Centering Theory

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Roadmap

- Centering Theory
  - Aim
  - Centers
  - Transitions
  - Rules: Rule 1 and Rule 2

- Rule 2
- Rule 1
- Some other issues
Aim of Centering

Centering is intended as “a theory that relates focus of attention, choice of referring expression, and perceived coherence of utterances within a discourse segment”. (Grosz, Joshi and Weinstein 1995:204)

- Focus of attention: who is being talked about
- Form of referring expressions: e.g. pronoun vs. full NP
- Discourse coherence vs. inferential complexity: measured in terms of perceived coherence and processing load
Aim of Centering

- For example, it seeks to explain the difference in perceived coherence between the anaphora resolution in (1) and (2):

  (1) a. Jeff helped Dick wash the car.
      b. He washed the windows as Dick waxed the car.
      c. After a while he got tired.

  (2) a. Jeff helped Dick wash the car.
      b. He washed the windows as Dick waxed the car.
      c. After a while he got tired.
Centers are semantic entities (= discourse referents in DRT) that are part of the discourse model for each utterance in a discourse segment.

**FORWARD-LOOKING centers:**

\[ \text{Cf}(U_i,D) = \text{the set of discourse entities evoked by an utterance } U_i \text{ in a discourse segment } D. \]

The entities in Cf are ranked according to discourse salience.

**BACKWARD-LOOKING center:** a special member of \( \text{Cf}(U_i,D) \), the one that \( U_i \) most centrally concerns, the ‘topic’ of \( U_i \).

\[ \text{Cb}(U_i,D) = \text{the highest ranked element of } \text{Cf}(U_{i-1},D) \text{ realized in } U_i. \]

**PREFERRED center:**

\[ \text{Cp}(U_i,D) = \text{the highest ranked element of } \text{Cf}(U_i,D). \]

\( \text{Cp} \) represents a prediction about the \( \text{Cb} \) of the following utterance.
Centers 2/3

- Cf Ranking for salience in English (Brennan et al. 1987):
  Subject > Object > Other
Question 1: Specify the Cf, Cp and Cb for each sentence U of the following discourses.

(1)  
  a. John was walking down the street.  
  b. John saw Bill.  
  c. John waved at Bill.  

(2)  
  a. John was walking down the street.  
  b. John saw Bill.  
  c. Bill smiled at John.
Based on the distribution of centers, a typology of transitions from $U_{i-1}$ to $U_i$ is defined that can be used to measure the coherence of a discourse segment in which $U_{i-1}$ and $U_i$ occur.

Two factors:
- Whether the backward-looking center, $C_b$, is the same from $U_{i-1}$ to $U_i$, and
- Whether this discourse entity is the same as the preferred center $C_p$ of $U_i$. 
Transitions 2/8

<table>
<thead>
<tr>
<th>Condition</th>
<th>Description</th>
<th>Right Condition</th>
</tr>
</thead>
</table>
| \( C_b(U_{i-1}) = C_b(U_i) \)  
\[ \text{ or } C_b(U_{i-1}) = [?] \] | \( C_b(U_{i-1}) \neq C_b(U_i) \)        |
| \( C_b(U_i) = C_p(U_i) \)     |                                          |
| \( C_b(U_i) \neq C_p(U_i) \) |                                          |
## Transitions \(3/8\)

<table>
<thead>
<tr>
<th></th>
<th>(\text{Cb}(U_{i-1}) = \text{Cb}(U_i))</th>
<th>(\text{Cb}(U_{i-1}) \neq \text{Cb}(U_i))</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(\text{Cb}(U_i) = \text{Cp}(U_i))</td>
<td>\text{CONTINUE}</td>
</tr>
</tbody>
</table>
**Transitions 4/8**

<table>
<thead>
<tr>
<th>Case</th>
<th>Rule</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>$Cb(U_{i-1}) = Cb(U_i)$</td>
<td>[ or $Cb(U_{i-1}) = [?]$ ]</td>
<td>$Cb(U_{i-1}) \neq Cb(U_i)$</td>
</tr>
<tr>
<td>$Cb(U_i) = Cp(U_i)$</td>
<td>CONTINUE</td>
<td></td>
</tr>
<tr>
<td>$Cb(U_i) \neq Cp(U_i)$</td>
<td>RETAIN</td>
<td></td>
</tr>
</tbody>
</table>

**RETAIN:**
The speaker has been (in $U_{i-1}$) and is (in $U_i$) talking about a particular entity, but he is intending to shift to a new entity in the next utterance ($U_{i+1}$) and is signalizing this by realizing the current $Cb$ in a lower-ranked position of the $Cf$. 

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SHIFTS:
The speaker has shifted from the Cb entity in $U_{i-1}$ to a new Cb entity in $U_i$. If this new entity is realized as Cp of $U_i$, then this signals that the speaker intends to continue talking about this entity and this is a SMOOTH-SHIFT. If it is not the Cp of $U_i$, then it is a ROUGH-SHIFT.
Transitions 6/8

Transition examples:

(3) a. John’s been having a lot of trouble arranging his vacation.

| Cb: ? | Cf: [ j, vacation] | -------- |

b. He cannot find anyone to take over his responsibilities.

| Cb: j | Cf: [ j, responsibilities ] | CONTINUE |
c. He called up Mike yesterday to work out a plan.
   \[\text{Cb: } j \quad \text{Cf: } [j, \ m, \ \text{plan}] \quad \text{CONTINUE}\]

d. Mike gave him some good advice.
   \[\text{Cb: } j \quad \text{Cf: } [\ m, \ j, \ \text{advice} ] \quad \text{RETAIN}\]

e. He told John to talk to his boss.
   \[\text{Cb: } m \quad \text{Cf: } [\ m, \ j, \ \text{boss} ] \quad \text{SMOOTH SHIFT}\]
Transitions 8/8

- **Question 2**: Give example of ROUGH-SHIFT.
- **Question 3**: Analyze the transitions of the discourse below under each of the alternative continuations (c.i)-(c.iv).

1. a. John was walking down the street.
   b. He (=John) saw Bill.
   c.i. He (=John) waved at him (=Bill).
   c.ii. He (=Bill) smiled at him (=John).
   c.iii. He (=Bill) stood next to a little girl.
   c.iv. A little girl stood next to him (=Bill).
Rules

For each $U_i$ in a discourse segment $D$ consisting of utterances $U_1, \ldots, U_m$:

- Rule 1: If some element of $Cf(U_{i-1}, D)$ is realized as a pronoun in $U_i$, then so is $Cb(U_i, D)$.

- Rule 2: Transition states are ordered. The CONTINUE transition is preferred to the RETAIN transition, which is preferred to SMOOTH-SHIFT, which is preferred to the ROUGH-SHIFT.
Roadmap

- Centering Theory
- Rule 2
  - Rule 2 and discourse coherence
  - Rule 2 and anaphora resolution
- Rule 1
- Some other issues
Rule 2

- Rule 2: CONTINUE > RETAIN > SMOOTH-SHIFT > ROUGH-SHIFT
- Recall Cf Ranking for salience in English: Subject > Object > Other
- Cf ranking in Japanese: Topic > Empathy > Subject > Object(s) > Others
Rule 2 and discourse coherence

Consider the difference in perceived coherence between (1) and (2):

(1) a. Jeff helped Dick wash the car.
   b. He washed the windows as Dick waxed the car.
   c. He soaped a pane.

(2) a. Jeff helped Dick wash the car.
   b. He washed the windows as Dick waxed the car.
   c. He buffed the hood.
Rule 2 and discourse coherence

(1) a. Jeff helped Dick wash the car.

Cb: ?
Cf: [ j, d, car ]

b. He washed the windows as Dick waxed the car.

Cb: j
Cf: [ j, windows, d, car ]

CONTINUE

c. He soaped a pane.

Cb: j
Cf: [ j, pane ]

CONTINUE
Rule 2 and discourse coherence

(2) a. Jeff helped Dick wash the car.

Cb: ?
Cf: [j, d, car]

b. He washed the windows as Dick waxed the car.

Cb: j
Cf: [j, windows, d, car]

CONTINUE

c. He buffed the hood.

Cb: d
Cf: [d, hood]

SMOOTH-SHIFT
Rule 2 and anaphora resolution

(4) a. Taroo bought a new computer.
   \[ \text{Cb: ?} \quad \text{Cf: [ t, computer ]} \quad \text{--------} \]

   b. (He) showed it at once to John.
   \[ \text{Cb: t} \quad \text{Cf: [ t, j, computer ]} \quad \text{CONTINUE} \]

   c. \(\emptyset\emptyset\) atarasiku sonawatta kinoo o setumeisimasita
   SUBJ OBJ2 newly equipped function OBJ explained
   ‘(He) explained the newly equipped functions to (him)’

Question 4: Depending on how we resolve the null SUBJ and OBJ2 pronouns, we get a transition or another. What are the choices?
Rule 2 and anaphora resolution

(4) a. Taroo bought a new computer.
   \[
   \begin{array}{|c|c|}
   \hline
   \text{Cb: } & ? \\
   \text{Cf: } & [t, \text{ computer }] \\
   \hline
   \end{array}
   \]

b. (He) showed it at once to John.
   \[
   \begin{array}{|c|c|}
   \hline
   \text{Cb: } & t \\
   \text{Cf: } & [t, j, \text{ computer }] \\
   \hline
   \end{array}
   \]
   CONTINUE

(He) explained the newly equipped functions to (him)

If interpreted as ‘Taroo explained them to John’:

\[
\begin{array}{|c|c|}
\hline
\text{Cb: } & t \\
\text{Cf: } & [t, j, \ldots] \\
\hline
\end{array}
\]
CONTINUE
Rule 2 and anaphora resolution

(4) a. Taroo bought a new computer.

| Cb: ? | Cf: [ t, computer ] | -------- |

b. (He) showed it at once to John.

| Cb: t | Cf: [ t, j, computer ] | CONTINUE |

c. (He) explained the newly equipped functions to (him)

If interpreted as ‘John explained them to Taroo’:

| Cb: t | Cf: [ j, t, … ] | RETAIN |
Rule 2 and anaphora resolution

When interpreting (4c): (Walker et al. 1994)

- 27 subjects preferred the CONTINUE pronoun resolution
- 1 subject preferred the RETAIN pronoun resolution

In sum, the proposed ranking of transition types is empirically supported by intuitions about perceived coherence and by data on pronoun resolution.
Roadmap

- Centering Theory
- Rule 2
- Rule 1
  - Example
- Some other issues
Rule 1

If some element of $\text{Cf}(U_{i-1}, D)$ is realized as a pronoun in $U_i$, then so is $\text{Cb}(U_i, D)$. 
Rule 1

- Acceptable, coherent discourse segment:
  (5) a. Susan gave Betsy a pet hamster.
     b. She reminded her that such hamsters are quite shy.
     c. Betsy told her that she really liked the gift.

- For many people, unacceptable discourse segment:
  (6) a. Susan gave Betsy a pet hamster.
     b. She reminded her that such hamsters are quite shy.
     c. She told Susan that she really liked the gift.

Question 5: Explain why.
Rule 1

- Acceptable, coherent discourse segment:
  (5) a. Susan gave Betsy a pet hamster.
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- For many people, unacceptable discourse segment:
  (6) a. Susan gave Betsy a pet hamster.
      b. She reminded her that such hamsters are quite shy.
      c. She told Susan that she really liked the gift.

Some element of Cf(U_{i-1},D) is realized as a pronoun in U_i, …

… but Cb(U_i,D) is not realized as a pronoun in U_i!
Roadmap

- Centering Theory
- Rule 2
- Rule 1
- Other issues
Some other issues

- Crosslinguistic research on Cf ranking.
- Form of reference
  - When a Cb is realized as a non-pronominal expression, it does more than just refer.
    
    1. My dog is getting quite obstreperous. I took him to the vet the other day. *The mangy old beast* always hates these visits.
  - In Italian, typically, a null pronoun signals a CONTINUE and a strong pronoun signals a RETAIN or a SHIFT. (Di Eugenio)
- Interaction of centering and starting a new segment.