SECAF:
A Span-level Emotion Cause Analysis Framework

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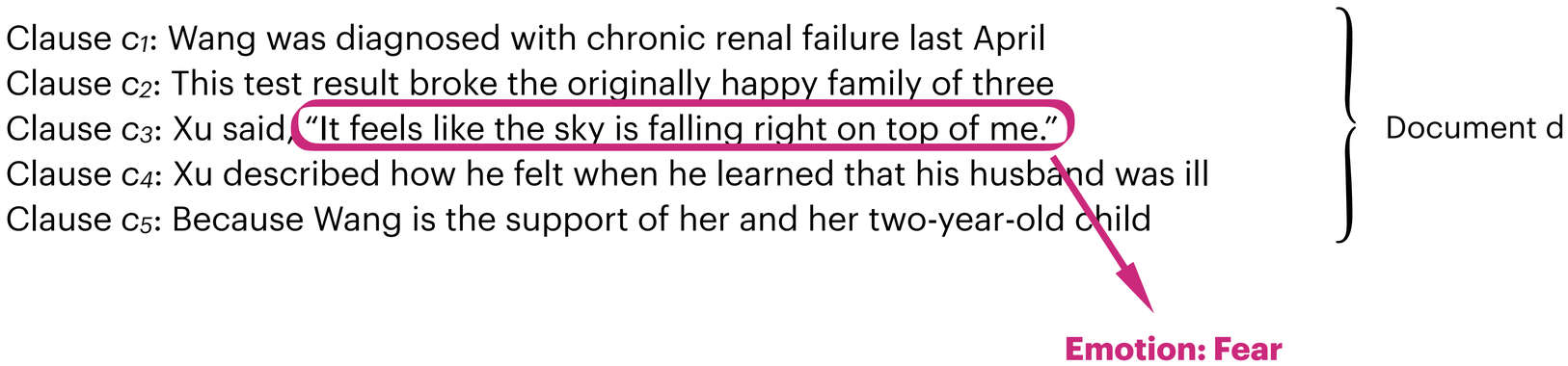
Outline

- Research Problems
- Dataset
- Model architectures
- Experiments
  - Results and discussions
  - Error analysis
- Future Directions

Research Problems

Problem 1: Emotion Cause Span Extraction (ECSE)

- Aims to extract the ***span*** in a document that corresponds to the *cause* of an emotion expressed within the document.
  - E.g.



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Clause c_1: Wang was diagnosed with chronic renal failure last April
Clause c_2: This test result broke the originally happy family of three
Clause c_3: Xu said, “It feels like the sky is falling right on top of me.”
Clause c_4: Xu described how he felt when he learned that his husband was ill
Clause c_5: Because Wang is the support of her and her two-year-old child

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Wang is the support of her and her two-year-old child

Research Problems

Problem 2: Emotion Expression Span Extraction (EESE)

- Aims to extract the ***span*** in a document that corresponds to the *emotion expression* in the document.
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} Document d

Research Problems

Problem 2: Emotion Expression Span Extraction (EESE)

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It feels like the sky is falling right on top of me

Research Problems

Problem 3: Emotion-Cause Span-Pair Extraction (ECSP)

- Aims to extract the ***span-pair*** of *emotion* and corresponding *cause* in a document
  - E.g.

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} Document d

Research Problems

Problem 3: Emotion-Cause Span-Pair Extraction (ECSP)

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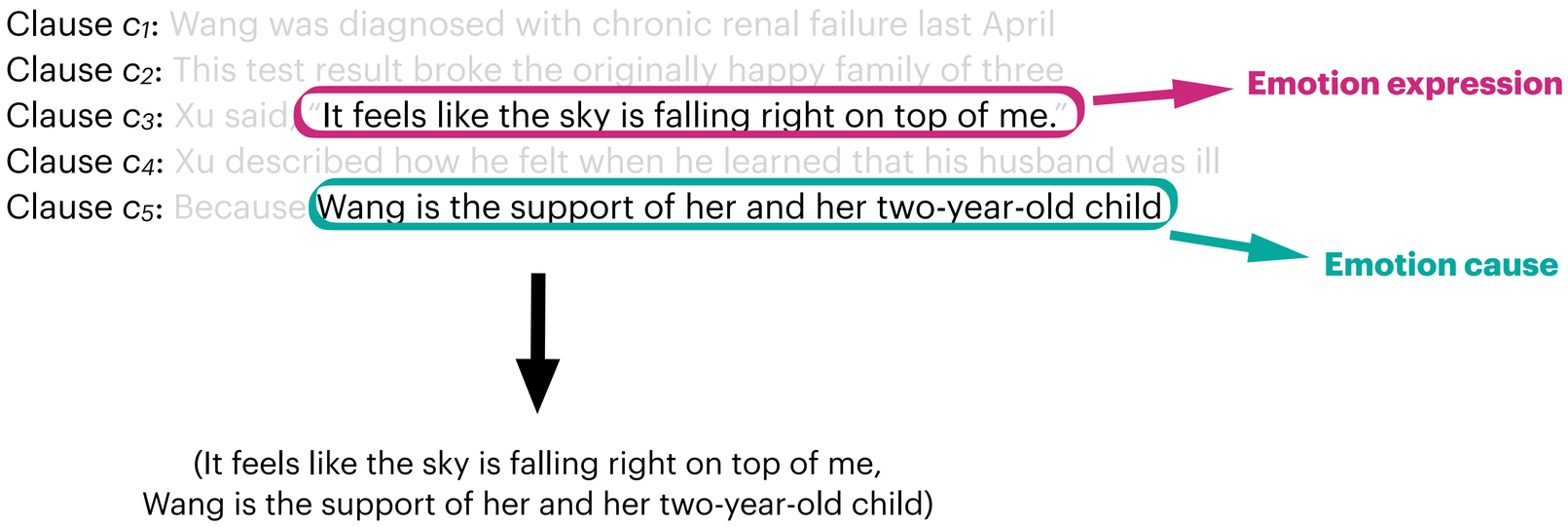


Dataset

- From (Gao, 2017): *Overview of NTCIR-13 ECA Task*
  - Domain: English novel text - 2403 documents
  - Contains emotion span, cause span and emotion category (6 classes)

```
<emotion id="1632">
    <category name="fear" value="2"/>
    <clause cause="N" id="1" keywords="N">
        <text>The Trojans heard that shout</text>
    </clause>
    <clause cause="N" id="2" keywords="N">
        <text> and saw that host</text>
    </clause>
    <clause cause="N" id="3" keywords="N">
        <text> And marvelled</text>
    </clause>
    <clause cause="N" id="4" keywords="Y">
        <text>ushed with fear were all their hearts Foreboding doom</text>
        <keywords keywords-begin="11" keywords-lenth="4">fear</keywords>
    </clause>
    <clause cause="Y" id="5" keywords="N">
        <text> for like a huge cloud seemed That throng of foes: with clashing
arms they came: Volumed and vast the dust rose 'neath their feet.</text>
        <cause begin="4" id="1" lenth="45"> like a huge cloud seemed That throng
of foes</cause>
    </clause>
</emotion>
```

Figure 2. An Annotated English Instance.

Table 3. Distribution of Emotion Categories (English)

Emotion	Number	Percentage
Fear	496	20.64
Surprise	323	13.44
Disgust	184	7.66
Sadness	527	21.93
Anger	227	9.45
Happiness	641	26.67

Table 1. Statistic of Emotion Causes

Item	Number (Chinese)	Number (English)
Instance	2619	2403
Clause	31110	34382
Emotion causes	4054	4858
Doc with 1 cause	1728	410
Doc with 2 cause	554	1817
Doc with 3 cause	211	2
Doc with 4 cause	76	140
Doc with 5 cause	33	0
Doc with 6 cause	9	24
Doc with 7 cause	4	0
Doc with 8 cause	3	9
Doc with 10 cause	1	2
Doc with 12 cause	0	1

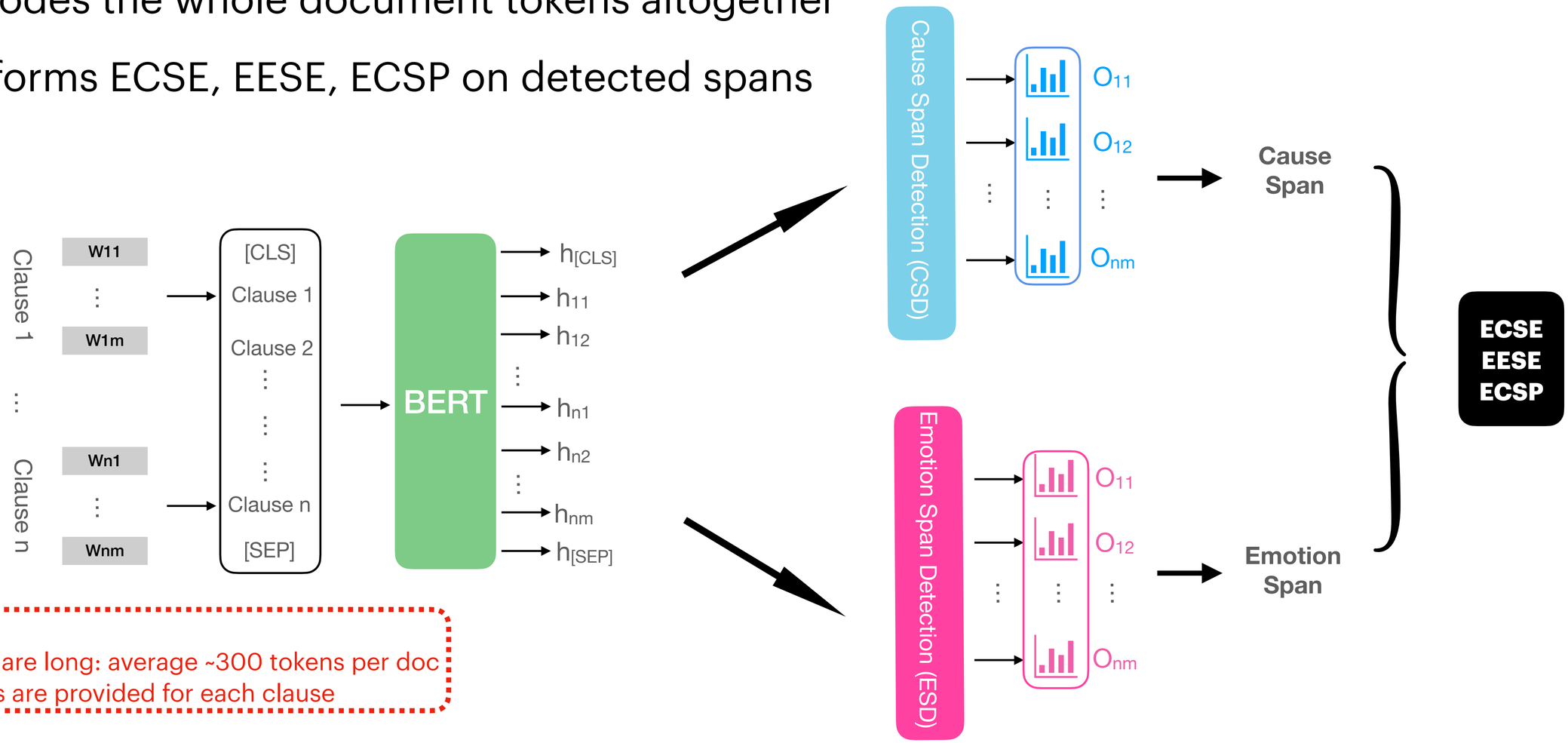
Model Architecture

Bert-based Emotion Cause Tagging (BECT)

- BECT from a document (BECT-doc)
- BECT from a clause (BECT-clause)
- BECT-clause+ BiLSTM
    - Capturing interactions between different clauses
- Commonsense knowledge encoded BECT (Comet-BECT)
    - Important for understanding emotion and its corresponding causes

Model Architecture

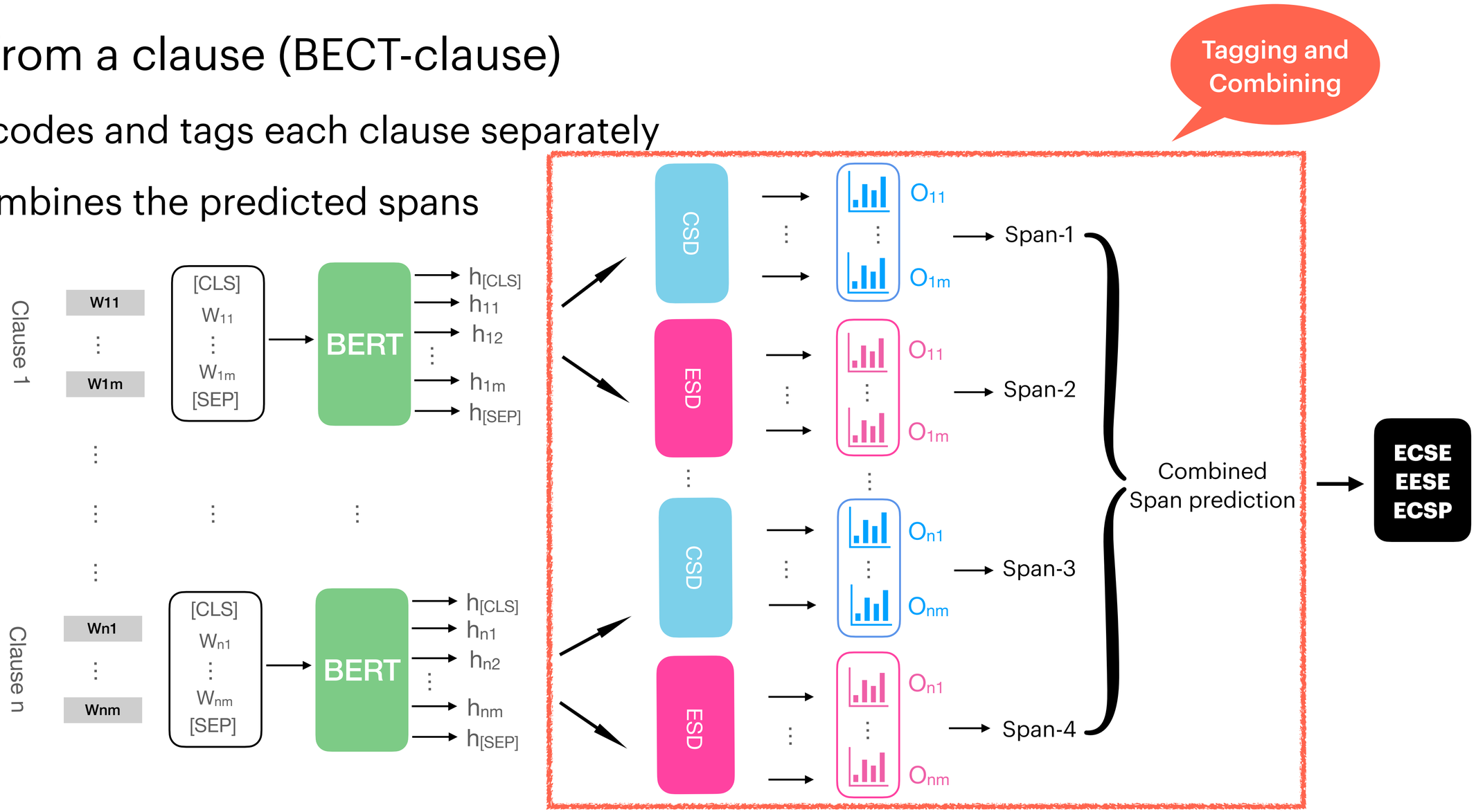
- BECT from a document (BECT-doc)
  - Encodes the whole document tokens altogether
  - Performs ECSE, EESE, ECSP on detected spans



Issues:
1) Documents are long: average ~300 tokens per doc
2) Annotations are provided for each clause

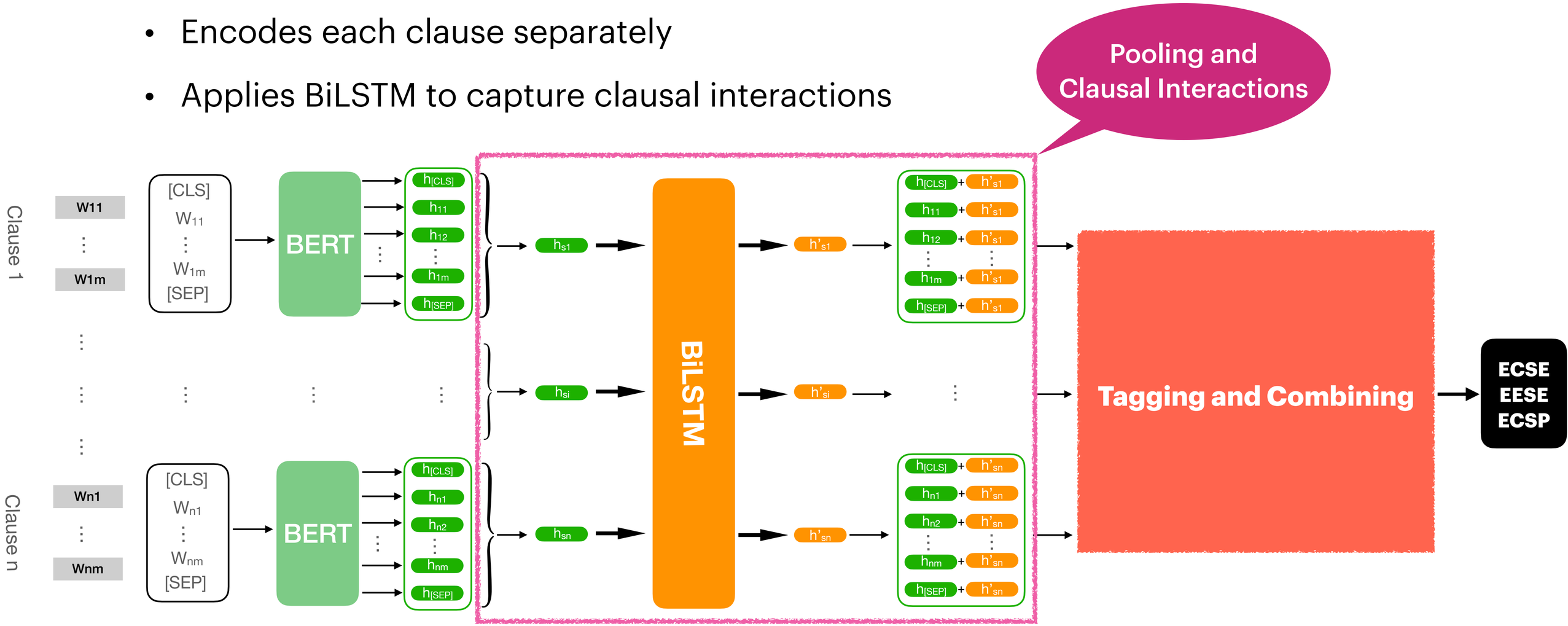
Model Architecture

- BECT from a clause (BECT-clause)
  - Encodes and tags each clause separately
  - Combines the predicted spans



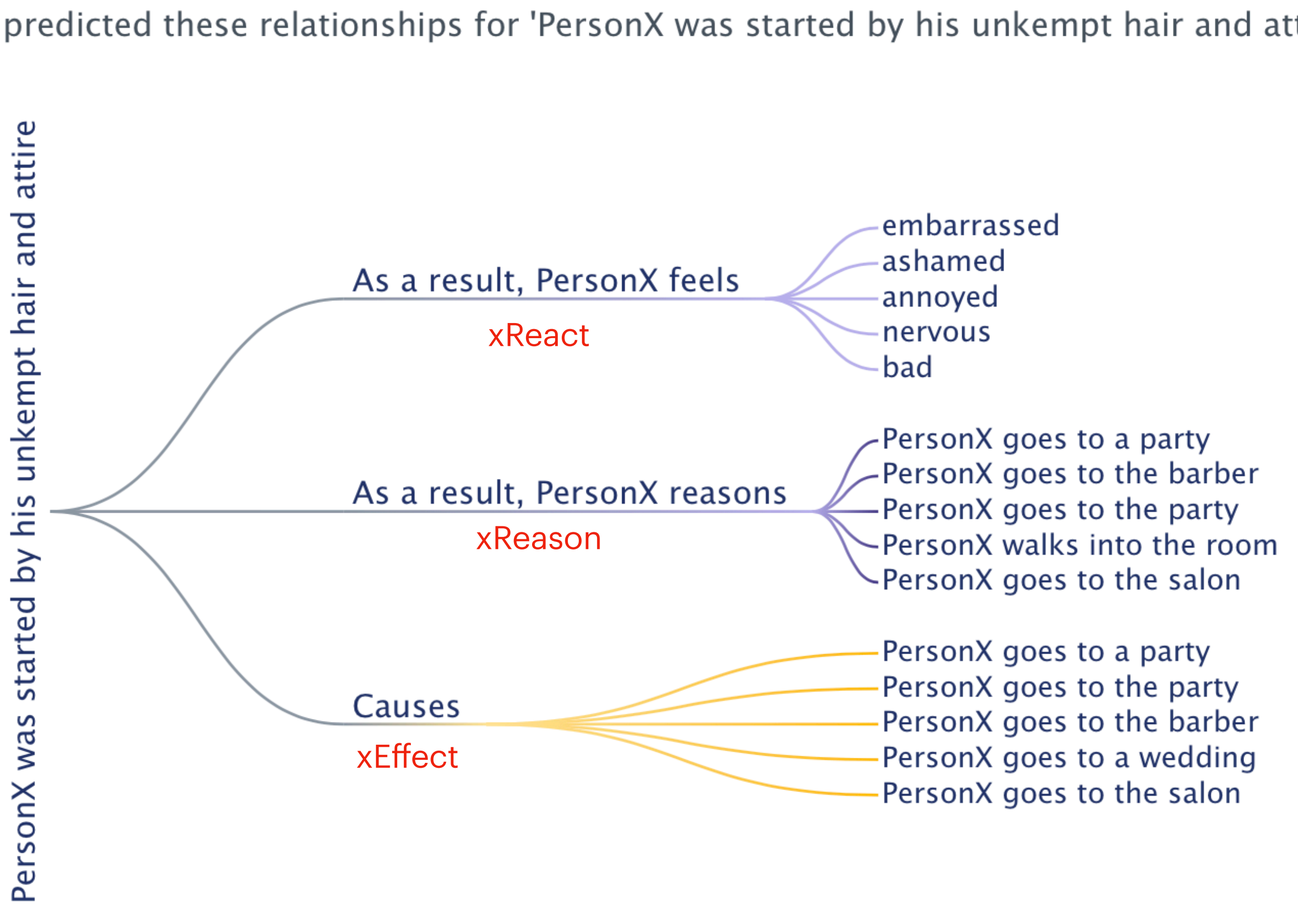
Model Architecture

- BECT-clause+ BiLSTM
  - Encodes each clause separately
  - Applies BiLSTM to capture clausal interactions



Model Architecture
COMET Usage

- COMET example



Model Architecture

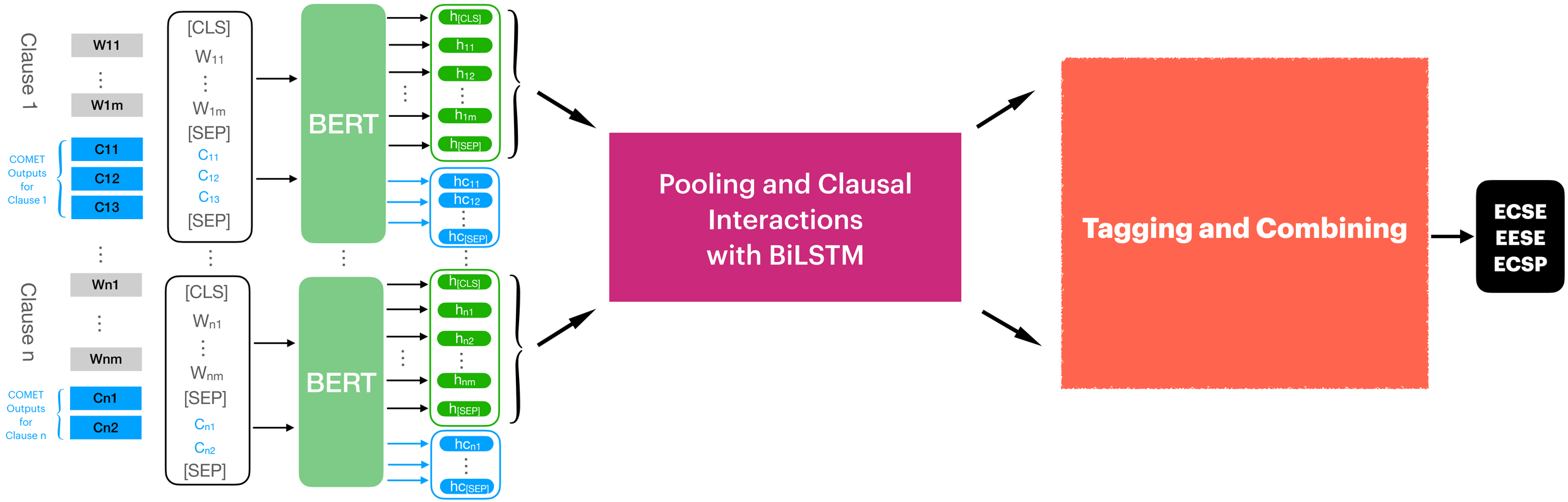
COMET Relations

- Relations in COMET
  - Event-centered:
    - HasSubEvent, Causes, xReason
  - Social-interaction:
    - xEffect, xReact

	Head	Relation	Tail	Size
PHYSICAL-ENTITY	bread	ObjectUse	make french toast	165,590
		AtLocation*	basket; pantry	20,221
		MadeUpOf	dough; wheat	3,345
		HasProperty*	cooked; nice to eat	5,617
	baker	CapableOf*	coat cake with icing	7,968
		Desires*	quality ingredients	2,737
		Not Desires*	bad yeast	2,838
EVENT-CENTERED	X runs out of steam	IsAfter	X exercises in the gym	22,453
		HasSubEvent	become tired	12,845
		IsBefore	X hits the showers	23,208
		HinderedBy	drinks too much coffee	106,658
		Causes	takes a break	376
		xReason	did not eat breakfast	334
	X watches --- anyway	isFilledBy	the game; the TV	33,266
SOCIAL-INTERACTION	X runs out of steam	xNeed	do something tiring	128,955
		xAttr	old; lazy; lethargic	148,194
		xEffect	drinks some water	115,124
		xReact	tired	81,397
		xWant	to get some energy	135,360
	X votes for Y	xIntent	to give support	72,677
		oEffect	receives praise	80,166
		oReact	grateful; confident	67,236
		oWant	thank X; celebrate	94,548

Model Architecture

- Commonsense knowledge encoded BECT-clause+BiLSTM (Comet-BECT)
  - For each clause, generate its commonsense knowledge using COMET (Bosselut, 2019)
    - Appends the COMET generated tokens to the original BERT inputs (Turcan, 2021)
    - COMET performed better at clause-level



Experiments
Evaluation Metrics

- Precision (P), Recall (R) and F1 scores:
  - Items: emotion spans or cause spans
  - Correct span: if both the start and end of the span are correctly predicted. (Bi, 2020)

$$Precision = \frac{\sum correct\_items}{\sum proposed\_items}, Recall = \frac{\sum correct\_items}{\sum annotated\_items}, F1 = \frac{2 * Precision * Recall}{Precision + Recall}$$

Experiments

Results and Discussions

- Result 1: BECT Model performance on three tasks -> *ECSE*, *EESE*, and *ECSP*
  - BECT-doc performed better than BECT-clause
    - BECT-clause is incapable of capturing interactions between different clauses
    - Adding Bi-LSTM helps -> better *ECSP* scores
      - Captures local and more detailed information within a clause

Model	ECSE			EESE			ECSP		
	P	*R*	*F1*	*P*	*R*	*F1*	*P*	*R*	*F1*
BECT-doc	21.34	25.23	23.12	49.66	**55.96**	**52.62**	21.09	22.75	21.89
BECT-clause	21.49	21.84	21.66	39.50	38.44	38.96	20.00	21.30	20.63
BECT-clause +BiLSTM	22.47	23.01	22.74	42.93	39.20	40.98	23.48	23.58	23.53
Comet-BECT +xEffect	24.04	25.30	24.65	48.63	36.70	41.83	23.56	23.90	23.73
Comet-BECT +xEffect +BiLSTM	23.24	24.19	23.71	**50.97**	41.22	45.58	20.08	22.81	21.36

Experiments

Results and Discussions

- Result 1: BECT Model performance on three tasks -> *ECSE*, *EESE*, and *ECSP*
  - "xEffect" is the relation type in Comet-atomic-2020-BART, under *Social Interaction* category -> works the best among all other event-related relations
    - Achieved best scores in *ECSE*, and *ECSP* among all baseline models
    - Adding Bi-LSTM helps with *EESE*

Cause-level task is more difficult
Reasoning is required

Model	ECSE			EESE			ECSP		
	P	*R*	*F1*	*P*	*R*	*F1*	*P*	*R*	*F1*
BECT-doc	21.34	25.23	23.12	49.66	55.96	52.62	21.09	22.75	21.89
BECT-clause	21.49	21.84	21.66	39.50	38.44	38.96	20.00	21.30	20.63
BECT-clause +BiLSTM	22.47	23.01	22.74	42.93	39.20	40.98	23.48	23.58	23.53
Comet-BECT +xEffect	**24.04**	**25.30**	**24.65**	48.63	36.70	41.83	**23.56**	**23.90**	**23.73**
Comet-BECT +xEffect +BiLSTM	23.24	24.19	23.71	**50.97**	41.22	45.58	20.08	22.81	21.36

Experiments

Results and Discussions

- Result 2: Comparisons among different event-related relations in COMET
  - “xEffect” demonstrated the best *ECSP* result
  - “Causes” and “xReason” is helpful in *ECSE*.
  - “xReact” performed the best in *EESE*.

Comet-BECT Model	ECSE			EESE			ECSP		
	P	*R*	*F1*	*P*	*R*	*F1*	*P*	*R*	*F1*
xReact	21.70	24.34	22.94	46.23	**43.28**	**44.71**	21.40	23.11	22.22
xEffect	24.04	**25.30**	24.65	**48.63**	36.70	41.83	**23.56**	**23.90**	**23.73**
Causes	25.20	25.00	25.10	46.24	38.74	42.16	22.46	23.56	22.99
HasSubEvent	23.44	20.29	21.75	48.07	36.32	41.38	22.12	23.70	22.88
xReason	**26.46**	24.18	**25.27**	48.49	40.14	43.92	20.17	20.43	20.30

Experiments
Error Analysis

- ECSE
  - *BECT-clause* vs *Comet-xEffect* vs *Comet-xReason*

Document	BECT-clause	xEffect	xReason
It wasn't that they could show him anything [C1], it was only that they could burn clear [C2]. To his surprise [C3], however [C4], after a while [C5] ***they did show him something***: ..... [C6]	they ✗	they did show him something ✓	they did show him something ✓
About a year later [C1], ***Mr Semple died*** [C2]. ..... The shock of death affected Mrs Semple greatly and left her for a time in a depressed state [C3].	Mr Semple died ✓	*Other spans* ✗	Mr Semple died ✓

Experiments
Error Analysis

- EESE
  - *Comet-xEffect* vs *Comet-xReact*

Document	xEffect	xReact
The two little pigs now felt sorry for [C1] ***having been so lazy***. [C2]	felt sorry	felt sorry for
I was terrified with news [C1] that ***the magistrate had ordered that I should go to service*** [C2].	*Null*	terrified

Experiments
Error Analysis

- ECSP
  - *BECT-clause* vs *BECT-clause-biLSTM*

Document	BECT-clause	BECT-clause-biLSTM
Let me say [C1] then [C2] as briefly as possible [C3] that I accompanied the engineer into the interior of the mine [C4] and became so strangely fascinated by ***its gloomy wonders*** [C5] and so interested in my friend's explorations [C6] that I prolonged my stay in the neighbourhood. [C7]	(fascinated, its gloomy wonders and so interested in my friend's explorations) ✗	(fascinated, its gloomy wonders) ✓
Shmuel pointed at Bruno's feet and the heavy boots he had taken from the house [C1] 'You'll have to leave them behind too ' [C2] he said [C3]. Bruno looked appalled [C4] 'But the mud ' [C5] he said [C6] 'You can't expect me to go barefoot [C7]. 'You'll be recognized otherwise ' [C8] said Shmuel [C9]. 'You don't have any choice' [C10]. Bruno sighed but he knew that his friend was right [C11] and he took off the boots and his socks and left them beside the pile of clothes on the ground [C12]. At first it felt horrible ***putting his bare feet into so much mud*** [C13], they sank down to his ankles and every time he lifted a foot it felt worse [C14]	✗ (first it felt horrible, putting his bare feet into so much mud)	✓ (horrible, putting his bare feet into so much mud)

Future Directions

- Multi-task learning
  - Emotion Detection + Cause/Emotion Span Detection
  - Intuition: emotion detection and cause/emotion span detection are closely related and can inform each other

- Better commonsense-knowledge-encoded embeddings for each token
  - Combines COMET encoder embeddings with discourse context information
  - Can we combine all useful relations for knowledge encoding?

Future Directions

- English ECA corpus with better quality
  - Current dataset (Gao, 2017) contains
    - duplicate annotations (~40%)
    - ill-formed annotation spans (~20%)
      - e.g. “I-CAU” or “I-EMO” occurs along
    - Emotion expressions are single words in most cases (~70%)
      - e.g. “He would feel more ***joy*** from the success of his son.”

Thank you!