

Referential Opacity: from Theory to Experiments

Hazel Pearson, ZAS Berlin

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Referential Opacity

- Topic: a phenomenon associated with interpretation of nominals in belief reports.
- How is this phenomenon characterized linguistically?
- What is its developmental profile and what does this tell us about theory of mind?

Entities and their properties

- A single entity may have many different properties.
- Take Barack Obama. He is:
 - a former Senator
 - a graduate of Harvard Law School
 - grey-hairedetc.

Entities and their properties

- Some of these properties are possessed by Obama and no-one else.
- Such properties can be referenced using definite descriptions.
- For example, Obama is:
 - the President of the USA
 - the husband of Michelle Obama
 - the person I heard give a speech at Harvard Law School in 2005.

Substitution

- We thus have several definite descriptions that pick out the same individual – Obama.
- Replacement of one description with the other is truth value preserving:
 1. The President of the USA has grey hair.
 2. The husband of Michelle Obama has grey hair.
 3. The person I heard speak at HLS in 2005 has grey hair.

Substitution

- But in belief reports, such substitutions are not always truth preserving.
1. Hazel thinks that **the President of the USA** has grey hair.
 2. Hazel thinks that **the husband of Michelle Obama** has grey hair.
 3. Hazel thinks that **the person she heard speak at HLS in 2005** has grey hair.

Beyond definite descriptions

- Of course, definite descriptions are not the only means at our disposal for picking out individuals:
 1. Hazel thinks that **Barack Obama** has black hair.
 2. Hazel thinks that **he** has black hair.

Beyond definite descriptions

- Situation: It's 2005. I haven't heard of Barack Obama, but I hear him give a speech at Harvard Law School. Since I miss the beginning, I don't find out his name. One of the beliefs I form about the speaker is that he has black hair.
- Hazel thinks that **Barack Obama** has black hair.

De re readings

- Hazel thinks that **Barack Obama** has black hair.

De re reading: True

- (i) Hazel thinks that the man she hears giving the speech has black hair.
- (ii) The man H. hears giving the speech is B.O.
- (iii) Hazel thinks that Barack Obama has black hair.

De dicto readings

- Hazel thinks that **Barack Obama** has black hair.
De dicto reading: False
- Hazel is not disposed to assent to 'Barack Obama has black hair'.

Substitution again

- Previous claim: Substitution is not truth preserving in belief reports.
- Revised claim: Substitution is not truth preserving in belief reports on **de dicto** reading.

Substitution again

1. Hazel believes that **Barack Obama** has black hair.
2. Hazel believes that **the man she hears giving the speech** at HLS has black hair.

De dicto: (1) is false; (2) is true.

De re: (1) and (2) both true.

Referential opacity

- Referential opacity is the failure to preserve truth in attitude reports (on de dicto readings).
- Topic in developmental literature: at what age are children competent with referential opacity?

Referential opacity and theory of mind

- De re reading: nominal interpreted with respect to actual world; from own perspective.
 - De dicto reading: nominal interpreted with respect to belief state of subject; from her perspective.
- ➔ Mature ToM (diagnosed by FB) necessary for success with de dicto reading. Is it sufficient?

Developmental literature

- If mature ToM is sufficient for competence with de dicto reading, this competence should emerge around age 4.
- Is this prediction borne out?

Developmental literature

- Literature varies regarding when children start to show success with referential opacity.

Eg.

4-5 years: Kamawar and Olson 1999; Robinson and Mitchell 1992, 1994; Rakoczy et al. 2014

6-7 years: Russell 1987; Apperly and Robinson 1998, 2003

Apperly & Robinson 1998

- A&R introduced 4 and 5 year olds to an object that was both a dice and an eraser, and a character who knows only that it is a dice.
- Critical question: ‘Does Heinz know there’s an eraser in the box?’
- Controls:
 - ‘Can Heinz see the eraser in the box?’
 - ‘Does Heinz know the dice is an eraser?’

Apperly & Robinson 1998

- Does Heinz know there's an eraser in the box?
De dicto reading: No.
De re reading: Yes.
- Suppose for now that the sentence only has a de dicto reading (perhaps intuitively correct?).
- Then the correct answer is 'no'.

Apperly & Robinson 1998

- Results: 4 year olds (percentage correct)
- Critical question: 'Does Heinz know there's an eraser in the box?' **11%**
- Controls:
 - 'Can Heinz see the eraser in the box?' **100%**
 - 'Does Heinz know the dice is an eraser?' **34%**

Apperly & Robinson 1998

- Results: 5 year olds (percentage correct)
- Critical question: 'Does Heinz know there's an eraser in the box?' 14%
- Controls:
 - 'Can Heinz see the eraser in the box?' 100%
 - 'Does Heinz know the dice is an eraser?' 69%

Apperly & Robinson 1998

Summary

- Referential opacity appears difficult for children, beyond age when they pass false belief task.
- Problem specific to attitude reports; children aren't just excessively liberal w.r.t. substitution.
- Difficulty seems to persist beyond stage at which children can recognize incomplete information of protagonist w.r.t. properties of an object.

Apperly & Robinson 1998

- But wait! How do we know children interpret critical question on de dicto reading?

‘Does Heinz know there’s an eraser in the box?’

- Are the data teaching us about the child’s linguistic competence, or theory of mind (or both)?

Apperly & Robinson 1998

Experiment 2

- Two objects: dice/eraser & eraser, placed in different boxes. Heinz doesn't know that the dice is also an eraser.
- 'Where will Heinz go to find an eraser?'
- 'Does Heinz know that the dice is an eraser?'

Apperly & Robinson 1998

Experiment 2: Results

- Children at chance on predicting where Heinz will look.
- At least some 6 year olds answered correctly.

Interim Summary

- Children show difficulty with reasoning about what a protagonist knows about the properties of an object.
- Can't be explained in terms of overgeneration of de re readings; also manifested in predictions about character's behavior.
- A&R: This suggests difficulty with referential opacity beyond age of success with FB task.

A worry

- Referential opacity has to do with the different descriptions that the attitude holder is disposed to apply to the same object, as determined by the properties that the attitude holder believes the object has.
- Children *can* reason about a protagonist's beliefs about (at least some) properties of an object from age 4 – e.g. object's location.

A worry

- Is there some special class of properties that children have difficulty with (e.g. functions) ?
- This runs the risk of characterizing referential opacity too narrowly.
- E.g. referential opacity effects can arise with properties of objects involving their location.

A worry

- Scenario: John's sock is in the drawer. Mary does not know where John's sock is. She thinks that John's sock smells bad.
 1. Mary thinks that **the thing that's in the drawer** smells bad.
 2. Mary thinks that **John's sock** smells bad.

Rakoczy et al. 2014

- Maybe A&R underestimate younger children's abilities in this domain.
- Simplified task: one object instead of two.
- E.g. soft toy that turns inside out:
bunny/carrot
- Susi does not know that bunny is also a carrot. Sees object being moved from box A to box B in carrot guise.
- 'Where will Susi look for her bunny?'

Rakoczy et al. 2014

Results

- 4-5 year olds show strong competence with task.
- Performance correlated with performance on standard false belief task.
- Suggests there is no difference between FB and referential opacity once tasks matched for complexity.

De re/de dicto again

- Where does this leave us w.r.t. de re/de dicto?
- If Rakoczy et al. are right, children have no greater difficulty reasoning about protagonist's beliefs about identity of object than about beliefs about location (say).

De re/de dicto again

- Still, children might show non-adult like performance w.r.t. belief *reports* that require such reasoning.
- Possible reasons:
 - No de dicto reading in child's grammar.
 - Difficulty with pragmatics of de re/de dicto.
 - De dicto reading harder for child to access.

Future work

- Belief reports with Rakoczy et al.'s simplified scenario.

'Susi thinks that a/the carrot is in Box 1.'

De re: true; De dicto: false

- Research question: at what age does de re/de dicto ambiguity become available?

Future work

- If children prefer de re to de dicto, why?
- Surprising: requires mixing of perspectives; on de dicto reading everything interpreted from subject's perspective.
- Is there a *general* de re preference? Another case: de re vs. **de se**.

Future work: de se/de re

Mary, Bob and John all like baking. Their teacher, Mr. Smith, wanted to know which of them baked the best cookies. He had an idea. Each of them would bake a batch of cookies, and then one of them would taste them and decide which one he or she thought was the best. Mr. Smith would give a prize to whoever's cookie was judged the best.

Future work: de se/de re

Mr. Smith picked Mary to be the judge, and decided that she should wear a blindfold for the tasting so she wouldn't know whose cookie was whose. When Mary tasted her own cookie, she couldn't tell that it was hers. She said, 'This is the best cookie. Whoever baked this cookie deserves the prize.'

Future work: de se/de re

Sam had been keeping track of who made which cookie, so that he could go and tell the results to Mr. Smith. He went to Mr. Smith and said, '**Mary claimed that she deserves the prize.**'

Question:

Is what Sam said to Mr. Smith true?

Future work: de se/de re

- ‘Mary claimed that **she** deserves the prize.’

De re: True

- (i) Mary claimed that the person who baked the cookie deserves the prize.
- (ii) Mary is the person who baked the cookie.
- (iii) Mary claimed that she deserves the prize.

Future work: de se/de re

- ‘Mary claimed that **she** deserves the prize.’

De se: False

Mary did not assent to ‘I deserve the prize.’

Do children show preference for de re reading here too? (Ongoing work with Tom Roeper.)

Conclusion

- A mismatch between referential opacity as studied in developmental literature vs. linguistic and philosophical literature.
- Developmental literature: focus on objects with 'dual identity' – but *anything* can yield referential opacity, which is a property of our mental states and not of the objects per se.

Conclusion

- This focus on a class of cases that is narrower than linguistic data suggests calls for justification.
- Is there independent reason to think that it has a special cognitive status?
- Do dual identity objects even behave like other objects w.r.t. referential opacity?
- The carrot is orange. / The bunny is orange.