

# Accented Pronouns and Unusual Antecedents: A Corpus Study

Anubha Kothari

Department of Linguistics  
Stanford University  
Stanford, CA 94305-2150  
anubha@stanford.edu

## Abstract

Accent on a pronoun has often been assumed to signal an “unusual” antecedent, i.e. something other than the most salient compatible antecedent. However, this assumption has not received adequate empirical investigation to date, and in particular, spontaneous conversational dialogues have never been studied to verify the saliency-based proposals. I analyze a richly annotated corpus of naturalistic speech, manually labeled for coreference relations, accents, and contrast, in order to understand what factors govern the presence of accent on a pronoun and thereby gain insight into what pronominal accent may be communicating. The results suggest that not only are differences among speakers and pronouns key components in explaining the variation in pronominal accentuation, but also that pronominal accent may often be signaling contrast rather than something about the attentional status or saliency of the pronoun’s referent.

## 1 Introduction

One phenomenon in which prosody is often assumed to play a disambiguating role is anaphora resolution. In particular, many have proposed that the presence of accent on a pronoun is a signal that the pronoun has an “unusual” antecedent, not the maximally salient compatible discourse referent, which is what an unaccented pronoun would normally refer to (Ariel, 1990; Cahn, 1995; Gundel et al., 1993;

Kameyama, 1999; Nakatani, 1997). The following pair illustrates this reference-switching effect:<sup>1</sup>

- (1) a. John hit Bill. Then he hit Mary. (*John hit Mary.*)  
b. John hit Bill. Then HE hit Mary. (*Bill hit Mary.*)

In (1a), *John* is the topic or maximally salient entity from the first sentence by virtue of being subject, and serves as the continuing topic and referent of *he* in the second sentence. In (1b), however, the accent signals a topic shift, indicating that the pronoun’s referent is lower in a saliency-ranked list of entities, which in this case forces it to be *Bill*. Thus, under such theories, the choice of an accented pronoun as a referring expression is linked directly to the attentional or cognitive status of the referent.

However, aside from analysis of short constructed discourses such as these, the attentional theories have seen very little empirical evaluation using longer, naturally-produced discourses. For applications that produce or comprehend naturalistic speech, it is crucial to understand what is being communicated by accent on a coreferential pronoun and what factors govern its presence, thereby also testing whether accent truly is a robust cue to “unusual” resolution. For instance, accent may instead be conveying contrast between the actual referent and the expected referent, a potential confound that has not been investigated in any study.

In this paper, I address these questions using a richly annotated corpus of spontaneous conversational speech, manually labeled for coreference relations, pitch accent, and contrast. Using logistic regression, I explore the usefulness of various factors

<sup>1</sup>Capitals indicate a pitch accent, in all examples here.

reflecting properties of the antecedent or of the pronoun itself in predicting the presence of accent on coreferential pronouns. Previous studies addressing these same questions have not had access to as large and ideal a corpus as the one I make use of here, and relatedly, have ignored various factors or could not arrive at statistically significant conclusions.

The rest of the paper is structured as follows: In Section 2, I summarize the relevant theoretical and experimental work to date on how prosodic prominence may affect anaphoric relationships. Section 3 describes the corpus and the features extracted from it. Section 4 presents the statistical models using these features and their analysis. The fifth section discusses the results more generally, and the final section lists the conclusions of this study.

## 2 Background

Accents tend to accompany information that is new in the discourse (Brown, 1983), so their presence on pronouns, words that stand for given and highly accessible information, is surprising. This has led to the hypothesis that pronominal accent is somehow special, and (based on examples like the one above) that it has an attentional function. For instance, in Gundel et al.'s (1993) Givenness Hierarchy, stressed pronouns are said to align with a referent that is 'activated' but not 'in focus'. Centering Theory (Grosz et al., 1995), however, has been the primary framework in which accented pronouns have been examined. Within this approach, Kameyama (1999) proposes that at least two linguistic hierarchies are relevant in ranking entities for salience: more salient entities are realized by a higher-ranked grammatical function (Subject > Object > Object2 > Others) or a higher-ranked expression type (Zero Pronominal > Pronoun > Definite NP > Indefinite NP). If so, subjecthood and pronominality should be two important properties in determining whether an antecedent is "unusual".

Watson et al. (2006) tested the first of these hierarchies in a controlled experiment, and found that speakers do produce NPs like *the bed* with acoustic prominence in mini-discourses like the following where the first mention has a lower-ranked grammatical function: *Put the house above the bed. Put the BED above the pineapple*. They concluded that a

shift in attentional salience plays a role. However, in a production experiment, Wolters and Beaver (2001) found that although speakers generally accented subject pronouns having object antecedents, the effect was very weak. The main problem appeared to be that the speaking styles varied considerably, from monotonous intonation contours to very natural ones. They also analyzed news stories read by 3 speakers who contributed 122, 22, and 8 pronouns respectively. They found a significant relationship between antecedent pronominality and accentuation of a pronoun, but most of the accented pronouns could also be analyzed as cuing some sort of contrast. Further work is necessary to understand the role of contrast, especially as the meaning effects of accent on pronouns might be no different than to evoke contrast within a contextually salient set of alternatives (De Hoop, 2003). Moreover, sparse and unequally distributed data meant that speaker effects could not be investigated rigorously in either study.

Wolters and Byron (2000) studied a larger corpus of task-oriented spontaneous dialogues from a total of 16 speakers (although the data are highly unbalanced as two of the speakers contribute 48% of the data). They found no correlations in their logistic regression experiments between acoustic prosodic properties of the pronoun and various properties of the antecedent, but SPEAKER was a significant factor in most of their models. They too concluded that inter-speaker variation gets in the way of safe generalizations and that different speaker types need to be understood. However, they included SPEAKER as a fixed-effect rather than a random-effect in their models which means they assumed that their speakers represent 16 repeatable and fixed levels of a factor. That is, they incorrectly assume that the speakers are mutually exclusive and exhaustive in representing speaker-types in the population.

## 3 The Corpus and Features

I use 19 dialogues of the Switchboard corpus of spontaneous phone conversations (Godfrey et al., 1992) that have manual annotations for the presence or absence of pitch accent on each word (Ostendorf et al., 2001; Calhoun, 2006), "kontrast" relations (Calhoun et al., 2005), and coreference links (Nissim et al., 2004). All non-demonstrative

<i>he</i>	<i>her</i>	<i>him</i>	<i>his</i>	<i>it</i>
56	19	17	13	303
<i>its</i>	<i>she</i>	<i>their</i>	<i>them</i>	<i>they</i>
2	56	37	101	230

Table 1: Number of instances of each pronoun-type

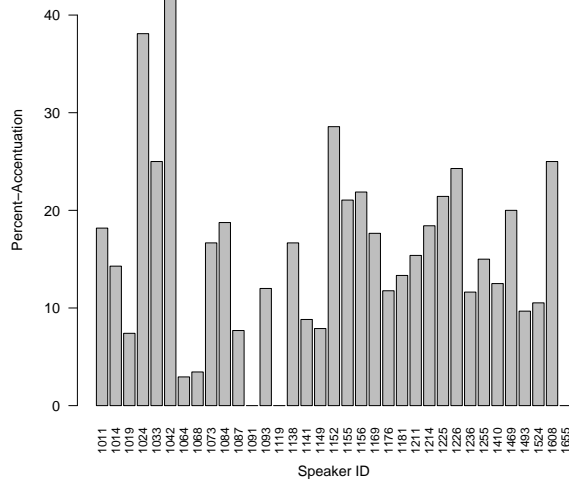


Figure 1: Variation between speakers

third-person coreferential pronouns were isolated for analysis, a total of 834 pronouns of which 15.6% bear a pitch accent.<sup>2</sup> The pronoun-types and their frequencies are given in Table 1; all pronouns were made case-insensitive and stripped of bound reduced verbs. A total of 35 speakers of American English contributed the pronouns, 22 females and 13 males, with a fairly balanced division of the pronouns amongst them.

One striking aspect of these data is that both speakers and pronouns exhibit great variation in accentuation. Figures 1 and 2 illustrate this, motivating some of the factors included in the models below.

A number of attributes of each pronoun and its antecedent were calculated or extracted from the annotations. These features are described in Table 2,

<sup>2</sup>English reflexives may bear an emphatic function and are disyllabic, differentiating them from other pronouns, so they were excluded. There were only 14 tokens in all.

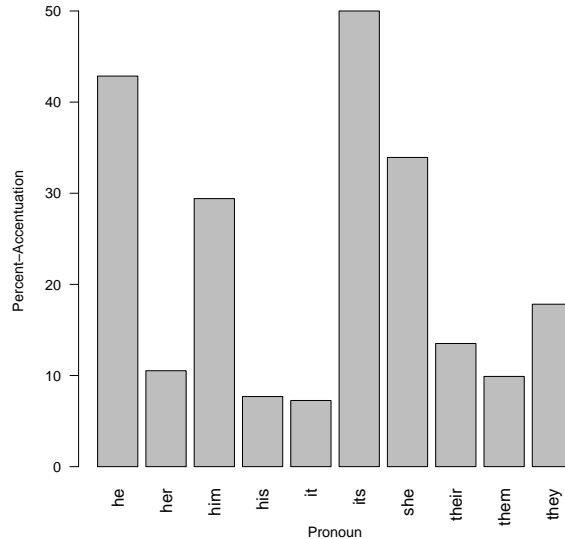


Figure 2: Variation between pronouns

and assigned to three groups.

The first set of features reflect antecedent properties that could be useful in detecting a relationship between “unusual” antecedents and *accent* (the presence or absence of accent on a pronoun). The two referential distance features are discourse measurements of topic continuity inspired by Givón (1983).<sup>3</sup> All features in this group bear a non-significant relationship to *accent* on the basis of chi-square and correlational tests, except for *antecDistCat* ( $p < .05$ ).

The second group has features that capture properties of the pronoun itself. The first two are primarily intended as control factors, in case disfluencies or reductions (as in *he’s*) behave in a non-standard manner. Chi-square tests revealed that these factors do not have a significant relationship with *accent* (both  $p > 0.1$ ). On the other hand, the last three features are all significantly related to *accent* (all  $p < .001$ ). Subject pronouns are

<sup>3</sup>A log-transformed distance metric was also explored but abandoned. Log-distance had a bimodal distribution while “regular” distance was skewed but unimodal. What the exploration did highlight is that most antecedents are in the same or adjacent clause, thus motivating the categorical distance metric I use.

said to continue topics, i.e. to refer to attentionally salient discourse referents, so pronoun-subjecthood could interact with other factors in an important way. The two `kontrast` features need much elaboration. A “kontrast” introduces a presupposition of alternatives to the contrasted word in the discourse context, thereby making it informationally salient. The feature `kontrast` reflects the reason or trigger for this salience (Calhoun et al., 2005). Several types of triggers were marked, but the two values which are of most concern here are: *contrastive*, for when the word is directly contrasted with a previous topical, semantically-related word, and *background* when the word is not intended to be salient. The second `kontrast` feature is a binned version that lumps together all values of `kontrast` except for `background` and `contrastive`; I created this to test particular `kontrast`-related conclusions below.

Finally, in the third group is `spkrAccentRate`, a rough approximation of speaker styles based on the percentage of pronouns a speaker accented. It is a continuous measure that represents “styles” ranging from “monotonous” speakers with low rates of accentuation to animated or expressive speakers who accent plenty of their pronouns. Naturally, this feature is significantly related to `accent` ( $p \approx 0$ ).

## 4 Analysis and Results

The general strategy adopted here is to test the usefulness of the features above by testing them simultaneously in logistic regression models predicting `accent`. In addition to these fixed-effects factors, I depart from previous studies in also including two random-effects factors, namely `Speaker` and `Pronoun`. Given the enormous inter-speaker and inter-pronoun variation demonstrated in Figures 1 and 2, it is essential to check for these dependencies; treating them as random-effects in mixed-effects logistic regression models is the most appropriate modeling technique here as then we do not tailor our models to the specific speakers and pronouns in the study but instead assume they are randomly sampled levels from a much larger population of interest. Within this setup I carry out two sets of studies, the first on all the pronouns isolated for analysis, and the second on only those pronouns with antecedents in adjacent clauses since these con-

stitute the type of 2-utterance discourses discussed most in the literature. I use the `lme4` and `Design` packages in R (Ihaka and Gentleman, 1996).

### 4.1 All Coreferential Pronouns

**Variable Selection:** In order to inspect the variables and select which ones to include in the final models, I use a regular logistic regression model to predict `accent` using all the fixed-effects factors in Table 2 (except for `kontrastBinned`). Fast backward elimination, a routine that deletes irrelevant factors by comparing the AIC model fit value of the full model against that of a reduced model lacking the factor being tested, retains only `pronIsSubj`, `kontrast`, and `spkrAccentRate`. So all the other fixed-effects factors, including antecedent properties and control factors `disfluency` and `cliticized` do not improve the quality of a model predicting `accent`. In the models that follow I do not include the control factors, though I retain the factors having to do with antecedents since these are of primary interest in this study.

I construct three kinds of models – (i) a fixed-effects-only model with only the selected fixed-effects, (ii) one using only the two random-effects factors, and (iii) a generalized linear mixed model that uses the two random-effects and the significant fixed-effects predictors from the first model (except `kontrastBinned` is substituted for `kontrast`).

**Fixed-effects-only Model:** I use a regular logistic regression model to predict `accent` using only `kontrast`, `spkrAccentRate`, and the factors related to antecedents. The VIF values of these factors range between 1 and 2.19 (all much lower than 10), so there is no danger of collinearities among the predictors. The coefficients, standard errors, and  $p$ -values for the different levels of these factors are reported in Table 3.<sup>4</sup> The quality of the model is modest (concordance C, a measure of model discriminability, is 0.741), but this is not surprising given that there are probably many other factors needed to predict accent placement, including speaker and pronoun variation. What is more interesting is that none of the factors related to unusual antecedents are significant, while `pronIsSubj`, `spkrAccentRate` and contrastive `kontrast` are significant (all  $p <$

<sup>4</sup> $p$ -value sig. codes: 0 ‘\*\*\*’ 0.001 ‘\*\*’ 0.01 ‘\*’ 0.05 ‘.’

Feature	Description	Possible Values
antecIsSubj	Antecedent is in subject position of its clause	yes, no
antecIsPro	Antecedent is pronominal	yes, no
antecDistCont	Distance $n$ to antecedent in number of clauses	$0 \leq n \leq 84$
antecDistCat	Location of antecedent clause relative to pronoun	same, adjacent, remote
disfluency	Disfluency characteristic of pronoun	none, repair, reparandum
cliticized	Pronoun followed by reduced verb	yes, no
pronIsSubj	Pronoun is in subject position of its clause	yes, no
kontrast	Reason for informational salience	adverbial, answer, background, contrastive, nonapplic, other, subset
kontrastBinned	Binned version of kontrast	background, contrastive, other
spkrAccentRate	Speaker's propensity to accent pronouns	0% - 38%

Table 2: Feature descriptions and values

	Coef.	S.E.	P-value
Intercept	-3.7401	0.3668	0.0000
antecIsSubj=yes	-0.1781	0.2207	0.4197
antecIsPro=yes	0.3105	0.2375	0.1912
antecDistCont	-0.0552	0.0469	0.2390
antecDistCat=adjacent	0.4608	0.2629	0.0797
antecDistCat=remote	0.0544	0.3277	0.8682
pronIsSubj=yes	0.6958	0.2353	0.0031 *
kontrast=adverbial	10.7832	79.0508	0.8915
kontrast=contrastive	2.0066	0.4683	0.0000 ***
kontrast=nonapplic	1.1516	0.7894	0.1446
kontrast=other	10.3226	45.3334	0.8199
kontrast=subset	-0.0635	1.0864	0.9534
spkrAccentRate	6.9339	1.1478	0.0000 ***

Table 3: Fixed-effects-only; all pronouns

.01). Their coefficients indicate that, as expected, the higher a speaker's propensity to accent pronouns the higher the log-odds of the pronoun being accented, and likewise if the pronoun is contrastive rather than backgrounded and if it is in subject-position rather than not. To check for overfitting I run bootstrap validation, and almost all runs remove all predictors other than `pronIsSubj`, `kontrast` and `spkrAccentRate`. The number of runs in which all seven predictors are retained is extremely small (4), so the model cannot be overfitting the data. Using penalized maximum likelihood estimation to discourage large values for the coefficients due to potentially extreme data points, I find that although all coefficients are slightly shrunk towards zero, the same factors remain significant. Finally, since only *contrastive* `kontrast` is a significant predictor within `kontrast`, it would

make sense to bin `kontrast` into `background`, `contrastive` and `other`, as I do below.

**Random-effects-only Model:** Next, I build a model with only the random-effects factors and find that this has a concordance of 0.723, slightly lower than the previous model but still decent, suggesting that inter-speaker and inter-pronoun variation could be critical components in determining accent placement on coreferential pronouns.

**Mixed-effects Model:** Finally, I build a mixed-effects model that has the two random-effects as well as `pronIsSubj`, `kontrastBinned` and `spkrAccentRate` as fixed-effects. This model has the highest concordance so far (0.761), so this combination of fixed- and random-effects factors leads to a model of better quality. Comparisons of fuller models to smaller sub-models using the difference of their log likelihoods reveals that only `kontrastBinned`, `spkrAccentRate`, and the `Pronoun` random-effect were significant, justified factors. Table 4 lists for each factor, the difference in log likelihood between the full model and a reduced model lacking that factor, as well as the  $p$ -value for the factor. From these results, it appears that `kontrast` and speaker style are beneficial in predicting accent and inter-pronoun variation is an important dependency as well. It appears that it could be useful to understand different speaker strategies or styles, beyond the crude metric used here; inter-speaker differences at an individual level are not as useful to study as seen by the insignificant `Speaker` random-effect. Since none of the antecedent properties were significant, these models could not verify that accent on a coreferential pro-

Factor	$\Delta\log\text{Lik}$	P-value
pronIsSubj	0.92	0.1747
kontrastBinned	9.37	8.528e-05 ***
spkrAccentRate	16.89	6.184e-09 ***
Speaker	0	0.9936
Pronoun	8.53	3.616e-05 ***

Table 4: Mixed-effects; all pronouns

	Coef.	S.E.	P-value
Intercept	-4.3109	0.6491	0.0000
antecIsSubj=yes	-0.5193	0.3858	0.1784
antecIsPro=yes	0.6126	0.4203	0.1449
pronIsSubj=yes	0.9163	0.4392	0.0369 .
kontrast=contrastive	3.3118	1.2220	0.0067 *
kontrast=nonapplic	3.2669	1.3964	0.0193 .
kontrast=other	9.5187	45.0338	0.8326
kontrast=subset	8.3827	45.0328	0.8523
spkrAccentRate	10.4269	2.1914	0.0000 ***

Table 5: Fixed-effects-only; adjacent antecedents

noun signals anything about antecedents, at least not in the presence of these other significant factors.

## 4.2 Only Adjacent Antecedents

Here I limit the dataset to only those pronouns with antecedents in the previous clause, thus reproducing the 2-utterance-scenario often discussed by the attentional theories. This dataset has only 257 pronouns. Still, most of the results of the larger dataset are again found to be valid here.

First, logistic regression without any random-effects (and without antecedent-distance metrics since distance is constant here) produces a model with a fairly good concordance of 0.805, and significant `pronIsSubj`, `contrastive kontrast` and `spkrAccentRate` again. Table 5 lists the coefficients,  $p$ -values etc. for the different levels of the various factors. Again, fast backward elimination only retains the last three factors, and none of the saliency-based antecedent factors.

However, the influence of speaker and pronoun variation is less clear here, perhaps due to the smaller size of this dataset. A model with only the two random-effects has a concordance of 0.745, which is close to but slightly lower than that of the fixed-effects only model. A full mixed-effects model with the two random-

Factor	$\Delta\log\text{Lik}$	P-value
pronIsSubj	1.33	0.1026
kontrast	8.73	0.0002 ***
spkrAccentRate	12.28	0.0000 ***
Speaker	0	0.9766
Pronoun	0.16	0.5703

Table 6: Mixed-effects; adjacent antecedents

Unaccented	antecIsPro = 0	antecIsPro = 1
antecSubj = 0	<b>24</b>	24
antecSubj = 1	17	54
Accented	antecIsPro = 0	antecIsPro = 1
antecSubj = 0	8	9
antecSubj = 1	3	<b>22</b>

Table 7: Subject pronouns with adjacent antecedents

effects and `pronIsSubj`, `kontrastBinned` and `spkrAccentRate` fixed-effects has about the same concordance as the fixed-effects-only model for this dataset, namely 0.795, but model comparisons show only `kontrastBinned` and `spkrAccentRate` to be significant (see Table 6).

## 5 Discussion

On the whole, the results suggest that pronominal accent may often be signaling contrast rather than something about the attentional status of the pronoun’s referent. At the very least, we have no evidence that topic shift is being signaled via accent in spoken conversational speech. Instead, the recurring theme is that speaker-propensities, pronoun identities, and contrast-status, will go a long way in predicting whether a speaker will produce a particular pronoun with an accent.

The two-utterance discourses studied theoretically or via controlled experiments do seem to intuitively support an attentional/saliency-ranking account, but actual naturalistic productions often do not accord with such an account. Consider the accent distribution among just subject pronouns in this corpus which have antecedents in the previous clause, given in Table 7. In spite of topic-discontinuity, 24 pronouns do not bear accent; and in spite of topic continuity, 22 pronouns bear an accent, counter to the predictions of the attentional story.

Here, for instance, is an example of a subject pronoun *she* which was accented by a *high* accenting speaker, even though the antecedent in the adjacent clause is pronominal and in subject position:<sup>5</sup>

- (2) Well, UM Y- you MENTIONED your DAUGHTER had graduated from COLLEGE. WELL, when SHE was in high SCHOOL did SHE always HAVE to have all the new FASHIONS?

And here is a long stretch of discourse in which the same speaker accents *he* nearly every time, even though the referent, her brother, is clearly the continuing topic throughout:

- (3) i MEAN UH MY BROTHER works for TI and HE'S a computer PROGRAMMER or computer ENGINEER. AND YOU know whenever HE was going to school HE was EXPECTING to HAVING to wear uh a TIE or a DRESS shirt EVERYDAY. BUT UH he GOES to WORK in HIS blue JEANS T-SHIRT and TENNIS shoes. And HE just LOVES it.

However, it isn't always the case that subject pronouns get accented. Here is a more "balanced" production by the same speaker with unaccented *she*:

- (4) But she NEVER would BUY me like the NEW designer JEANS that had come OUT that were THIRTY dollars or UM or she wouldn't BUY me the FIFTY dollar TENNIS shoes and stuff like THAT.

On the other hand, the following is an accented subject pronoun *he* with an adjacent antecedent, labeled as 'contrastive' because the referent, the speaker's dad, is being compared to people who do not care about the environment:

- (5) Well, my DAD'S in the in the SOLAR energy BUSINESS. SO uh you know WE'RE ACCUTELY AWARE of a lot of this. BUT you KNOW on the OTHER hand he VOTED for George BUSH. So UM you KNOW i i WONDER SOMETIMES if HE knows what he's DOING.

The presence of accent on a coreferential pronoun could be the result of many interacting constraints, semantic and prosodic, including those imposed by both the larger discourse context and the words immediately surrounding the pronoun. For example, the dialogue act, the speaker's and pronoun's tendencies, the overall prosody of the utterance, and the presence of other referring expressions such as *my dad* or even *I* or *you* must all interfere with the presence of accent on a coreferential pronoun.

<sup>5</sup>Audio clips: [www.stanford.edu/~anubha/accentedPro.html](http://www.stanford.edu/~anubha/accentedPro.html).

While the models and examples presented here cannot shed light on the precise mechanisms and constraints, they do show that a simple attentional story suffers from being limited to the analysis of local 2-utterance-windows and (primarily) pronouns like *he* or *she*. Also, they demonstrate that the role of contrast may have been seriously underestimated by previous theoretical work. It is especially vital to understand whether contrast might in fact subsume the attentional explanation for pronominal accent because switching to a less salient referent for an accented pronoun might very well be viewed as contrast between the expected situation (where the topic is expected to be continued) and the unexpected situation in which a lower ranked referent takes front stage. So in example (1), where the accented *HE* is taken to refer to the lower-ranked object *Bill* from the previous sentence, the accent could be signaling contrast between the expected referent *John* and the unexpected but true referent *Bill*.

Topic-continuity could be just one type of (linguistic) expectation language-users are sensitive to, such that they might choose to signal a violation of that expectation through accentuation. Other expectation-violations do lead to similar accentuation patterns, as when a situation is judged to be unexpected by common knowledge or context; this is evident in an utterance like "*SHE married HIM?*", expressing surprise at an unlikely couple. A contrast-based explanation is bolstered by the eye-tracking experiments of Venditti et al. (Venditti et al., 2002) which show that both potential antecedents are evoked upon hearing an accented pronoun rather than just the antecedent predicted by a saliency ranking; in fact, the referent is not fixed until more propositional information is encountered and the discourse coherence relation determined. Moreover, if not for contrast, there is no explanation of why accent appears appropriate on the pronouns in the following discourse, even though their referents are not ambiguous at all:

- (6) John called Mary a Republican. Then SHE insulted HIM.

Future work would need to look at genres of speech other than spontaneous conversational dialogue. Even more data from more speakers would be beneficial, in order to cluster them into meaningful speaker types or styles.

## 6 Conclusions

The analysis presented here makes use of a large quantity of spontaneous speech, with more features and more sophisticated statistical models than have been available or employed to date. The ensuing results lead to the following conclusions:

- Pronominal accent is not a robust cue of an “unusual” antecedent, at least not when “unusual” is defined in terms of the attentional salience of the pronoun’s referent.
- Pronominal accent does serve as a cue to contrast beyond the effects of antecedent properties and speakers’ accentuation preferences, though the exact constraints and interactions need to be understood. A contrast-based explanation may subsume the salience-based examples.
- Understanding speaker and pronoun dependencies is highly important. It may be quite fruitful to discover speaker types or styles. Also, inter-pronoun variation in accentuation is also a significant predictor of how likely a given pronoun is to bear accent, although it is possible that variation between pronouns is an indirect reflection of yet-to-be-discovered constraints.

**Acknowledgements** This research was partly funded by the Edinburgh-Stanford Link. Many thanks to Joan Bresnan and Ani Nenkova for helpful discussion, and to Jason Brenier and Sasha Calhoun for help in collecting the prosodic data.

## References

Mira Ariel. 1990. *Accessing Noun-Phrase Antecedents*. Routledge, London, UK.

Gillian Brown. 1983. Prosodic Structure and the Given/New Distinction. D. R. Ladd and A. Cutler, eds., *Prosody: Models and Measurements*, 67–78. Springer Verlag, Berlin, Germany.

Janet Cahn. 1995. The Effect of Pitch Accenting on Pronoun Referent Resolution. *Proc. of the Association for Computational Linguistics*, 290–293.

Sasha Calhoun. 2006. *Information Structure and the Prosodic Structure of English: a Probabilistic Relationship*, Ph.D. thesis, University of Edinburgh.

Sasha Calhoun, Malvina Nissim, Mark Steedman, and Jason Brenier. 2005. A Framework for Annotating Information

Structure in Discourse. *Proc. of the Association for Computational Linguistics Conference Workshop on Frontiers in Corpus Annotation II: Pie in the Sky*.

Talmy Givón. 1983. *Topic Continuity in Discourse*. John Benjamins, Philadelphia, PA.

John J. Godfrey, Edward C. Holliman, and Jane McDaniel. 1992. SWITCHBOARD: Telephone Speech Corpus for Research and Development. *Proc. of the International Conference on Acoustics, Speech, and Signal Processing*, 1:517–520.

Barbara Grosz, Aravind Joshi, and Scott Weinstein. 1995. Centering: A Framework for Modeling the Local Coherence of Discourse. *Computational Linguistics*, 21(2):203–225.

Jeanette K. Gundel, Nancy Hedberg, and Ron Zacharski. 1993. Cognitive Status and the Form of Referring Expressions in Discourse. *Language*, 69(2):274–307.

Helen de Hoop. 2003. On the Interpretation of Stressed Pronouns. *Proc. of the Conference “sub7 - Sinn und Bedeutung”*, 159–172.

Ross Ihaka and Robert Gentleman. 1996. R: A Language for Data Analysis and Graphics. *Journal of Computational and Graphical Statistics*, 5(3):299–314.

Megumi Kameyama. 1999. Stressed and Unstressed Pronouns: Complementary Preferences. Peter Bosch and Rob van der Sandt, eds., *Focus: Linguistic, Cognitive, and Computational Perspectives*, 306–321. Cambridge University Press, Cambridge, UK.

Christine Nakatani. 1997. *The Computational Processing of Intonational Prominence: A Functional Prosody Perspective*, Ph.D. thesis, Harvard University.

Malvina Nissim, Shipra Dingare, Jean Carletta, and Mark Steedman. 2004. An Annotation Scheme for Information Status in Dialogue. *Proc. of the 4th Language Resources and Evaluation Conference*.

Mari Ostendorf, Izhak Shafran, Stefanie Shattuck-Hufnagel, Leslie Carmichael, and William Byrne. 2001. A Prosodically Labeled Database of Spontaneous Speech. *Proc. of the ISCA Workshop on Prosody in Speech Recognition and Understanding*, 119–121.

Jennifer Venditti, Matthew Stone, Preetham Nanda, and Paul Tepper. 2002. Discourse Constraints on the Interpretation of Nuclear-accented Pronouns. *Proc. of the 2002 International Conference on Speech Prosody*.

Duane Watson, Jennifer E. Arnold, and Michael K. Tanenhaus. 2006. Acoustic Prominence and Reference Accessibility in Language Production. *Proc. of the 2006 International Conference on Speech Prosody*.

Maria Wolters and David Beaver. 2001. What does *he* mean? *Proc. of the Annual Meeting of the Cognitive Science Society*.

Maria Wolters and Donna K. Byron. 2000. Prosody and the Resolution of Pronominal Anaphora. *Proc. of COLING2000*.