

	Product Review Domain					
	Bags	KBs	Boots	B/T	TVs	VCs
$\beta$	0.01	0.02	0.01	0.02	0.02	0.02
I	6	4	6	8	6	4
$\tau$	1e-3	1e-5	1e-5	1e-4	1e-3	1e-6
$\lambda$	5	3000	10	5	10	3000
$d_1$	2	128	16	16	16	128
$d_2$	128	32	16	32	16	4
$d_3$	8	64	8	16	16	64

Table 1: Hyper-parameter settings for the product review.

	Restaurant Review Domain					
	En	Sp	Fr	Ru	Du	Tur
$\beta$	0.01	0.02	0.02	0.02	0.01	0.01
I	4	4	6	2	4	2
$\tau$	1e-3	1e-5	1e-6	1e-3	1e-3	1e-5
$\lambda$	100	100	10	1000	100	1
$d_1$	16	16	32	16	32	2
$d_2$	32	64	16	32	32	32
$d_3$	128	128	64	32	64	32

Table 2: Hyper-parameter settings for the restaurant review datasets.

## APPENDIX

We provide more information on datasets (Section 1.1) and implementation details (Section 1.2). Besides, we report more detailed experimental results (Section 1.3), and parameter sensitivity analysis (Section 1.4).

### Datasets

During training, segment aspect labels (9-class for product reviews and 12-class for restaurant reviews) are not available but provided during validation and test. For instance, in the Laptop Bags domain, the review segments’ aspects could be Compartments, Customer Service, Looks, or Price. Note that a general aspect is assigned if the segment doesn’t discuss any specific aspects. For each domain, we train our model on a training set only with seed words  $G$  via the teacher. For the aspect seed words, we follow Angelidis and Lapata (2018); Karamanolakis et al. (2019) to use the same 30 seed words for two datasets. Besides, for two datasets, we follow Angelidis and Lapata (2018); Karamanolakis et al. (2019) to do data preprocessing, such as removing stop-words.

For the Amazon review dataset, the reviews of each domain are already segmented by (Angelidis and Lapata 2018), where they use a Rhetorical Structure Theory parser (Feng and Hirst 2012) to segment reviews into elementary discourse units (EDUs). Across domains, the average numbers of training, validation, and test segments are around 1 million, 700 segments, respectively. For restaurant reviews, the reviews of each language are already segmented into sentences. Across languages, the average number of training and test segments is around 2500 and 800 segments, respectively.

### Implementation details

For HDAE, the details hyper-parameter settings are given in Table 1 and 2, which are determined by optimizing on a validation set. We also provide the parameter sensitivity experiment of latent semantic modeling distance  $d_1$ ,  $d_2$ , and

Model	Restaurant Review Domain					
	En	Sp	Fr	Ru	Du	Tur
ABAE	35.8	-	-	-	-	-
SSCL-BT*	47.3	-	-	-	-	-
LDA-AR	28.5	17.7	13.1	14.8	25.9	27.7
MATE	41.0	24.9	17.8	18.4	36.1	39.0
MATE-UW	40.3	18.3	19.2	21.8	31.5	25.2
TS-Teacher	44.9	41.8	34.1	54.4	40.7	30.2
TS-ATT	47.8	41.7	32.4	59.0	42.1	42.3
TS-BT	51.8	42.0	39.2	58.0	43.0	45.0
HDAE	<b>57.9</b>	<b>65.7</b>	<b>48.6</b>	<b>62.9</b>	<b>57.2</b>	<b>50.8</b>

Table 3: Micro-averaged F1 reported for 12-class sentence-level aspect detection in restaurant reviews.

$\tau$	1e-1	1e-2	1e-3	1e-4	1e-5	1e-6
Bags	67.1	67.5	<b>68.8</b>	67.8	67.8	68.2
B/T	68.4	69.1	71.1	<b>71.9</b>	70.4	70.3
Boots	61.8	62.4	63.5	63.7	<b>64.0</b>	63.7
TVs	69.8	70.8	<b>71.2</b>	70.4	70.3	70.0

Table 4: Micro-averaged F1 of HDAE given grumbel-softmax temperature  $\tau$ .

$d_3$ , Grumbel-Softmax temperature  $\tau$ , ratio of distillation objective  $\lambda$ , number of latent semantic I in section . The total number of negative examples  $k_n$  was set to 10. We followed the procedure in Angelidis and Lapata (2018) to set the 200-dimensional word embeddings for the Amazon product reviews and the 300-dimensional multilingual word2vec embeddings from Ruder, Ghaffari, and Breslin (2016) for restaurant reviews. For all models, the same 30 seed words were set per aspect. For HDAE, model parameters are optimized by using the Adam optimizer (Kingma and Ba 2014). For setting distillation objective, the teacher, a bag-of-word classifier, is implement, and we use iterative co-training to update each seed word’s predictive quality. For TS-\*, we report the result from iterative co-training, and in each round, we divide the learning rate by 10. For SSCL-BT\*, we use code provided in<sup>1</sup> and conduct aspect mapping after training the teacher model. The smooth factor  $\lambda$  is set to 0.5 and temperature is set to 1. For all models, the learning rate was selected from  $[2 \times 10^{-4}, 1 \times 10^{-6}, 5 \times 10^{-7}, 5 \times 10^{-8}, 1 \times 10^{-8}]$ . Other hyperparameters were optimized according to validation results. For each model, we repeat each experiment 5 times and report the average test performance with the parameter configuration that achieves the best validation performance.

### Experimental Results

we provide the performance the unsupervised based method ABAE and SSCL on English Restaurant review, as shown in Table 3

Then, we provide more results for seed word based approaches’ inference performance per aspect and their corresponding embedding visualization on Bags, Bluetooth Headsets, Boots, Keyboards, Televisions, and Vacuums (VCs) datasets, shown in Figure 1, 2, 3, 4, 5, 6, respectively.

<sup>1</sup><https://github.com/tshi04/AspDecSSCL>

$\lambda$	5	10	100	500	1000	3000
Bags	<b>68.8</b>	68.1	67.5	67.0	66.9	66.0
B/T	<b>71.1</b>	70.8	69.0	67.9	67.2	63.3
Boots	62.4	<b>63.7</b>	62.8	62.4	61.2	60.7
TVs	70.1	<b>71.2</b>	70.3	70.1	69.8	69.4

Table 5: Micro-averaged F1 of HDAE given  $\lambda$

I	2	4	6	8
Bags	68.0	68.3	<b>68.8</b>	68.3
B/T	68.5	69.1	70.3	<b>71.9</b>
Boots	61.8	62.4	<b>64.0</b>	63.9
TVs	69.3	69.8	<b>71.2</b>	70.5

Table 6: Micro-averaged F1 of HDAE given I.

### Parameter Sensitivity Analysis

In this section, we provide more results for parameter sensitivity. Table 4 shows effects of the grumbel-softmax temperature  $\tau$  on the performance of HDAE. We find that our model achieves the best results when small  $\tau$  is set, suggesting that it is important to not to mix the latent semantic when predicting the segment’s aspect. Table 5 shows effects of the distillation objective ratio  $\lambda$  on the performance of HDAE. It is found that HDAE achieves the best performance when  $\lambda$  is set to 5 or 10. From Table 6, we see effects of number of latent semantics I and HDAE achieves best result when large I is set. From Table 7, we see effects of  $\beta$  and HDAE achieves the best result when  $\beta$  is set to 0.01 or 0.02.

### Results in ground truth aspect labels ratios

In this section, we provide results for baselines with (HDAE, MATE, TS-ATT, TS-BT) or without (W2V, BERT) leveraging seed word in different ground truth aspect labels ratios. We find the proposed model HDAE can achieve best performance in different ground truth aspect labels ratios, suggesting the effectiveness of purposed hyperbolic disentangled based method. Besides, we notice that in the low aspect labels data ratios, seed word based approaches (MATE, TS-ATT, TS-BT, and HDAE) can achieve better, demonstrating that seed words can give useful guidance and assist models to improve aspect inference ability.

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- Karamanolakis, G.; Hsu, D.; Hsu, D.; and Gravano, L. 2019. Leveraging Just a Few Keywords for Fine-Grained Aspect Detection Through Weakly Supervised Co-Training. *CoRR*, abs/1909.00415.
- Kingma, D. P.; and Ba, J. 2014. Adam: A Method for Stochastic Optimization. *arXiv e-prints*, arXiv:1412.6980.

$\beta$	0.005	0.01	0.02	0.05
Bags	67.8	<b>68.0</b>	67.7	66.6
B/T	70.5	71.2	<b>71.9</b>	71.3
Boots	63.1	<b>64.0</b>	63.7	63.2
TVs	68.1	69.8	<b>70.5</b>	70.0

Table 7: Micro-averaged F1 of HDAE given  $\beta$

ratio r	Restaurant review domain (En)				
	10%	30%	50%	70%	100%
W2V-Gold	16.3	33.0	38.6	46.7	58.8
BERT-Gold	24.8	36.5	48.5	55.9	63.1
MATE	43.8	46.7	50.4	54.3	60.1
TS-ATT	48.5	50.6	53.2	57.7	61.1
TS-BT	53.6	56.1	58.4	61.2	64.2
HDAE	<b>58.6</b>	<b>62.2</b>	<b>64.1</b>	<b>66.9</b>	<b>70.5</b>

Table 8: Micro-averaged F1 for 12-class sentence-level aspect detection in restaurant reviews in English with different ratios of training set r.

Ruder, S.; Ghaffari, P.; and Breslin, J. G. 2016. A Hierarchical Model of Reviews for Aspect-based Sentiment Analysis. *CoRR*, abs/1609.02745.

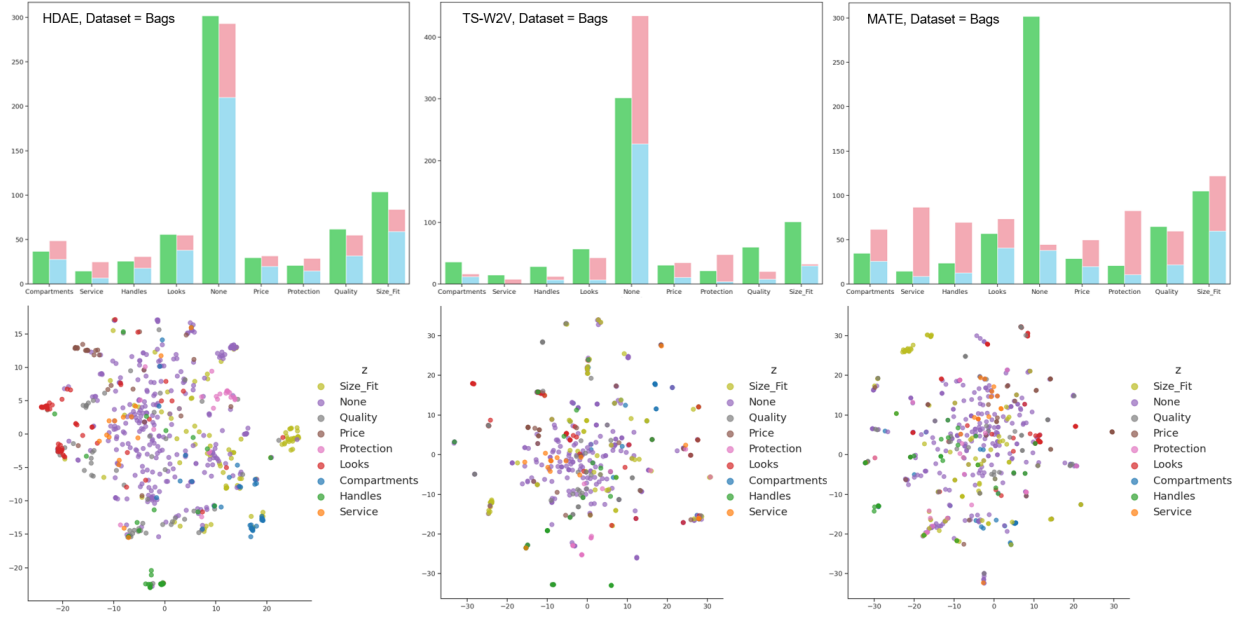


Figure 1: Inference performance per aspect of HDAE, TS-W2V, and MATE on Bags dataset. The following figure is segment vector t-SNE visualization of each model, where the different color of point represent different aspect.

ratio r	Restaurant review domain (Sp)				
	10%	30%	50%	70%	100%
W2V-Gold	21.3	32.2	35.5	40.1	50.4
BERT-Gold	29.2	39.1	42.2	46.0	51.6
MATE	32.5	39.4	45.1	48.5	52.4
TS-ATT	42.3	46.8	54.4	58.2	62.3
TS-BT	44.0	46.5	52.6	60.7	66.6
HDAE	<b>66.8</b>	<b>68.1</b>	<b>70.0</b>	<b>72.1</b>	<b>72.5</b>

Table 9: Micro-averaged F1 for 12-class sentence-level aspect detection in restaurant reviews in Spanish with different ratios of training set r.

ratio r	Restaurant review domain (Ru)				
	10%	30%	50%	70%	100%
W2V-Gold	28.5	32.5	43.5	50.0	55.7
BERT-Gold	23.5	31.5	41.3	47.9	55.3
MATE	22.6	30.3	36.8	44.3	51.2
TS-ATT	58.8	59.1	59.8	62.1	65.5
TS-BT	59.5	61.3	62.1	65.5	67.4
HDAE	<b>61.3</b>	<b>65.0</b>	<b>67.8</b>	<b>71.5</b>	<b>76.8</b>

Table 11: Micro-averaged F1 for 12-class sentence-level aspect detection in restaurant reviews in Russian with different ratios of training set r.

ratio r	Restaurant review domain (Fr)				
	10%	30%	50%	70%	100%
W2V-Gold	21.2	29.9	37.1	43.1	50.4
BERT-Gold	20.2	24.8	33.0	40.9	50.6
MATE	28.7	34.8	40.5	45.2	48.1
TS-ATT	32.8	38.1	44.1	46.6	50.1
TS-BT	43.0	44.9	46.5	48.0	53.0
HDAE	<b>48.7</b>	<b>51.8</b>	<b>54.9</b>	<b>60.8</b>	<b>65.4</b>

Table 10: Micro-averaged F1 for 12-class sentence-level aspect detection in restaurant reviews in French with different ratios of training set r.

ratio r	Restaurant review domain (Du)				
	10%	30%	50%	70%	100%
W2V-Gold	24.4	32.8	42.4	47.3	51.4
BERT-Gold	28.1	40.8	47.5	51.6	53.5
MATE	38.8	40.9	46.2	48.4	52.0
TS-ATT	43.9	45.8	51.8	53.5	55.4
TS-BT	45.4	47.1	50.4	53.6	57.6
HDAE	<b>58.5</b>	<b>62.5</b>	<b>68.3</b>	<b>72.1</b>	<b>73.8</b>

Table 12: Micro-averaged F1 for 12-class sentence-level aspect detection in restaurant reviews in Dutch with different ratios of training set r.

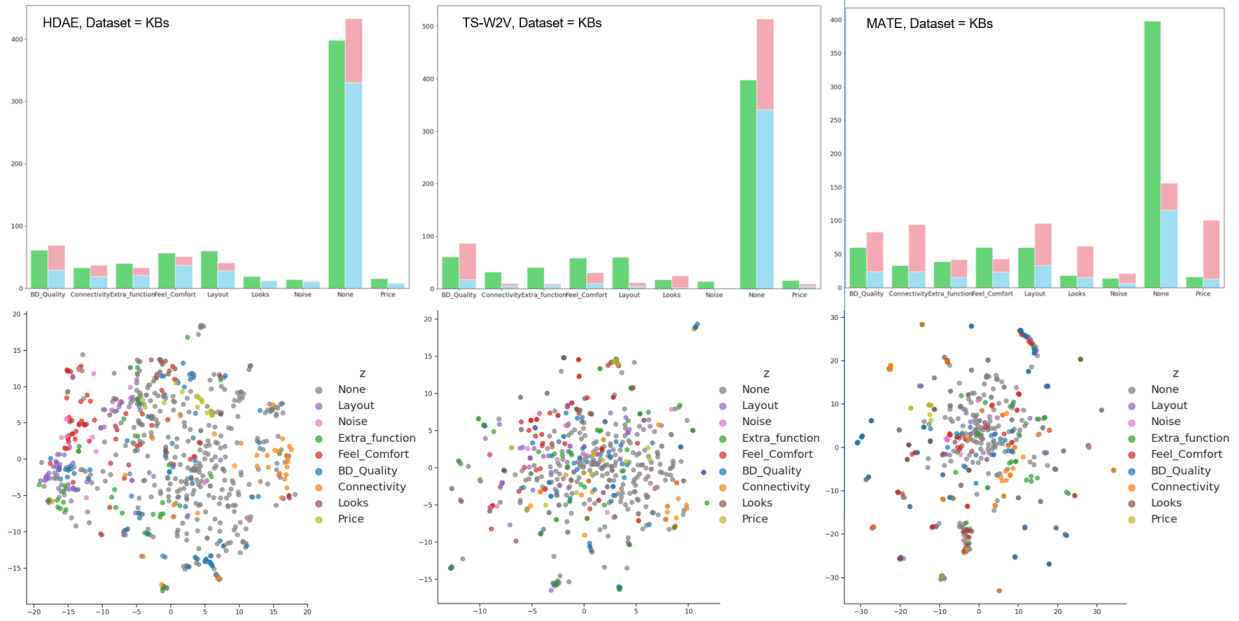


Figure 2: Inference performance per aspect of HDAE, TS-W2V, and MATE on Keyboards dataset. The following figure is segment vector t-SNE visualization of each model, where the different color of point represent different aspect.

ratio r	Restaurant review domain (Tur)				
	10%	30%	50%	70%	100%
W2V-Gold	28.6	37.2	42.3	50.8	55.7
BERT-Gold	31.5	39.0	45.6	52.3	56.5
MATE	41.3	44.9	47.1	49.9	53.0
TS-ATT	45.9	47.5	49.7	52.8	55.5
TS-BT	45.5	48.7	52.6	54.3	57.6
HDAE	<b>49.8</b>	<b>52.4</b>	<b>56.9</b>	<b>60.1</b>	<b>65.4</b>

Table 13: Micro-averaged F1 for 12-class sentence-level aspect detection in restaurant reviews in Turkish with different ratios of training set r.

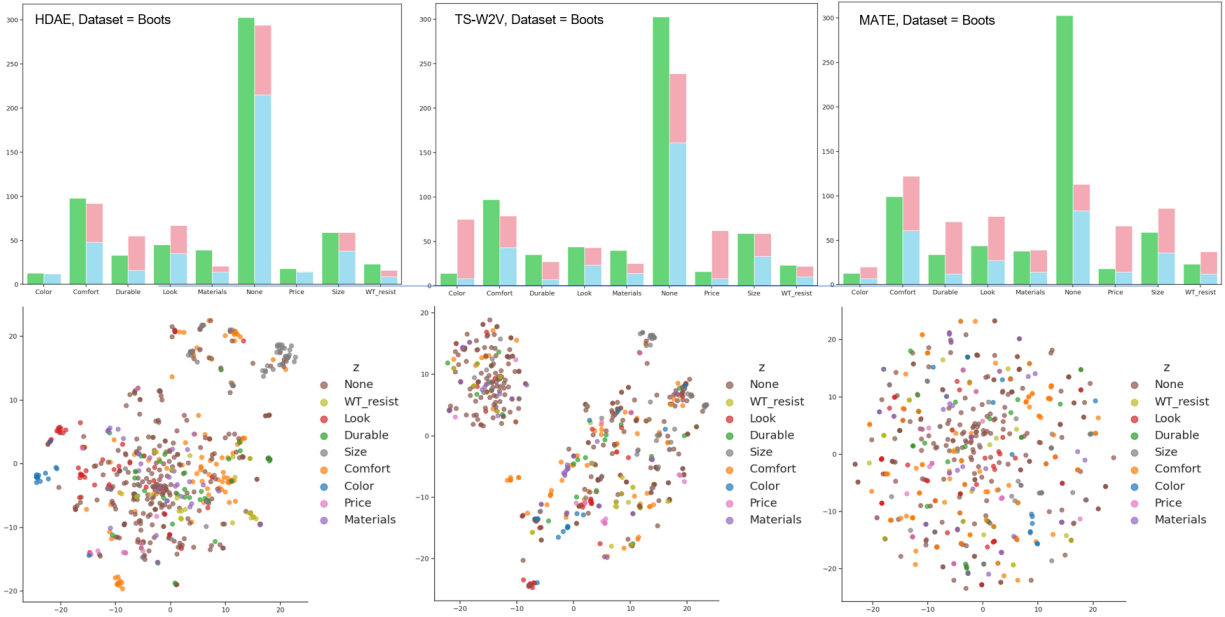


Figure 3: Inference performance per aspect of HDAE, TS-W2V, and MATE on Boots dataset. The following figure is segment vector t-SNE visualization of each model, where the different color of point represent different aspect.

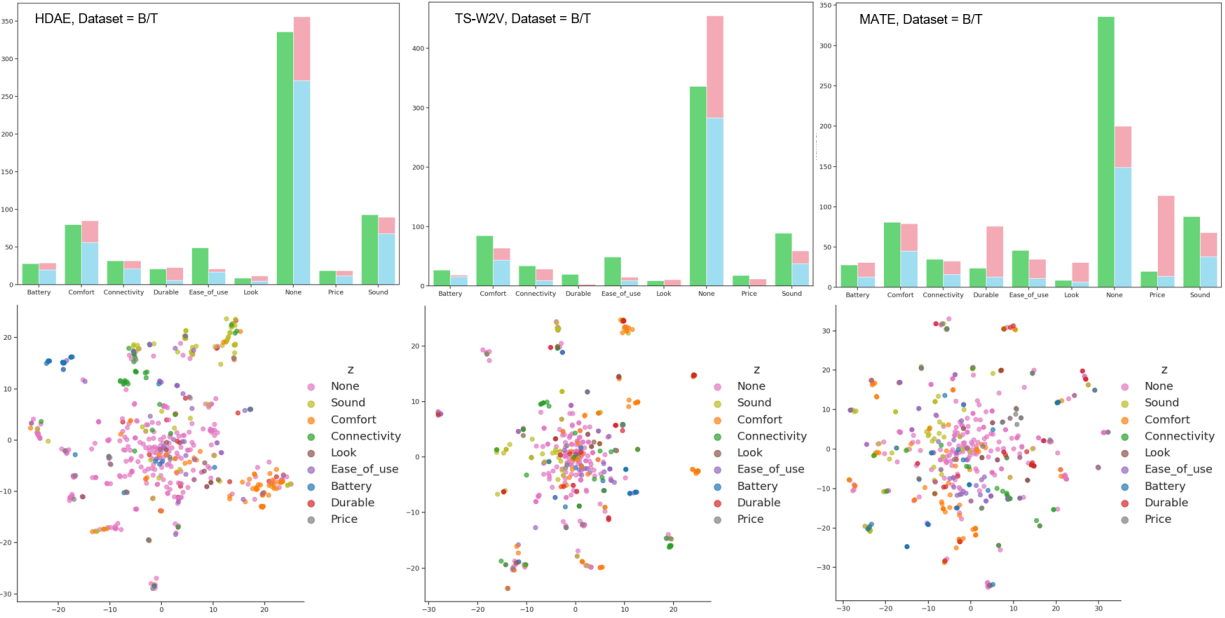


Figure 4: Inference performance per aspect of HDAE, TS-W2V, and MATE on Bluetooth Headsets dataset. The following figure is segment vector t-SNE visualization of each model, where the different color of point represent different aspect.

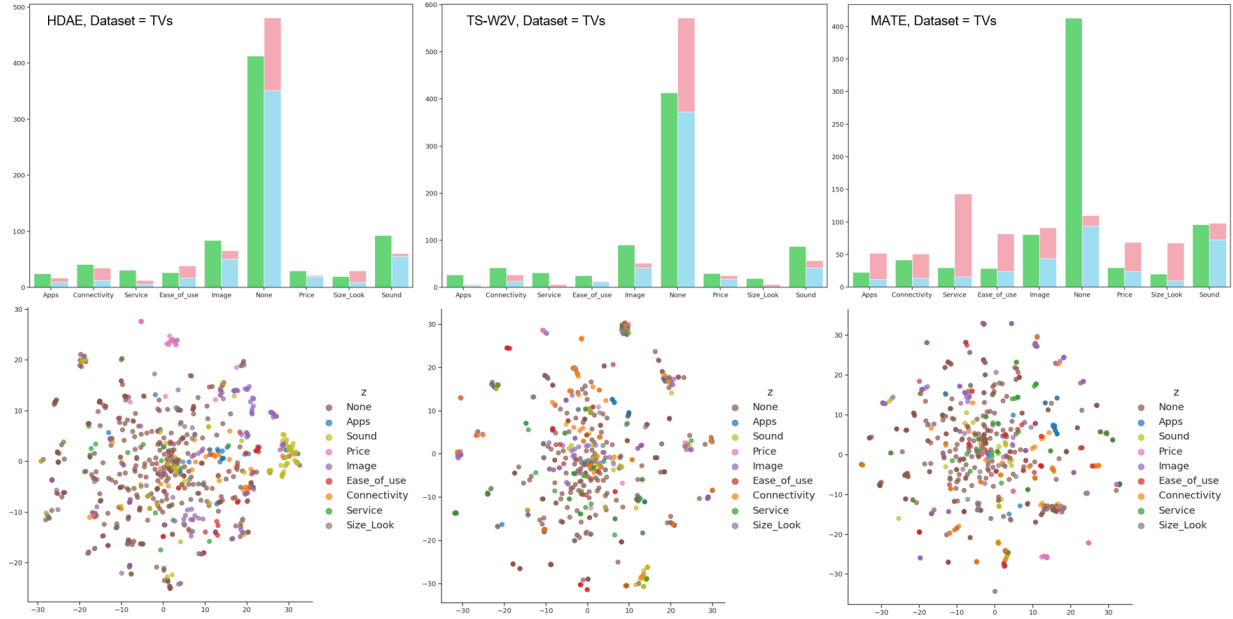


Figure 5: Inference performance per aspect of HDAE, TS-W2V, and MATE on Televisions dataset. The following figure is segment vector t-SNE visualization of each model, where the different color of point represent different aspect.

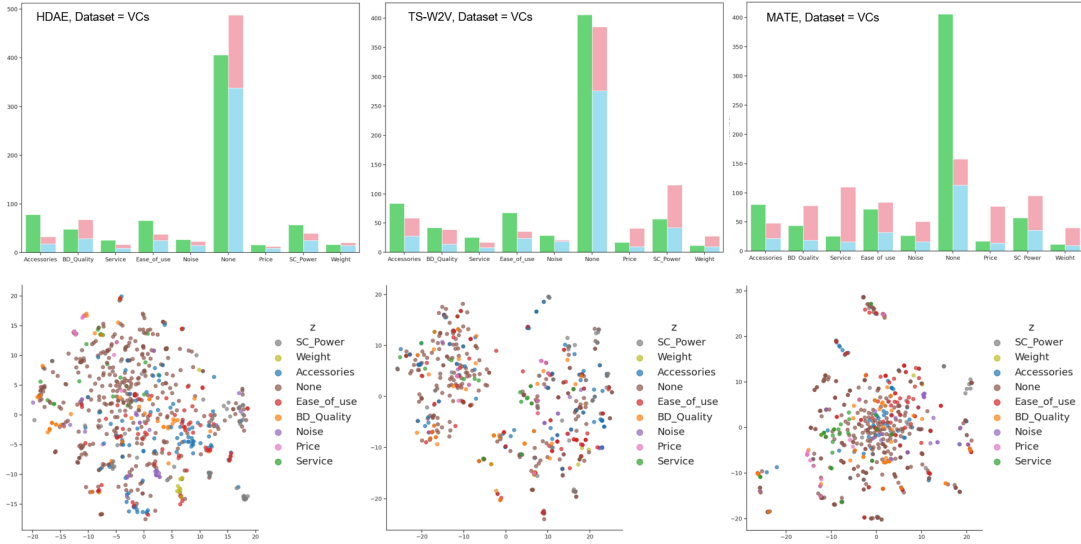


Figure 6: Inference performance per aspect of HDAE, TS-W2V, and MATE on Vacuums dataset. The following figure is segment vector t-SNE visualization of each model, where the different color of point represent different aspect.

Do not purchase.			GT: Noise
Seed Words: loud, noise, noisy, quiet, action, sound, quieter, know, make			
HDAE: General ✗	MATE: General ✗	TS-W2V: General ✗	
Which died.			GT: General
Seed Words: think, recommend, purchase, using, unit, star, microsoft, mouse			
HDAE: Build Quality ✗	MATE: Build Quality ✗	TS-W2V: Build Quality ✗	
Except the keyboard was one of those high keyed, clackety-clunkety types.			GT: General
Seed Words: think, recommend, purchase, using, unit, star, microsoft, mouse			
HDAE: General ✓	MATE: General ✓	TS-W2V: Comfort ✗	
I really liked the look of it.			GT: Looks
Seed Words: look, slim, original, appearance, little, attractive, beautiful			
HDAE: Looks ✓	MATE: General ✗	TS-W2V: Looks ✓	
I liked the feel of the keys.			GT: Comfort
Seed Words: feel, comfortable, mushy, key, like, keyboard, good, perfect			
HDAE: Comfort ✓	MATE: General ✗	TS-W2V: Looks ✗	
But it has all the buttons to interface with my iMac.			GT: Extra functionality
Seed Words: buttons, light, pencil, volume, power, feature, bright, mute, handy, low, dark			
HDAE: Extra functionality ✓	MATE: Extra functionality ✓	TS-W2V: Extra functionality ✓	
It is quiet.			GT: Noise
Seed Words: loud, noise, noisy, red, action, sound, quieter, know, make			
HDAE: Noise ✓	MATE: Noise ✓	TS-W2V: Noise ✓	
The layout of the keys makes it difficult for me to use, with keys like the backspace.			GT: Layout
Seed Words: key, delete, backspace, size, layout, end, insert, home, bar, perfect, space			
HDAE: Layout ✓	MATE: General ✗	TS-W2V: Layout ✓	
And doesn't depress at times			GT: Build Quality
Seed Words: working, build, stopped, quality, month, spacebar, stuck, left, plastic, kind, died			
HDAE: Build Quality ✓	MATE: Build Quality ✓	TS-W2V: General ✗	
And the key for the "t" is already broken.			GT: Build Quality
Seed Words: working, build, stopped, quality, month, spacebar, stuck, left, plastic, kind, died			
HDAE: Build Quality ✓	MATE: Layout ✗	TS-W2V: Comfort ✗	
Has a top row of quick link			GT: Extra functionality
Seed Words: button, light, pencil, volume, power, feature, bright, mute, handy, low, dark			
HDAE: Extra functionality ✓	MATE: Extra functionality ✓	TS-W2V: Comfort ✗	
The keyboard is sleek and visually appealing.			GT: Looks
Seed Words: look, slim, original, appearance, little, attractive, beautiful			
HDAE: Looks ✓	MATE: General ✗	TS-W2V: General ✗	
That had popped off.			GT: Build Quality
Seed Words: working, build, stopped, quality, month, spacebar, stuck, left, plastic, kind, died			
HDAE: Build Quality ✓	MATE: Build Quality ✓	TS-W2V: General ✗	
It is very responsive.			GT: Comfort
Seed Words: feel, comfortable, mushy, key, like, keyboard, good, perfect, press, wrist, action, shallow, smooth			
HDAE: Comfort ✓	MATE: Connectivity ✗	TS-W2V: General ✗	

Table 14: Comparison of predictions on sample Keyboards product review segments between HDAE, MATE, and TS-W2V. For each review segment, the ground true (GT) aspect and its corresponding seed words are provided.

But may be unsightly.			GT: Look
Seed Words: cute, look, looked, great, fringe, great, fringe, style, color, love, design, going, unattractive, attractive			
HDAE: Durability ✗	MATE: Size ✗	TS-W2V: General ✗	
However, I bought them in February.			GT: General
Seed Words: return, pair, thought, year, boot, high, kind, merrell, excited, wore, disappointed, buy, problem			
HDAE: General ✓	MATE: Price ✗	TS-W2V: General ✓	
I ordered these a half-size up			GT: Size
Seed Words: size, ordered, half, order, big, little, bigger, usually, narrow, normally, width			
HDAE: Size ✓	MATE: General ✗	TS-W2V: Size ✓	
Nice looking shoes.			GT: Look
Seed Words: cute, look, looked, great, fringe, great, fringe, style, color, love, design, going, unattractive, attractive			
HDAE: Look ✓	MATE: Look ✓	TS-W2V: Color ✗	
Hurt after 30 minutes			GT: Comfort
Seed Words: comfortable, fit, foot, hurt, ankle, comfy, blister, comfort, break, wear, able, extreme, walking, sock			
HDAE: Comfort ✓	MATE: Comfort ✓	TS-W2V: Comfort ✓	
The material is very thin and flimsy			GT: Materials
Seed Words: leather, inside, fringe, material, heel, cheaper, soft, sole, buckle, suede, true, rubber, advertised			
HDAE: Materials ✓	MATE: Materials ✓	TS-W2V: Materials ✓	
Which helps in the Maine <b>winter</b> .			GT: Weather resistance
Seed Words: dry, waterproof, rain, wet, water, foot, soaked, <b>snow</b> , <b>cold</b> , puddle, warm, got, chicago, protect, suppose			
HDAE: Weather resistance ✓	MATE: General ✗	TS-W2V: General ✗	
It was a washed <b>purplish</b> but not a true <b>purple</b>			GT: Color
Seed Words: <b>color</b> , love, <b>style</b> , unbelievably, gorgeous, blue, favorite, taupe, wonderful, red, exactly, design			
HDAE: Color ✓	MATE: Size ✗	TS-W2V: General ✗	
I wanted a true <b>purple</b> boot.			GT: Color
Seed Words: <b>color</b> , love, style, unbelievably, gorgeous, blue, favorite, taupe, wonderful, red, exactly, design			
HDAE: Color ✓	MATE: General ✗	TS-W2V: Price ✗	
That I can easily <b>slip on</b> and not <b>struggle</b> to put it on.			GT: Comfort
Seed Words: comfortable, <b>fit</b> , foot, hurt, ankle, comfy, blister, <b>comfort</b> , break, <b>wear</b> , able, extreme, walking, sock			
HDAE: Comfort ✓	MATE: Comfort ✓	TS-W2V: General ✗	
seem pretty <b>solid</b> to me.			GT: Durability
Seed Words: rubber, quality, use, buckle, appear, heel, <b>long</b> , time, <b>breaking</b> , enjoy, provide			
HDAE: Durability ✓	MATE: Durability ✓	TS-W2V: General ✗	
And <b>scratch up</b> your fingers getting your foot into the things though.			GT: Comfort
Seed Words: <b>comfortable</b> , fit, foot, hurt, ankle, comfy, blister, comfort, break, wear, able, extreme, walking, sock			
HDAE: Comfort ✓	MATE: General ✗	TS-W2V: Weather Resistance ✗	
It would <b>stay tied</b> as well.			GT: Durability
Seed Words: rubber, quality, use, buckle, appear, heel, <b>long</b> , time, breaking, enjoy, provide, <b>protection</b> , clearly, cheaply			
HDAE: Durability ✓	MATE: Look ✗	TS-W2V: General ✗	
You need to design these with a <b>zipper</b> .			GT: Materials
Seed Words: leather, inside, fringe, <b>material</b> , heel, cheaper, soft, sole, buckle, suede, true, rubber, advertised			
HDAE: Materials ✓	MATE: Materials ✓	TS-W2V: General ✗	

Table 15: Comparison of predictions on sample Boots product review segments between HDAE, MATE, and TS-W2V. For each review segment, the ground true (GT) aspect and its corresponding seed words are provided.



Plus, a lot of the more expensive cases aren't as bright as this one. Seed Words: look, color, pink, stylish, looked, pretty, lime, green, fashionable, picture, awesome, good, great			GT: Looks
HDAE: General ✗	MATE: Price ✗	TS-W2V: General ✗	
And we bought two of this sleeve. Seed Words: recommend, bought, used, hard, bag, work, using, pleased, say, backpack, weight, case, new, purchased			GT: General
HDAE: General ✓	MATE: Size fit ✗	TS-W2V: General ✓	
My only complaint is the interior color Seed Words: look, color, pink, stylish, looked, pretty, lime, green, fashionable, picture, awesome, good, great			GT: Looks
HDAE: Looks ✓	MATE: Looks ✓	TS-W2V: Looks ✓	
About what size laptop fits in it. Seed Words: fit, size, macbook, big, space, air, slightly, lot, bulk, perfect, inch, laptop, perfectly, 13, cable, folder, notebook			GT: Size fit
HDAE: Size fit ✓	MATE: Looks ✗	TS-W2V: Size fit ✓	
I can barely sling it over my shoulder. Seed Words: strap, handle, shoulder, broke, later, month, hand, comfortable, plastic, wear, tear, ripped			GT: Handles
HDAE: Handles ✓	MATE: Handles ✓	TS-W2V: Handles ✓	
It just looks kinda funny. Seed Words: look, color, pink, stylish, looked, pretty, lime, green, fashionable, picture, awesome, good, great, design, fre, cell, styling			GT: Looks
HDAE: Looks ✓	MATE: Looks ✓	TS-W2V: Looks ✓	
Starting to fall apart. Seed Words: quality, material, handle, poor, broke, durable, month, later, wear, tear, zipper, chemical, started, excellent, terrible			GT: Quality
HDAE: Quality ✓	MATE: Looks ✗	TS-W2V: General ✗	
And part of it chipped off Seed Words: quality, material, handle, poor, broke, durable, month, later, wear, tear, zipper, chemical, started, excellent, terrible			GT: Quality
HDAE: Quality ✓	MATE: Handles ✗	TS-W2V: General ✗	
Very fast shipping. Seed Words: hassle, return, unable, Christmas, difficult, free, replaced, arrived, promptly, gift, easy, getting, returned, week, amazon			GT: Customer service
HDAE: Customer service ✓	MATE: General service ✗	TS-W2V: General ✗	
The case is so small Seed Words: fit, size, macbook, big, space, air, slightly, lot, bulk, perfect, inch, laptop, perfectly, 13, cable, folder			GT: Size fit
HDAE: Size fit ✓	MATE: Protection ✗	TS-W2V: General ✗	
Which is a good deal Seed Words: price, worth, pay, good, great, requested, believe, send, 100, suppose, buck, based, reasonable, inexpensive			GT: Price
HDAE: Price ✓	MATE: Price ✓	TS-W2V: Looks ✗	
On the plus side it does have a lot of nooks and crannies to put stuff in. Seed Words: pocket, cable, compartment, outside, lot, wish, wallet, connector, space, power, pen, folder, charger, flap, mouse, nice			GT: Compartments
HDAE: Compartments ✓	MATE: Size Fit ✗	TS-W2V: Size Fit ✗	

Table 16: Comparison of predictions on sample Bags product review segments between HDAE, MATE, and TS-W2V. For each review segment, the ground true (GT) aspect and its corresponding seed words are provided.

If you don't need all the features. Seed Words: netflix, user, file, hulu, apps, watch, flash, internet, smart, video			GT: Apps Interface
HDAE: Ease of use ✗	MATE: Size Look ✗	TS-W2V: General ✗	
The Yahoo! widgets do not work Seed Words: netflix, user, file, hulu, apps, watch, flash, internet, smart, video			GT: Apps Interface
HDAE: Apps Interface ✓	MATE: Customer Service ✗	TS-W2V: Apps Interface ✓	
The picture quality is very sharp crisp Seed Words: picture, color, quality, back, bright, nice, clear, look, excellent, crisp, screen, right, dead, pixel, trace, beautiful			GT: Image
HDAE: Image ✓	MATE: Price ✗	TS-W2V: Image ✓	
The price is enticing. Seed Words: price, value, money, 1500, worth, 300, paid, solid, used, pretty, great			GT: Price
HDAE: Price ✓	MATE: Image ✗	TS-W2V: Price ✓	
But bright colors generally looked Seed Words: picture, color, quality, back, bright, nice, clear, look, excellent, crisp, screen, right, dead, pixel, trace, beautiful			GT: Image
HDAE: Image ✓	MATE: Image ✓	TS-W2V: Image ✓	
The sound from the TV itself is very tiny. Seed Words: sound, speaker, good, quality, loud, tinny, bass, hear, horrible, treble, change			GT: Sound
HDAE: Sound ✓	MATE: General ✗	TS-W2V: Sound ✓	
The cable connection port Seed Words: hdmi, port, computer, input, component, usb, internet, connection, output, server, connect, audio, play, stopped			GT: Connectivity
HDAE: Connectivity ✓	MATE: Connectivity ✓	TS-W2V: Connectivity ✓	
Picture and sound are both acceptable. Seed Words: sound, speaker, good, quality, loud, tinny, bass, hear, horrible, treble, change			GT: Sound
HDAE: Sound ✓	MATE: Sound ✓	TS-W2V: Sound ✓	
Are difficult to use and setup Seed Words: easy, channel, remote, setup, feature, user, menu, use, setting, using, turn, set, input, cause, shuts, cycle, signal			GT: Ease of Use
HDAE: Ease of Use ✓	MATE: Ease of Use ✓	TS-W2V: Ease of Use ✓	
Fast moving objects were incredibly pixelated and blotchy. Seed Words: picture, color, quality, back, bright, nice, clear, look, excellent, crisp, screen, right, dead, pixel, trace, beautiful			GT: Image
HDAE: Image ✓	MATE: Image ✓	TS-W2V: General ✗	
Lacks a net browser and the only thing. Seed Words: netflix, user, file, hulu, apps, watch, flash, internet, smart, video			GT: Apps Interface
HDAE: Apps Interface ✓	MATE: Ease of Use ✗	TS-W2V: Sound ✗	
Is pandora. Seed Words: netflix, user, file, hulu, apps, watch, flash, internet, smart, video			GT: Apps Interface
HDAE: Apps Interface ✓	MATE: General ✗	TS-W2V: General ✗	
Washed out but 720p movies. Seed Words: picture, color, quality, back, bright, nice, clear, look, excellent, crisp, screen, right, dead, pixel, trace, beautiful			GT: Image
HDAE: Image ✓	MATE: General ✗	TS-W2V: Connectivity ✗	

Table 17: Comparison of predictions on sample Televisions product review segments between HDAE, MATE, and TS-W2V. For each review segment, the ground true (GT) aspect and its corresponding seed words are provided.

To roll the windows up. Seed Words: sound, quality, hear, noise, volume, end, audio, good, voice, conversation, people, told, clearly, background			GT: Sound
HDAE: General ✗	MATE: General ✗	TS-W2V: General ✗	
The volume is GREAT! Seed Words: sound, quality, hear, noise, volume, end, audio, good, voice, conversation, people, told, clearly, background			GT: Sound
HDAE: Sound ✓	MATE: Price ✗	TS-W2V: Look ✗	
Very easy to put on. Seed Words: easy, control, button, simple, setup, mic, phone, colored, flashing, confusing, make, convenient			GT: Ease Of Use
HDAE: Ease of use ✓	MATE: Durability ✗	TS-W2V: Ease Of Use ✓	
I have had mine for about a week Seed Words: week, long, month, durable, sweat, charging, turn, second, expected, holding, standard, comment			GT: Durability
HDAE: Durability ✓	MATE: General ✗	TS-W2V: Durability ✓	
They hurts your ears. Seed Words: ear, fit, comfortable, bud, feel, jaybird, comfortably, lightweight, wear, readjusting, hard			GT: Comfort
HDAE: Comfort ✓	MATE: Comfort ✓	TS-W2V: Comfort ✓	
Attached to a non bluetooth phone, a Razr, and a Blackberry with excelent results in every case Seed Words: phone, range, easy, easily, galaxy, foot, connection, optimal, zone, cut, paired, link, connects			GT: Connectivity
HDAE: Connectivity ✓	MATE: Durability ✗	TS-W2V: Connectivity ✓	
As for the ear pad. Seed Words: ear, fit, comfortable, bud, feel, jaybird, comfortably, lightweight, wear, readjusting, hard			GT: Comfort
HDAE: Comfort ✓	MATE: Comfort ✓	TS-W2V: Comfort ✓	
Strengths : Sweat and water resistant, lighter. Seed Words: week, long, month, durable, sweat, charging, turn, second, expected, holding, standard, comment			GT: Durability
HDAE: Durability ✓	MATE: Durability ✓	TS-W2V: Durability ✓	
It is portable and sweat proof. Seed Words: week, long, month, durable, sweat, charging, turn, second, expected, holding, standard, comment			GT: Durability
HDAE: Durability ✓	MATE: Durability ✓	TS-W2V: Durability ✓	
I do like the design of it and the fact. Seed Words: look, appearance, hs850, nice, earpiece, h700, smaller, feel, fine, bluetooth, great, good, headset			GT: Look
HDAE: Look ✓	MATE: Durability ✗	TS-W2V: General ✗	
To roll the windows up Seed Words: sound, quality, hear, noise, volume, end, audio, good, voice, conversation, people, told, clearly, background			GT: Sound
HDAE: Sound ✓	MATE: Comfort ✗	TS-W2V: General ✗	
The style is very cool and the unit feels top quality. Seed Words: look, appearance, hs850, nice, earpiece, h700, smaller, feel, fine, bluetooth, great, good, headset			GT: Look
HDAE: Look ✓	MATE: General ✗	TS-W2V: Look ✓	
On the plus side, the call quality is good. Seed Words: sound, quality, hear, noise, volume, end, audio, good, voice, conversation, people, told, clearly, background			GT: Sound
HDAE: Sound ✓	MATE: Price ✗	TS-W2V: Look ✗	
It starting to hurt me. Seed Words: ear, fit, comfortable, bud, feel, jaybird, comfortably, lightweight, wear, readjusting, hard			GT: Comfort
HDAE: Comfort ✓	MATE: Comfort ✓	TS-W2V: General ✗	

Table 18: Comparison of predictions on sample Bluetooth Headsets product review segments between HDAE, MATE, and TS-W2V. For each review segment, the ground true (GT) aspect and its corresponding seed words are provided.

Eventually I started listening to my iPod.			GT: General
Seed Words: vac, cleaner, vacuum, buy, bought, new, better, year, recommend, product, owned, review, gave, away, kenmore, dyson			
HDAE: Build Quality ✗	MATE: Build Quality ✗	TS-W2V: General ✓	
It is easy to move because of the adjustable wheels on the side of the brush			GT: Ease of use
Seed Words: easy, cord, push, corner, vacuuming, pile, maneuver, nozzle, awkward, crevice, constantly, bog, impossible, short			
HDAE: Ease of use ✓	MATE: Accessories ✗	TS-W2V: Ease of use ✓	
Too bulky, cord is unusually stiff and tangles are impossible to remove.			GT: Ease of use
Seed Words: easy, cord, push, corner, vacuuming, pile, maneuver, nozzle, awkward, crevice, constantly, bog, impossible, short			
HDAE: Ease of use ✓	MATE: Build Quality ✗	TS-W2V: Ease of use ✓	
It is so easy to maneuver.			GT: Ease of Use
Seed Words: easy, cord, push, corner, vacuuming, pile, maneuver, nozzle, awkward, crevice, constantly, bog, impossible, short			
HDAE: Ease of use ✓	MATE: Weight ✗	TS-W2V: Ease of Use ✓	
Because it was so loud.			GT: Noise
Seed Words: quiet, noisy, loud, powerful, noise, louder, ear, loudest, light, incredibly, deafening, seriously, actually			
HDAE: Noise ✓	MATE: Noise ✓	TS-W2V: Noise ✓	
And have powerful suction.			GT: Suction Power
Seed Words: suction, pick, powerful, power, good, hair, carpet, such, quiet, really, performs, dirt, tile, ok			
HDAE: Suction Power ✓	MATE: Suction Power ✓	TS-W2V: Suction Power ✓	
While the suction is very good.			GT: Suction Power
Seed Words: suction, pick, powerful, power, good, hair, carpet, such, quiet, really, performs, dirt, tile, ok			
HDAE: Suction Power ✓	MATE: Noise ✗	TS-W2V: Suction Power ✓	
Which prevents wearing and tearing the plastic parts on the brush			GT: Build Quality
Seed Words: belt, broke, turn, working, burning, electrical, built, stop, month, roller, time, minute			
HDAE: Build Quality ✓	MATE: Accessories ✗	TS-W2V: Build Quality ✓	
The sides wrapped with protective rubber like rim			GT: Build Quality
Seed Words: belt, broke, turn, working, burning, electrical, built, stop, month, roller, time, minute, problem			
HDAE: Build Quality ✓	MATE: Noise ✗	TS-W2V: General ✗	
Then the engine completely stopped vacuuming.			GT: Build Quality
Seed Words: belt, broke, turn, working, burning, electrical, built, stop, month, roller, time, minute, problem, brush, design			
HDAE: Build Quality ✓	MATE: Suction Power ✗	TS-W2V: Ease of Use ✗	
A small, light-weight appliance that can do a big job.			GT: Weight
Seed Words: light, weight, lightweight, heavy, size, compact, maneuver, guess, quiet, quite, probably			
HDAE: Weight ✓	MATE: Price ✗	TS-W2V: Suction Power ✗	
You have to hold it at a very uncomfortable angle			GT: Ease of Use
Seed Words: easy, cord, push, corner, vacuuming, pile, maneuver, nozzle, awkward, crevice, constantly, bog, impossible, short			
HDAE: Ease of Use ✓	MATE: Ease of Use ✓	TS-W2V: General ✗	
The tools were previously stored inside the canister			GT: Accessories
Seed Words: filter, brush, attachment, roll, turbo, easily, expensive, wide, turn, bag, replacing, typical, hepa			
HDAE: Accessories ✓	MATE: Build Quality ✗	TS-W2V: General ✗	

Table 19: Comparison of predictions on sample Vacuums product review segments between HDAE, MATE, and TS-W2V. For each review segment, the ground true (GT) aspect and its corresponding seed words are provided.