

Scalar implicature processing: slowly accepting the truth (literally)

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The overall project

- Comparing
 - Scalar implicatures
 - Presuppositions

The overall project

- Three perspectives
 - Processing
 - Acquisition
 - Language disorders

Today

- Zooming in on
 - Scalar Implicatures
 - Processing

Today

- *Measure*: Reaction Time

Today

- Investigating the processing of
 - Direct Scalar Implicatures (DSIs)
 - Indirect Scalar Implicatures (ISIs)

Today

- Comparing processing of
 - Direct Scalar Implicatures (DSIs)
 - Indirect Scalar Implicatures (ISIs)
- *terminological distinction treated uniformly*

Direct SIs

(I) John sometimes went to the movies
 \leadsto *John didn't always go to the movies*

Indirect SIs

- (2) John didn't always go to the movies
 \leadsto *John sometimes went to the movies*

The processing of SIs

- SIs and the 'experimental turn'
2014)

(See Chemla and Singh

- Processing in particular

The processing of DSIIs

- The literature has mostly focused on DSIIs
- Reaction Time experiments
- DSIIs found to be associated with a delay
(Bott and Noveck 2004, Bott et al 2012, Chemla and Bott 2013, Cremers and Chemla 2014)

The processing of ISIs

- ISIs have been studied less
- Two studies with contrasting results

The processing of ISIs

- ISIs associated with a delay in RTs
(Cremers and Chemla 2014 - C&C)
- ISIs not associated with a delay
(Romoli and Schwarz 2014 - R&S)

Questions for today

- (A) Do RTs yield uniform evidence for a delay of SIs?
- (B) Are DSIs and ISIs uniform in processing?

Our experiment

- Investigating these two questions
- Comparing the processing of DSIs and ISIs

Our answers

(A) Do RTs yield uniform evidence for a delay of SIs?

Our answers

(A) Do RTs yield uniform evidence for a delay of SIs?

- NO!

Our answers

(A) Do RTs yield uniform evidence for a delay of SIs?

- NO!
- it depends on whether we look at acceptance or rejection responses

Implications

This undermines the idea of
SIs being associated with a delay in RTs

Our answers

(B) Are DSIs and ISIs uniform in processing?

Our answers

(B) Are DSIs and ISIs uniform in processing?

- YES!

Our answers

(B) Are DSIs and ISIs uniform in processing?

- YES!
- they yield the same pattern of responses

Implications

This supports uniform accounts of DSIs and ISIs

Today

- Scalar implicatures and their derivation
- Processing of DSIs and ISIs
- The contrasting results on ISIs
- Experiment
- Results, Implications, Further directions

Direct and Indirect Scalar Implicatures

Direct and indirect scalar implicatures

- (1) John sometimes went to the movies
 \leadsto *John didn't always go*
- (2) John didn't always go to the movies
 \leadsto *John sometimes went*

Cancellation

- Scalar implicatures can be cancelled
- One of the hallmarks of SIs

Cancellation

- (1) John sometimes went to the movies...
In fact, he always did!
- (2) John didn't always go to the movies...
In fact, he never went!

Compare with entailments

(4) John and Mary went to the movies last
week

\leadsto *John went to the movies last week*

Compare with entailments

(4) John and Mary went to the movies last
week...#In fact John didn't go!

In sum

- Theoretical Goals:
 - explain how DSIs and ISIs arise
 - predict in what circumstances these inferences occur
 - Allow for cancellation

A sketch of SI derivation

Deriving SIs: the Gricean algorithm

- Hear an utterance
- Compare with an alternative utterance
- If competitor is stronger than the assertion, conclude that competitor is false

How do we obtain competitors?

- replace certain words in the assertion
 - <some, all>
 - <sometimes, always >
 - ...

Deriving direct SIs

- (1) John **sometimes** went to the movies
 - (2) John **always** went to the movies
- John didn't always go to the movies

Deriving indirect SIs

- (1) John didn't **always** go to the movies
- (2) John didn't **sometimes** go to the movies

→ It's false that John didn't sometimes go to the movies

= John went sometimes

A unified approach

- A scalar implicature algorithm
- A theory of competitors
- A unified account of direct and indirect SIs

Cancellation

- How do we allow for cancellation of SIs?

Cancellation

- The data again
- (I) John went to the movies sometimes...in fact he always went!

Cancellation

- The speaker uttered the competitor
- She cannot think that the competitor is false
- The scalar implicature is cancelled/not derived

In sum

- A unified account of direct and indirect SIs

In sum

- A unified account of direct and indirect
- How SIs can be absent

In sum

- A unified account of direct and indirect
- How SIs can be absent
- Expectation of uniformity

Processing

The processing of SIs

- Processing of SIs studied extensively
- DSIs found to be associated with a delay in Reaction Times (Bott and Noveck 2004, Chemla and Bott 2013, Bott et al 2012, Cremers and Chemla 2014)

Parenthesis

- Other methodologies (e.g., eye-tracking, self-paced reading) have given rise to more mixed results (Huang and Snedeker 2009, Breheny et al. 2006 vs. Grodner et al 2012, Degen and Tanenhaus 2011, Breheny et al 2013)

Parenthesis

- Other methodologies (e.g., eye-tracking, self-paced reading) have given rise to conflicting results (Huang and Snedeker 2009, Breheny et al. 2006 vs. Grodner et al 2012, Degen and Tanenhaus 2011, Breheny et al 2013)
- We focus on RTs for today
- Ultimately the question is how to integrate results from different methodologies

The processing of ISIs

- Two studies with RTs on ISIs
- Two (seemingly) contrasting results

The processing of ISIs

- ISIs associated with a delay in RTs (C&C)
- ISIs not associated with a delay (R&S)

What's coming next

- Briefly review these two experiments
- Point to a crucial difference motivating the present experiment

Cremers and Chemla 2014

Goal

- Comparing RTs of ISIs vs. DSIs
- Using and refining the classical Bott and Noveck 2004's paradigm

Their main point

- Differences between DSIs and ISIs could be due to superficial differences
 - The presence of negation
 - Other confounds

First experiment

- *Some elephants are mammals*
 \leadsto *not all elephants are mammals*
- SI reading = False
- No SI/Literal reading = True
- Same methodologies as Bott and Noveck (2004) exp 3; also Chemla and Bott 2013, Bott et al 2012

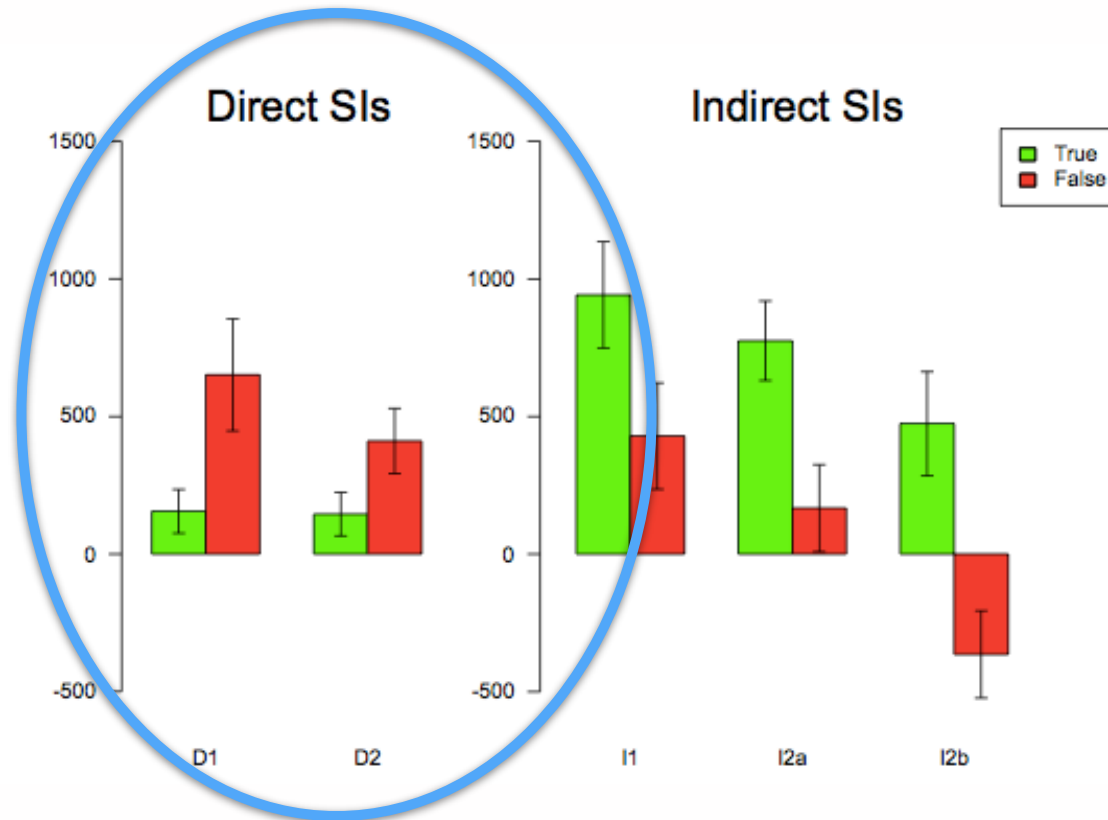
First experiment

- *False* associated with a SI interpretation
- *True* associated with a Literal interpretation

First experiment

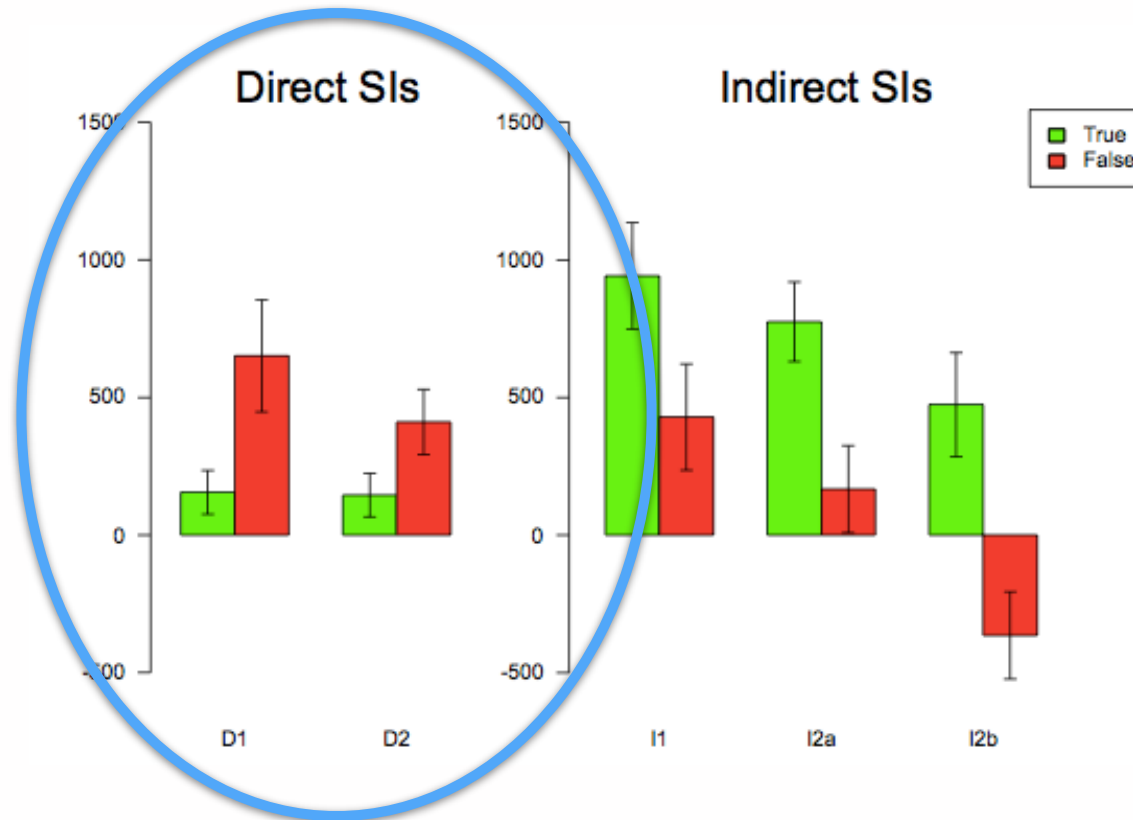
Comparing RTs of *True/Literal* vs *False/SI* responses

Results



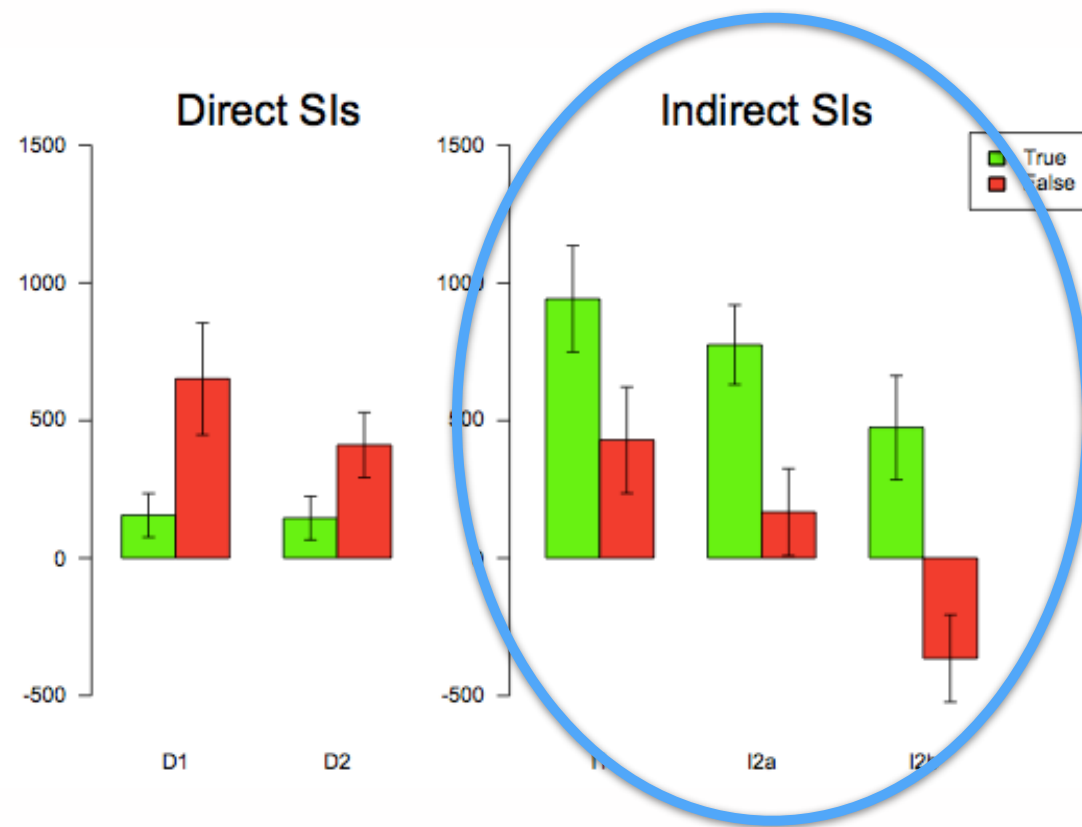
Replicate previous B&N's finding that false responses are slower than true

Results



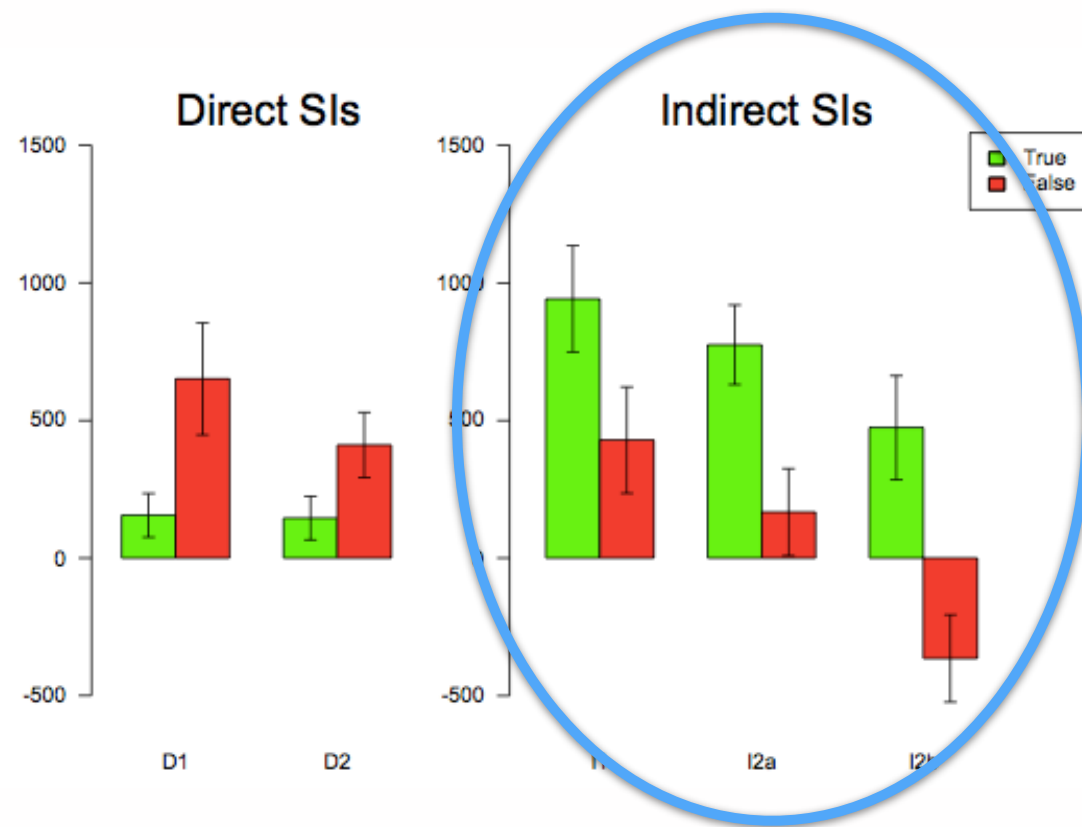
Interpretation: DSIs are associated with a delay

Results



However - they find the opposite pattern with ISIs

Results



Interpretation: ISIs are not associated with a delay?

Discussion

- A potential conclusion
 - DSI and ISI's processing profiles are different

Discussion

- C&C's
 - The difference might have some other source
 - Go on to explore this in Experiment two

Second experiment

- Same type of sentences
- Effect of training of participants
- Bott and Noveck 2004 experiment I

Second experiment

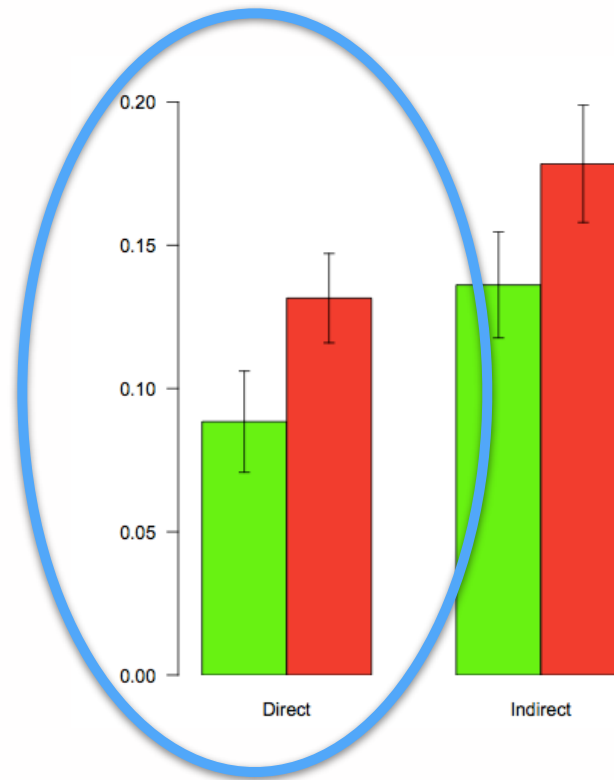
- A group of participants trained to literal interpretations (Literal/*true*)
- The other trained scalar interpretations (SI/*false*)

Second experiment

Literal Participants were **faster** than SI ones

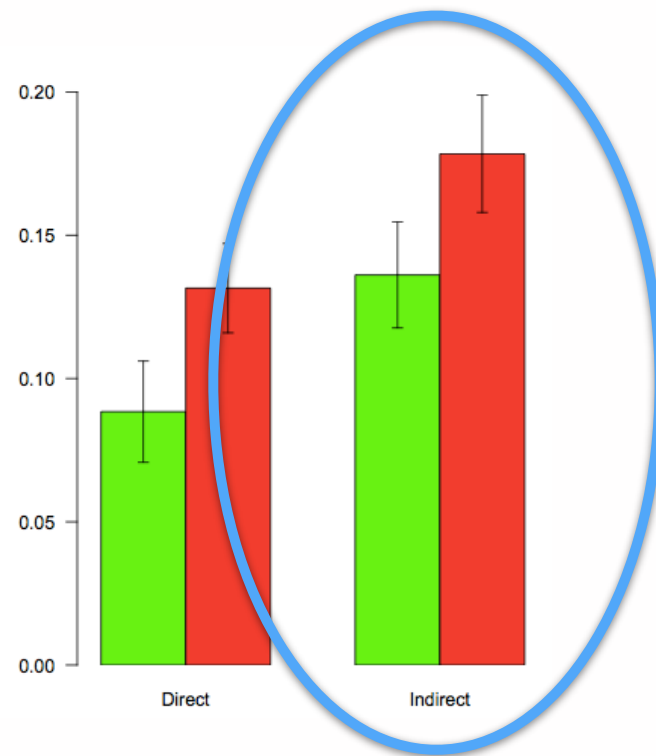
Interpretation: SIs associated with a delay

Results



Replicating B&N's effect for DSIs

Results



This time, same pattern for ISIs

Discussion

The effect of training is the same for DSIs and ISIs

ISIs have the same processing profile as DSIs

Discussion

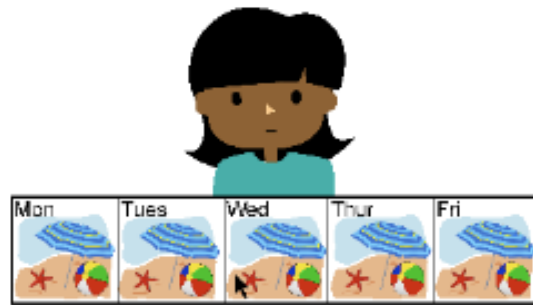
Both DSIs and ISIs associated with a delay

Romoli and Schwarz
2014

Goal

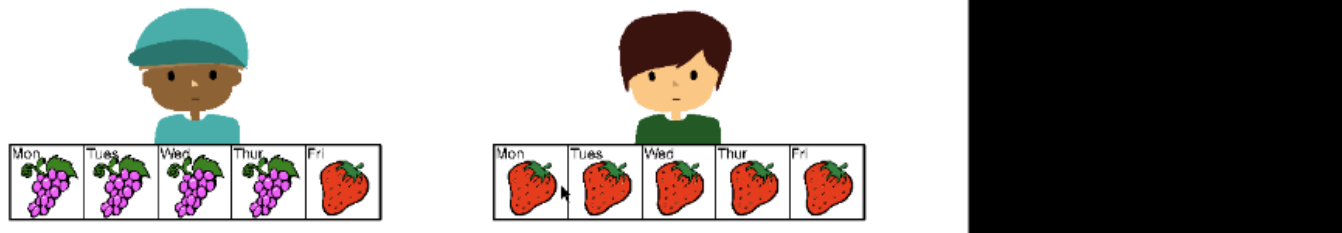
- Comparing RTs of
 - ISIs
 - Presuppositions

Participants, material and Procedure



- Sentence picture matching task
- Pictures representing a character and her schedule

Participants, material and Procedure



- Participants chose among three pictures
- One target, one distractor, and one covered
(Huang et al 2013, Romoli et al 2011)

Instruction

one and only one picture matches the sentence

Design

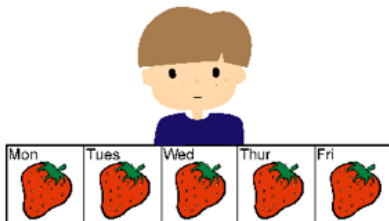
- 2×2
 - Type of trigger
 - *stop* vs. *always*
 - Inference?
 - SI/Ps or Literal

Design

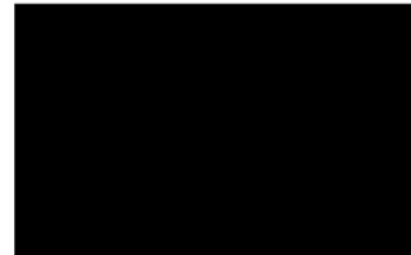
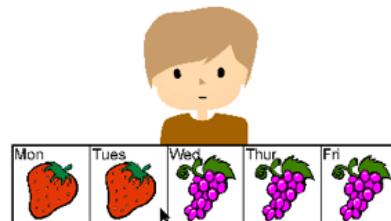
- 2×2
- Type of trigger
 - *stop* vs. *always*
- Inference?
 - SI/Ps or Literal

Always-SI condition

Distractor



Target

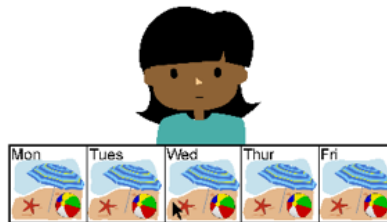


Jacob didn't always eat strawberries last week.

Always-Literal condition

Target

Distractor

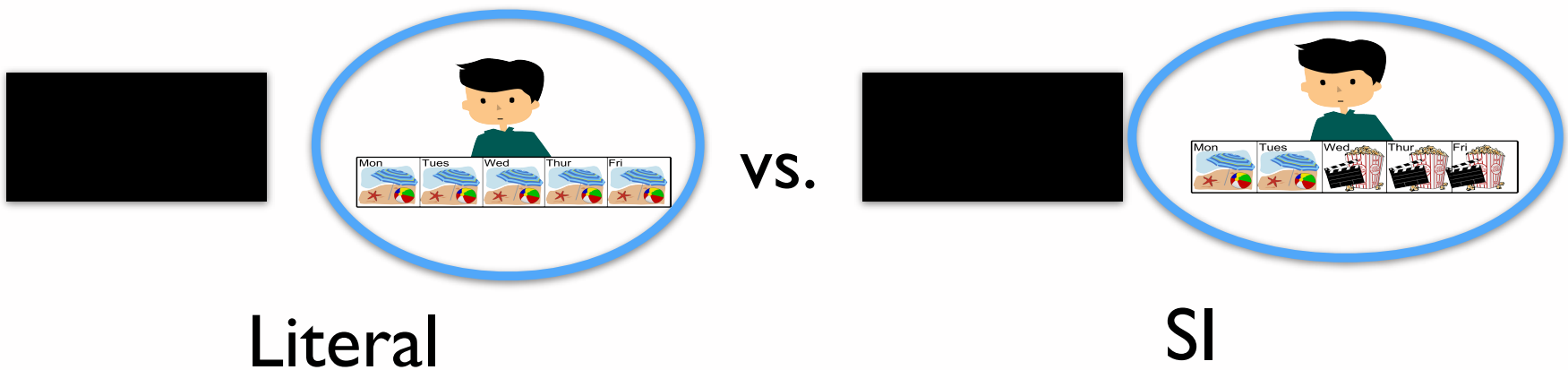


Emma didn't always go to the library last week.

Comparison

- Comparison
 - **Target choices** in SI condition
 - **Target choices** in Literal condition

Comparison



John didn't always go to the movies

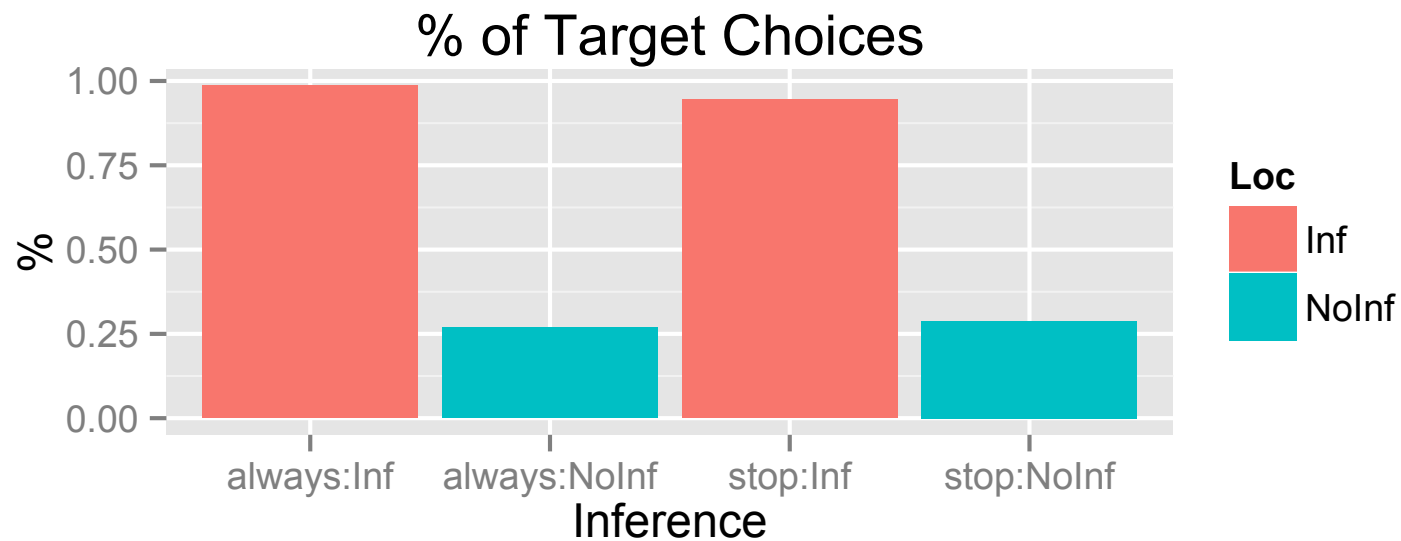
→ *John sometimes went*

Results and discussion

Dependent variables

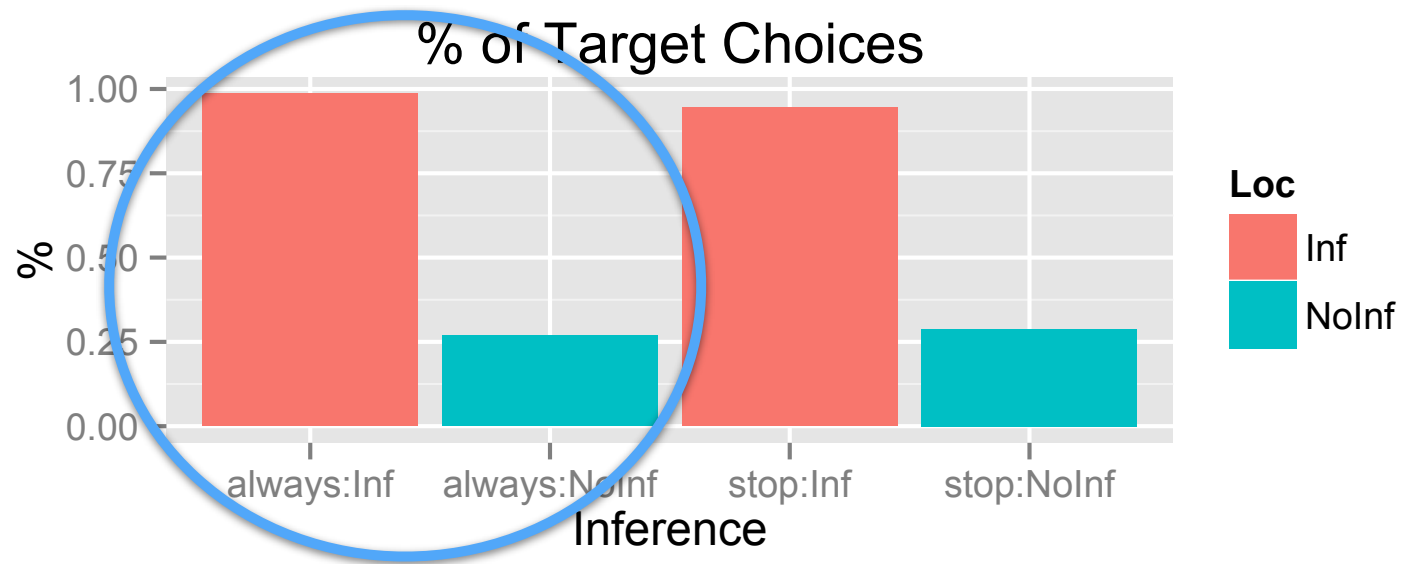
- Response rate
- Reaction times of target choices

Response Data



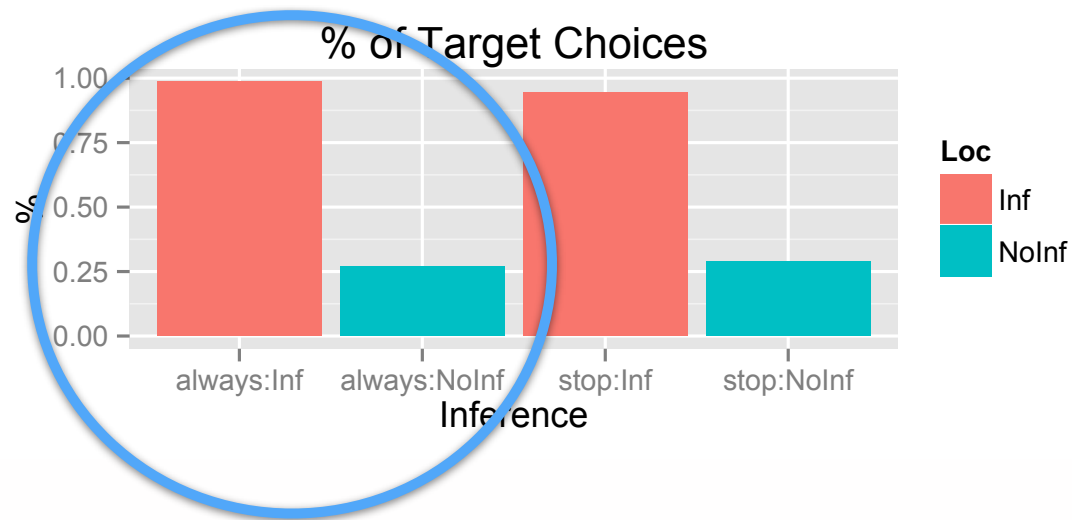
- Main effect of inference
- (No interaction)

Response Data



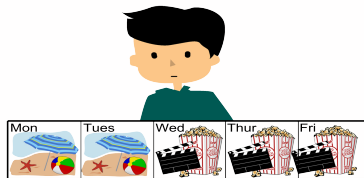
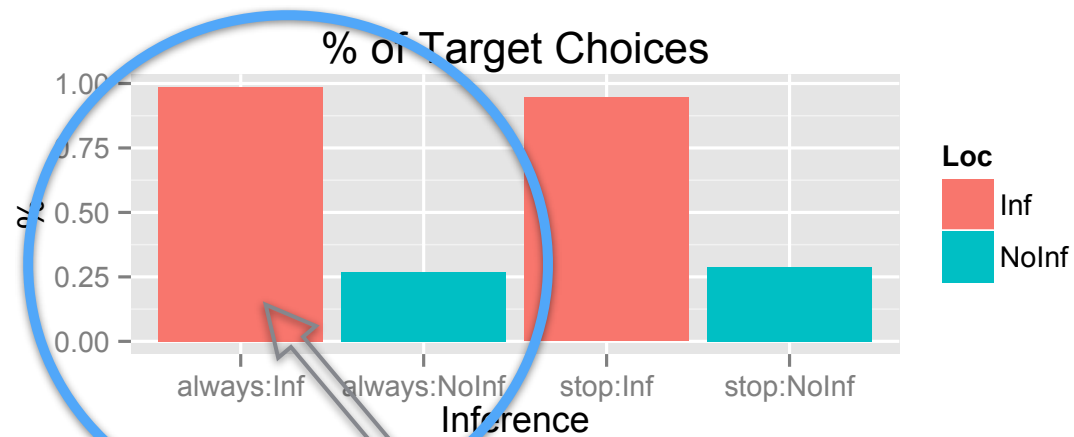
- Main effect of inference
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Response Data



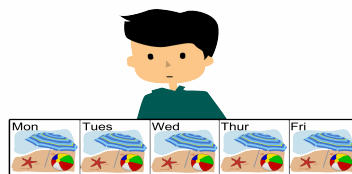
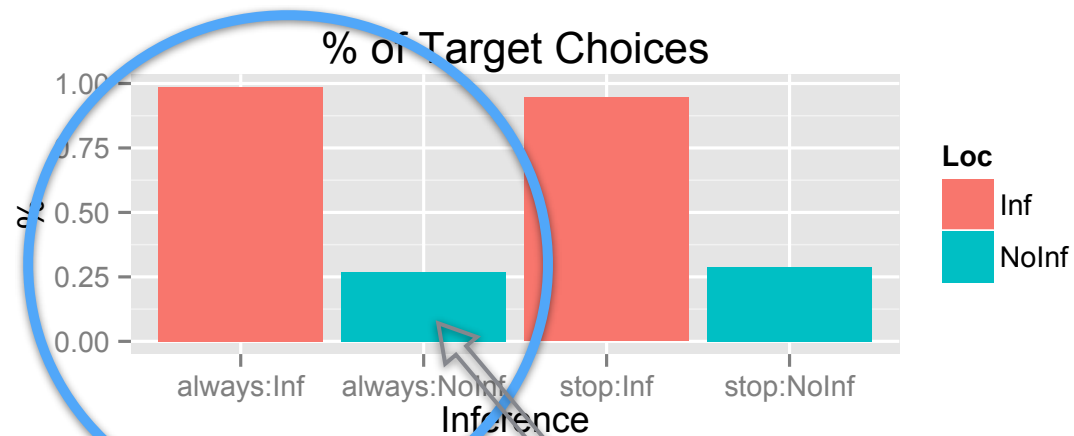
- Target choices much higher for SI targets

Response Data



SI

Response Data

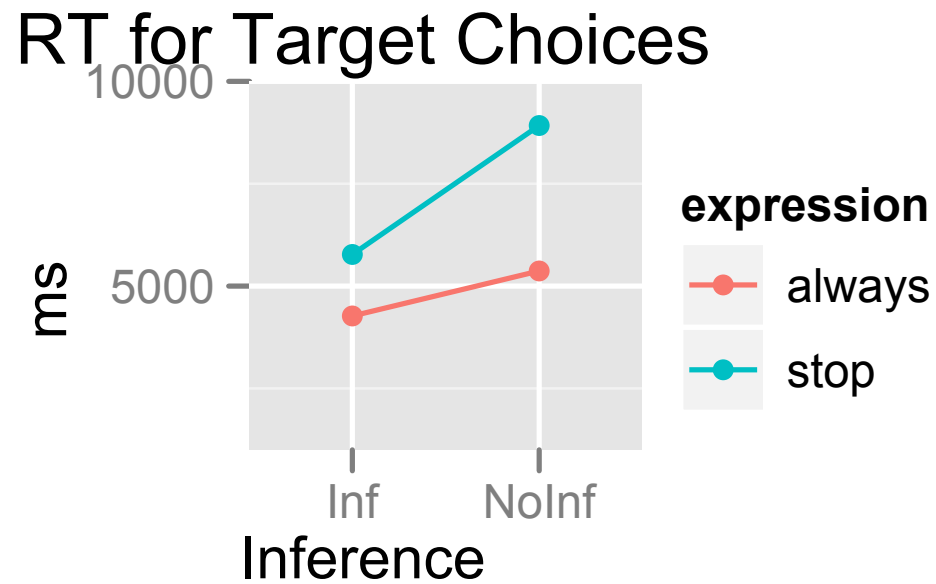


Literal

RTs

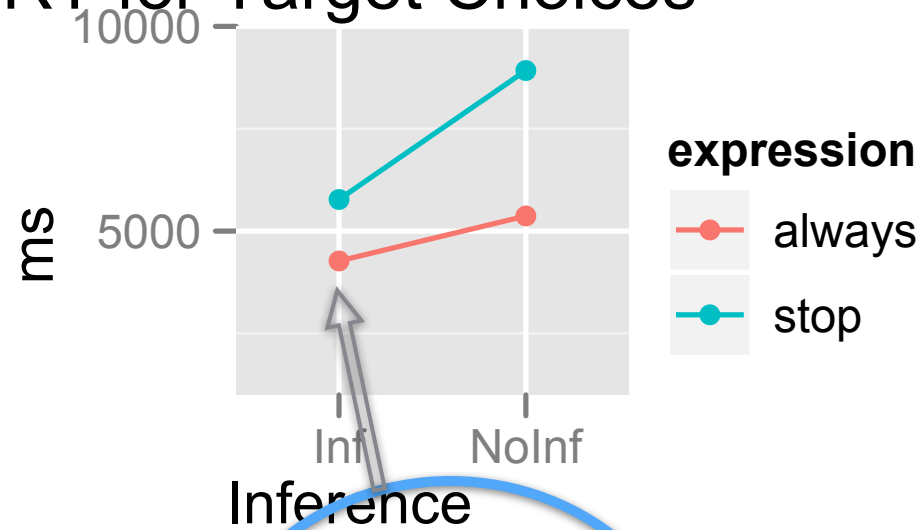
- Comparing RTs of Target choices

RTs

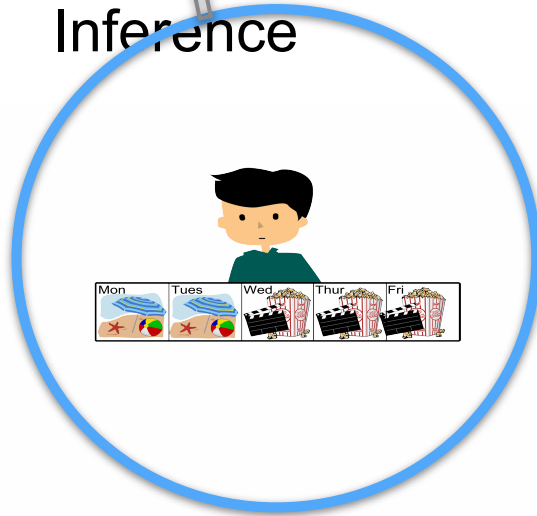


- Main effect of Inference
- (no interaction)

RT for Target Choices



Inference

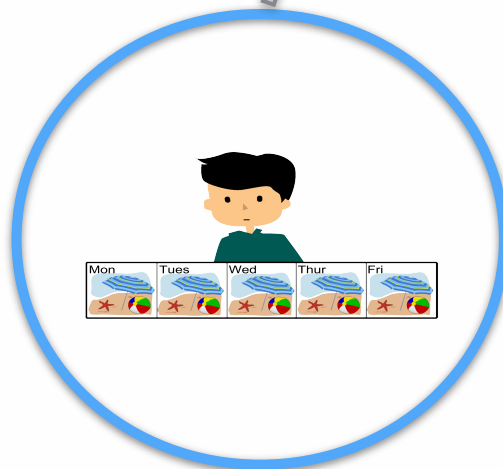


SI

RT for Target Choices

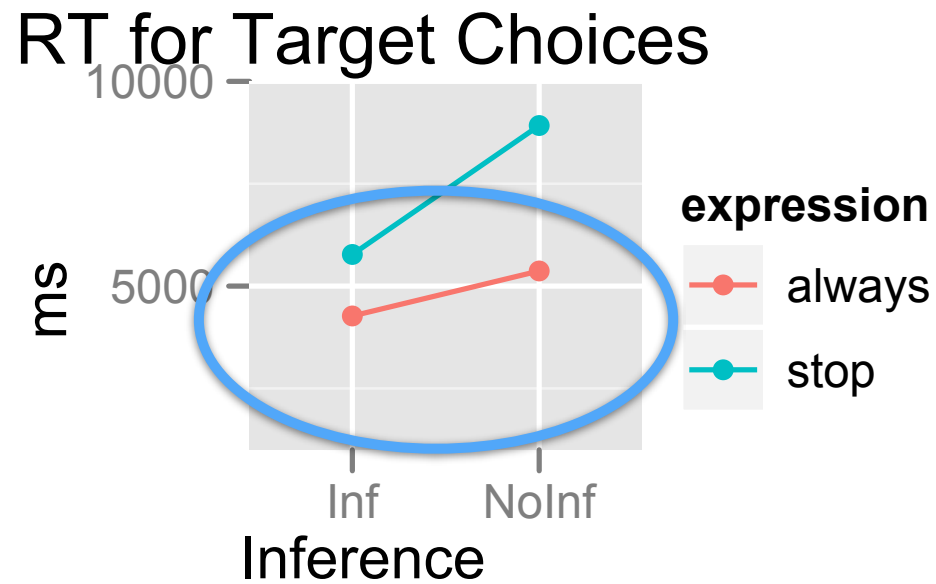


Inference



Literal

RTs



- Target choice in the SI condition was **faster**

Results

- Computing ISIs does not appear to be associated with a delay
- (Same pattern for ISIs and Presuppositions)

Discussion

- C&C's results
 - ISIs, like DSIs, associated with a delay
- R&S's result:
 - ISIs not associated with a delay

Discussion

- How do we reconcile these results?

A difference

- C&C focuses on RTs for **rejection** responses based on SIs
 - as compared to acceptance of the literal

A difference

- R&S focuses on **acceptance** responses consistent with SIs
 - as compared to acceptance of literal

Next step

- Comparing DSIs and ISIs on both acceptance and rejection responses

Parenthesis

- In R&S and present experimental paradigm:
 - Rejection = Covered Picture
 - Acceptance = Target Picture

Acceptances comparison



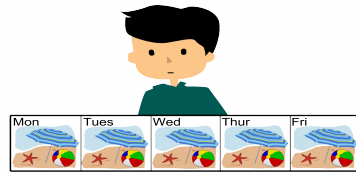
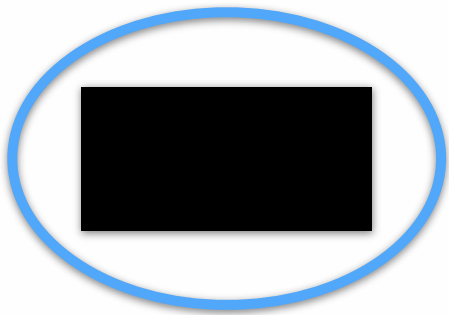
John didn't always go to the movies

\leadsto John sometimes went

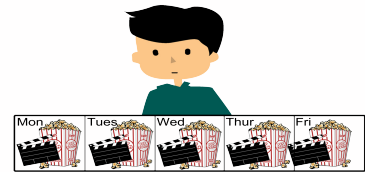
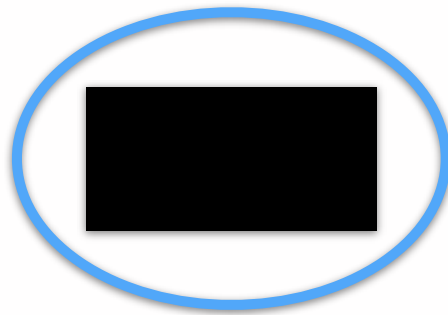
Rejections comparison

- A comparison related to B&N/C&C's one
 - **Rejection** responses in Literal
 - **Rejection** responses in False

Rejections comparison



Literal

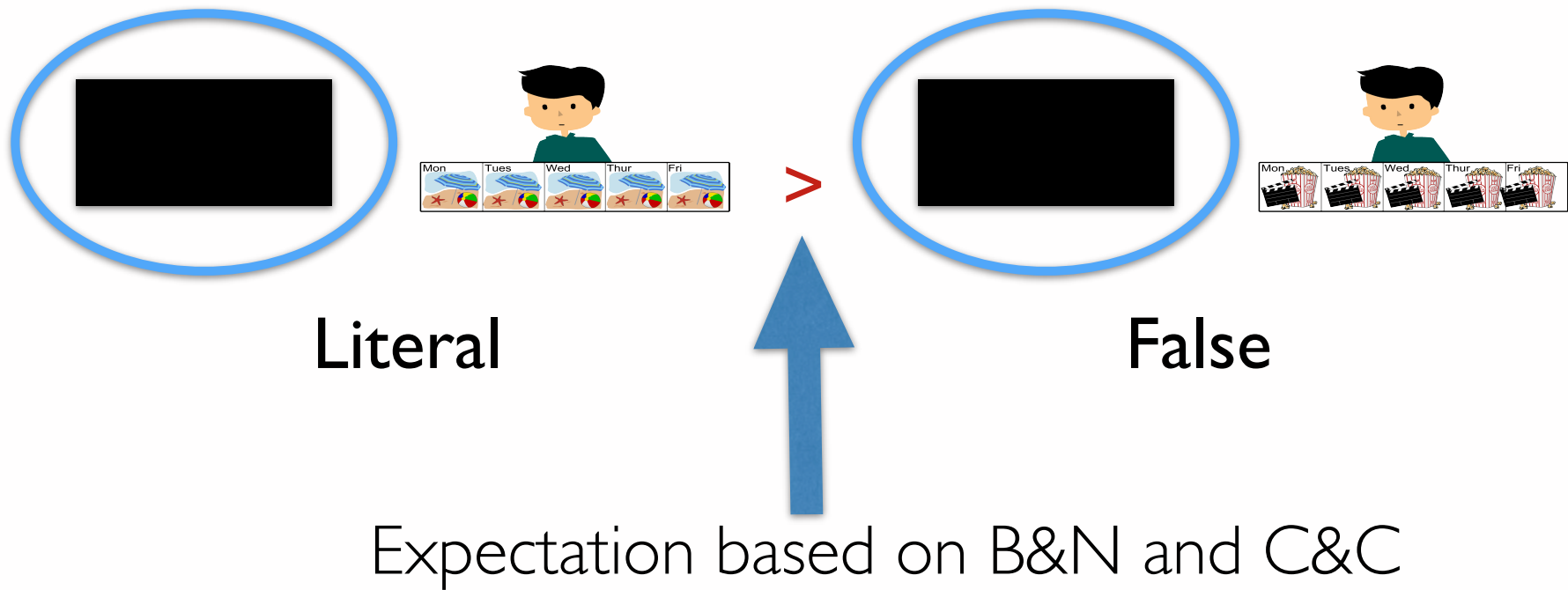


False

John didn't always go to the movies

\leadsto *John sometimes went*

Rejections comparison



In sum

- A novel set of comparisons
 - **Acceptances comparison**
 - **Rejections comparison**

Experiment

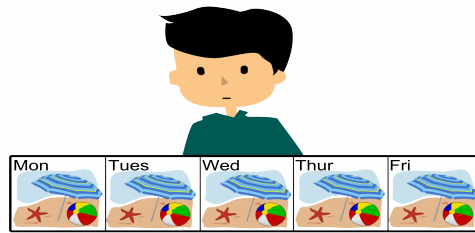
Goal

- Comparing ISIs and DSIs
- Both Target and Covered box choices

Participants

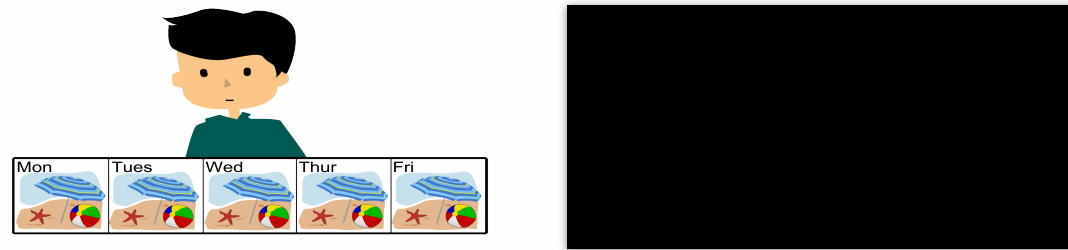
- 35 native speaker of English
- Macquarie University Undergraduates

Material and Procedure



- Similar design as R&S 2014
- But this time comparing ISIs and DSIs
- Looking at SI, Literal conditions and also false

Material and Procedure



- Participants chose among **two** pictures
- One target and one covered

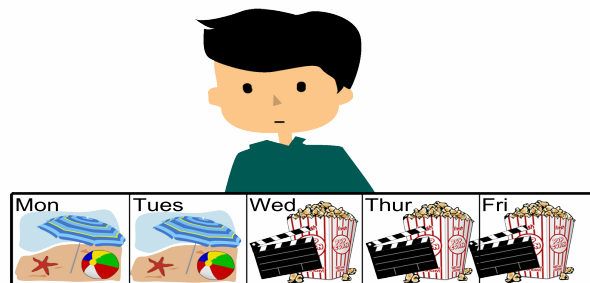
Test trials

- 36 test trials
 - (18 *always*; 18 *sometimes*)
- 18 controls with *always* and no negation
 - 6 simple negation controls
 - 12 fillers from another experiment

Design

- 2×3
- Type of scalar item
 - *sometimes vs. always*
- Status
 - SI vs Literal vs False

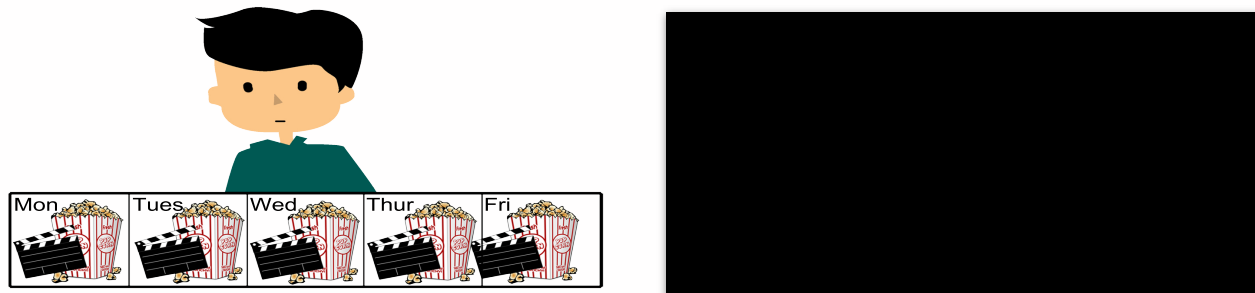
Sometimes-SI



John sometimes went to the movies

↪ *John didn't always go*

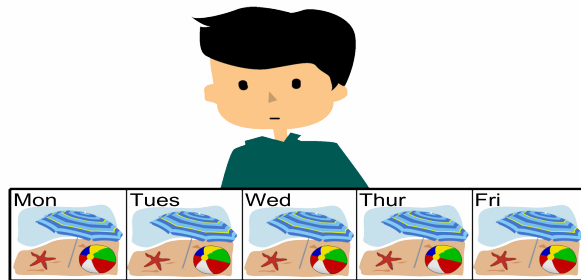
Sometimes-Literal



John sometimes went to the movies

→ *John didn't always go*

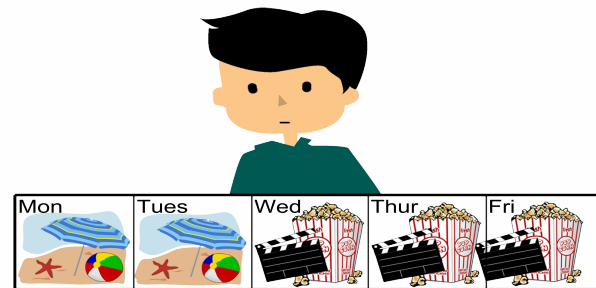
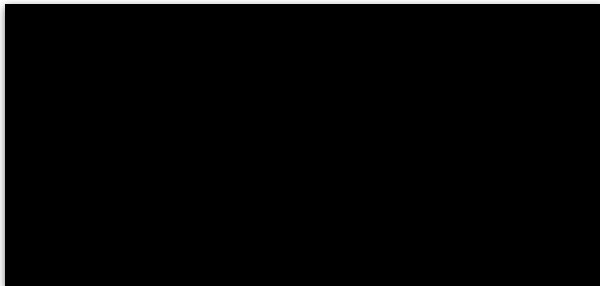
Sometimes-false



John sometimes went to the movies

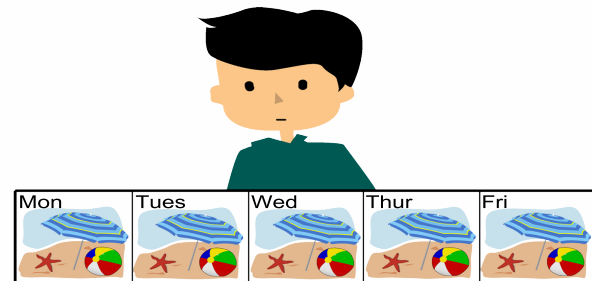
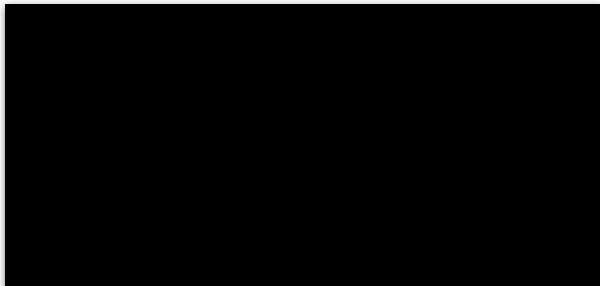
→ *John didn't always go*

Always-SI



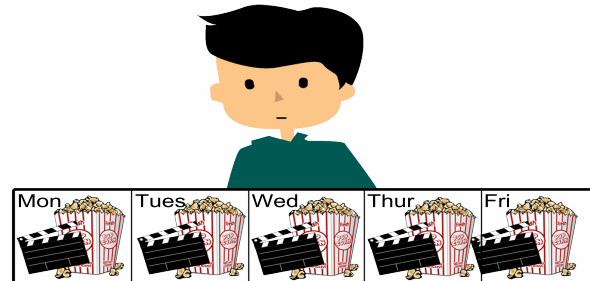
John didn't always go to the movies
→ John sometimes went

Always-Literal



John didn't always go to the movies
→ *John sometimes went*

Always-false



John didn't always go to the movies
 \leadsto *John sometimes went*

Results and discussion

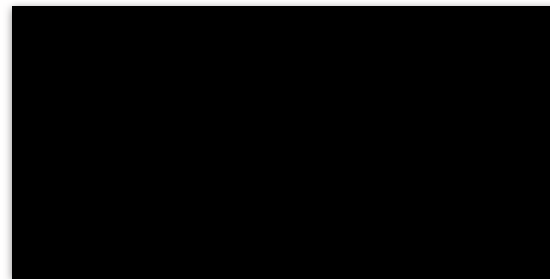
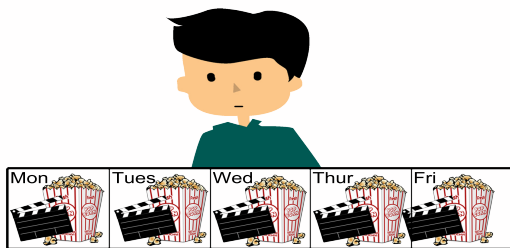
Data Analysis

- Responses were coded as:
- **Literal**: response justifiable
based on literal meaning alone
- **Scalar**: response compatible
with the scalar implicature

Data Analysis

- This cuts across *rejection* (covered box) and *acceptance* (overt picture) responses

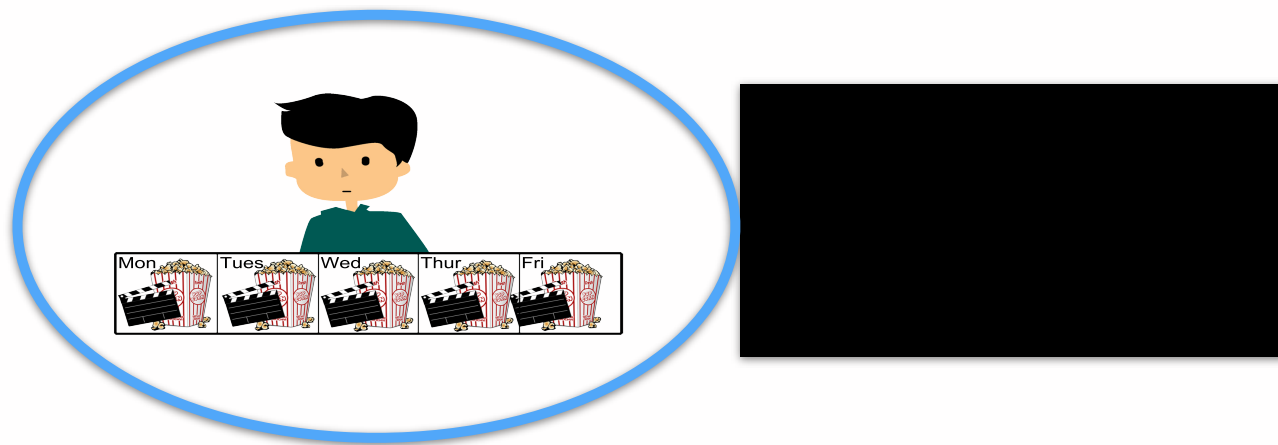
Sometimes Literal acceptance



John sometimes went to the movies

→ *John didn't always go*

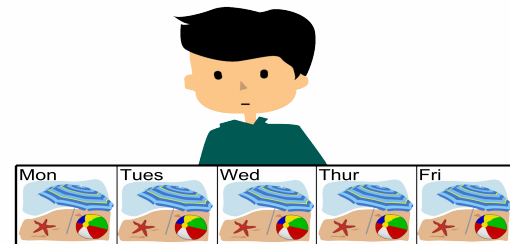
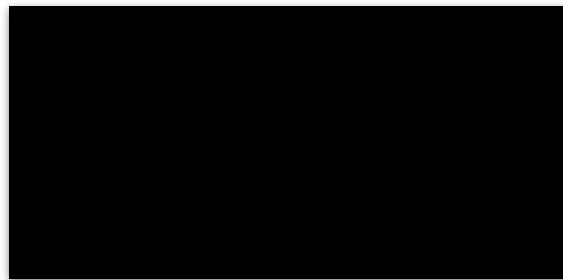
Sometimes Literal acceptance



John sometimes went to the movies

→ *John didn't always go*

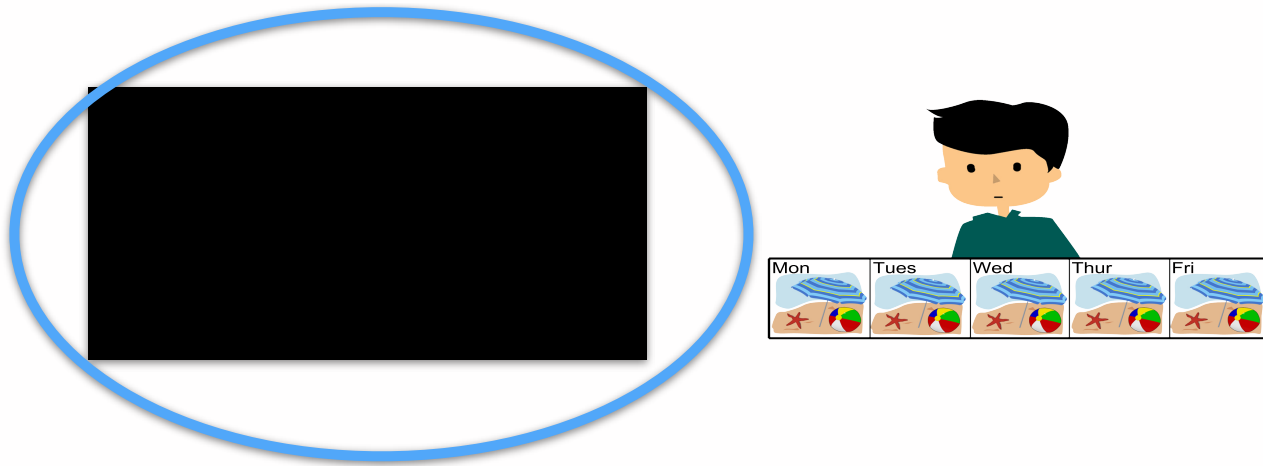
Sometimes Literal rejection



John sometimes went to the movies

→ *John didn't always go*

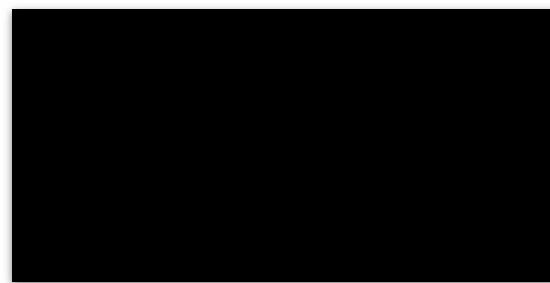
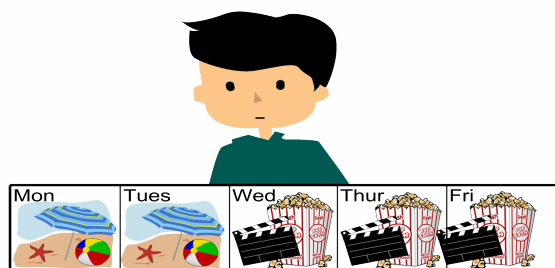
Sometimes Literal rejection



John sometimes went to the movies

→ *John didn't always go*

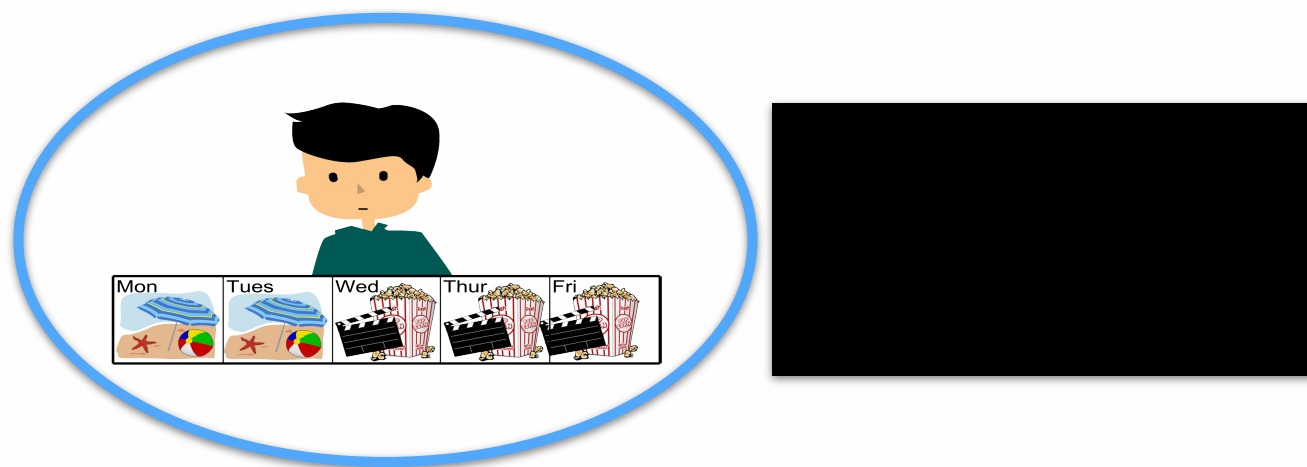
Sometimes scalar acceptance



John sometimes went to the movies

→ John didn't always go

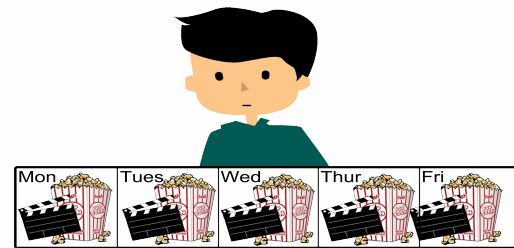
Sometimes scalar acceptance



John sometimes went to the movies

→ *John didn't always go*

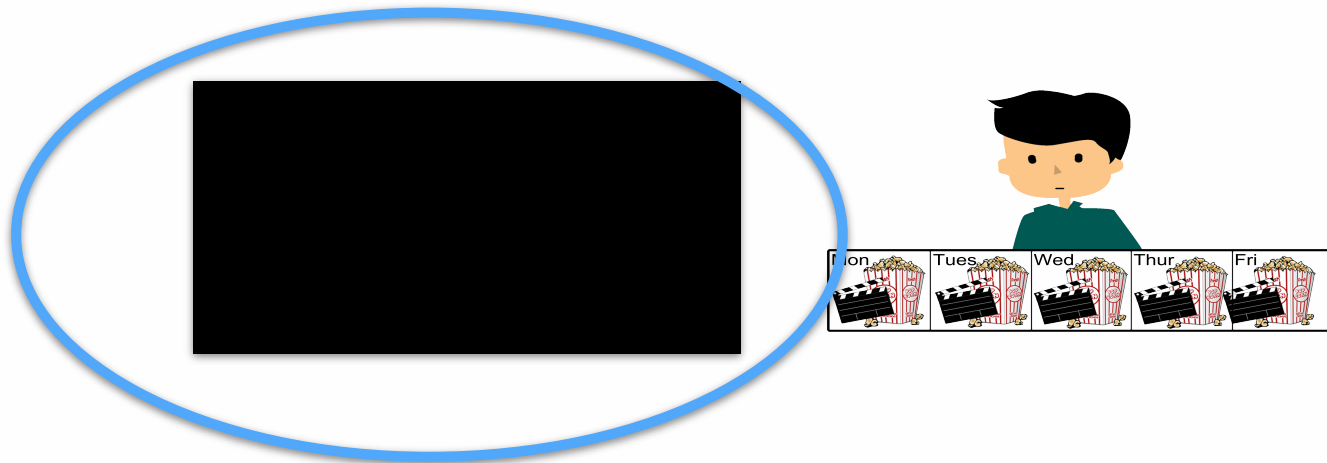
Sometimes scalar rejection



John sometimes went to the movies

→ *John didn't always go*

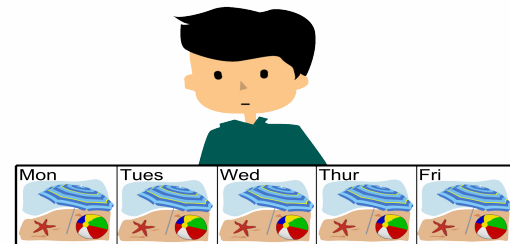
Sometimes scalar rejection



John sometimes went to the movies

→ *John didn't always go*

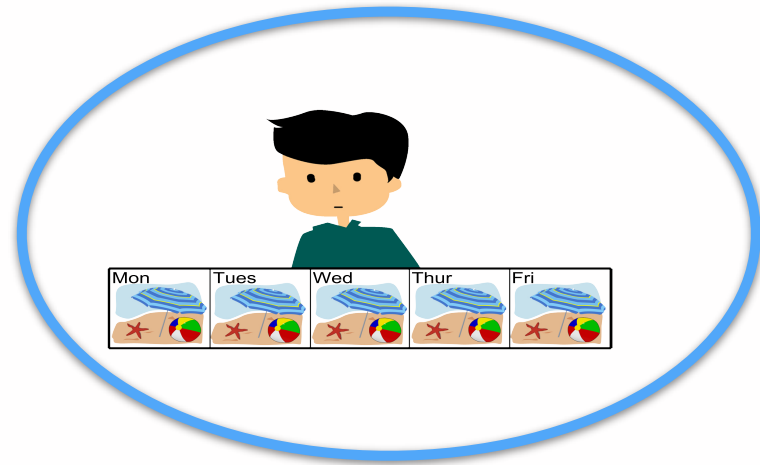
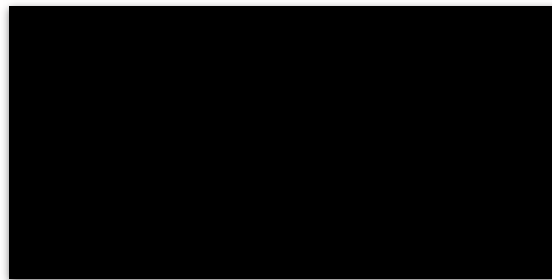
Always Literal acceptance



John didn't always go to the movies

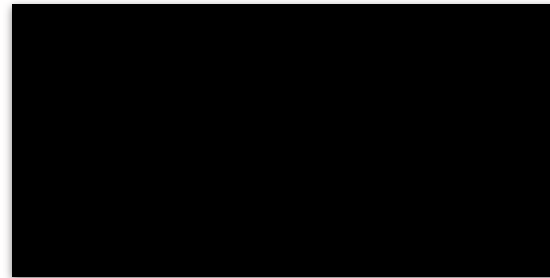
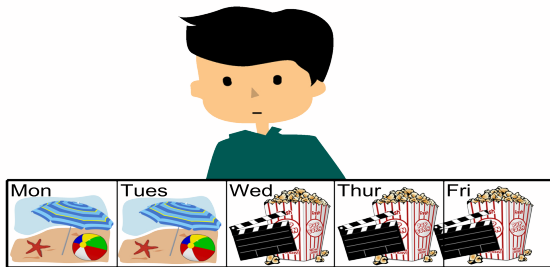
→ *John sometimes went*

Always Literal acceptance



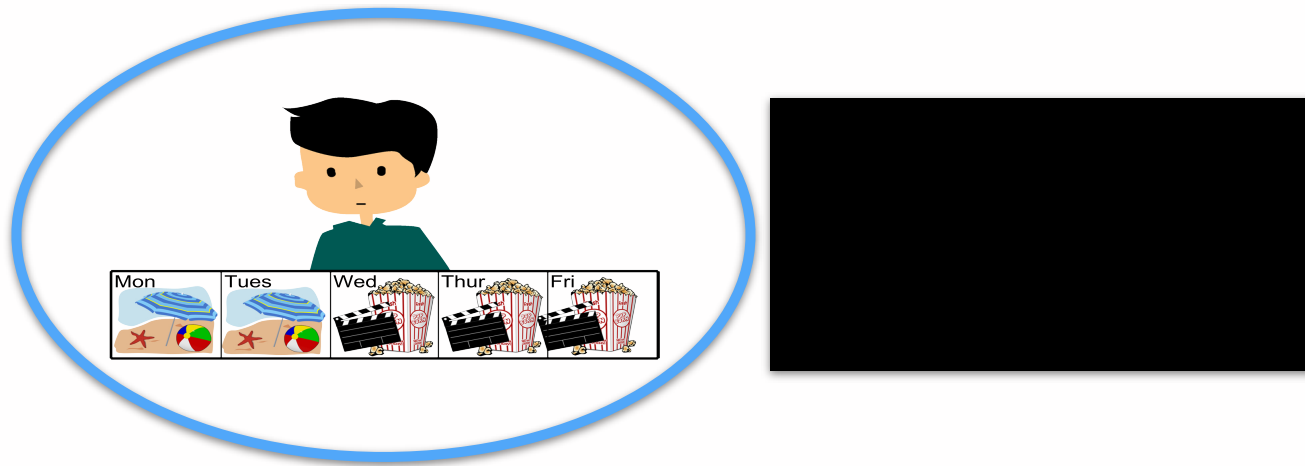
John didn't always go to the movies

Always scalar acceptance



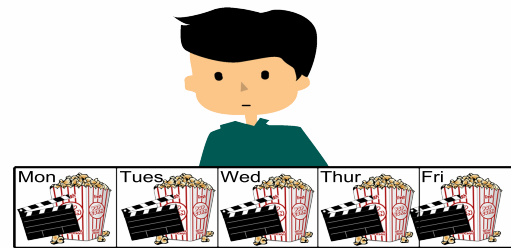
John didn't always go to the movies

Always scalar acceptance



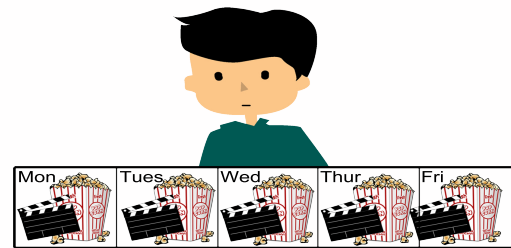
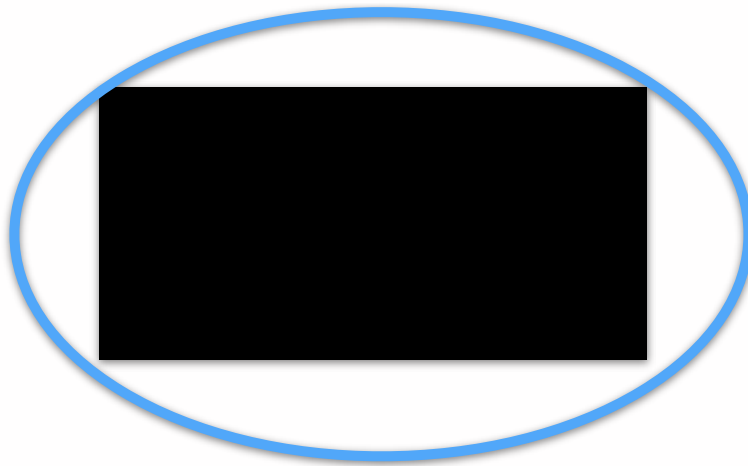
John didn't always go to the movies

Always Literal rejection



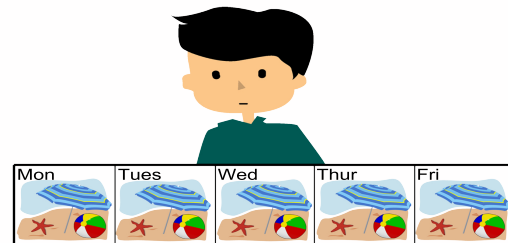
John didn't always go to the movies

Always Literal rejection



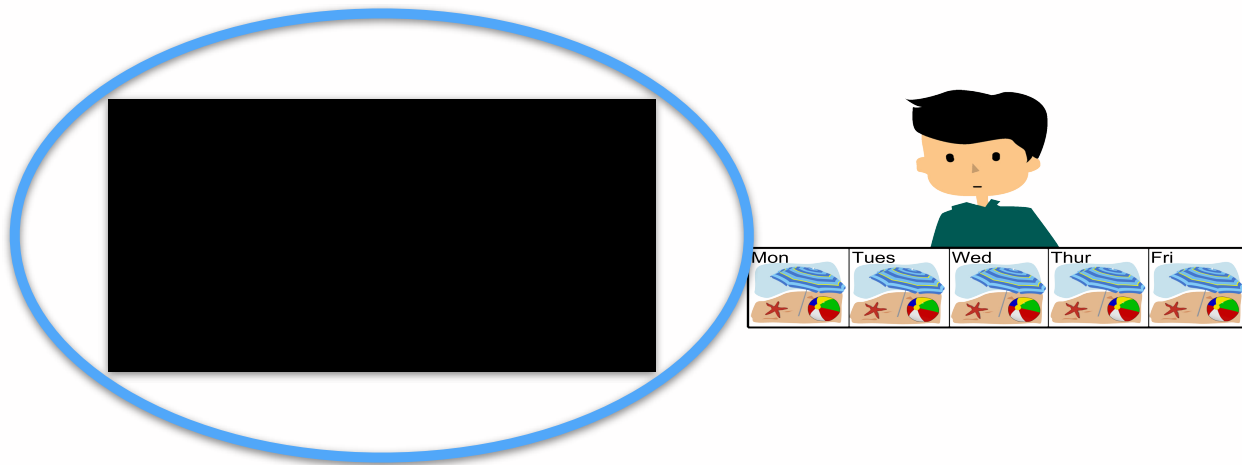
John didn't always go to the movies

Always scalar rejection



John didn't always go to the movies

Always scalar rejection



John didn't always go to the movies

Dependent variables

- for both DSI and ISI:
- Choice of Literal vs Scalar responses
- RTs of Literal vs. Scalar responses

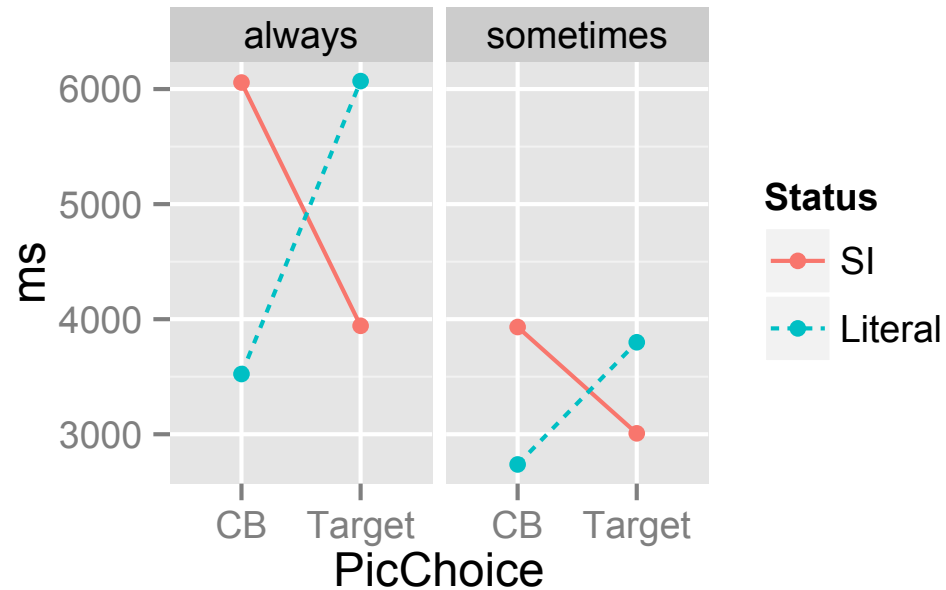
Response rate

- Scalar responses for DSI = 77% of the time
- Scalar responses for ISI = 49% of the time
- Significant: $DSI > ISI$

A difference

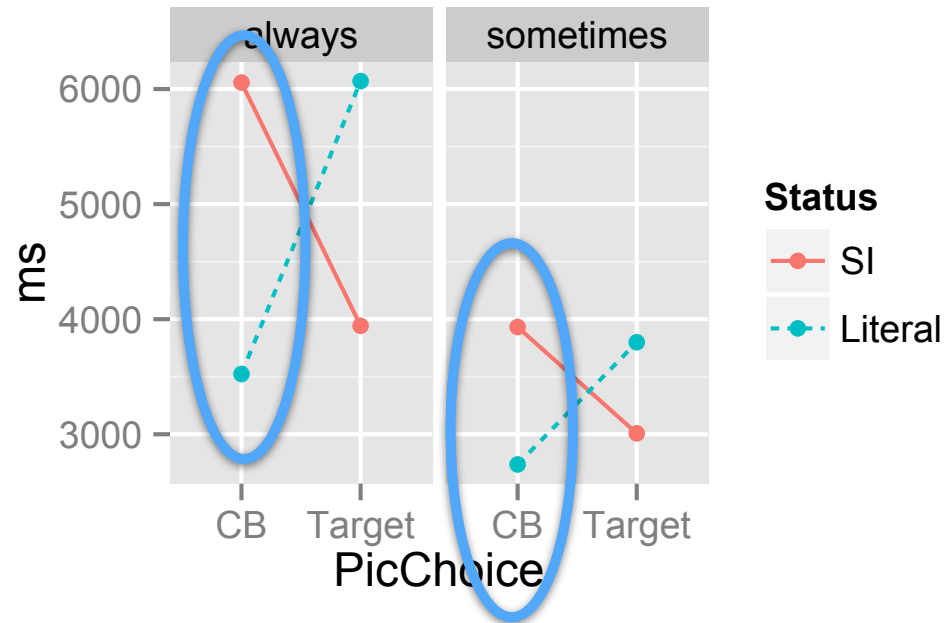
- Overall proportion of Scalar interpretations lower for ISIs
- This replicates a similar effect found in R&S

RTs



- Main effect of implicature type
- 2x2 Interactions
- Simple effects of Rejection vs Acceptance

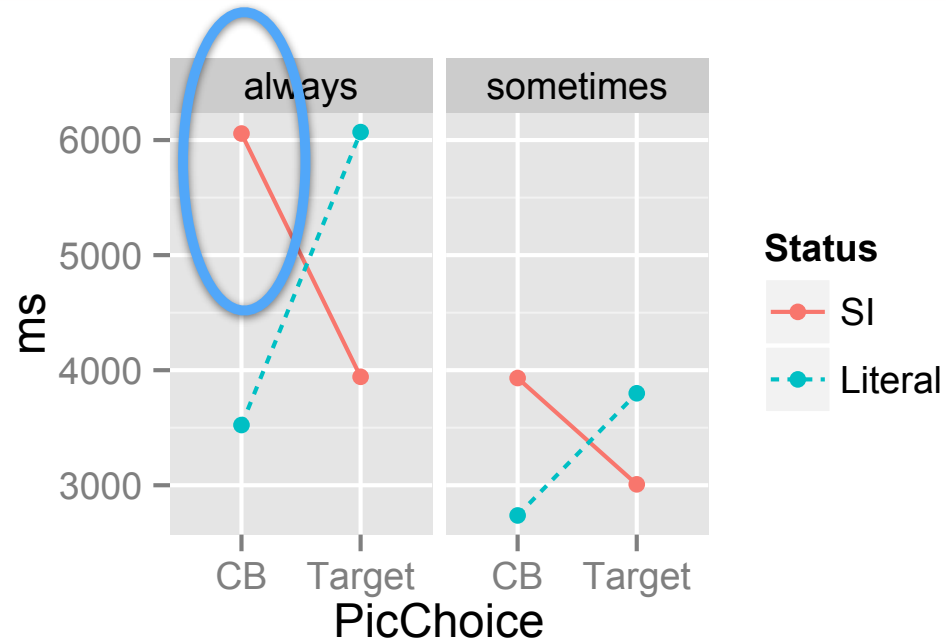
RTs



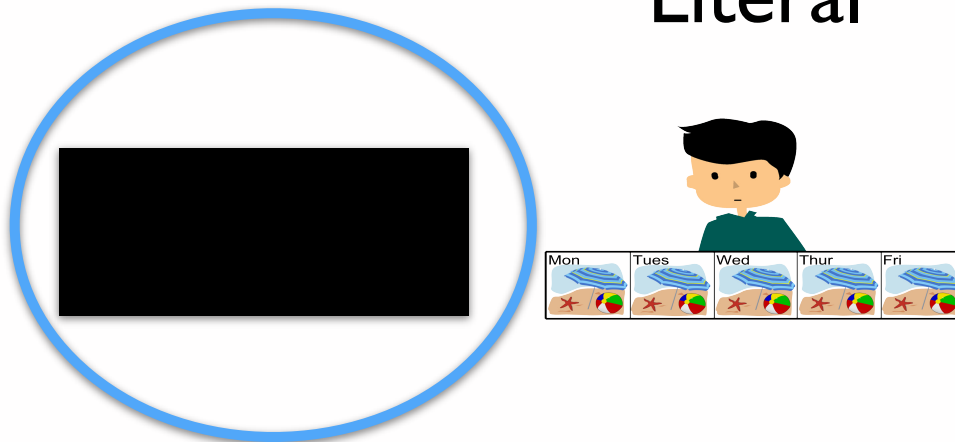
- Rejection based on ISIs and DSIs were slower

Rejection Literal

John didn't always go to the movies

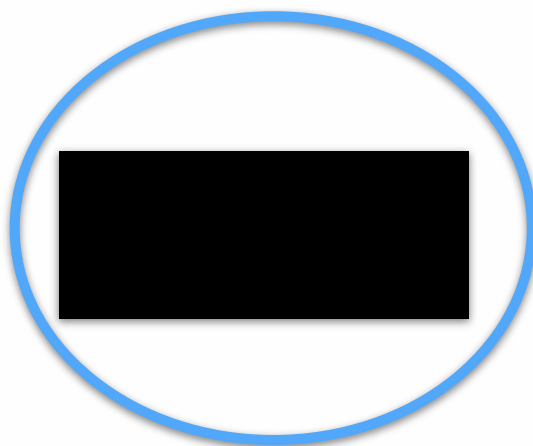
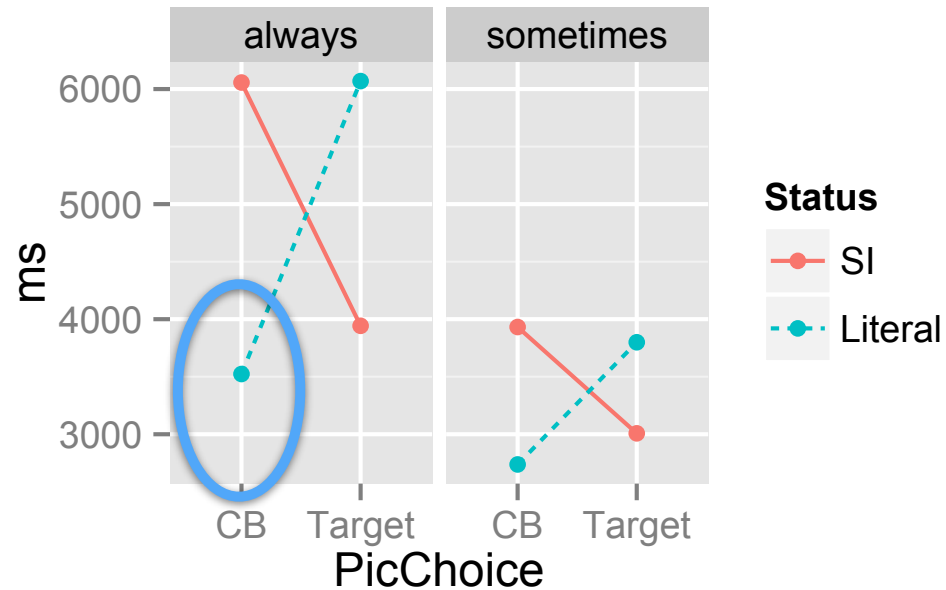


Literal

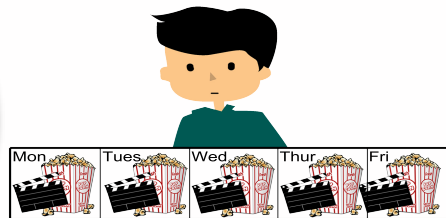


Rejection False

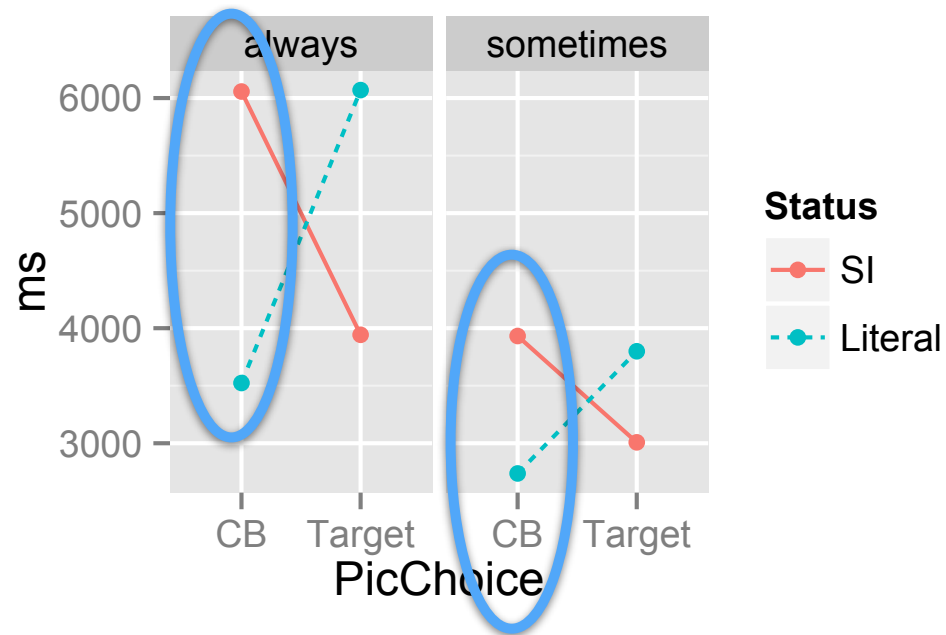
John didn't always go to the movies



False

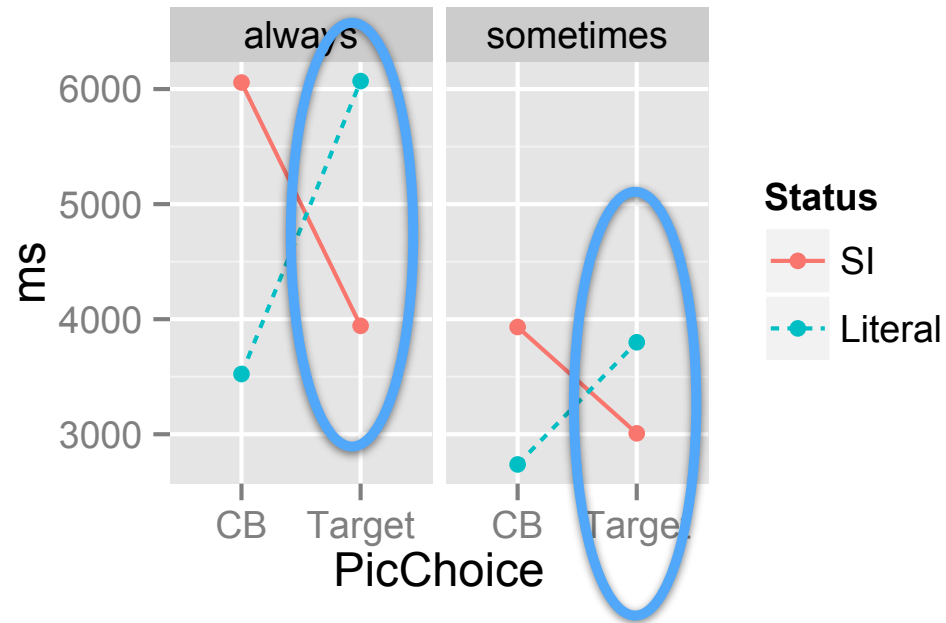


RTs



- Rejection based on ISIs and DSIs were slower
- consistent with C&C and previous results

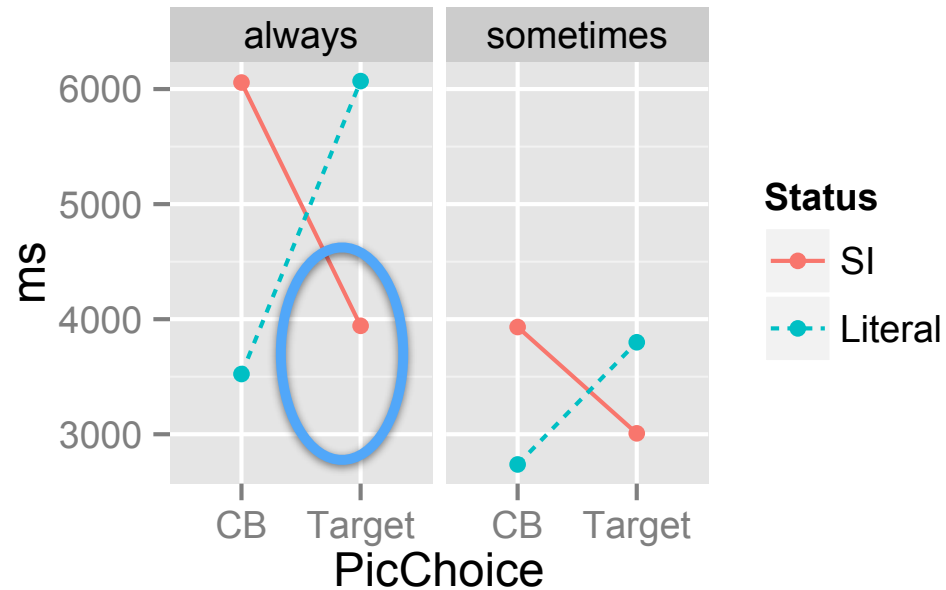
RTs



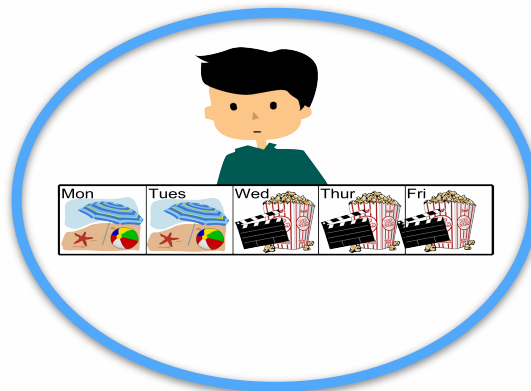
- Acceptance responses based on scalar were faster for both ISIs and DSIs

Acceptance SI

John didn't always go to the movies



SI

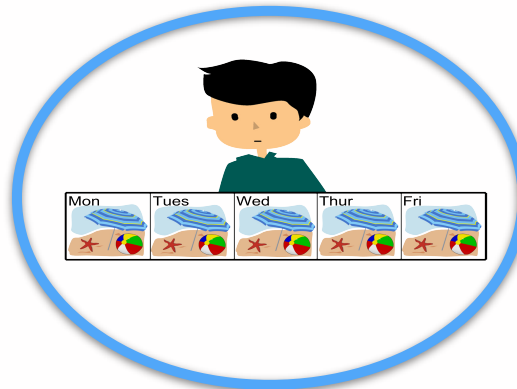


Acceptance Literal

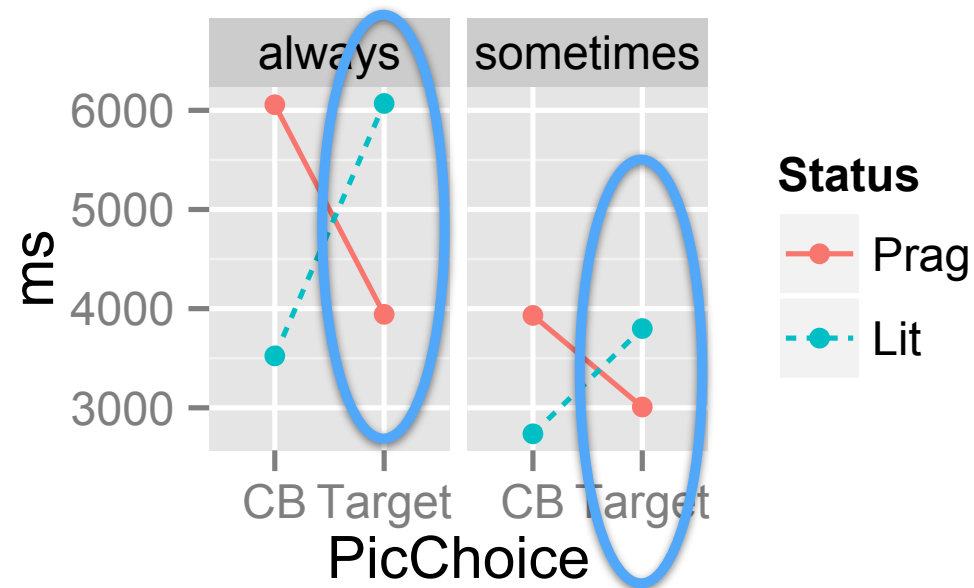
John didn't always go to the movies



Literal



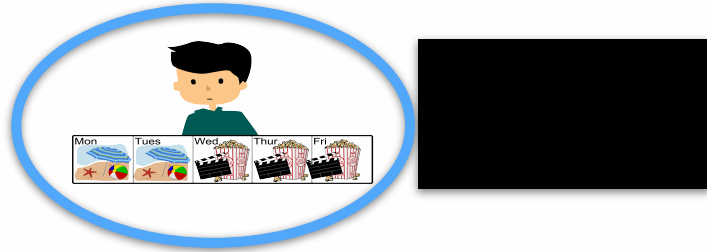
RTs



- For ISIs: same result as R&S
- For DSIs: **novel result**

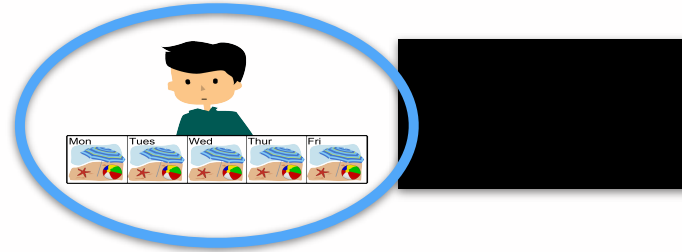
In sum - the pattern

SI acceptance



<

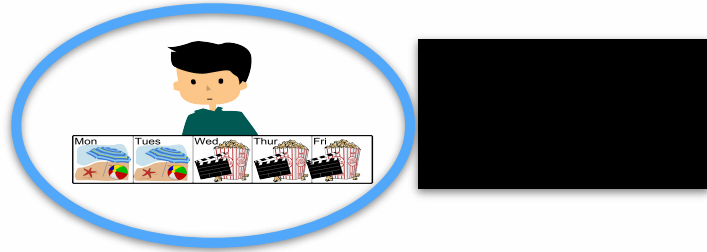
Literal acceptance



John didn't always go to the movies

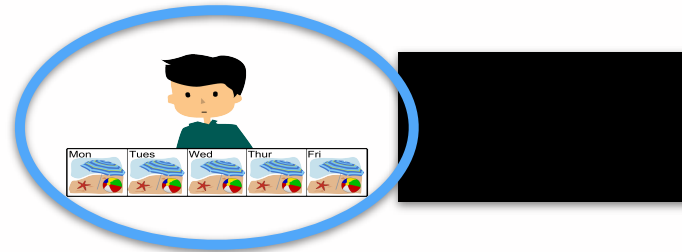
In sum - the pattern

SI acceptance



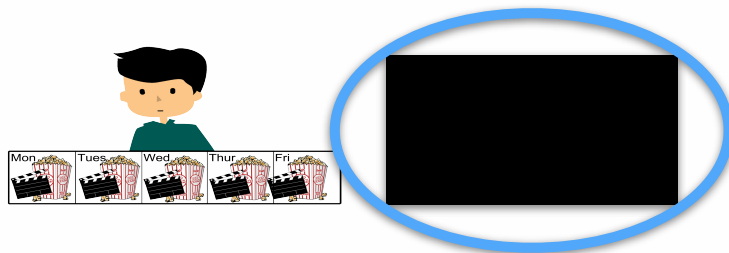
<

Literal acceptance



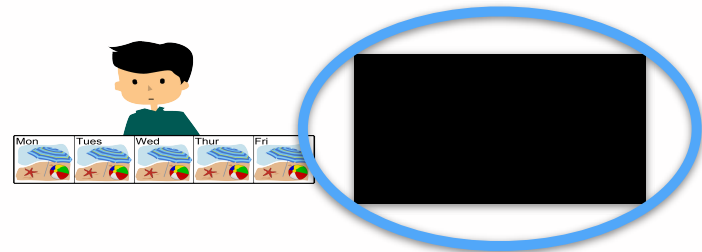
John didn't always go to the movies

False rejection



<

Literal rejection



Discussion

- Reconciling C&C and R&S

Discussion

First result: rejection choices in Literal conditions were *slower* than those in false condition

Discussion

First result: rejection choices in Literal conditions were *slower* than those in false condition

Second result: acceptance choices compatible with SI are *faster* than those only compatible with the literal meaning

Discussion

We agree with C&C's methodological point

Rather than playing with regressing factors

We look at the comparison between ISIs and DSIs from a different angle

Implications

Same pattern of delay/non-delay depending on whether we look at acceptance or rejection

Implications

However it is not clear that a SIs are delayed story can explain the full pattern of results

Discussion

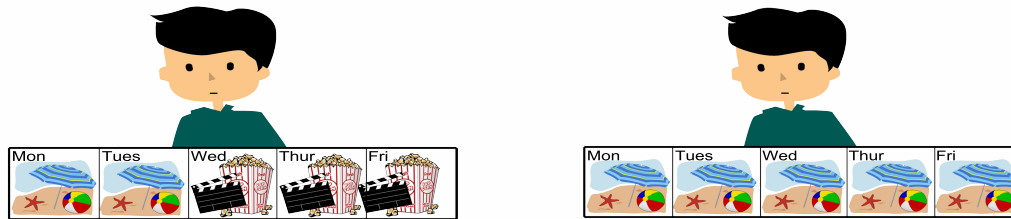
First result: rejection choices in Literal conditions were *slower* than those in false condition

Second result: acceptance choices compatible with SI are *faster* than those only compatible with the literal meaning

Discussion

The **second result** appears incompatible with an account of the **first result** based on delay in the availability of the SI

John didn't always go to the movies



In both cases the literal meaning is true so why should you be faster in the SI-condition?

Back to the questions

- (A) Do RTs yield uniform evidence for a delay of SIs?
- (B) Are DSIs and ISIs uniform in processing?

Back to the questions

(A) Do RTs yield uniform evidence for a delay of SIs?

NO! - it depends on whether you look at acceptance or rejection responses

Back to the questions

(B) Are DSIs and ISIs uniform in processing?

YES! - they exhibit the same pattern of responses

Back to the questions

The uniformity between DSIs and ISIs consistent with uniform treatments

Back to the questions

But we need a different story than SIs are delayed for explaining the pattern in acceptance and rejection responses

Explaining the result

Two pragmatic principles

- Interaction between two pragmatic principles

Two pragmatic principles

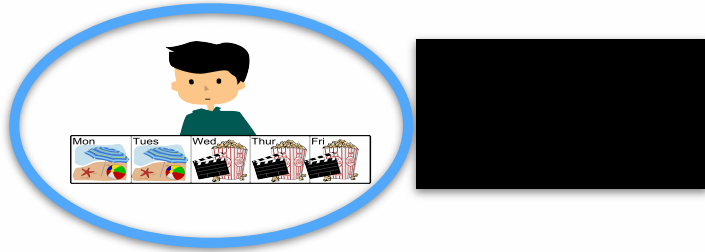
- (Some version of a) Principle of charity:
Construe utterances as true if possible
- Preference for scalar meanings

Hypothesis

- Delay occurs when these two principles conflict

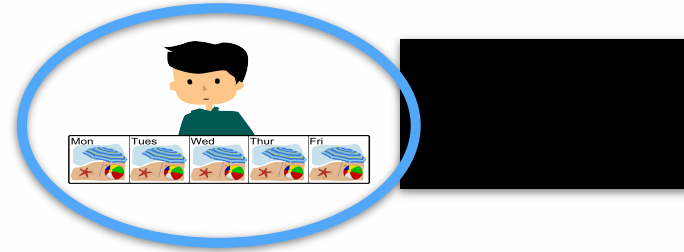
The pattern

SI acceptance



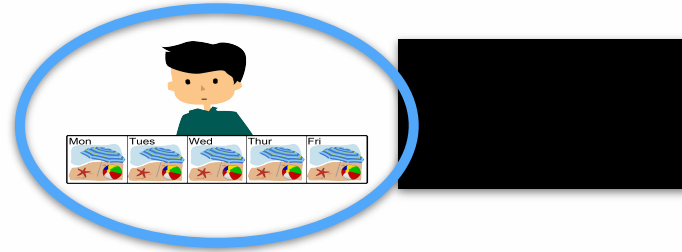
<

Literal acceptance



The pattern

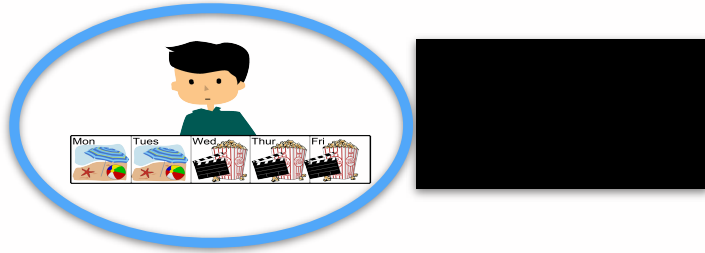
Literal acceptance



In the Literal condition the charity principle is in conflict with the preference for the scalar interpretation

The pattern

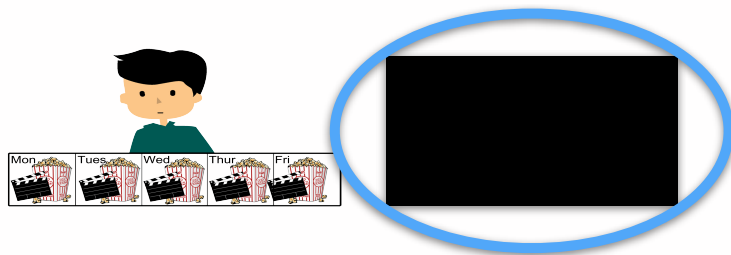
SI acceptance



In the SI condition no conflict between the two principles

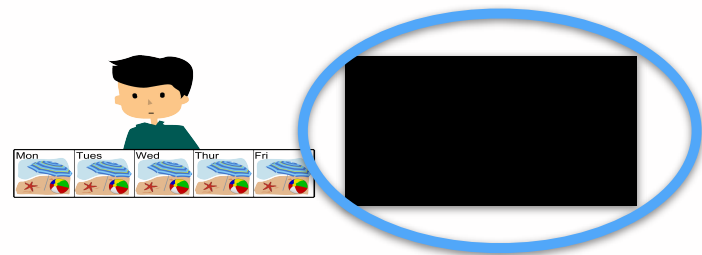
The pattern

False rejection



<

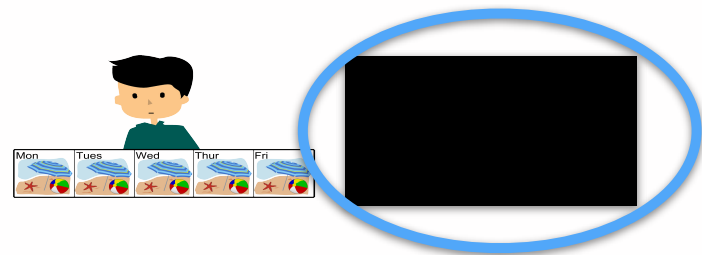
Literal rejection



The pattern

In the Literal condition the charity principle is in conflict with the preference for the scalar interpretation

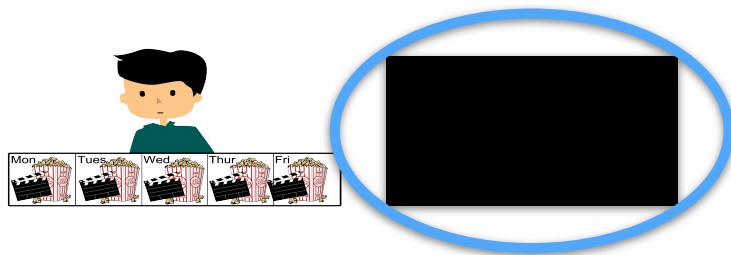
Literal rejection



The pattern

In the false condition no conflict between the two principles

False rejection



In sum

- The processing profile of SIs with RTs has to do more with a conflict between pragmatic principles
- Rather than a delay associated with SIs

Conclusions

The processing of SIs

- Processing of SIs studied extensively
- DSIs found to be associated with a delay in Reaction Times (Bott and Noveck 2004, Chemla and Bott 2013, Bott et al 2012, Cremers and Chemla 2014)

The processing of ISIs

- ISIs have been studied less and with conflicting results

Our experiment

- Comparing the processing of DSIIs and that of ISIIs
- looking at both acceptance and rejection responses

Conclusions

- Reconciling the conflicting results
- the difference appears to be in term of acceptance and rejection

Conclusions

- Acceptance consistent with SI is **faster** than acceptance consistent only with literal meaning

Conclusions

- Rejection based on SI is **slower** than rejection based on the literal meaning alone

Implication

- DSIs and ISIs behave uniformly as expected by standard accounts

Implication

- But then no evidence that scalar implicatures are associated with a delay in RT

Proposal

- The delay arises because of conflict between pragmatic principles

Conclusions & further directions

- Remaining questions
 - explaining B&N and C&C effects with the conflicts of principles story

Conclusions & further directions

- Remaining questions
 - integrating these results with results obtained with other methodologies

Conclusions & further directions

- Comparing DSI vs. ISIs
 - Other processing measures
 - acquisition
 - language disorders

Conclusions & further directions

- Add back presuppositions to the comparison

Thanks!

COLLABORATORS



Others Rosalind Thornton, Kelly Rombough, Dorothy Ann, Emmanuel Chemla, Stephen Crain, Danny Fox, Lynda Kennedy, Clemens Mayr, Raj Singh, Benjamin Spector, Yasutada Sudo, Lyn Tieu