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Local Coherence in Stream-of-Consciousness Discourse: A Centering Approach

ZHAO Wei[a],*

[a]School of Foreign Languages & Literature, Shandong Normal University, Ji'nan, China.
*Corresponding author.

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Abstract

An evaluation metric comprising a battery of five-test criteria other than the standard Centering of "salience" and "cohesion" and Kibble's version of "cohesion", "salience", "cheapness" and "no backward-looking center" is developed in this paper to involve "coherence", "salience", "cheapness", "cohesion" and "no backward-looking center" in measuring the degree of coherence of different transition sequences in stream-of-consciousness (SOC) discourse on the premise of the distinction between coherence and cohesion. The addition of "coherence" and the distinction between lexical cohesion and cognitive and/or pragmatic coherence are crucial to the characterization of coherence in stream-of-consciousness discourse, which the Rule 2 of standard Centering cannot adequately capture. Cohesion mainly dwells upon semantic relatedness between two backward-looking centers, which can be resolved in frame semantics. Coherence cares more about relatedness between two backward-looking centers motivated by cognitive and/or pragmatic factors. In other words, two backward-looking centers may be semantically unrelated, but they strike up a relation with each other either temporarily or permanently due to cognitive and/or pragmatic factors.

Key words: Centering theory; Transition rules; Cohesion; Coherence; Evaluation metric

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INTRODUCTION

Centering Theory, one of formally more explicit theories of anaphora resolution, in spite of its limitations, has attracted a growing amount of attention from some researchers (e.g., Grosz, Joshi, & Weinstein, 1983, 1995; Joshi & Kuhn, 1979; Joshi & Weinstein, 1981; Miltsakaki, 1999, 2002, 2007; Strube & Hahn, 1999) and acquired wide applications in various subfields of linguistics. These studies are mostly devoted to capturing transitions across pairs of utterances with the backward-looking center (Cb) realized as pronouns or zero pronouns in naturally occurring discourse. Less attention is paid to how to describe transitions across utterances with the typical backward-looking center—bridging anaphora (BA) in stream-of-consciousness discourse, in which the interior monologue segment is characterized by associative leaps in syntax and narrative non-linearization. Cb realized as bridging full noun phrases (FNP) and elliptical zero pronouns (EZP) across discourse segment boundaries or between two adjacent utterances seem incoherent, but they are actually coherent in the reader's mind, which defies the intuition of standard Centering Theory. Given Centering's exact predictions for pronoun resolution, it can be well suited to handling bridging anaphora as part of more comprehensive discourse theories if some revisions are made with the transition rules.

1. TRANSITION SEQUENCES AND LOCAL COHERENCE

There has been a controversy about whether Centering applies to single transitions or to pairs of adjacent utterances. Although Rule 2 is originally formulated in terms of sequences of utterances, many applications of this rule to discourse processing algorithms have restricted the rule to pairs of utterances, as formulated in (1).

(1) Transition states are ordered. The CONTINUE transition is preferred to the RETAIN transition, which is preferred to the SMOOTH -SHIFT transition, which is preferred to the ROUGH-SHIFT transition.

Centering transitions can also be defined as follows in terms of two constraints, i.e., cohesion and salience (Kibble, 2001):

CONTINUE: cohesion and salience both hold; same center (or Cb (U_n) undefined), realized as Subject in U_{n+1};
RETAIN: cohesion only; i.e., center remains the same but is not realized as Subject in U_{n+1};
SMOOTH SHIFT: salience only; center of U_{n+1} realized as Subject but not equal to Cb (U_n);
ROUGH SHIFT: neither cohesion nor salience holds.
NO CB: this transition is used by some researchers but not discussed by GJW.

These uses of Rule 2 fail to capture the intuition that what matters to coherence are centering TRANSITIONS throughout a segment, not only between pairs of utterances. It is, however, easier to evaluate coherence between a pair of utterances than over a whole segment (Grosz & Sidner, 1998, p.48). A somewhat intermediate approach is taken by Di Eugenio (1998) and Turan (1995), who are concerned with certain pairs of TRANSITIONS (e.g., CON-CON, RET-CON, SHIFT-CON).

Rule 2 "reflects our intuition that continuation of the CENTER and the use of retentions when possible to produce smooth transitions to a new CENTER provide a basis for local coherence" (Grosz, Joshi, & Weinstein, 1995, p. 215). This implies that the CON-RETAIN-SHIFT sequence is a valid way for CENTER movement. The rule also predicts that certain sequences produce a higher inference load upon the reader than others. The CON-CON sequence is predicted to require a lower inferencing cost than the RET-RET or the SHIFT-SHIFT sequence. The CON-SHIFT sequence is hypothesized to be more costly than the CON-RETAIN sequence. Therefore, the present paper is intended to follow the TRANSITION-sequence approach to coherence-driven preferences, rather than the single-TRANSITION approach as proposed by Brenann, Friedman, and Pollard (1987).

Rule 2 claims that some transitions between utterances are more coherent than others by stipulating that these transitions are preferred over others. And maximally coherent segments are those that require less processing time. However, Matusi (2000) suggests that coherent segments require cognitive efforts worth its contextual effects. Actually it can be assumed that as measuring coherence is based on an estimate of the hearer's inference load, relative to other choices the speaker has as to how to realize the same propositional content. That is to say, to take the reader's inference load into account is predicated on the involvement of contextual effects. Put differently, a coherent reading between utterances has in effect been defined implicitly in standard Centering. This means coherence is the contextual effects readers finally achieve via cognitively/pragmatically inferential efforts. Therefore, while still under the spirit of Centering, the three criteria of evaluation metric of entity coherence proposed by Kibble (2001) can be extended with the addition of another criterion of "Coherence" presupposed in Centering but never explicitly stated. The mechanism of measuring coherence of transition types remain the same, the difference is that the aspect of coherence is given a more due emphasis than in the original Centering. We have mentioned that in previous work (Taboada & Zabala, 2008), Rule 2 of Centering is fragile, and in corpus work, it has applied mostly to the two extremes. In other words, CONTINUE is always the most preferred transition, whereas ROUGH SHIFT is the least preferred, to the point of being non-existing in some studies. Centering as a "parametric theory", it allows for "parameter" setting according to text type, language and tasks (Poesio et al., 2004). That being the case, it should also allow for analysis-by-analysis setting so that it can best suit the objectives of particular applications of the theory. Some notions and definitions in Centering, for example, parameters are left unspecified, and rules are provided as preferences, rather than as hard rules. This has spurred much subsequent work to make further specifications, reformulations and extensions of the theory (inter alia, Walker, Iida, & Cote, 1994; Strube & Hahn, 1999; Kibble, 2001). Hence, we can believe that a five-way distinction of transition sequences proposed in this paper seems to better capture coherence in SOC discourse, and the continuum between obeying one and another. We simply suggest that the strict hierarchy be changed to a relaxed ranking, with CONTINUE and ROUGH SHIFT at the edges, and with a ranking of degree of coherence between $COHESIVE_1$, $COHESIVE_2$, RETAIN and SMOOTH SHIFT in a descending order. Rule 2 would be reformulated as follows:

CONTINUE > $COHESIVE_1$ > $COHESIVE_2$ > REAIN > SWIFT SHIFT > ROUGH SHIFT

Following Fais (2004), the transition types in SOC discourse can be defined as below:

For the purpose of judging discourse coherence, we intend to examine the scale showing that certain combinations are preferable to others. Considering adjacent transition pairs as an indicator of validity of utterance combination, the six centering transitions can be combined with each other as a pair to produce thirty-six types of transition sequence patterns, which are listed below:

Table 1
Transition Definitions in Stream-of-Consciousness Discourse

	Cb (Ui) = Cb (Ui-1) OR Cb (Ui -1) = ? and Cb (Ui)! = ?	Cb (Ui)!= Cb (Ui-1)	Cb (Ui) = ?	
Cb (Ui) = Cp (Ui)	CONTINUE	SMOOTH SHIFT	COHESIVE1 (mereologically)	Cb (Ui)≈Cb (Ui-1)
			COHESIVE2 (frame-related)	Cb (Ui)≈Cb (Ui-1)
Cb (Ui)!=Cp (Ui)	RETAIN	ROUGH SHIFT		

Table 2
Thirty-Six Types of Transition Sequence Patterns in Stream-of-Consciousness Discourse

CON-CON	COH_1-CON	COH_2-CON	RET-CON	SSH-CON	RSH-CON*
CON-RET	COH_1-RET	COH_2-RET	RET-RET	SSH-RET	RSH-RET*
CON-SSH	COH_1-SSH	COH_2-SSH	RET-SSH	SSH-SSH	RSH-SSH*
CON-COH_1	COH_1-COH_1	COH_2-COH_1	RET-COH_1	SSH-COH_1	RSH-RSH*
CON-COH_2	COH_1-COH_2	COH_2-COH_2	RET-COH_2	SSH-COH_2	RSH-COH_1*
CON-RSH*	COH_1-RSH*	COH_2-RSH*	RET-RSH*	SSH-RSH*	RSH-COH_2*

2. TOWARDS AN EVALUATION METRIC

Centering provides us with the basic guidelines that correspond to our intuitions about the entity-based coherence of a segment, but does not define a formal evaluation metric on its own which is adapted to SOC discourse. Hence, this paper is intended to revise Kibble and Power's (2000) metric and use the principles that lie behind Centering to estimate the overall entity-based coherence of a segment in SOC discourse. We argue that different weightings for each type of constraints are specified. Each criteria of entity-based coherence is viewed as a ranked violable constraint in the sense of Optimality Theory (Prince & Smolensky, 1997). The system evaluates candidate solutions by applying a battery of evaluation metrics to each transition sequence. Each evaluation metric is supposed to identify whether the transition sequence is subject to a particular defect. For each type of defect a weight is specified indicating its importance. Summing the weighted costs for all defects, a total cost for the solution is obtained. The transition sequences are ranked in terms of the total cost in an ascending order.

Kibble and Power (2000) suggest, in evaluating continuity of reference, the defect "No Cb", for example, might be regarded as more significant (that is, more highly ranked) than other defects such as "coherence", "cheapness", "salience" in rank of significance. As indicated by the asterisks in the following table, each transition types are assigned different weightings against the four constraints listed above. For instance, CON-CON transition sequence is the optimal structure since it violates none of the four constraints, and SHIFT-SHIFT transition sequence violates all of them with other transition sequences in between. In general, Kibble and Power (2000) seems to be a very good starting point for any attempt to implement Centering for natural language generation.

There is one thing we should bear in mind that there exist revealing differences between coherence and cohesion. On the one hand, for a set of utterances to be a discourse, it must exhibit coherence. Coherence, however, is a cognitive state; it is not in the language itself, but is rather perceived by language users, who unite utterances into a coherent representation of discourse via cognitive and/or pragmatic efforts. On the other, these utterances may contain linguistic devices that can help the speaker/writer and the hearer/reader in establishing coherence. The speaker/writer may utilize such linguistic devices, called cohesion, and the hearer/reader recognizes them, to establish coherence in discourse, often supplemented by their different knowledge sources of the world. The recognition of cohesion in the linguistic input leads to a better perception of coherence or a more coherent mental representation of the discourse, and hence to better comprehension. However, this alone is not sufficient. Comprehension is a complex cognitive process that also involves extensive inferential processes drawn on the linguistic, situational and encyclopedic knowledge as well as on memory for the preceding discourse. Inferencing that takes place in the comprehension process is the second major mechanism in creating coherence, after cohesion. Inferencing can be defined as involving any piece of information not explicitly stated in a discourse, which is however required to establish a coherent mental representation of the SOC discourse. To sum up, cohesion is more concerned with formal aspect of language, whereas coherence is more motivated by cognitive and/or pragmatic inferencing evoked by and built on language form. And the form of language can in turn predict the inferencing cost it entails and markedness of a message and a situation.

Therefore, another constraint can be added to the original 4-test criteria proposed by Kibble and Power

(2000). As a result, there are 5-test criteria with all weights equal to 1:

1. No Cb (U_n), that is, there is no common referent between (U_n) and (U_{n-1}).
2. Coherence violation: Cb (U_n)!≈Cb (U_{n-1}).
3. Cheapness violation: Cb (U_n)!=Cp (U_{n-1}).
4. Salience violation: Cb (U_n)!=Cp (U_n).
5. Cohesion violation: Cb (U_n)!=Cb (U_{n-1})

Table 3
Transition Sequence Types and Five Constraints in Stream-of-Consciousness Discourse

Constraints	No Cb	Coherence Cb(Un)!≈Cb(U_{n-1})	Cheapness Cb(Un)!=Cp(U_{n-1})	Salience Cb(Un)!=Cp(U_n)	Cohesion Cb(Un)!=Cb(U_{n-1})	weights
Transition sequences						
CON-CON						0
CON-COH_1			*			1
CON-COH_2			*		*	2
COH_1-COH_1			*		*	2
COH_1-COH_2			*		*	2
COH_1-CON						0
RET-CON			*			1
SSH-CON						0
RET-SSH	*		*		*	3
CON-RET			*	*		2
RET-RET			*	*		2
RET-COH_1			*		*	2
CON-SSH			*		*	2
COH_1-RET				*		1
COH_1-SSH	*		*		*	3
RET- COH_2			*		*	2
SSH-COH_1					*	1
SSH-COH_2			*		*	2
SSH-RET				*		1
SSH-SSH	*	*	*		*	4
COH_2-CON						0
COH_2-RET				*		1
COH_2-SSH		*	*		*	3
COH_2-COH_1			*		*	2
COH_2-COH_2					*	1

According to the evaluation metric formulated above, 25 transition sequences can be ranked in terms of degree of coherence in a descending order below:

CON-CON>COH_1-CON>SSH-CON > COH_2-CON>CON-COH_1>RET-CON> COH_1-RET > SSH-RET >COH_2-RET>SSH-COH_1>COH_2-COH_2>CON-RET>RET-RET>CON-COH_2>COH_1-COH_1>COH_1-COH_2>SSH-COH_2>RET-COH_1>CON-SSH>RET-COH_2>COH_2-COH_1>COH_2-SSH>RET-SSH>COH_1-SSH>SSH-SSH (> indicates precedence)

CONCLUSION

We have employed mereological or frame relatedness between bridging centers to supplement the standard inventory of transitions with well-defined transition types that more accurately characterize the nature of coherence in SOC discourse. The proposed transition types provide a characterization of a previously unaccounted-for situation in Centering, namely, the coherence of utterance sequences containing bridging Cbs. This is a crucial improvement over the standard model because the number of inexplicit Cbs plays a very critical part in some genres such as SOC discourse, a portion of the discourse undescribed in

standard centering. The combination of constraints, rules and transition states makes a set of predictions about which interpretations hearers will prefer.

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