Toward Comprehensive Understanding of Sentiment Based on Human Motives

Naoki Otani and Eduard Hovy

ACL 2019

Understanding sentiment – Sentiment analysis

Sentiment – A speaker's attitude (good/bad) toward entities (restaurants, laptops, …) or their aspects (quality, price, …).

Review text: My wife took me here on my birthday for breakfast and it was *excellent.* … - **Rating:** 5 (positive)

- Can be harvested from web sites like Yelp and Amazon. → A handy testbed of statistical models.

Aspect-based sentiment analysis: People also decompose target of sentiments into data-specific aspects.

Text: Their sake list was extensive, but we were looking for Purple Haze, which wasn't listed but made for us upon request!
Aspects and polarity: DRINKS#STYLE= positive, SERVICE#GENERAL = positive

- Some web sites have multi-dimensional ratings from which we can obtain aspect-based sentiment analysis dataset.
- Some manually created datasets are also publicly available (e.g., SemEval2014-16).

Main approach: find each 'local' sentiment by *word matching* and combine the local sentiment values to obtain an overall sentiment score.

- Neural nets are very powerful in finding surface-level clues (e.g., too expensive → negative) and combining them.

What is the reason for a sentiment value?

Many studies have only focused on the aspect & polarity of sentiment

`Everything is always cooked to perfection.` ☻ (FoodQuality, P)
`The waiter was rude at times.` ☹ (Service, N)

but have paid little attention to *the reasons* for holding sentiment.

Aspects are typically limited to properties of entities
and do not show *why* and *how* such aspects cause sentiment.
→ Clues to better respond to the sentiments.

We assume that sentiment is triggered by whether the holder's *motive* is satisfied.(Li&Hovy,17)

Human motive is a key to understand human's sentiments and behaviors

Situation 1: When you want quick lunch, you go to…

- iNoodle, McDonald's, … because you want *quick service* and *cheap food.*

Situation 2: When your parents come to see you, you go to…

- Porch, Lucca, … because you want *good atmosphere* and *nice food/service.*

Photo: https://apps.studentaffairs.cmu.edu/dining/conceptinfo/?page=conceptDetails&conceptId=110

Photo: https://www.visitpittsburgh.com/directory/the-porch-at-schenley/

Human motive is a key to understand human's sentiments and behaviors

Situation 3: When you buy a camera for climbing, you look for

- Sturdy camera … because it should not be easily damaged.

Situation 4: When you buy a camera for traveling, you look for

- Stylish and light camera … because you want to look good but have a lot to carry

https://getolympus.com/digitalcameras/tough/tg-5.html

https://shop.usa.canon.com/shop/en/catalog/powershot-g9-x-silver

People are happy/unhappy if their motives are satisfied/unsatisfied.

Proposing a task of human motive detection as the first step toward understanding sentiments.

Given a text, we identify relevant human motives

Everything is always cooked to perfection. ☺

Feeling satisfied Self-fulfilment

The waiter was rude at times. ☹

Being treated well Social Relation

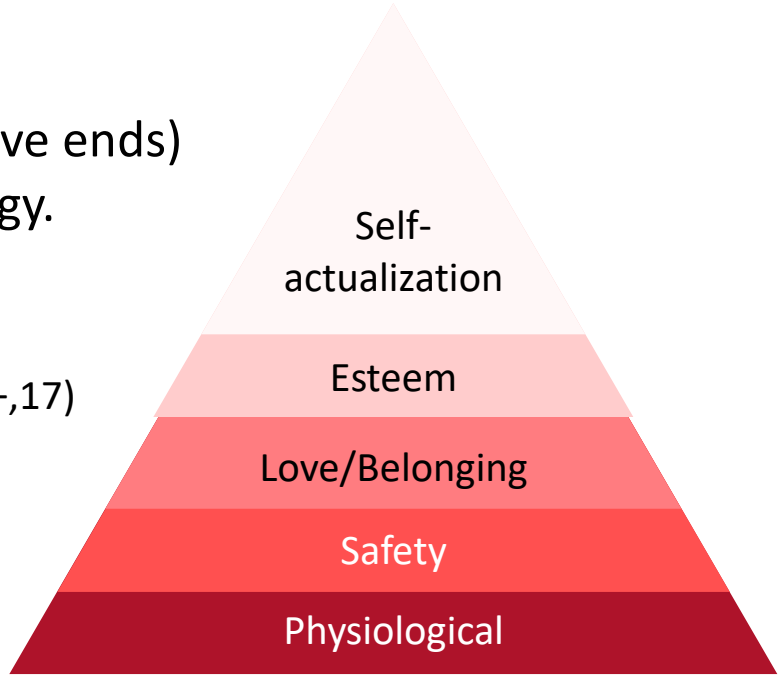
Highlights of our work

- Explore the *reason* for sentiment
  - We define six basic motives covering a wide range of topics in review texts.
- Annotate 1,600 restaurant & laptop reviews by crowdsourcing.
- Empirically show that underlying motives are universal across domains.

Background – Human motives

What are human motives? – Existing work

- Motives are reasons that people hold for initiating and performing voluntary behavior.(Reiss,04)
- How to categorize human motives is a long-standing challenge.
  - Aristotle (384-322BC): ends (ultimate goals) and means (subgoals to achieve ends)
  - Many categorization of 'ends' have been proposed in the field of psychology.
    - Some empirical studies observed and analyzed animal behavior.
  - Maslow (1943): Maslow's hierarchy.
- **Key idea:** human motives can be organized hierarchically.(Talevich+,17)
  - A few abstract, high-level motives.
  - Many concrete, lower-level motives.



Maslow. 1943. A theory of human motivation. *Psychological Review*.
Reiss. 2004. Multifaceted Nature of Intrinsic Motivation: The Theory of 16 Basic Desires. *Review of General Psychology*.
Talevich et al. 2017. Toward a Comprehensive Taxonomy of Human Motives. *PLOS ONE*.

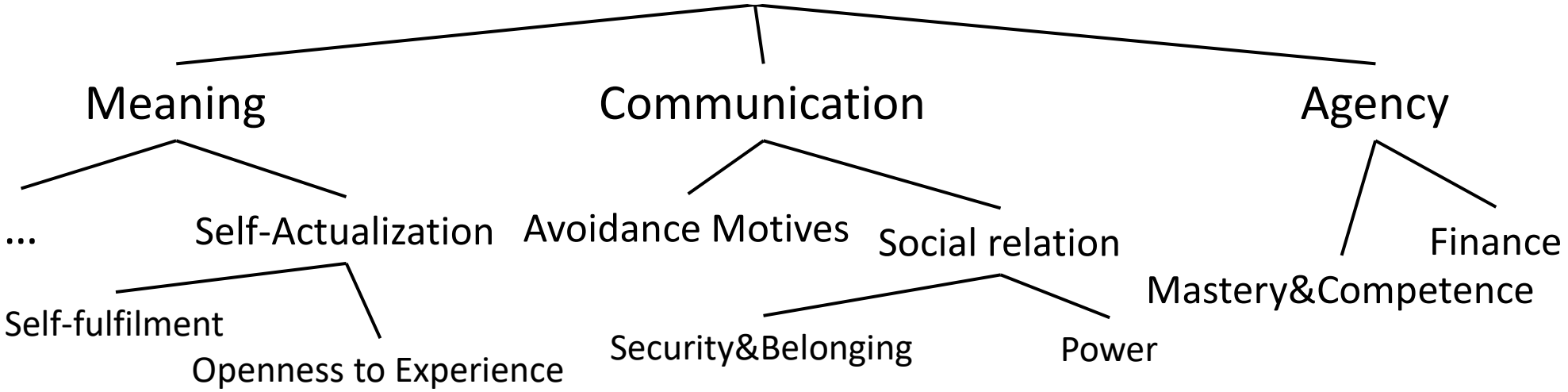
What are human motives? - 161 motives by Talevich et al (2017).

Taxonomy creation

1. Collect motives + their descriptions from previous human motive studies.
2. Ask human subjects to pair similar motives.
3. Run a hierarchical clustering algorithm to group them.

The strengths of their motive taxonomy

- ✔ Comprehensive (161 motives)
- ✔ Links to well-known theories like Maslow's hierarchy
- ✔ Easy to adjust the granularity based on the hierarchical structure




V-level (44 clusters)
W (24)
X (14)
Y (9)
Z(3)
V1
Social Values W1
Morals & Values X1
Morality & Virtue Y1
V2
Personal Morals W2
Social Giving V3
Help Others W3
Virtues X2
Interpersonal Care V4
Respected V5
Highly Regarded W4
Inspiring V6
V7
W5 X3 Religion & Spirituality Y2
MEANING Z1
V8
Wisdom & Serenity W6
Self-fulfill X4
Self-Actualize Y3
Self-knowledge V9
Self-knowledge & Contentment W7
Happiness V10
V11
Appreciating Beauty W8
Openness to Experience X5
Exploration V12
Embrace & Explore Life W9
Pursue Ideals & Passions V13
Enjoy Life V14
Avoid Stress & Anxiety V15
Avoid Instability W10
Self-protect X6
Avoidance Motives Y4
Avoid Harm V16
Avoid Rejections V17
Avoid Rejection & Conflict W11
Avoid Conflict V18
Avoid Socializing V19
W12 Avoid Hassle X7
Avoid Effort V20
COMMUNION Z2
Interpersonally Effective V21
Relate & Belong W13
Security & Belonging X8
Social Relating Y5
Social Life & Friendship V22
Liked V23
Sexual Intimacy V24
Intimacy W14
Emotional Intimacy V25
Fastidious V26
Stability W15
Stability & Safety V27
Better than Others V28
Dominate Others W16
Power X9
Control of Others V29
V30
Leadership W17

What are human motives? – Our taxonomy

We picked seven motives* from the second and third layers based on a pilot annotation study.

SELF-FULFILLMENT (SF)	Finding meaning in life. Feeling satisfied with one's life.	"Ess-A-Bagel is by far the best bagel in NY."
*EMBRACE &EXPLORE LIFE (EE)	Being entertained. Exploring a new thing.	"The wine list is extensive."
APPRECIATING BEAUTY (BA)	Enjoying fine design/natural beauty. Being creative.	"A beautifully designed dreamy restaurant."
SOCIAL RELATION (SR)	Being treated well by others. Belonging to a social group.	"Everyone was cheerfully cooperative."
HEALTH (H)	Being physically healthy.	"The fish was not fresh and the rice tasted old."
AMBITION&ABILITY (AA)	Being competent/knowledgeable. Keeping things in order. Being efficient.	"I've waited over one hour for food."
FINANCE (F)	Saving money Getting things worth the financial cost.	"The prices are high, but I felt it was worth it."

These motives cover major topics in the target datasets (explained next).

*'Embrace&explore life' was later merged into 'Self-fulfillment'.

'Aspect'-based SA
Entity-centric (drinks of a restaurant, etc.)

Data collection by crowdsourcing

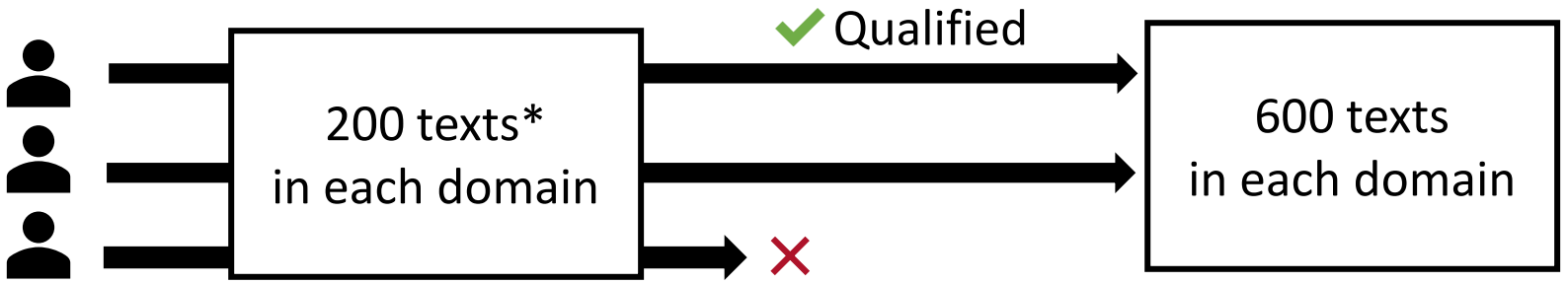
Data and annotation design

Data: SemEval 2016 dataset(Pontiki+,16)

- Domain: (1) restaurant review, (2) laptop review
- We randomly sampled 800 sentences (# of tokens $\leq$ 25) from each domain.

Annotation: Amazon mTurk, 3 workers / text

- Pre: I asked some of my friends to annotate data based on my annotation guidelines.
  *VERY IMPORTANT: do internal annotation trials BEFORE launching mTurk task!
- 1st round: 200 sentences in each domain
  - I also annotated the same texts manually as gold standards.
  - We made a pool of workers whose F1 score exceeds 0.5.
- 2nd round: 600 sentences in each domain



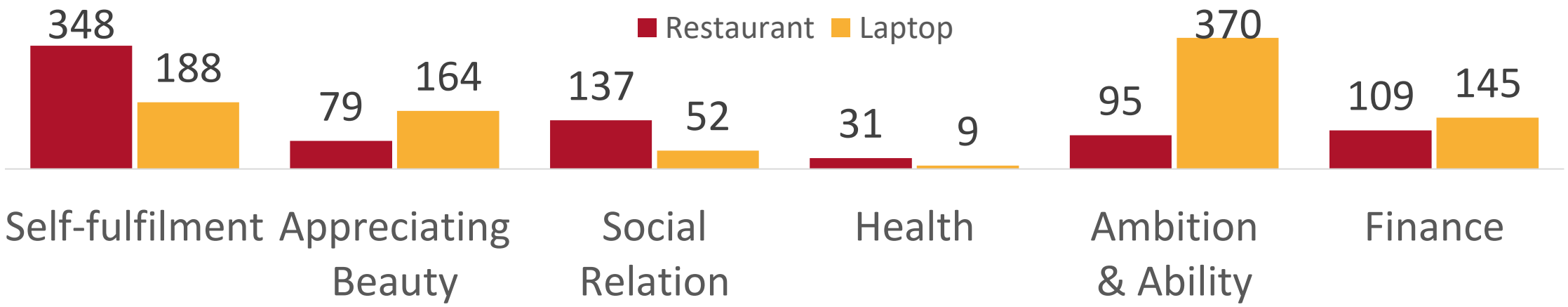
Krippendoff's α: 0.51 (restaurant), 0.61 (laptop)

Pontiki et al. 2016. SemEval-2016 Task 5: Aspect Based Sentiment Analysis. In *SemEval.*

Annotation results

Label distribution

We used MACE[(Hovy+,13)] to aggregate crowd annotations.



Hovy et al. 2013. Learning Whom to Trust with MACE. In *NAACL-HLT.*

Experiments

Experiments – Human motive detection

Task: Given a sentence, predict relevant motives. (Multi-label classification)

`Service is fast, and everything is always cooked to perfection.`

Ambition&Ability

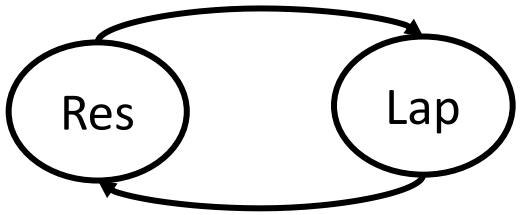
Self-fulfilment

Hypothesis: as human motives are universal across domains, we can effectively transfer a human motive identifier from domain to domain.

Baselines: Linear SVM, Multi-layer perceptron (MLP)

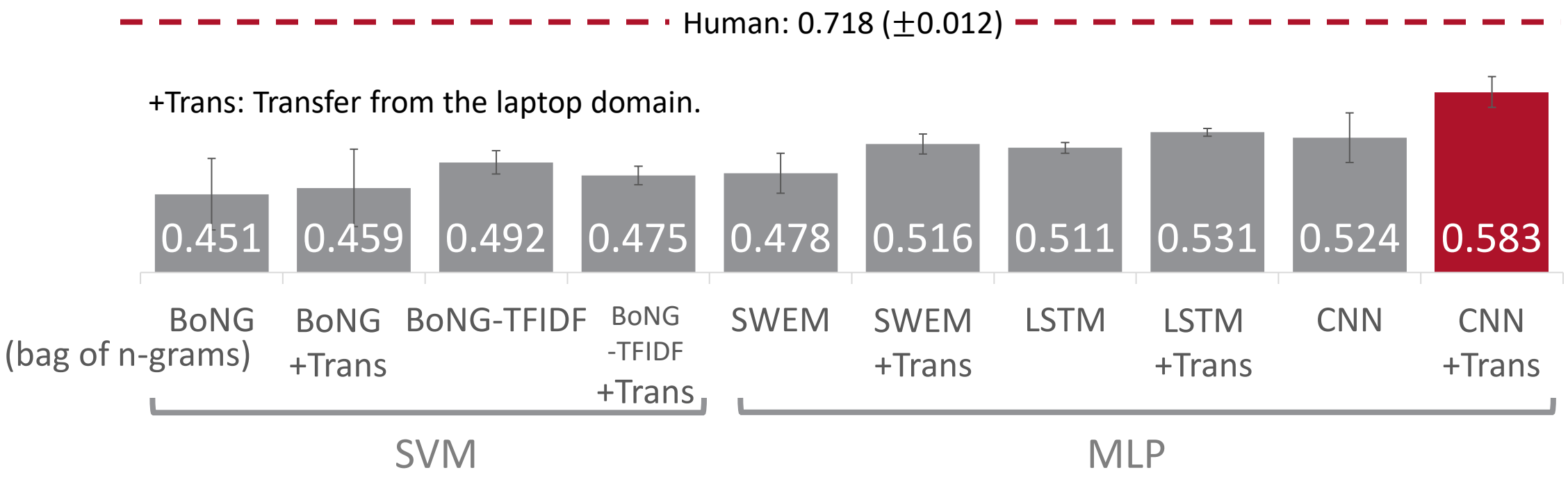
Transfer learning: $\mathcal{L}' = \mathcal{L}_{\text{in}} + \lambda \mathcal{L}_{\text{out}}$

In-domain Out-domain



Experiments – Results (Restaurant review)

Key finding: Out-of-domain training data helps.

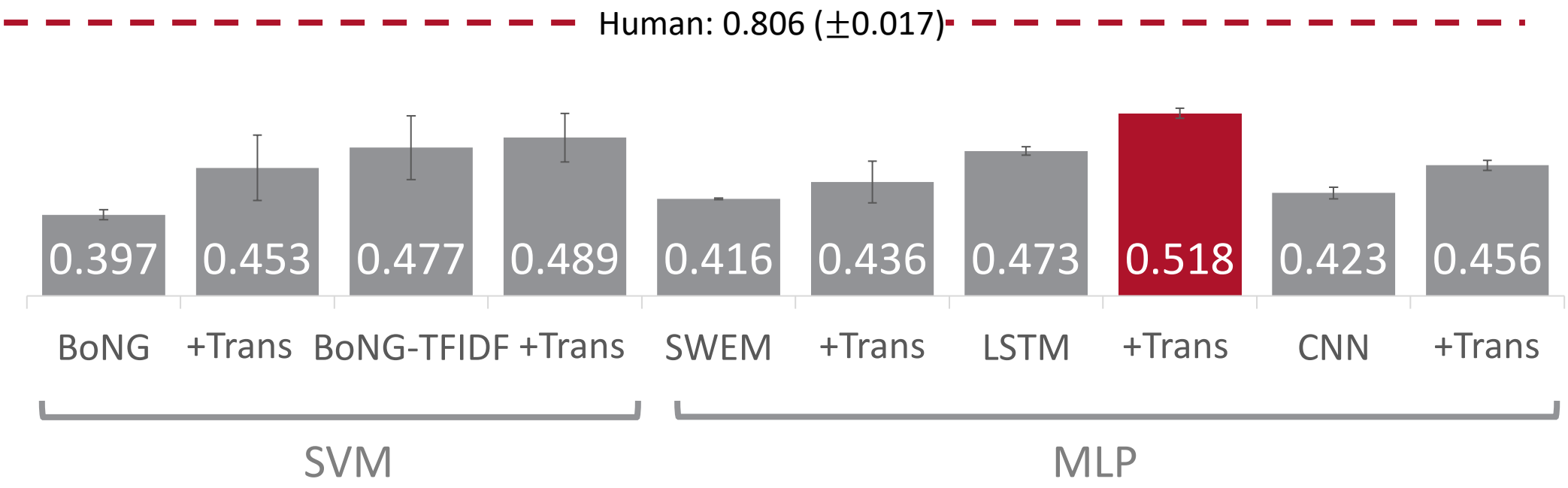


Three encoders before MLP

- SWEM[(Shen+,18)]: concat. of average and max-pooling
- CNN
- LSTM

Experiments – Results (Laptop review)

Key finding: Out-of-domain training data helps.



Three encoders before MLP

- SWEM[(Shen+,18)]: concat. of average and max-pooling
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Conclusion and future work

Conclusion:

- Aspects are not real explanations for sentiment. (e.g. the price of food → not always the most important factor.)
  - So, instead, we explored underlying human motives
  - We propose a task of human motive detection.
  - We defined six motives based on an existing psychological study and annotated review texts.
  - We built a classifier that detects relevant human motives in each text.
- Our experiments demonstrate that a motive identifier is transferable across domains – the strength of universal target labels across domains (human motives).

Future work:

- Not all sentiments are goal-oriented ("I like blue") … how can we handle non-logical preference?
- Investigate other domains, like movie reviews, hotel reviews, …
- Analyze whether each motive is satisfied and summarize the overall satisfaction of the sentiment holder.
- Discover individual distributions of human motives.
  - Some people may prioritize cost performance while others appreciate the quality more.
  - How can we analyze personal preference and utilize them to better communicate with humans?