EMERGENCE OF COUNTERFACTUAL REASONING AND LANGUAGE IN CHILD DEVELOPMENT

Nina Kazanina
What is this talk about

- Development of event semantics in children – correspondence between a real-world event and a predicate used to denote it

- **Counterfactual events** - conflict the state of affairs in the actual world
  - exist in someone’s mind and can be described linguistically
  - never took place in the actual world – ‘not real events’
Mary drew a(n) ....
Mary was drawing a bike

- The form *was drawing a bike* (but not *drew a bike*) can describe a counterfactual event, i.e. an event in which no bike gets drawn.
Roadmap

- Can young children represent counterfactual events?
- How do children discover that a linguistic form refers to a counterfactual event
  - Acquisition of Russian Imperfective
  - Acquisition of transfer verbs in English
  - Actuality Bias hypothesis
Mary was drawing a bike
Children understand others’ unfulfilled intentions?

- 18-month olds discern unfulfilled intention/goal behind people’s actions (Meltzoff 1995)

- 3-year-olds use intentions for deciding on the object’s name (Gelman & Ebeling, 1998)

- 3 yr olds use mental verbs like *want* to talk about their own or other people’s fulfilled or unfulfilled desires, intentions or goals (Bartsch & Wellman, 1995).
Children able to entertain counterfactual worlds?

Robinson & Beck (2000)

- Future: What if next time he drives the other way, where will he be?
- Past: What if he had driven the other way, where would he be?

3- & 4-year olds find it more difficult to imagine alternatives to past than future events (see also Perner, Sprung & Steinkogler, 2004; Beck, Robinson, Carooll & Apperly, 2006)
  - NB: do children understand linguistic forms above properly?
Roadmap

- Can young children represent counterfactual events?
- How do children discover that a linguistic form refers to a counterfactual event
  - Acquisition of Russian Imperfective
  - Acquisition of transfer verbs in English
  - Actuality Bias hypothesis
Previous Research on Acquisition of Aspect

- Spontaneous Speech: Russian children produce both aspectual forms appropriately from a very young age (< 2 years) (Gvozdev, 1961; Bar-Shalom & Snyder 2000)
- Picture-matching task (Vinnitskaya & Wexler, 2001)

Mal’čik čital knigu.
*The boy was reading the book.*

Mal’čik pročital knigu.
*The boy read all of the book.*

What about *past incomplete* events?
Experiments 1 & 2: Design

- **Exp 1:** Creation predicates
  - sobiralaľ/ sobralaľп gnomika  ‘assemble a smurf’
  - stroilľ/ postroilп domik  ‘build a house’
  - sostavljalľ/ sostavljalп kartinku  ‘do a puzzle’
  - lepilľ/ vylepilп medvedja  ‘mould a bear’

- **Exp 2:** Change-of-state predicates
  - perevoračivalľ/ perevernulп kartinku  ‘turn over a picture’
  - napolnjalľ/ napolnilп stakančik  ‘fill a glass’
  - razvoračivalľ/ razverнулп podarok  ‘unwrap a gift’
  - zakrašivalľ/ zakrasilп cvetok  ‘color in a flower’

- Russian monolingual children, aged 3-6 (Exp 1: n=25, Exp 2=41)
- 4 stories per child, within-subject design

Kazanina & Phillips 2007
A road with 3 landmarks: a flower-bed, a castle and a tree. There are parts of a smurf at each location. A monkey makes a journey down the road.
Where has the monkey assembled/was the monkey assembling the smurf?
Experiment 1: Results

**Adultlike group, N=8**
83% (24/29)

**Non-adultlike group, N=15**
92% (53/60)
### Experiments 1 & 2: Results

#### Experiment 1 (creation)

<table>
<thead>
<tr>
<th>Group</th>
<th># subjects</th>
<th>% correct</th>
<th>Mean age</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adultlike</td>
<td>8</td>
<td>83% (24/29)</td>
<td>5;2</td>
</tr>
<tr>
<td>Non-adultlike</td>
<td>15</td>
<td>8% (4/50)</td>
<td>4;8</td>
</tr>
<tr>
<td>Other</td>
<td>2</td>
<td>3;8</td>
<td></td>
</tr>
</tbody>
</table>

#### Experiment 2 (change-of-state)

<table>
<thead>
<tr>
<th>Group</th>
<th># subjects</th>
<th>% correct</th>
<th>Mean age</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adultlike</td>
<td>16</td>
<td>89% (50/56)</td>
<td>5;3</td>
</tr>
<tr>
<td>Non-adultlike</td>
<td>20</td>
<td>6% (4/71)</td>
<td>4;2</td>
</tr>
<tr>
<td>Other</td>
<td>5</td>
<td>3;11</td>
<td></td>
</tr>
</tbody>
</table>

**Adultlike Group**: accepted PERF with complete events, IMP with both complete & incomplete events

**Non-adultlike Group**: accepted PERF with complete events, rejected IMP with incomplete events in at least all but one trials

- similar results across creation & change-of-state predicates
- failure not due to the special status of the object of Creation verbs
Russian Imperfective: Children

- Present Ongoing
  - The monkey is building a smurf.
- Past Incomplete (Exp. 1&2)
  - The monkey was building a smurf.

Delidaki & Varlokosta 2003; van der Feest & van Hout 2002
A. **Insider perspective** on the event \( \rightarrow \) IMP/PROG lacks completion entailments

B. Link to the closest relevant **possible world** \( \rightarrow \) an incomplete event gets a full event’s label (Dowty 1979, Landman 1992)
- relate an incomplete event in the actual world \( W \) to a **complete version of the same event** in a certain **non-actual world \( W' \)**
Russian Imperfective: Children

- **Present Ongoing**: The monkey is building a smurf.
- **Past Incomplete (Exp. 1&2)**: The monkey was building a smurf.

**Perspective**: take an insider perspective on the event

- Do nothing
- Shift the perspective back into past
Russian Imperfective: Children

- **Present Ongoing**: The monkey *is building* a smurf.

- **Past Incomplete (Exp. 1&2)**: The monkey *was building* a smurf.

**Possible-world** : find a complete event

- **Non-counterfactual**
  - Stay in the real world and continue the event

- **Counterfactual**
  - Must switch to a non-actual world
The monkey is building a smurf.

The monkey was building a smurf.

While the boy was watering flowers, the girl was cleaning the table.
Experiments 3 & 4: Results

Exp 3: Insider Perspective, non-counterfactual

Exp 4: Insider Perspective, counterfactual

The same children who rejected simple IMP sentences with incomplete events in Experiments 1 & 2, accepted IMP with subparts of events in Experiments 3 & 4
Experiments 3 & 4: Conclusions

- Children know that the IMP can refer to ...
  - subparts of full events [children rejected the PERF sentence => they assessed the matrix verb at the evaluation interval => children know that IMP is true of subparts of the whole event]
  - subparts of events that do not reach completion in the actual world (Exp.4) <=> accept IMP with counterfactual events when a narrow perspective is provided

**IMP/PERF**: While the boy was watering flowers, the girl was cleaning / cleaned up the table.
Exp. 1&2: Past Incomplete  The monkey was building a smurf.

Exp. 3: Perspective, non-counterfactual  While the boy was watering the flowers the girl was cleaning the table.

Exp. 4: Perspective, counterfactual  While the boy was watering the flowers the girl was cleaning the table.
Russian Imperfective: conclusions

→ 3+ year old Russian children know that the IMP can refer to counterfactual events, although their ability to take an insider perspective is not adultlike

→ Important role of perspective in the semantics of the imperfective
Roadmap

- Can young children represent counterfactual events?
- How do children discover that a linguistic form refers to a counterfactual event
  - Acquisition of Russian Imperfective
  - Acquisition of transfer verbs in English
  - Actuality Bias hypothesis
John threw a ball to Mary.
... but Mary didn’t catch it/ but Bill caught it.

- John – agent
- ball - transferred entity
- Mary – recipient

Oehrle, 1976
Jackendoff, 1990
Goldberg, 1995
Rappaport Hovav & Levin, 2008
Demirdache & Martin, 2015
Martin & Schäfer 2015
Ditransitive verbs are not all the same

John threw/sent a book to Mary ...
... but she didn’t catch/receive it. (√)

John gave/handed a book to Mary ...
... but she didn’t get it. (✗)

John sold/passed a book to Mary ...
... but she didn’t buy/get it. (✗)
Sublexical modality (Koenig & Davis, 1995)

- Two components of verb meaning:
  - situational core: categorizes types of relations between participants in situations and the roles these participants play in them
  - sublexical modality: indicates whether these relations are to be held in the actual world $W$ or some possible world $w'$

- $X$ give $Y$ to $Z$: $X$ cause $Z$ be at $Y$
- $X$ throw $Y$ to $Z$: $X$ cause $Z$ go to $Y$
Sublexical modality (Koenig & Davis, 1995)

- Two components of verb meaning:
  - situational core: categorizes types of relations between participants in situations and the roles these participants play in them
  - sublexical modality: indicates whether these relations are to be held in the actual world $W$ or some possible world $w'$

- $X\ give\ Y\ to\ Z$: $X$ cause $Z$ be at $Y$

- $X\ throw\ Y\ to\ Z$: $X$ cause $[w', Z\ go\ to\ Y]$
  - $w'$: a plausible continuation of $R$ in accordance with the Agent’s intentions
Research question

- Are young children aware of sublexical modality of *throw/send*?
Experiment 1

- **Truth Value Judgment task**
  - 25 3 yr olds (mean: 43 months)
  - 28 4 yr-olds (mean: 52 months)

- Throwing/sending events that did not reach the intended recipient because of an external adversity

- The child is asked to judge
  
  **X threw/sent Y to Z**

*Kazanina, Baker, Hood & Seddon (2011, BUCLD Proceedings)*
IR-sentence: Jane threw a ball to Woolly
AR-sentence: Jane threw a ball to Tom
Want-to sentence: Who did Jane want to throw the ball to?
Correct response: Woolly (IR)
Both verbs

<table>
<thead>
<tr>
<th></th>
<th>IR-sentence</th>
<th>AR-sentence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adults</td>
<td>90%</td>
<td>17%</td>
</tr>
<tr>
<td>Children</td>
<td>49%</td>
<td>57%</td>
</tr>
</tbody>
</table>

Children’s data split by verb

<table>
<thead>
<tr>
<th></th>
<th>IR-sentence</th>
<th>AR-sentence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Send</td>
<td>58%</td>
<td>58%</td>
</tr>
<tr>
<td>Throw</td>
<td>41%</td>
<td>56%</td>
</tr>
</tbody>
</table>

‘Actuality Errors’ – children over-accept IR sentences

They impose a successful transfer entailment on *throw* & *send*
**Want-to question**
Who did Jane want to throw the ball to? (Correct: IR)

- Better performance on syntactically more complex *want-to* sentences
- Children can remember the unfulfilled Agent’s intention

**‘Actuality Errors’** – children over-accept IR sentences

They impose a successful transfer entailment on *throw & send*
No correlation between children’s performance in the false beliefs task and on *throw/send*

- Actuality errors are not due to conceptual inability to entertain possible worlds (as also suggested by performance on *want-to* questions)
- **Children’s semantic representation of *throw/send* is non-adultlike**
An alternative explanation

- Children possess an adultlike semantics for *throw* and *send* and able to entertain counterfactual possible worlds but succumb to **interferences from competing representations** (inhibition deficit)
Experiment 2: inanimate Actual Recipient

Jane

Woolly

trees
Jane threw a ball to Woolly

Jane threw a ball to the trees

IR-sentence

AR-sentence

‘ACTUALITY ERRORS’ – children over-accept IR sentences
Why mistakes with *throw/send*?

- **X throw Y to Z**: X **CAUSE** [\(w'\) Z **GO** TO Y]

- **X throw Y to Z**: X **CAUSE** Z **GO** TO Y

- Children correctly represent the situational core for *throw/send*
  (sub-events **CAUSE** and **GO**, event participants, mapping between participants and syntactic positions)

- Problems with **sublexical modality component**: \(w'\)
  absent from the children’s representation
Roadmap

- Can young children represent counterfactual events?
- How do children discover that a linguistic form refers to a counterfactual event
  - Acquisition of Russian Imperfective
  - Acquisition of transfer verbs in English
  - Actuality Bias hypothesis
Actuality Bias

- **Actuality Bias**: children initially construct verb’s semantics without appealing to non-actual worlds

- **Why** such a **linguistic** bias?
  - (given that even very young children are aware of the agent’s mental states)
  - Enables verb learning on the basis of positive evidence
Actuality Bias

- Jill de Villiers (2005): “the child begins with all verbs having the same status, as realis, connected to ongoing events"
  - Verbs of desire (*want*), communication (*say*) and mental activity (*think*): the clausal argument must be assessed in a set of possible worlds

- We extend de Villers’ claim to non-clausal arguments, i.e. modal meanings that are categorical (Rus IMP) or sublexical (*throw/send*)
Do children encounter IMP with incomplete events?

Ded bilIMP-bilIMP – ne razbilPERF
‘The old man was breaking it– did not break’
Do children encounter IMP with incomplete events?

Baba bila\textsuperscript{IMP}-bila\textsuperscript{IMP} – ne razbila\textsuperscript{PERF}

‘The old woman was breaking it – did not break’
Myshka probezhala, xvostikom maxnula, yaichko upalo i razbilos’
‘A mouse ran by, waved her tail, the egg fell and broke’
Roadmap

- Can young children represent counterfactual events?
- How do children discover that a linguistic form refers to a counterfactual event

- Acquisition of Russian Imperfective
- Acquisition of transfer verbs in English
- Actuality Bias hypothesis
Acknowledgements

- Sara Baker (U. of Cambridge)
- Colin Phillips (U. of Maryland)
- Hayley Seddon (Priory Hospital Roehampton)
- Gaetano Fiorin (U. of Utrecht)
- Norman Freeman, Bruce Hood (U. of Bristol)
- Liina Pylkkanen (NYU)

- Alice Mills, Izzy Hearn
- Bristol Cognitive Development Centre
- Children who participated in our study, their parents and teachers