

SITS: A Hierarchical Nonparametric Model using Speaker Identity for Topic Segmentation in Multiparty Conversations

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UNIVERSITY OF
MARYLAND

Outline

1 Motivating Examples and Problem Definition

2 Our Approach: SITS

3 Experiments and Results

- Topic Segmentation Task
- Speakers' Topic Shift Tendency

4 Conclusions and Future Work



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2 Our Approach: SITS

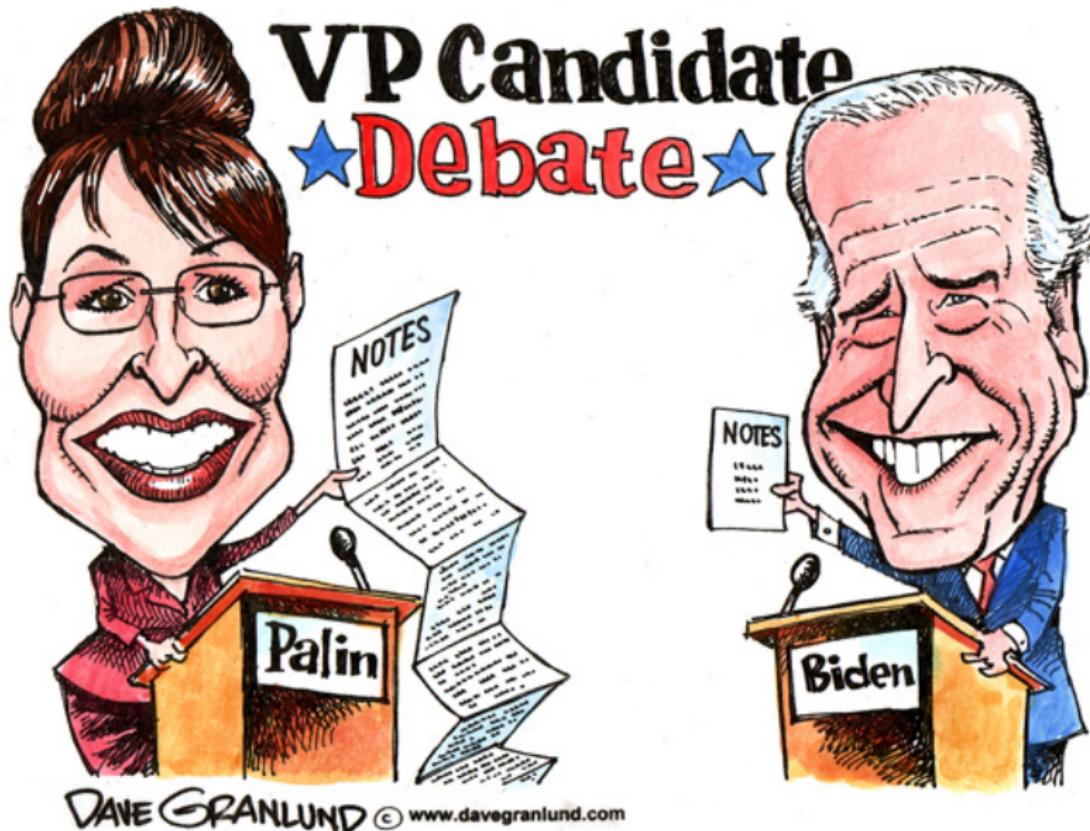
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2008 U.S. Presidential Election



2008 U.S. Presidential Election



Gwen Ifill

Senator Biden, you voted for this bankruptcy bill. Senator Obama voted against it. Some people have said that mortgage-holders really paid the price.

2008 U.S. Presidential Election



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Joe Biden

Well, mortgage-holders didn't pay the price. Only 10 percent of the people who are – have been affected by this whole switch from Chapter 7 to Chapter 13 – it gets complicated. But the point of this – Barack Obama saw the glass as half-empty. I saw it as half-full. We disagreed on that, and 85 senators voted one way, and 15 voted the other way. But here's the deal. Barack Obama pointed out two years ago that there was a subprime mortgage ... And there – ways that we're offering are not being supported by – by the Bush administration nor do I believe by John McCain and Governor Palin.

2008 U.S. Presidential Election



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Joe Biden

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Sarah Palin

That is not so, but because that's just a quick answer, I want to talk about, again, my record on energy ... When we talk about energy, we have to consider the need to do all that we can to allow this nation to become energy independent ... East Coast politicians who don't allow energy-producing states like Alaska to produce these, to tap into them, and instead we're relying on foreign countries to produce for us.

Multiparty Conversations



What's the
guy's
name on
first base?



No. What
is on
second
base!



I'm not
asking you
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Who's on
first?

Multiparty Conversations



What's the guy's name on first base?



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Who's on first?

- Understanding the hidden structure of conversations is important

Multiparty Conversations



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Questions

- Can we incorporate speaker identity into an unsupervised model?
- Does it help?

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Basic Ideas



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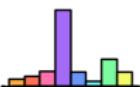
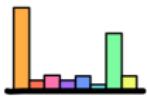
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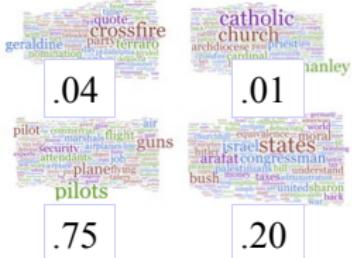


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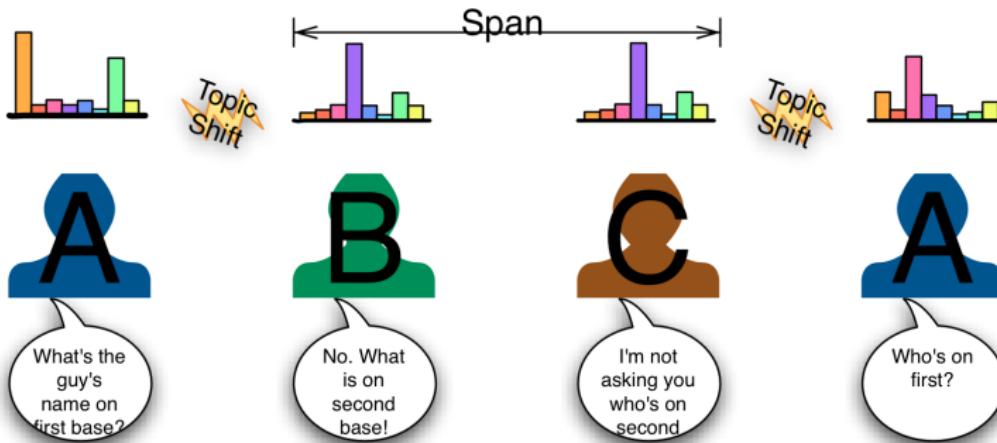
Who's on first?

- Viewing each turn as a distribution over topics



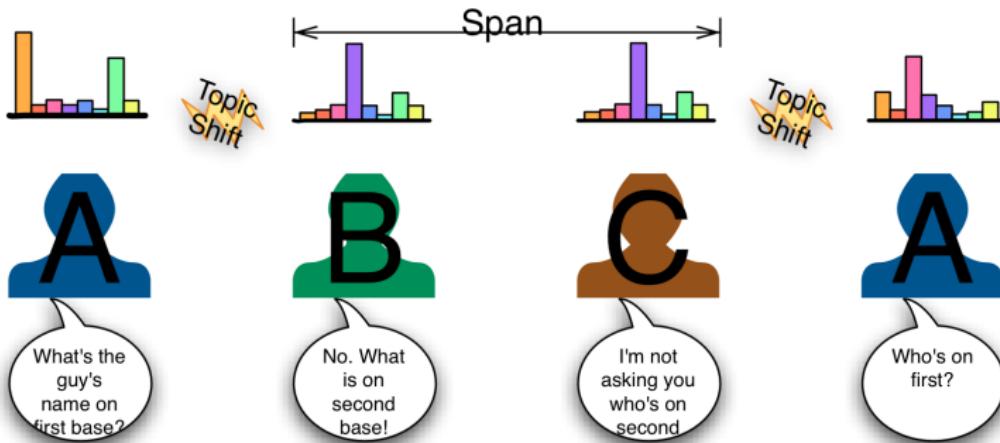
"Norm Mineta tells me, and Homeland Security Adviser Tom Ridge tells me, and they are against it. And I think the reason they are against it is you don't want the guy who's flying one of these big busters up there also with a gun in his hand trying to protect his plane [...]"

Basic Ideas



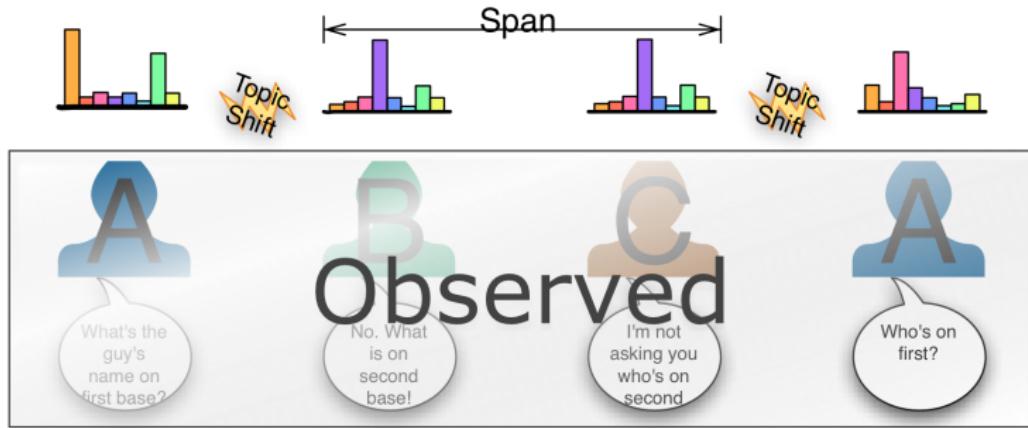
- Viewing each turn as a distribution over topics
- Endowing each turn with a binary latent variable to indicate whether the topic is shifted

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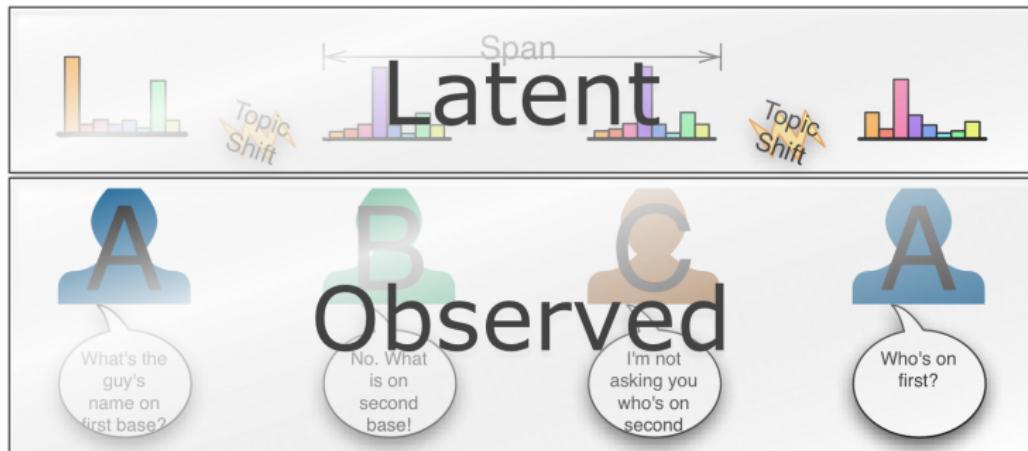
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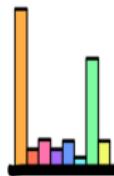
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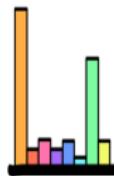
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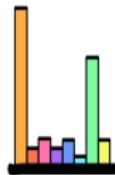


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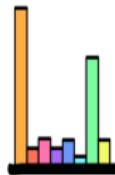


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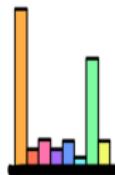


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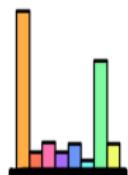


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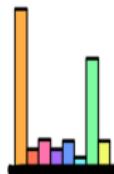


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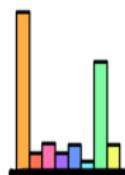


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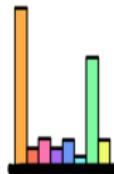
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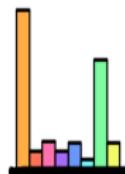
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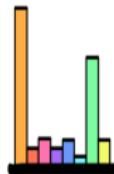


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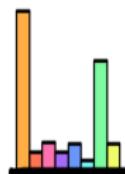


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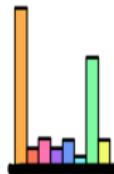


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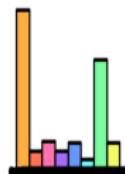


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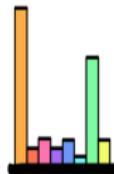


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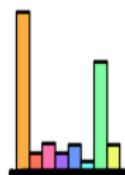


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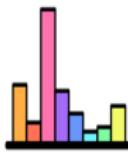
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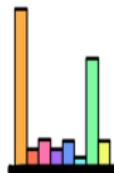


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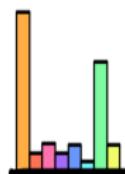


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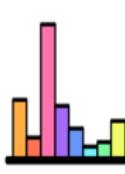
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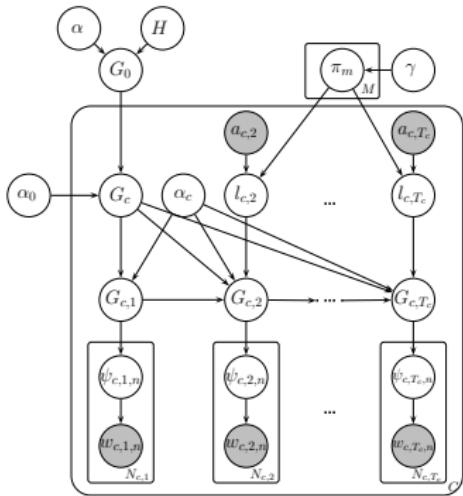
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TRYLN

Generative Process

- ➊ For speaker $m = 1 \dots M$, draw speaker shift probability $\pi_m \sim \text{Beta}(\gamma)$
- ➋ Draw global probability measure $G_0 \sim \text{DP}(\alpha, H)$
- ➌ For each conversation $c \in [1, C]$ and each turn $t \in [1, T_c]$ with speaker $a_{c,t}$
 - ➀ If $t = 1$, set the topic shift $l_{c,t} = 1$. Otherwise, draw $l_{c,t} \sim \text{Bernoulli}(\pi_{a_{c,t}})$
 - ➁ If $l_{c,t} = 1$, draw $G_{c,t} \sim \text{DP}(\alpha_c, G_c)$. Otherwise, set $G_{c,t} \equiv G_{c,t-1}$
 - ➂ For each word index $n \in [1, N_{c,t}]$
 - ➃ Draw $\psi_{c,t,n} \sim G_{c,t}$
 - ➄ Draw $w_{c,t,n} \sim \text{Mult}(\psi_{c,t,n})$



Relationships with previous work

- Nonparametric (number of topics is not fixed)
- Conversations share hierarchical topics
- Parametric version without speaker identity
[*Purver et al.* 2006]
- Only allow one topic per turn, “sticky HMM”
[*Fox et al.* 2008]



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Datasets



ICSI: 75 transcripts of Berkeley meetings (segmented)



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Debates: 2008 presidential debates (segmented,
[Boydston et al. 2011])

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Crossfire: CNN's debate TV show (unsegmented), 2000-2004

Detected Topic Shifts

2008 Election Debates

	Previous turn	Turn detected as shifting topic
Debates Dataset	PALIN: Your question to him was whether he supported <i>gay marriage</i> and my answer is the same as his and it is that I do not.	IFILL: Wonderful. You agree. On that note, let's move to <i>foreign policy</i> . You both have sons who are in Iraq or on their way to Iraq. You, Governor Palin, have said that you would like to see a real clear plan for an exit strategy. [...]
	MCCAIN: I think that Joe Biden is qualified in many respects. [...]	SCHIEFFER: [...] Let's talk about <i>energy</i> and <i>climate control</i> . Every president since Nixon has said what both of you [...]
	IFILL: So, Governor, as vice president, there's nothing that you have promised [...] that you wouldn't take off the table because of this <i>financial crisis</i> we're in?	BIDEN: Again, let me – let's talk about those tax breaks. [Obama] voted for an energy bill because, for the first time, it had real support for alternative energy. [...] on eliminating the tax breaks for the oil companies, Barack Obama voted to eliminate them. [...]

Example of turns designated as a topic shift by SITS. Turns were chosen with speakers to give examples of those with high topic shift tendency π .

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Detected Topic Shifts

Crossfire

	Previous turn	Turn detected as shifting topic
Crossfire Dataset	PRESS: But what do you say, governor, to Governor Bush and [...] your party who would let politicians and not medical scientists decide what <i>drugs</i> are distributed [...]	WHITMAN: Well I disagree with them on this particular issues [...] that's important to me that George Bush stands for education of our children [...] I care about tax policy, I care about the environment. I care about all the issues where he has a proven record in Texas [...]
	WEXLER: [...] They need a Medicare prescription drug plan [...] Talk about schools, [...] Al Gore has got a real plan. George Bush offers us vouchers. Talk about the environment. [...] Al Gore is right on in terms of the majority of Americans, but George Bush [...]	KASICH: [...] I want to talk about choice. [...] George Bush believes that, if schools fail, parents ought to have a right to get their kids out of those schools and give them a chance and an opportunity for success. Gore says "no way" [...] Social Security. George Bush says [...] direct it the way federal employees do [...] Al Gore says "No way" [...] That's real choice. That's real bottom-up, not a bureaucratic approach, the way we run this country.
	PRESS: Senator, Senator Breaux mentioned that it's President Bush's aim to start on education [...] [McCain] [...] said he was going to do introduce the legislation the first day of the first week of the new administration. [...]	MCCAIN: After one of closest elections in our nation's history, there is one thing the American people are unanimous about They want their government back. We can do that by ridding politics of large, unregulated contributions that give special interests a seat at the table while average Americans are stuck in the back of the room.

Example of turns designated as a topic shift by SITS. Turns were chosen with speakers to give examples of those with high topic shift tendency π .



Segmentation Performance

Quantitative Results

Evaluation Measurements:

- P_k
- WindowDiff
- EMD: Earth Mover Distance



Segmentation Performance

Evaluation Measurement: WindowDiff

Conversation
Turns



Reference
Segmentation

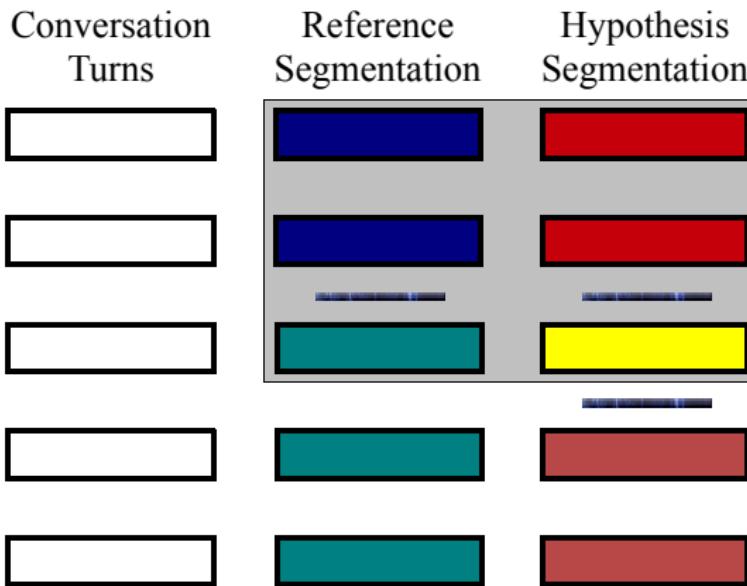


Hypothesis
Segmentation



Segmentation Performance

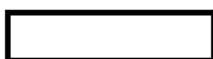
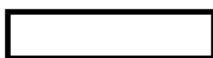
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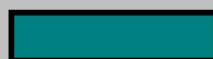
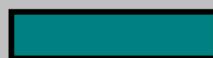
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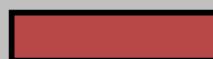
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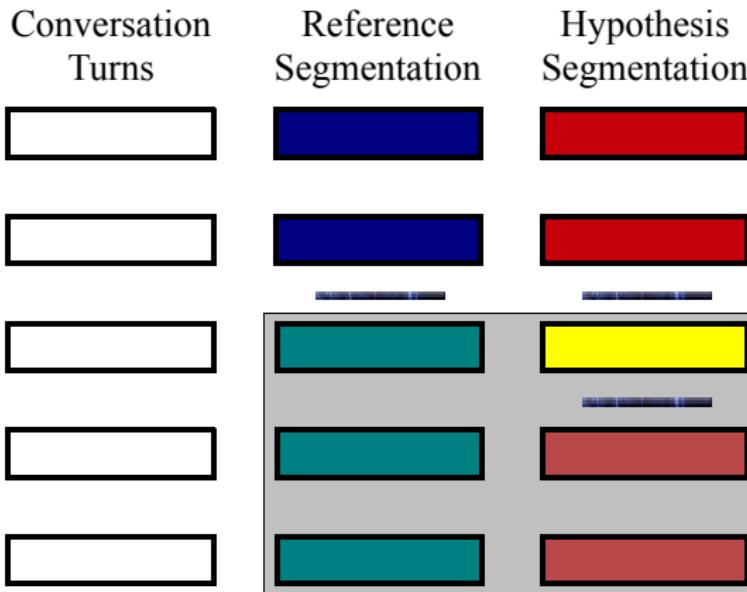


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Segmentation Performance

ICSI Dataset

	Model	EMD	P_k			WindowDiff		
			$k = 5$	10	15	$k = 5$	10	15
ICSI	TextTiling	2.507	.289	.388	.451	.318	.477	.561
	P-NoSpeaker-S ¹	1.949	.222	.283	.342	.269	.393	.485
	P-NoSpeaker-M	1.935	.207	.279	.335	.253	.371	.468
	P-SITS	1.807	.211	.251	.289	.256	.363	.434
	NP-HMM ²	2.189	.232	.257	.263	.267	.377	.444
	NP-SITS	2.126	.228	.253	.259	.262	.372	.440

- EMD, P_k , and WINDOWDIFF measure the difference between the hypothesis segmentation and the reference segmentation. (k is the window size).
- For all measurements, lower is better.

¹[Purver et al. 2006]

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			$k = 5$	10	15	$k = 5$	10	15
ICSI	TextTiling	2.507	.289	.388	.451	.318	.477	.561
	P-NoSpeaker-S ¹	1.949	.222	.283	.342	.269	.393	.485
	P-NoSpeaker-M	1.935	.207	.279	.335	.253	.371	.468
	P-SITS	1.807	.211	.251	.289	.256	.363	.434
	NP-HMM ²	2.189	.232	.257	.263	.267	.377	.444
	NP-SITS	2.126	.228	.253	.259	.262	.372	.440

- EMD, P_k , and WINDOWDIFF measure the difference between the hypothesis segmentation and the reference segmentation. (k is the window size).
- For all measurements, lower is better.

¹[Purver et al. 2006]

²[Fox et al. 2008]

Segmentation Performance

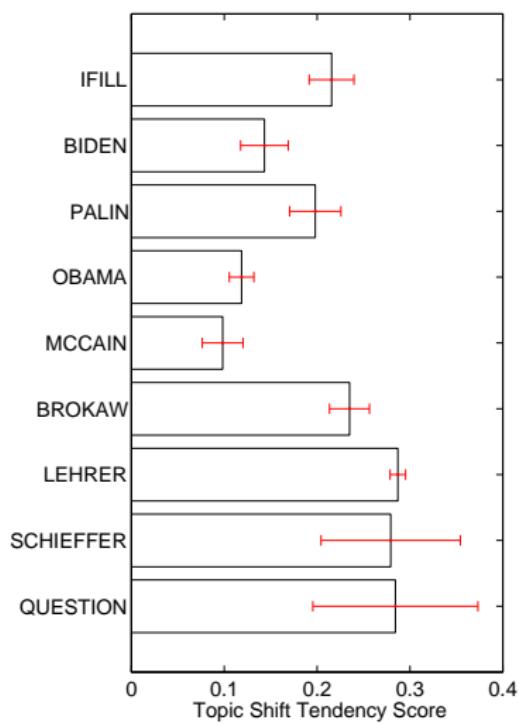
Debates Dataset

	Model	EMD	P_k			WindowDiff		
			$k = 5$	10	15	$k = 5$	10	15
Debates	TextTiling	2.821	.433	.548	.633	.534	.674	.760
	P-NoSpeaker-S	2.822	.426	.543	.653	.482	.650	.756
	P-NoSpeaker-M	2.712	.411	.522	.589	.479	.644	.745
	P-SITS	2.269	.380	.405	.402	.482	.625	.719
	NP-HMM	2.132	.362	.348	.323	.486	.629	.723
	NP-SITS	1.813	.332	.269	.231	.470	.600	.692

- EMD, P_k , and WINDOWDIFF measure the difference between the hypothesis segmentation and the reference segmentation. (k is the window size).
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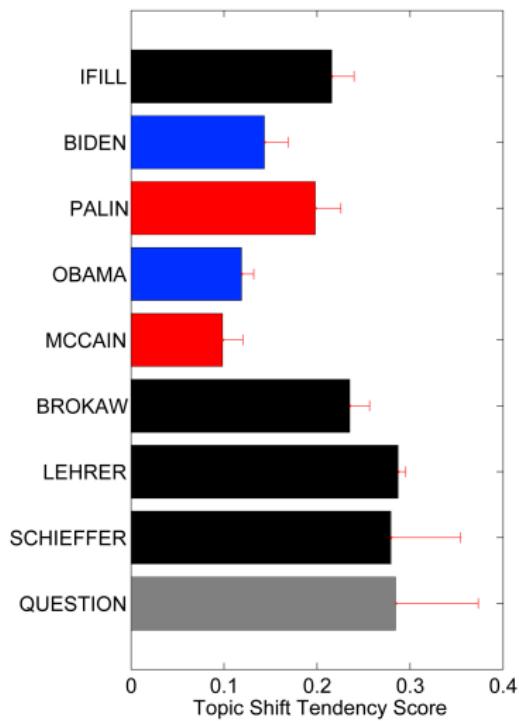
What about the speakers?

2008 Presidential Debates



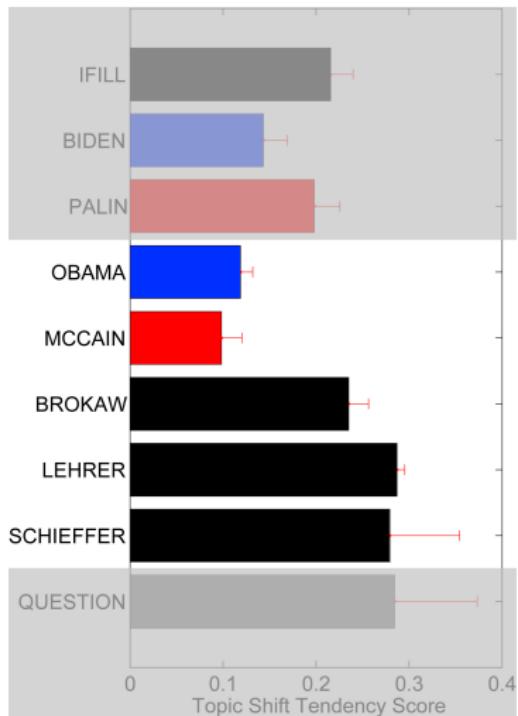
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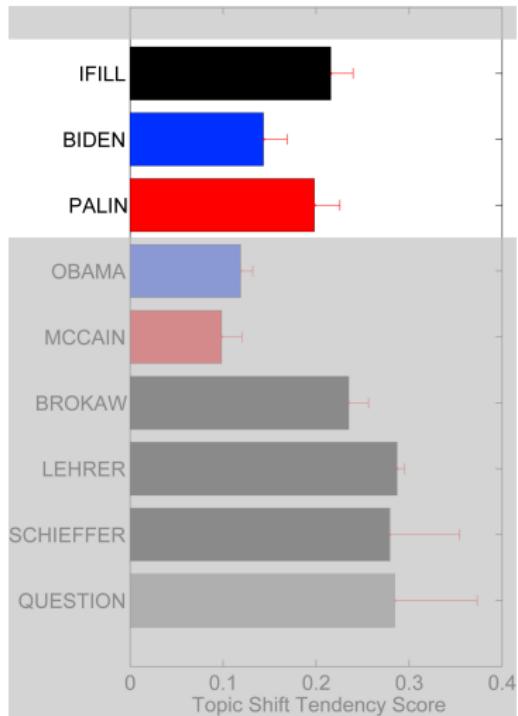


- In presidential debates, moderators have much higher scores than candidates do



What about the speakers?

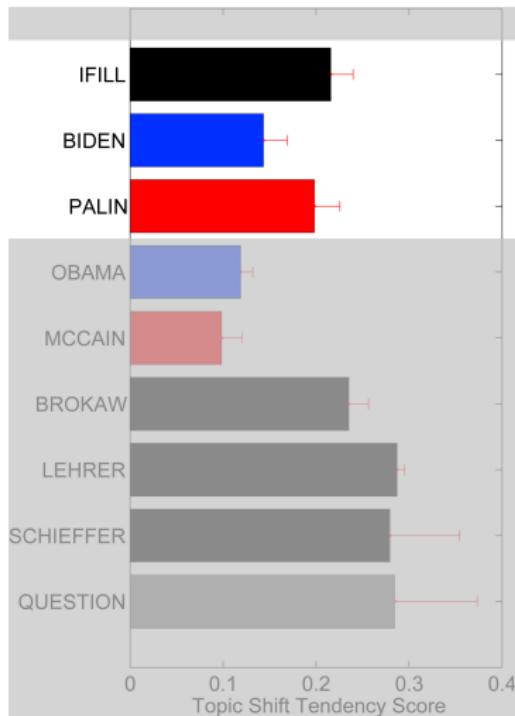
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- In the VP debate, IFILL's score is only slightly higher than those of PALIN and BIDEN

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2008 Presidential Debates



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- In the VP debate, IFILL's score is only slightly higher than those of PALIN and BIDEN

The Ifill Factor

By Scott Horton



.... Ifill's questioning and moderating was, as The Atlantic's James Fallows remarked, "terrible." She asked open-ended, utterly predictable questions which presented very little challenge to the candidates. But even more important to the McCain campaign's strategy, Palin was able to simply ignore the questions and recite her talking points.



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Outline

1 Motivating Examples and Problem Definition

2 Our Approach: SITS

3 Experiments and Results

- Topic Segmentation Task
- Speakers' Topic Shift Tendency

4 Conclusions and Future Work



Conclusions & Future work

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Conclusions & Future work

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 - Quantifying qualitative conclusions
- Thanks!

Backup Slides



Detected Topic Shifts

2008 Election Debates - Example 2

Ifill

So, Governor, as vice president, there's nothing that you have promised as a candidate that you would – that you wouldn't take off the table because of this **financial crisis** we're in?



Detected Topic Shifts

2008 Election Debates - Example 2

Ifill

So, Governor, . . . that you wouldn't take off the table because of this **financial crisis** we're in?

Palin

There is not. And how long have I been at this, like five weeks? So there hasn't been a whole lot that I've promised, except to do what is right for the American people, **put government back on the side of the American people, stop the greed and corruption on Wall Street.** And the rescue plan has got to include that massive oversight that Americans are expecting and deserving. And I don't believe that John McCain has made any promise that he would not be able to keep, either.



Detected Topic Shifts

2008 Election Debates - Example 2

Ifill

So, Governor, . . . that you wouldn't take off the table because of this **financial crisis** we're in?

Palin

There is not. And how long have I been at this, [...]

Biden

Again, let me – **let's talk about those tax breaks.** Barack Obama – Obama voted for an energy bill because, for the first time, it had real support for alternative energy. When there were separate votes on eliminating the tax breaks for the oil companies, Barack Obama voted to eliminate them. John did not. [...]



What about the speakers?

Crossfire

Rank	Speaker	π	Rank	Speaker	π
1	Announcer	.884	10	Kasich	.570
2	Male	.876	11	Carville [†]	.550
3	Question	.755	12	Carlson [†]	.550
4	G. W. Bush [‡]	.751	13	Begala [†]	.545
5	Press [†]	.651	14	Whitman	.533
6	Female	.650	15	McAuliffe	.529
7	Gore [‡]	.650	16	Matalin [†]	.527
8	Narrator	.642	17	McCain	.524
9	Novak [†]	.587	18	Fleischer	.522

Top speakers by topic shift tendencies. We mark hosts ([†]) and “speakers” who often (but not always) appeared in clips ([‡]). Apart from those groups, speakers with the highest tendency were political moderates.



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