Capturing Ambiguity in Crowdsourcing Frame Disambiguation

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What is FrameNet?

- **FrameNet:** computational linguistics resource based on the frame semantics theory (Baker, Fillmore, Lowe, 1998)
  - collection of **semantic frames**
  - **documents** annotated with these frames

- **semantic frame:** abstract representation of a word sense, describing a type of *entity*, *relation*, or *event* and identifies the *associated roles* implied by the frame

Frame Disambiguation

= task of selecting the best frame for a word phrase

We try to avoid shops ***aimed*** at tourists.

- purpose (*)
- aiming

The frame picked by the expert is marked with (*).

Frame Disambiguation

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Illegal ***skimming*** of profits is rampant.

- removing (*)
- theft
- commiting crime
- cause change

The frame picked by the expert is marked with (*).

CrowdTruth

- Annotator disagreement is **signal, not noise**

- It is indicative of the **variation in human semantic interpretation**

- It can indicate **ambiguity**, **vagueness**, **similarity**, over-generality, as well as **quality**

Experimental setup

- 433 sentence-word pairs from FrameNet corpus
  - words have *expert annotation*
  - POS: verb, noun

- for each word, find candidate frames:

  - match word to *synonym sets* in WordNet corpus (Miller, 1995)

  - match synonym set to FrameNet frame using *Framester* corpus (Gangemi et al., 2016)

- **goals:**

  - crowdsource frame disambiguation

  - capture & interpret disagreement to model ambiguity

Crowdsourcing task

The sentence:

Anarchism is a political philosophy that **advocates** self-governed societies based on voluntary institutions.

What are the possible meaning(s) of advocates in the context of the sentence above? Check ALL that apply.

☐ **Communication:** A *Communicator* conveys a *Message* to an *Addressee*; the *Topic* and *Medium* of the communication also may be expressed.

> Click to hide examples where the highlighted word expresses **Communication**
>
> It **says** a lot that he didn't come back.
>
> Putting his arm around her protectively achieved nothing but **announcing** to their captors their vulnerability.
>
> This painting really **speaks** to me.

☐ **Attempt suasion:** The *Speaker* expresses through language his wish to get the *Addressee* to act. There is no implication that the *Addressee* forms an intention to act, let alone acts.

> Click to see examples where the highlighted word expresses **Attempt suasion**

CrowdTruth metrics

- **Frame-Sentence Score (FSS):**
  - the degree with which a frame matches the sense of the word in the sentence
  - = ratio of workers that picked the frame / all the workers that read the sentence, weighted by the worker quality (WQS)
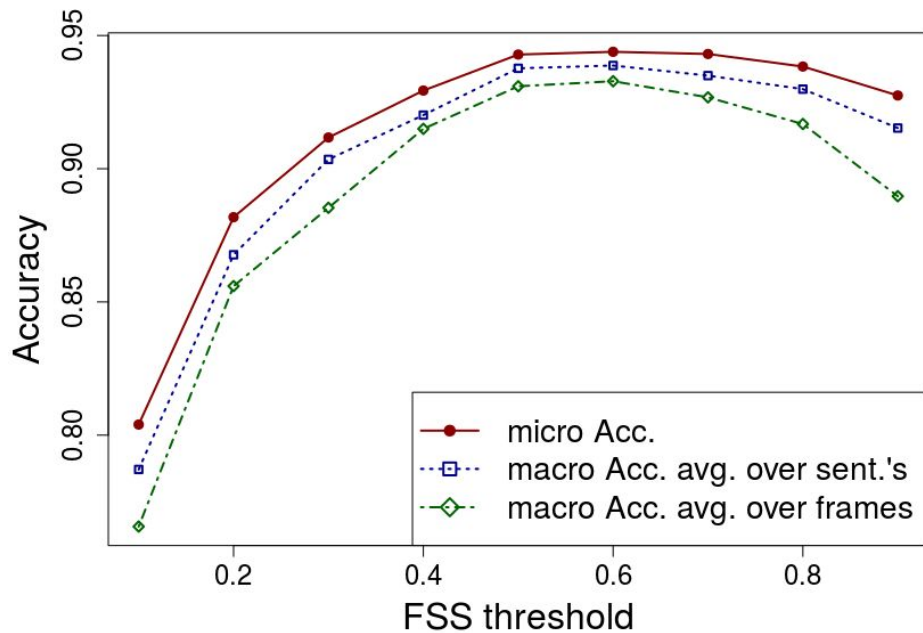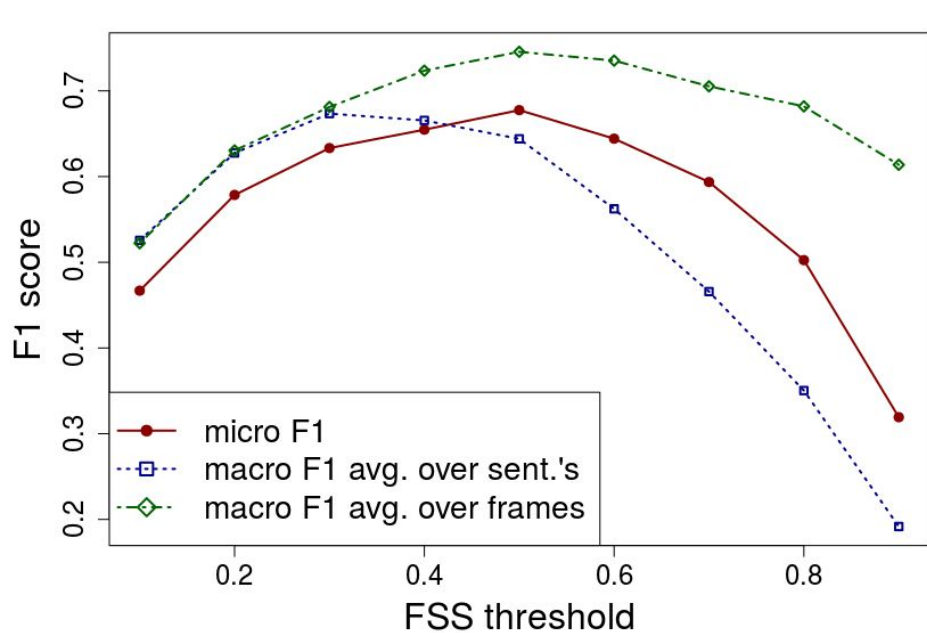
- **Sentence Quality Score (SQS):**
  - overall worker agreement over one sentence
  - = average cosine similarity over all worker vectors for one sentence, weighted by the worker quality (WQS) & frame quality (FQS)

- **Frame Quality Score (FQS):**
  - agreement over a frame in all sentences that it appears
  - = $P(X$ annotates f in $s \mid Y$ annotates f in $s)$, $\forall$ X, Y - workers, s - sentence, weighted by the worker quality (WQS) & sentence quality (SQS)

Comparing crowd to FrameNet experts

Crowd performance is comparable to the experts.

When crowd & expert disagree

#	Sentence	Frame	FSS
S1	Shops *aimed* at the tourist market are interspersed with the more workaday ironmongers.	$aiming$ $purpose^{(*)}$	0.808 0.288
S2	The major *changes* were not to daily tasks and routines , but to the political power base.	$cause\_change$ $undergo\_change^{(*)}$	0.804 0.305
S3	This *investigation* has been stymied stopped, obstructions thrown up every step of the way.	$criminal\_investigation$ $scrutiny^{(*)}$	0.898 0.377
S4	Does supersizing *cause* obesity?	$cause\_to\_start$ $causation^{(*)}$	0.804 0.608
S5	The loud, raucous Jamaican English dialect and the *waving* hands reflect the joy with which social relations are conducted here.	$body\_movement$ $gesture^{(*)}$	0.861 0.463
S6	The Intifada *heralded* the rise of the Muslim fundamentalism.	$heralding$ $omen^{(*)}$	0.777 0.227
S7	Fish (heads discreetly *wrapped* in paper) are still hung out to dry in the sun.	$adorning$ $filling^{(*)}$	0.31 0.278

The frame picked by the expert is marked with (*).

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Crowd misunderstood the frame definition.

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Information in the sentence is incomplete.

The frame picked by the expert is marked with (*).

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Crowd is correct.

The frame picked by the expert is marked with (*).

FSS as a measure of how clear the frame is expressed in the sentence

#	Sentence	SQS	Frame	FSS
P1	Egypt has provided no evidence demonstrating the *elimination* of its biological warfare ability, which has existed since at least 1972.	0.841	$removing^{(*)}$ $cause\_change$ $event$	0.938 0.175 0.032
P2	First, he forbade seeking the aid of infidels when the Syrian Mujahiddin asked Saddam Hussein to *overthrow* the regime of Hafiz Al-Assad in Syria.	0.669	$change\_of\_leadership^{(*)}$ $removing$ $eventive\_cognizer\_affecting$ $people$	0.847 0.539 0.087 0.005
P3	Their influence helped draw a line in the desert sand between legitimate operations and mob casinos, where illegal *skimming* of profits was rampant.	0.366	$removing^{(*)}$ $theft$ $committing\_crime$ $misdeed$ $cause\_change$	0.532 0.494 0.459 0.431 0.273
P4	The above mentioned protection *procedures* are only for observation purposes, while patrols check the fences, the barriers, and the towers.	0.786	$means^{(*)}$ $being\_employed$	0.889 0.11
P5	We've expanded Goodwill's proven *methods* to towns and neighborhoods where they are needed most.	0.364	$means^{(*)}$ $expertise$ $domain$ $fields$	0.601 0.342 0.173 0.131
P6	The latest *approach* is perhaps the best of the post-mob era : the comprehensive resort.	0.208	$means^{(*)}$ $conduct$ $path\_traveled$ $communication$	0.457 0.225 0.159 0.121

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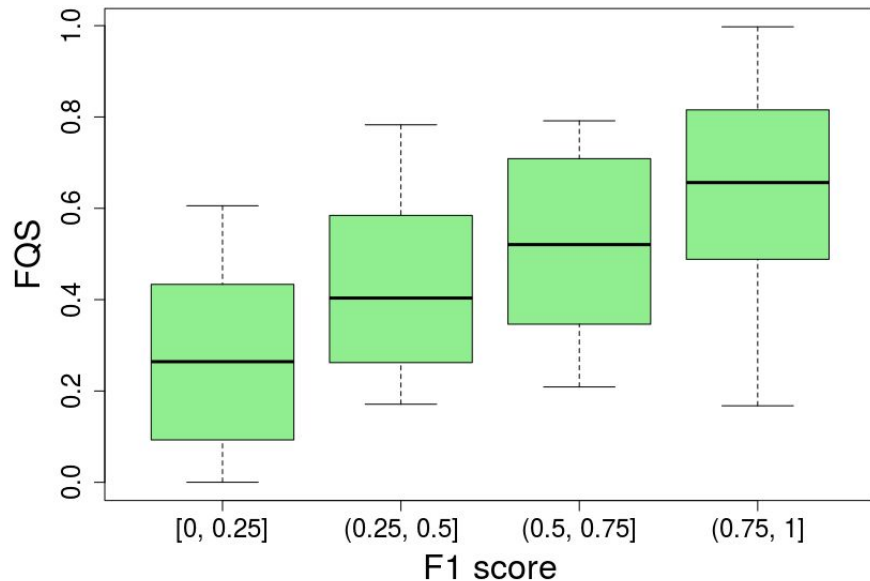
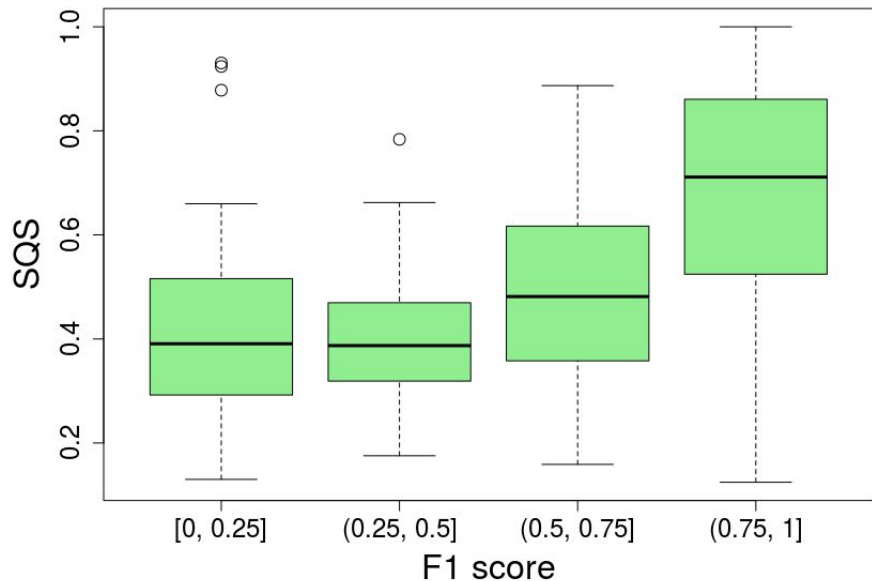| #	Sentence	SQS	Frame	FSS
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Degrees of clarity for the frame **removing**.

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Degrees of clarity for the frame **means**.

Evaluating SQS and FQS

High SQS or FQS is correlated with high F1 score.

SQS as a measure of how ambiguous the sentence is

#	Sentence	SQS	Frame	FSS
Q1	Although David bought the land for the Temple and carefully assembled its building materials, he was deemed unworthy of *constructing* the Temple.	0.711	$building^{(*)}$ $manufacturing$ $create\_physical\_artwork$	0.925 0.183 0.056
Q2	Passageways for cars and pedestrians should be designated 4- Road bumps: Six successive bumps should be *constructed* at 500 meters from the location.	0.542	$building^{(*)}$ $manufacturing$ $create\_physical\_artwork$	0.768 0.326 0.089
Q3	*Constructed* in wood, brick, stone, ceramic, and bronze, this is a work of extravagant beauty, uniting many ancient art forms.	0.351	$building^{(*)}$ $create\_physical\_artwork$ $manufacturing$	0.515 0.335 0.237
Q4	U.S. Congressman Tony Hall arrived here Sunday evening, *becoming* the first U.S. lawmaker to visit Iraq since the 1991 Gulf War.	0.901	$becoming^{(*)}$ $cause\_change$ $undergo\_change$	0.995 0.24 0.212
Q5	Cheung Chau *becomes* the center of Hong Kong life once a year, usually in May , during the Bun Festival, a folklore extravaganza.	0.562	$becoming^{(*)}$ $undergo\_change$ $cause\_change$	0.783 0.783 0.402
Q6	Are there any *efforts* to bring back small investors?	0.811	$attempt^{(*)}$ $commitment$	0.926 0.178
Q7	At AOL there was a conscious *effort* to develop other "characters," for lack of a better word.	0.588	$attempt^{(*)}$ $commitment$	0.739 0.468

Sentences featuring word phrase **construction**.

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Sentences featuring word phrase **construction**.

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Sentences featuring word phrase **becoming**.

SQS as a measure of how ambiguous the sentence is

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Sentences featuring word phrase **effort**.

FQS as a measure of how ambiguous the frame is

Frame	FQS	Definition	Example Sentences	FSS
killing	0.954	A Killer or Cause causes the death of the Victim.	$F1$: Older kids left homeless after a recent murder-*suicide* in Indianapolis claimed Mom and Dad.	0.8
			$F2$: The incident at Mayak was the third *shooting* in recent weeks involving nuclear weapons or facilities in Russia.	0.75
food	0.838	Words referring to items of food.	$F3$: Lamma Island is perfect for sitting back to watch *bananas* grow.	1.0
			$F4$: Along with the usual *chickens*, you will see for sale snakes, dogs, and sometimes monkeys - all highly prized delicacies .	0.838
			$F5$: You can browse among antiques, flowers, *herbs*, and more.	0.503
assistance	0.634	A Helper benefits a Benefited party by enabling the culmination of a Goal of the Benefited party.	$F6$: Your support *helps* provide real solutions.	0.955
			$F7$: Unemployment *provides* benefits that many entry-level jobs don't.	0.467
			$F8$: Your support of Goodwill will *provide* job training.	0.401
purpose	0.63	An Agent wants to achieve a Goal. A Means is used to allow the Agent to achieve a Goal.	$F9$: The *objective* of having kiosks is they serve as communication points between the guards	0.94
			$F10$: They are antiviral drugs *designed* to shorten the flu.	0.476
			$F11$: It seems that the city produced artists of this stature by accident, even against its *will*.	0.241
subjective influence	0.366	An Agent has influence on a Cognizer. The influence may be general, manifested in an Action as a consequence of the influence.	$F12$: There have been changes, many of them due to economic progress, new construction, and other factors that *influence* cities.	0.54
			$F13$: The Cycladic culture was *influenced* by societies in the east.	0.46
			$F14$: Their complaint: the system *discourages* working.	0.364
undergo change	0.313	An Entity changes, either in its category membership or in terms of the value of an Attribute.	$F15$: The animosity between these two traditional enemies is beginning to *diminish*.	0.805
			$F16$: The *shift* in the image of Gates has been an interesting one for me to watch.	0.351
			$F17$: The settlements of Thira and Akrotiri *thrived* at this time.	0.256

FQS as a measure of how ambiguous the frame is

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			*F*7: Unemployment *provides* benefits that many entry-level jobs don't.	0.467
			*F*8: Your support of God will *provide* job training.	0.401
purpose	0.63	An Agent wants to achieve a Goal. A Means is used to allow the Agent to achieve a Goal.	*F*9: The *objective* of having kiosks is they serve as communication points between the guards	0.94
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Concrete frames have high FQS

FQS as a measure of how ambiguous the frame is

Abstract frames have low FQS.

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			*F*8: Your support of Goodwill will *provide* job training.	0.401
purpose	0.63	An Agent wants to achieve a Goal. A Means is used to allow the Agent to achieve a Goal.	*F*9: The *objective* of having kiosks is they serve as communication points between the guards	0.94
			*F*10: They are antiviral drugs *designed* to shorten the flu.	0.476
			*F*11: It seems that the city produced artists of this stature by accident, even against its *will*.	0.241
subjective influence	0.366	An Agent has influence on a Cognizer. The influence may be general, manifested in an Action as a consequence of the influence.	*F*12: There have been changes, many of them due to economic progress, new construction, and other factors that *influence* cities.	0.54
			*F*13: The Cycladic culture was *influenced* by societies in the east.	0.46
			*F*14: Their complaint: the system *discourages* working.	0.364
undergo change	0.313	An Entity changes, either in its category membership or in terms of the value of an Attribute.	*F*15: The animosity between these two traditional enemies is beginning to *diminish*.	0.805
			*F*16: The *shift* in the image of Gates has been an interesting one for me to watch.	0.351
			*F*17: The settlements of Thira and Akrotiri *thrived* at this time.	0.256

FQS as a measure of how ambiguous the frame is

Frame	FQS	Definition	Example Sentences	FSS
killing	0.954	A Killer or Cause causes the death of the Victim.	F1: Older kids left homeless after a recent murder-*suicide* in Indianapolis claimed Mom and Dad.	0.8
			F2: The incident at Mayak was the third *shooting* in recent weeks involving nuclear weapons or facilities in Russia.	0.75
food	0.838	Words referring to items of food.	F3: Lamma Island is perfect for sitting back to watch *bananas* grow.	1.0
			F4: Along with the usual *chickens*, you will see for sale snakes, dogs, and sometimes monkeys - all highly prized delicacies .	0.838
			F5: You can browse among antiques, flowers, *herbs*, and more.	0.503
assistance	0.634	A Helper benefits a Benefited party by enabling the culmination of a Goal of the Benefited party.	F6: Your support *helps* provide real solutions.	0.955
			F7: Unemployment *provides* benefits that many entry-level jobs don't.	0.467
			F8: Your support of Goodwill will *provide* job training.	0.401
purpose	0.63	An Agent wants to achieve a Goal. A Means is used to allow the Agent to ac...	F9: The *objective* of having kiosks is they serve as communication points between the guards	0.94
			F10: ... the flu.	0.476
			F11: It seems that the city produced artists of this stature by accident, even against its *will*.	0.241
subjective influence	0.366	An Agent has influence on a Cognizer. The influence may be general, manifested in an Action as a consequence of the influence.	F12: There have been changes, many of them due to economic progress, new construction, and other factors that *influence* cities.	0.54
			F13: The Cycladic culture was *influenced* by societies in the east.	0.46
			F14: Their complaint: the system *discourages* working.	0.364
undergo change	0.313	An Entity changes, either in its category membership or in terms of the value of an Attribute.	F15: The animosity between these two traditional enemies is beginning to *diminish*.	0.805
			F16: The *shift* in the image of Gates has been an interesting one for me to watch.	0.351
			F17: The settlements of Thira and Akrotiri *thrived* at this time.	0.256

Overlap in frame definitions causes low FQS.

Conclusion

- **results:**
  - 433 sentences from FrameNet annotated with CrowdTruth
  - crowd performance comparable to experts
  - disagreement is a good indicator of ambiguity in sentences, frames

- **future work:**
  - extended annotations to large corpus
  - publish resource paper