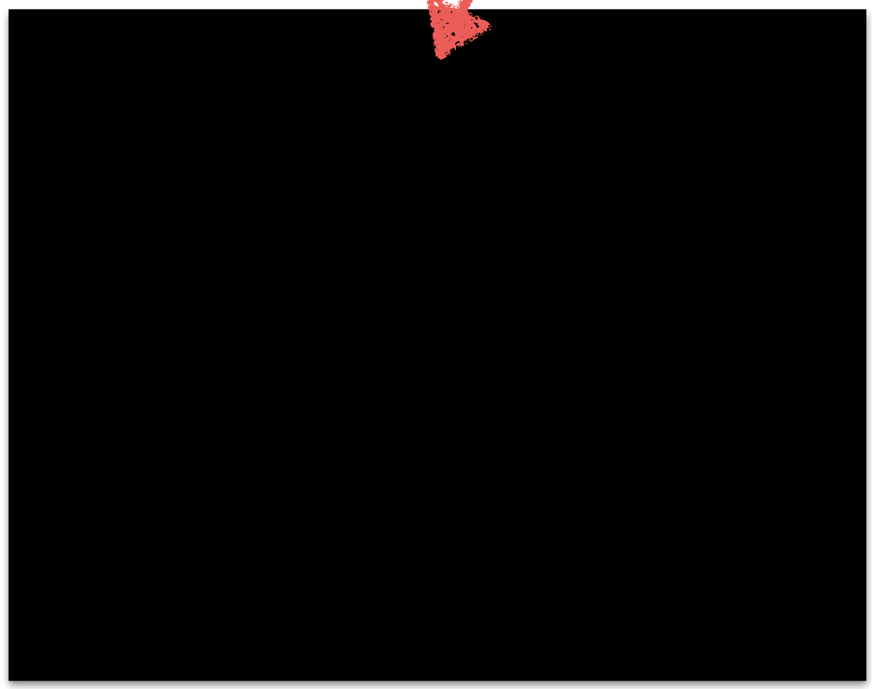
Presuppositions in BA

- Children struggle with the suspension of presuppositions *(Bill et al 2014)*

Presuppositions in BA

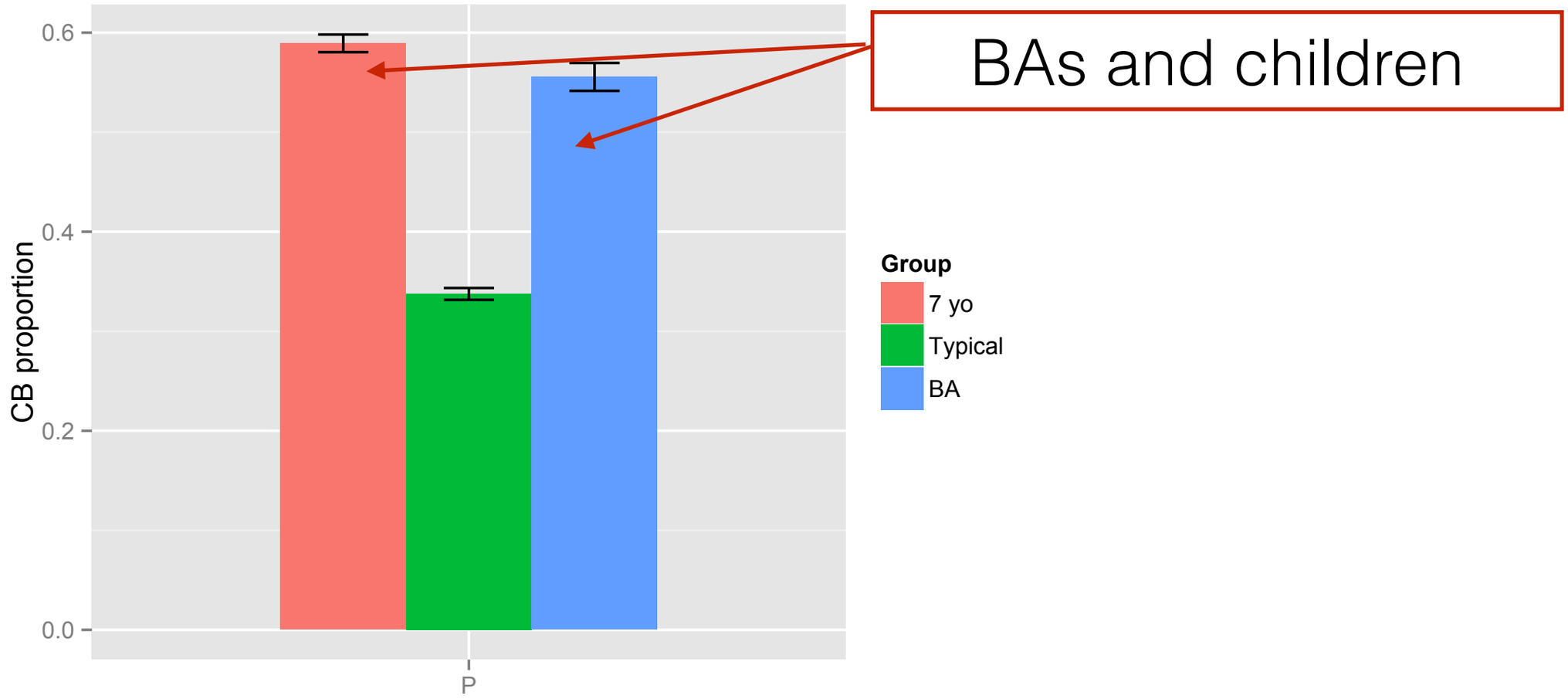
PS interpretation
'Bear participated and didn't win'





Suspension of PS
'*Bear didn't participate and didn't win*'

Presuppositions and BA



- BAs performed **on par with children** and different from adults

The bigger picture

- BAs show a processing impairment ***outside of syntax***

The bigger picture

- This can tell us something about what is spared and retained in Broca’s aphasia

The bigger picture

- It can also tell us something about the nature of these semantic/pragmatic inferences and how they are processed by different populations

Conclusions

Conclusions

- BAs can compute PIs
- They show sensitivity to monotonicity
- Consistent with findings of our previous study with classical SIs
- *However,* they are not universally successful on all semantic/pragmatic inferences

Further research

- Direct experimental comparison between SIs and PIs

- Develop a better understanding of the difference between SIs and Ps

- Bridging results on semantic/pragmatic inferences with other research in BA

    - Ongoing project on syntax/semantics: *scope ambiguity in BA*

Acknowledgements

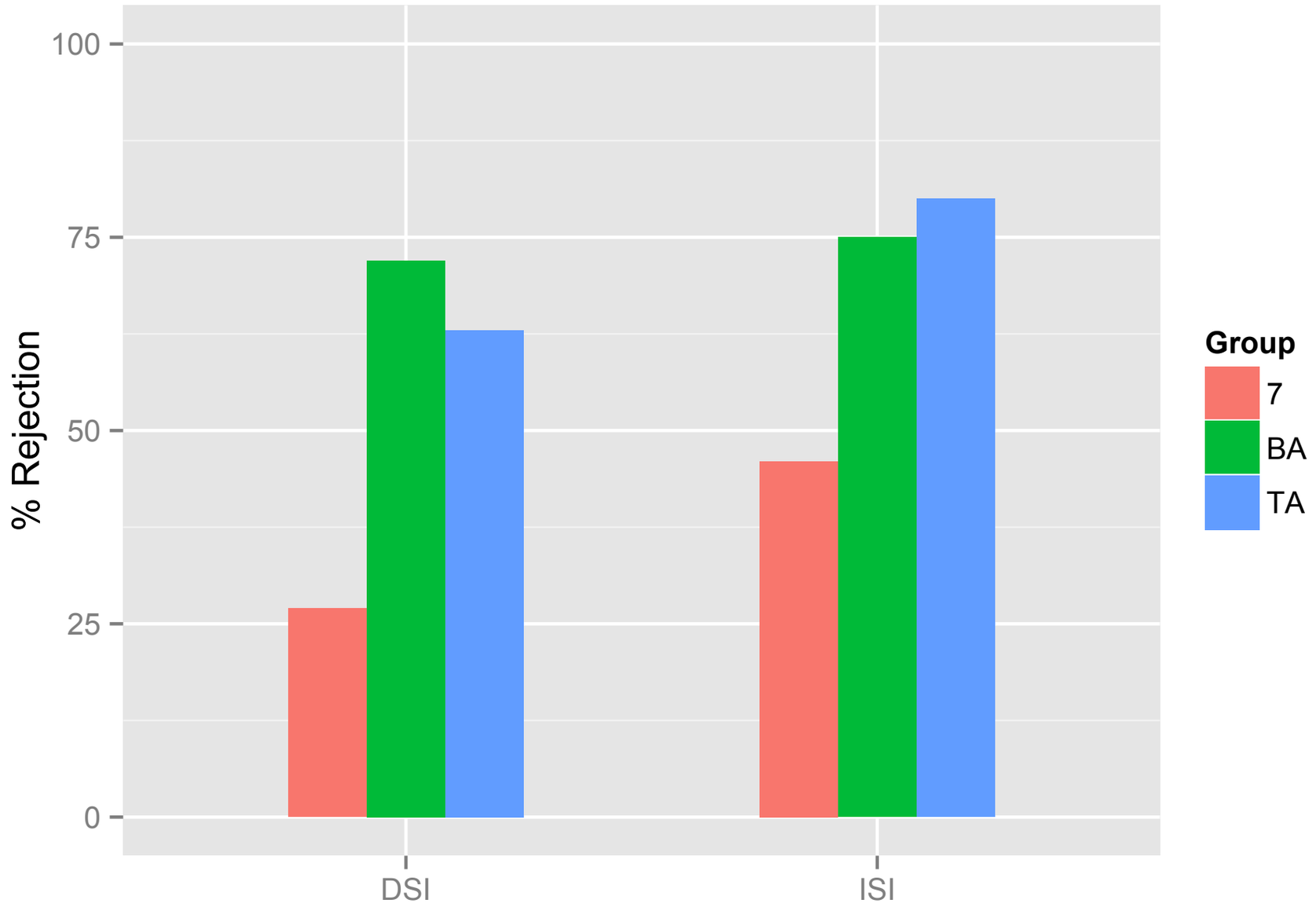
- **Participants**: members of StrokeNI

Acknowledgements

Collaborators: Jacopo Romoli, Lyn Tieu, Christina Sevdali, Cory Bill, Stephen Crain and Raffaella Folli

also from **Experiment 1**: Florian Schwarz

DSI vs IDSI



Language Screening

- (agrammatic) Broca's aphasia diagnosed on:

1. Clinical impression of SLT
2. Assessment on WAB *(Kertesz 1982)*
3. Impaired on syntactically complex sentences on the VAST *(Bastiaanse et al. 2001)*
4. Agrammatic speech production
5. Left sided CVA

SI approach to PI

- Semantically, **plural =singular**
- Comparison with the singular which has been enriched with its own SI

  ->**the negation of the enriched singular gives rise to the plural implicature**

SIs vs Ps: possible answers

(1) The processes underlying SI computation are spared in BA (but those underlying Ps accommodation are impaired)

SIs vs PS: possible answers

(2) SIs are **not costly** after all (e.g. Grodner et al. 2010, Breheny et al. 2013) and *contra* Huang and Snedeker (2009 a.o)

Assuming (2) 'SIs are not costly' how do we explain children's persistent poor performance on SIs?

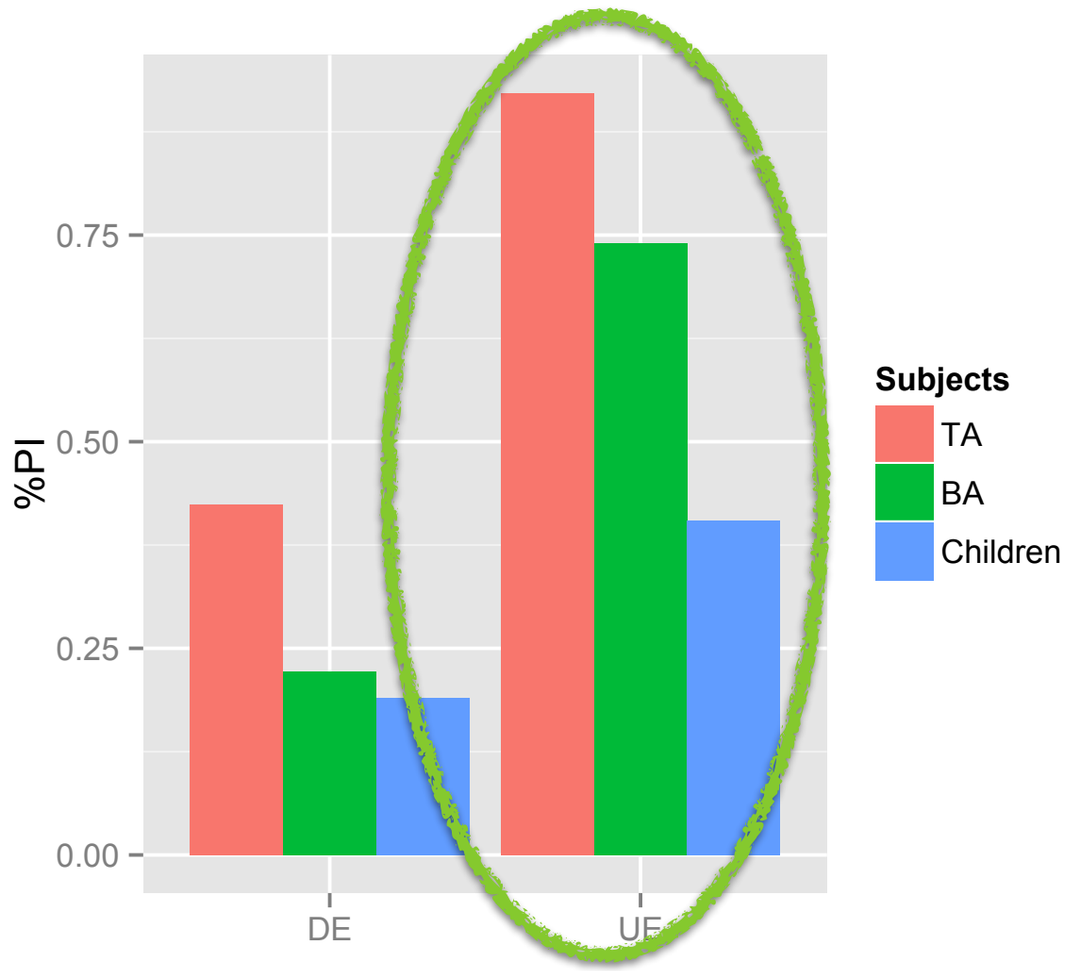
Hypotheses

1. Lexical knowledge *(e.g. Barner et al. 2011)/access to scalar* alternatives*(e.g. Chierchia et al. 2001)*

2. Pragmatic tolerance *(e.g Kastos et al. 2010)*

Remaining question

How do we explain our results showing BAs can compute PIs but performance is '*in-between*' that of typical adults and children?



Hypothesis

- **Lexical access** is impaired in BA*(e.g. Prather et al. 1997, Zurif 2003)*

- **Lexical Knowledge** spared in BA but ‘impaired’ in children *(Barner et al. 2011)*