

Representing the Linguistic Style of Sentences

A Hands-On Introduction to Style Embeddings

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**Utrecht
University**

Style Embeddings

- Oh yea and that young dr got bad hair

- r u a fan of them or something?

- Are you one of their fans?

Learning Style Representations

Authorship Verification (AV)

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don't suggest an open relationship if you're not ready

Aren't open relationships usually just about fixing something in the relationship?

it's clear that these are wildly different situations

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Label: ■ Author 1 ■ Author 2

Learning Style Representations

Authorship Verification (AV)

e.g., [Zhu et al., Idiosyncratic but not arbitrary: Learning idiolects in online registers reveals distinctive yet consistent individual styles., 2021; Rivera-Soto et al., Learning Universal Authorship Representations, 2021]

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+ extensive training (similar to Next Sentence Prediction)

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+ extensive training (similar to Next Sentence Prediction)

+ content controlled

[Wegmann et al., Same Author or Just Same Topic? Towards Content-Independent Style Representations, 2022]

as training task:

don't suggest an open relationship if you're not ready_

Aren't open relationships usually just about fixing something in the relationship?

it's clear that these are wildly different situations_

Label: ■ Author 1 ■ Author 2
Src: ■ conversation C_1 ■ conversation C_2

Style Representations



Try me!

⚡ Hosted inference API ⓘ

📄 Sentence Similarity

Examples



Source Sentence

r u a fan of them or something?

Sentences to compare to

Are you one of their fans?

Oh yea and tha young dr got a bad haircut.

Style

“[...] style features reflect **aesthetic** preferences, associated with particular authors or historical periods”

– Biber & Conrad (2009)

“[...] style may refer to some or **all language habits** shared by a group of people [...]”

– Crystal & Davy (1969)

“Style is a **socially meaningful clustering of features**, within and across linguistic levels and modalities.”

– Campbell-Kibler (2006)

“[...] the data-driven definition of style extends the linguistic style to a broader concept - the **general attributes in text.**”

– Jin & Jin (2021)

Evaluation

1. Authorship Verification

Are same author sentences close to each other?

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Are same author sentences close to each other?

True. Some of them are **religious** nut-bars.

Lol all i can say is gottem. you got wrecked by a class A douchebag

I mean Judaism and **Sikhi** also **believe** that.

Label: ■ Same Author

Domain: ■ r/OkCupid ■ r/DebateReligion

Evaluation

1. Authorship Verification

Are same author sentences close to each other?

2. Content Independence

Are known style dimensions (e.g., formal vs. informal) preferred over content information?

Evaluation — 2. Content Independence

based on [Wegmann et al., STEL, 2021]

r u a fan of them
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Same Style Paraphrase

Evaluation — 2. Content Independence

based on [Wegmann et al., STEL, 2021]

r u a fan of them
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Same Style

Paraphrase

- formal/informal

Yahoo! Answers [Rao et al., Dear Sir or Madam, May I Introduce the GYAFC Dataset: Corpus, Benchmarks and Metrics for Formality Style Transfer, 2018]

- (no) numb3r substitution

based on **Reddit** utterances

- complex/simple

Wikipedia [Xu et al., Optimizing Statistical Machine Translation for Text Simplification, 2016]

- (no) con'raction

based on **Wikipedia** abstracts

Applications with Style Representations

clustering & probing

C #	Consistent	Example
3	no last punct.	I am living in china, they are experiencing an enormous baby boom
4	punctuation / casing	huh thats odd i'm in the 97% percentile on iq tests, the sat, and the act
5	' vs '	I assume it's the blind lady?
7	linebreaks	I admire what you're doing but [...] I know I'm [...]

► Interpreting representations

Applications with Style Representations

audience design, linguistic
accommodation, idiolect...

- ▶ **Interpreting representations**
- ▶ **Representing Style for Digital Humanities & Social Sciences**

Applications with Style Representations

- ▶ **Interpreting representations**
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⇒ **potential to increase classification performances for diverse demographics & social groups**

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Data & Code: github.com/nlpsoc/style-embeddings

Evaluation — 1. Authorship Verification

selected results from [Wegmann et al., Same Author or Just Same Topic? Towards Content-Independent Style Representations]

Training Task	No CC	CC
	AUC	
untrained baseline*	0.61	0.53
No Content Control	0.77	0.58
Content Control (CC)	0.71	0.69

* baseline corresponds to semantic sentence representations generated by the base RoBERTa Transformer model [Liu et al., RoBERTa, 2019] using the Masked LM pretraining task; the other models are fine-tuned based on the RoBERTa model using the SBERT python library [Reimers et al., Sentence-BERT: Sentence Embeddings using Siamese BERT-Networks, 2019]

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- ▶ Authorship Verification performance improves
- ▶ Authorship Verification with content control (CC) is harder

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based on [Wegmann et al., STEL, 2021]

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Task Statistics – 600 conversations from 100 subreddits

CC level	Data Split	Setup		Utterance #	Author		(A_1, A_2)		(A_1, B)	
		# AV	# CAV		#	ma	co	do	co	do
Conversation	train set	420,000	210,000	546,757	194,836	9	0.27	0.56	1.00	1.00
	dev set	90,000	45,000	116,451	41,848	8	0.26	0.55	1.00	1.00
	test set	90,000	45,000	116,621	41,902	8	0.27	0.55	1.00	1.00
Domain	train set	420,000	210,000	544,587	240,065	9	same pairs	0.01	1.00	
	dev set	90,000	45,000	116,490	50,939	8	as	0.02	1.00	
	test set	90,000	45,000	116,586	51,182	8	conversation	0.02	1.00	
No	train set	420,000	210,000	548,082	270,079	9	same pairs	0.00	0.01	
	dev set	90,000	45,000	117,149	57,352	8	as	0.00	0.01	
	test set	90,000	45,000	117,434	57,726	8	conversation	0.00	0.02	

Table 1: **Data Split Statistics.** Per content control (CC) level, we display the number of tasks per setup (# CAV, # AV), unique utterances and authors for each split. We also show the maximum number of times an author occurs as A_1 's author (ma) and the fraction of same author (A_1, A_2) and utterance pairs of different authors (A_1, B) that occur in the same conversation (co) and domain (do).

STEL Task Generation*

*Examples shortened

formal	informal
Are you one of their fans?	<u>r u</u> a fan of them or something?
Oh, and also that young physician got an unflattering haircut	Oh <u>yea</u> and that young <u>dr</u> got a bad haircut

- formal/informal

Yahoo! Answers paraphrases from [Rao and Tetreault, Dear Sir or Madam, May I Introduce the GYAFC Dataset: Corpus, Benchmarks and Metrics for Formality Style Transfer, 2018]

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r u a fan of them or something?

Oh, and also that young physician got an unflattering haircut

Are you one of their fans?

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STEL Task Generation*

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simple	complex
These rock formations are made of sandstone.	These rock formations are <u>composed</u> of sandstone.
The Odyssey is an old poem written by Homer.	The Odyssey is an <u>ancient</u> poem <u>attributed</u> to Homer.



These rock formations are composed of sandstone.

These rock formations are made of sandstone.

The Odyssey is an ancient poem attributed to Homer.

The Odyssey is an old poem written by Homer.



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STEL Task Generation*

*Examples shortened

no nb3r	nb3r
<3 friends for-ever	<3 friends <u>4</u> ever
Dude 30\$ is heaps cheap	<u>D00d</u> 30\$ is heaps cheap



<3 friends forever

<3 friends 4ever

D00d 30\$ is heaps cheap

Dude 30\$ is heaps cheap

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- (no) num3r substitution

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STEL Task Generation*

*Examples shortened

no con'raction	con'raction
It has become one of the world's most significant cities.	<u>It's</u> become one of the world's most significant cities.
Will does not refer to any particular desire.	Will <u>doesn't</u> refer to any particular desire.



It has become one of the world's most significant cities.

It's become one of the world's most significant cities.

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Style 1	Style 2
Anchor Sentence 1	Anchor Sentence 2
Alternative Sentence 2	Alternative Sentence 1

Paraphrases



Anchor Sentence 1

Anchor Sentence 2

Alternative Sentence 1

Alternative Sentence 2



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Anchor Sentence 2

Alternative Sentence 1

Alternative Sentence 2



STEL is modular:

- formal/informal

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