

# Narrative Discovery in Social Media Discussions

## Anonymous Authors

### Abstract

Social media platforms give rise to an abundance of posts and comments on every topic imaginable. Many of these posts express opinions on various aspects of society, but their unfalsifiable nature makes them ill-suited to fact-checking pipelines. In this work, we aim to distill such posts into a small set of narratives, that capture the essential claims related to a given topic. Understanding and visualizing these narratives can facilitate more informed debates on social media. As a first step towards systematically identifying the underlying narratives on social media, we introduce, PAPYER👉, a fine-grained dataset of online comments related to hygiene in public restrooms, which contains a multitude of unfalsifiable claims. We present a human-in-the-loop pipeline that uses a combination of machine and human kernels to discover the prevailing narratives and show that this pipeline outperforms recent large transformer models and state-of-the-art unsupervised topic models.

### Introduction

Social media platforms have changed the ways information is produced, disseminated, and consumed, creating new opportunities along with complex challenges. One of these challenges is how to grasp, use, and interpret a large corpus of text from online discussion.

Several works (Blei, Ng, and Jordan 2003; Churchill and Singh 2021; Thompson and Mimno 2020; Moody 2016; Sia, Dalmia, and Mielke 2020) aim to distill large documents either through topic modeling or document summarisation. Our work falls into this category, however, we focus on identifying narratives in fine-grained topic-specific discussions.

Our use of the term *narrative* follows the vulgar sense found in arguments in social media, as opposed to the literary sense that refers to connected events in a story involving a protagonist, villain, transformation, etc. The former sense frequently appears in accusations of the form *you don't mention X because it doesn't fit narrative Y*, where *X* is a check-worthy claim and *Y* is an unfalsifiable claim. Consider the following tweet:

The FBI wants to push the narrative  
that white nationalism is the biggest

Copyright © 2021, Association for the Advancement of Artificial Intelligence (www.aaai.org). All rights reserved.

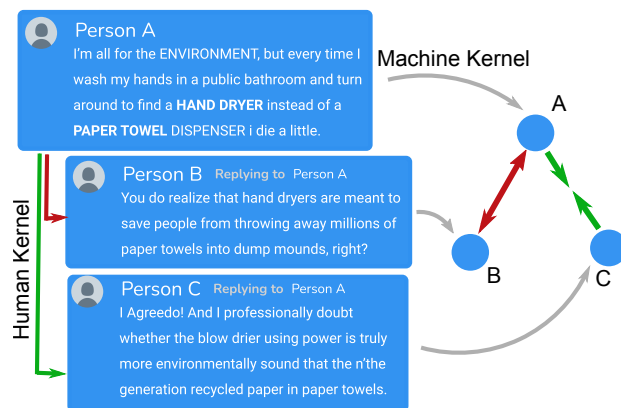


Figure 1: Using a combination of machine and human kernels, we strive to discover the underlying narratives in online discussions. Our human kernel acts on triplets, posing the question of who would likely take the same side in a debate. In this example, while person *A* and *C* express different ideas, they both prefer paper towels over air dryers, making them better suited to team with one another rather than person *B*. These claims illustrate the complexity of the task at hand that requires an understanding of content, context, slang, humor and sarcasm. In this work, we demonstrate that human annotated triplets enable us to learn a low-dimensional representation of such claims, which reveals clusters of narratives from online discussions.

domestic threat we face today. Here's the problem: the facts don't fit that narrative.

Whether the FBI would agree that they espouse the above narrative is not within the scope of our current work. We focus instead on the following problems, which we pursue in a human-in-the-loop framework: (1) inferring narratives from comments and (2) computing distances between text excerpts with respect to narrative alignment.

With such a distance function in hand, one can obtain a valuable signal that is more fine-grained compared to traditional topic modeling, illuminating cases in which differently-worded content resolves to the same narrative. In organic discussions on social media, such narrative-based

analysis could facilitate more informed debate, in the sense that participants can marshal facts more efficiently to support a compact set of distilled, indexed narratives. In less organic settings, as in cases of astroturfing or sock-puppet infiltration, we envision that such narrative based analysis could point to the existence of latent, manufactured talking points. Furthermore, such narrative-based analysis can complement and extend current fact-checking pipelines, which only consider falsifiable claims.

There are a number of reasons why it is difficult to label narratives present in tweets and other social media comments. (1) Doing so requires insight into the topic, for which the set of potentially relevant narratives is, in practice, not known beforehand. (2) The appropriate level of label granularity is not obvious. (3) The number of labels per topic varies. We, therefore, propose to cast narrative discovery as a triplet-based metric learning problem. This allows us to ask annotators whether comment *A* belongs with comment *B* or *C* without depending on ground truth class annotations, simplifying the annotation process.

Directly presenting annotators with randomly sampled triplets, however, is impractical in terms of the human effort required. In the computer vision literature, SNaCK (Wilber et al. 2015) offers an effective means of combining visual similarity with triplet constraints to increase the information gain per new annotation. In that work, Wilber et al. applied SNaCK to a set of food images, presenting human annotators with Human Intelligence Tasks (HITs) tapping into their perception of the taste of the depicted food, ultimately producing a low-dimensional embedding of the meals as points in flavor space, without appealing to ground truth labels of cuisine types. In the present work, we adapt this method for the annotation of text, with *narrative* used in place of *taste*.

In our experiments, we focus on a discussion topic related to hygiene and present PAPYER 🧻, a dataset contains narratives related to the use of hand drying in public restrooms (i.e., *paper* vs. *air dryer*). We select this topic as it (a) gives rise to vigorous discussions in social media, (b) is widely relatable, (c) is manageable in scope, and (d) possesses elements analogous to a variety of other domains involving human decision making.

Our main contributions are as follows: (1) the introduction of a new human-in-the-loop machine learning problem of social media narrative discovery, (2) a workflow for narrative annotation based on SNaCK, and (3) a dataset for quantitative narrative analysis.

## Related Work

We first review topic modeling and fact-checking, as our work can be considered an instance of fine-grained topic modeling adjacent to conventional fact-checking workflows. We examine connections to other approaches such as document summarization, online discourse, and sentiment analysis. Lastly, we review the relations between our workflow, crowd kernel learning, and human-in-the-loop annotation for modeling abstract narrative similarity.

**Topic modeling.** aims to discover groups of words corresponding to subcategories in a collection of documents in an unsupervised manner. The best-known approach is Latent Dirichlet Allocation (LDA) (Blei, Ng, and Jordan 2003), which uses Dirichlet priors to characterize distributions of topics and words. Since the introduction of word2vec (Mikolov et al. 2013) newer models have incorporated word embeddings to help reduce the sparsity of the word co-occurrence space (Moody 2016; Gui et al. 2019; de Arruda, da Fontoura Costa, and Amancio 2016). This has enabled models to handle data from a variety of sources including tweets, scientific articles, short texts, and books (Churchill and Singh 2021). However, we find that these methods tend to not discover the prevailing narratives, as this task requires an understanding of context, humor, sarcasm, etc.

**Fact checking.** One of our long-term motivations to discover narratives is to complement fact-checking pipelines that currently do not have a use for unfalsifiable claims.

Concretely, a statement such as “*Queen Elizabeth II was born in 1926.*” is considered falsifiable and hence check-worthy (Jaradat et al. 2018; Gencheva et al. 2017; Hassan et al. 2017), while “*The royal family is a waste of taxpayers’ money.*” is an unfalsifiable claim. A common fact-checking pipeline would discard the latter type of claims being not check-worthy nor easily verifiable (Augenstein 2021). In case of a check-worthy claim, it then proceeds to retrieve evidence from documents drawn from a database curated by annotators. The claims under consideration could be numerical properties, quotes, or event participation. Our approach is not applied in any fact-checking pipeline, but can be seen as complementary, as annotators no longer need to consider the veracity of claims, and instead only think about underlying similarity in terms of views held by the individuals making the claims. In doing so, we aim to discover a summary of claims that can subsequently describe all facets of a debate. This brings us to our next subarea of related work.

**Document summarization.** Discovering the prevailing narratives in a text corpus can also be viewed as an instance of document summarization. Document summarization has been studied extensively in two major ways; one that rearranges the content of the document to produce a summary (extractive) and another that generates a summary given context (abstractive) (Carenini and Cheung 2008). In the latter, a summary is provided as a target, while in the former, one selects sentences directly using scoring functions such as the Jaccard distance between the sentence and intermediate key phrases (Jadon and Pareek 2016). Recently, Tan et al. (2020) made it possible to generate abstractive summaries using any aspect, such as “sports” or “health.” The method allows for fine-grained controllability of the text generation by incorporating knowledge through weak supervision using ConceptNet (Speer, Chin, and Havasi 2017) or BART (Lewis et al. 2020). Despite not directly using any summarization methods, our approach can be seen as attempting to find sentences that would cluster around an abstractive summary, i.e., a latent narrative that

shares many similarities with statements in online discourse.

**Online discourse analysis.** Our work is closely intertwined with mediated narrative analysis, which explains how characters share stories on social media and how tellers position themselves compared to the narratives (Page 2018), be it through hashtags or other means (Zappavigna 2015). There has been remarkable progress in mapping out different types of storytelling on different social media platforms (Yus 2021). Additionally, what is considered acceptable social behavior drives storytelling and hence the narratives surrounding the story (Forbes et al. 2020). This is complementary to our work, as we only focus on narratives that have gone viral, not finding the causes behind surpassing a certain virality threshold, how they were shared, or the affective state in which people might view them. Instead, our proposed approach is conditioned on having a sufficiently large body of comments to investigate for narratives.

**Sentiment analysis.** Narratives often contain subjective unfalsifiable information coming from social media and one could therefore study it with sentiment analysis. Sentiment analysis, which shares similarities with stance detection (Al-Dayel and Magdy 2021), has been applied to a variety of topics, but relies on a discrete classification of sentiments (Li and Caragea 2019). An important application of sentiment analysis is hate speech detection, which can be considered a fine-grained category of the former, as it can be incorporated as an auxiliary classification task (Schmidt and Wiegand 2017). In this work, we do not classify the sentiment of claims, but let humans decide how sentences align in an online debate. Thus, the sentiment is decoupled as sentences with different sentiments can belong to the same narrative.

**Human-in-the-loop** approaches leverage both machine and human intelligence in an AI pipeline. For example, Perona (2010) started the Visipedia project to integrate human visual knowledge into a searchable and organized format, initially as a GUI for annotating images, helping people capture and share visual expertise. Multiple works leveraging human knowledge through crowdsourcing have since appeared in the same or other formats (Jia et al. 2021a; Wilber et al. 2015; Van Horn et al. 2018; Jia et al. 2021b; Branson et al. 2010). Related initiatives in arts and entertainment include TV-tropes (Proper Media, LLC 2022) and the Periodic Table of Storytelling (James Harris 2022), which enable community members both to submit and query narratives in modern pop culture.

According to Miller (2019), people are interested in contrastive explanations – why  $X$  instead of  $Y$ ? – and selective explanations; only the most important information for decision making is shown. Accordingly, we base our crowdwork annotation interface on triplet-based relative preferences. Our long-term vision is analogous to Visipedia: we wish to capture and share human narratives in online discussions across a wide array of topics. The present work represents our first foray in this direction, with a

deep dive into a single topic. Due to the volume of topics and discussions in online forums, our proposed approach must tap into the complementary strengths of humans and machines, as described next.

**Crowd Kernel Learning** is a strategy for capturing human notions of similarity or dissimilarity that remain elusive to state-of-the-art machine learning based representations. For instance, Agarwal et al. (2007) investigate how humans perceive light from surfaces by presenting annotators image triplets depicting the Stanford Bunny with varying material properties. The annotators were asked which bunnies were more similar, revealing a perceptual space for reflectance. Analogously, CKL (Tamuz et al. 2011) presents annotators for triplets of necktie images and asked them whether they would purchase  $b$  or  $c$  if  $a$  was sold out. With these triplet annotations, they uncovered a necktie space where nearest neighbors are explicable in terms of glossiness, pattern, and color. Similarly, van der Maaten and Weinberger (2012) use  $t$ -STE (stochastic triplet embedding) to produce a genre embedding for musical artists. Wilber et al. (2015) introduced SNaCK with the motivation of capturing the taste-based similarity of food dishes, addressing cases such as guacamole vs. wasabi that, despite their visual similarity, are far apart in taste space. In this paper, we take a similar approach as illustrated in Figure 1. We provide annotators with triplets of text snippets, and ask the annotators “who would be on the same side of a debate on this topic?” to uncover a latent narrative space.

## Method

Assume a collection of  $N$  comments extracted from an online discussion. Our approach iteratively applies SNaCK (Wilber et al. 2015) to learn a low dimensional representation  $Y \in \mathbb{R}^{N \times d}$  of these comments. We first run SNaCK, and use the obtained embedding to select informative triplets to annotate. We then update the embedding with the newly annotated triplets. We repeat this process till convergence. We show that this iterative optimization clusters the underlying narratives, when enough human domain knowledge has been supplied.

**Formulation.** The objective of SNaCK is the weighted sum of the  $t$ -SNE and  $t$ -STE losses

$$C_{SNaCK} = \lambda C_{tSNE} + (\gamma) C_{tSTE}. \quad (1)$$

The loss function for  $t$ -SNE is given by

$$C_{tSNE} = KL(P||Q) = \sum_{j \neq i} p_{ij} \log \frac{p_{ij}}{q_{ij}}, \quad (2)$$

Similarly to Wilber et al. (2015), we use a Gaussian kernel  $K \in \mathbb{R}^{N \times N}$ , such that

$$p_{ij} = \frac{1}{2N} (p_{j|i} + p_{i|j}) \quad (3)$$

$$p_{j|i} = \frac{\exp(-K_{ij}^2/2\sigma_i^2)}{\sum_{k \neq i} \exp(-K_{ik}^2/2\sigma_i^2)}. \quad (4)$$

This loss function can be interpreted as finding a low-dimensional distribution of points that maximizes the information gain from the original high-dimensional space (Van

Der Maaten 2014). The bandwidth of the Gaussian kernel  $\sigma_i$  is set such that the perplexity of the conditional distribution  $p_{j|i}$  equals a predefined perplexity  $u$ .

The embedding similarity  $q_{ij}$  between the two points  $y_i$  and  $y_j$  is computed as a normalized Student’s  $t$  kernel with a single degree of freedom

$$q_{ij} = \frac{\left(1 + \|y_i - y_j\|^2\right)^{-1}}{\sum_{k \neq l} \left(1 + \|y_k - y_l\|^2\right)^{-1}}. \quad (5)$$

The loss function for t-STE is given by

$$C_{tSTE} = \sum_{(i,j,k) \in T} \log p_{(i,j,k)}^{tSTE}, \quad (6)$$

and can be interpreted as the joint probability of independently satisfying all triplet constraints (van der Maaten and Weinberger 2012). We use a Student’s  $t$  kernel with  $\alpha$  degrees of freedom

$$p_{(i,j,k)}^{tSTE} = \frac{\left(1 + \frac{\|y_i - y_j\|^2}{\alpha}\right)^{-\frac{1+\alpha}{2}}}{\left(1 + \frac{\|y_i - y_j\|^2}{\alpha}\right)^{-\frac{1+\alpha}{2}} + \left(1 + \frac{\|y_i - y_k\|^2}{\alpha}\right)^{-\frac{1+\alpha}{2}}}. \quad (7)$$

In all experiments, we set  $\lambda = 0.1$  and  $\gamma = 5$ , which makes the gradient norm of  $C_{tSTE}$  and  $C_{tSNE}$  equal.

## PAPYER

We construct a new dataset to conduct our narrative analysis. The dataset focuses on the topic of hand drying in public restrooms. As discussions on this topic largely center on the *paper* vs. *air dryer* debate, we name the dataset PAPYER 🧻.

We first scrape Reddit for posts related to hygiene in public restrooms. We manually filter the comments and split them into short text excerpts (1-2 sentences). Based on these excerpts, we manually define 31 narratives across 4 supercategories: 15 pro-paper towel, 8 pro-air dryer, 7 other (related to hand drying), and 1 for irrelevant (not related to hand drying). We illustrate the narratives in a tree structure in Figure 3, which highlights the granularity of narratives in online discussions. Finally, we assign a label to each excerpt by selecting the best match from the list of 31 narratives, which we dub the 31 crystallised narratives. The dataset consists of 600 excerpts. We report the dataset summary statistics, such as Token Type Ratio (TTR) and the number of examples in Table 1. Figure 2 shows the sentence lengths of the four narrative supercategories.

We note that such a manually driven process of collecting and labeling presents practical scaling challenges. It requires access to curators with a complete understanding of all the prevailing narratives before one can begin the annotation process, which is especially challenging because of the multiple levels of granularity and the continuous evolution of narratives in online debates. Neither is it expected that models trained on a specific topic will generalize to narratives for other topics. To use an analogy from our earlier discussion on related work, musical artists continue to produce

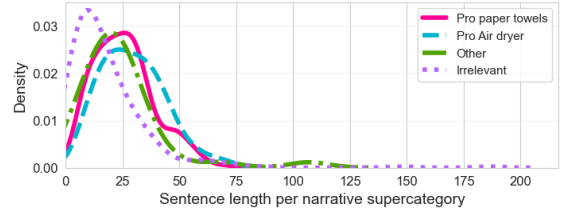


Figure 2: Sentence length distribution by supercategory.

	Pro Paper	Pro Dryer	Other	Irrelevant
Avg. Length	26	28	26	18
Word Types	1444	1019	612	1959
TTR	0.33	0.39	0.47	0.37
Examples	169	92	49	290

Table 1: Statistics for the PAPYER 🧻 dataset. Sentences in across supercategories have roughly equal length, except the irrelevant category, which indicates that length can only be used to distinguish the sentences in the irrelevant category from the rest. The TTR for the Other category is higher than rest of the categories since it has fewer word types.

music that defies existing genre delineations, and the same goes for chefs exploring new culinary directions. This means that (1) we cannot simply train a static supervised classifier on these topics, (2) we must strive for more efficient labeling methods that do not require comprehensive knowledge of topic-specific nomenclature, and (3) we need methods that can accommodate multi-level granularity in the data. That being said, the only manner to evaluate more efficient methods in a quantitative manner involves going through this tedious, hand-crafted labeling process. We highlight that the purpose of this dataset is to address the above-mentioned scaling problems and therefore only use the labels for evaluation. We believe that the presented dataset is a challenging, real-world example of an online discussion with a number of unfalsifiable claims, and that methods that can efficiently discover the prevailing narratives for this dataset will perform well across other topics.

## Playback Simulation

We propose to use triplet labeling to improve the efficiency and scalability of collecting and annotating data for narrative discovery. In triplet labeling, an annotator is asked to judge *if text a should be associated with text b or text c*. The main advantages of triplet labeling in our setting are that (1) the annotators are not required to know nor consider all the underlying narratives to label the data, and (2) it organically handles the multi-level granularity as we study similarities rather than class probabilities. This makes data labeling easier and more scalable. To validate if triplet labeling can be used to discover the underlying narratives, we first conduct a playback simulation, that is, we present a computer (a.k.a., a synthetic worker) with triplets of text excerpts and use the ground-truth labels to simulate what a human annotator would select as the

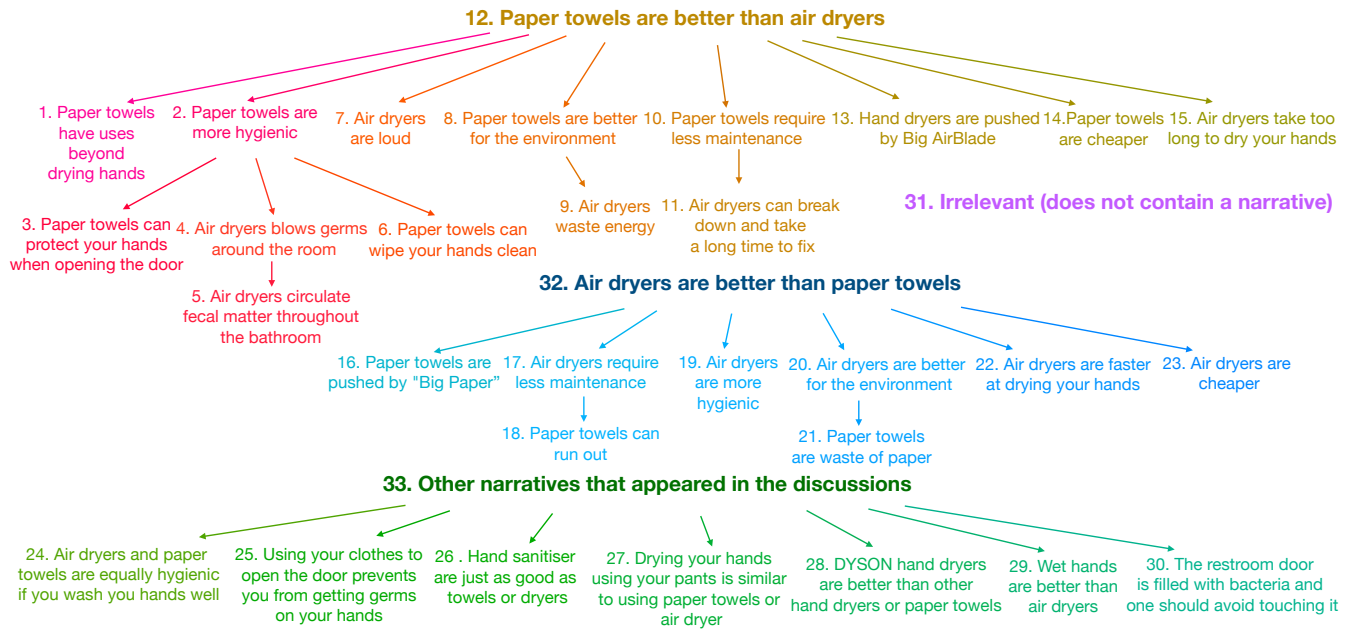


Figure 3: **Overview of the prevailing narratives.** The narratives are grouped into supercategories: pro-paper towels (in red, orange, yellow), pro-air dryers (in blue), other (green), and irrelevant (in purple). Each sub-narrative has a unique color, which we will use in the rest of the paper. The tree structure highlights the different levels of granularity that may exist within the landscape of narratives.

best match. This playback simulation allows us to explore multiple hyper-parameters before we embark an annotation campaign using Amazon Mechanical Turk (mturk). We explore three hyper-parameters: (1) sentence embedding network, (2) triplet sampling strategy, and (3) number of positive/negative examples. Lastly, we describe how we simulate human annotators.

**Sentence Embedding Networks.** Recent, large transformer models understand grammatical and semantic information. We investigate embeddings of several of these models to examine whether they may allow one to discover narratives and which model is most suitable as the machine kernel in SNaCK. More specifically, we explore several sizes of BERT (Devlin et al. 2019), RoBERTa (Liu et al. 2019), GPT2 (Radford et al. 2019), and T5 (Raffel et al. 2020).

**Sampling Strategy.** Randomly presenting five text excerpts per anchor will generally result in choices that are very different from the anchor, thus tasking the annotator to label triplets that will lead to a low information gain. Therefore, we investigate sampling strategies that maximize the information gain per annotation. We explore the following strategies:

- **Random:** Randomly sample 5 sentences.
- **Top-k:** Retrieve the 5 closest text excerpts based on embedding distance for each anchor.
- **Distance:** Retrieve the 20 closest text excerpts for each

anchor, and sample among these sentences with a probability proportional to their distance to the anchor.

- **Distance-Rnd:** The same as Distance except for the last excerpt which is a randomly (Rnd) sampled sentence, not being the anchor nor the 20 nearest neighbors.
- **Oracle:** Randomly retrieve 2 text excerpts from the same narrative as the anchor and randomly select 3 from different narratives using the ground-truth labels.

**Number of positive and negative examples.** During training, we force workers to choose  $k$  positives (examples most similar to the anchor) from a list of  $n$  examples. Earlier studies (Wilber, Kwak, and Belongie 2014) have shown the effectiveness of choosing large values of  $k$  and  $n$  to generate more triplet constraints. However, these studies assumed image stimuli, which humans can process efficiently in parallel. Text, on the other hand, is processed sequentially, thus in practice does not enjoy the same scaling properties. Therefore, we limit  $n \leq 5$  so as not to overwhelm the annotators with text.

**Simulated Annotations.** We simulate human decisions with the following selection procedure. We use the ground-truth labels to select positives that have the same crystallised narrative as the anchor sentence. If the number of sentences with the same narrative as the anchor is not  $k$ , we select the sentences that are closest in embedding space.

These synthetic experiments are intended to provide insights into designing our experiment and hyper parameters before collecting human-annotated data with mturk.



	# Parameters	Triplet generalization ratio		KNN generalization ratio	
		Embedding	$t$ -SNE	Embedding	$t$ -SNE
T5-base	220 M	58.36 $\pm$ 1.58	60.41 $\pm$ 1.93	27.46 $\pm$ 3.62	25.12 $\pm$ 3.79
T5-3B	3 B	<b>62.48 <math>\pm</math> 1.29</b>	<b>63.63 <math>\pm</math> 1.37</b>	<b>33.84 <math>\pm</math> 3.42</b>	<b>29.84 <math>\pm</math> 3.26</b>
T5-11B	11 B	62.01 $\pm$ 1.14	62.32 $\pm$ 1.51	33.19 $\pm$ 4.30	29.11 $\pm$ 4.31
bert-base	110 M	55.89 $\pm$ 1.75	55.18 $\pm$ 1.83	20.82 $\pm$ 3.76	14.42 $\pm$ 3.11
bert-large	130 M	54.73 $\pm$ 1.76	54.62 $\pm$ 1.58	19.54 $\pm$ 3.18	12.35 $\pm$ 2.52
roberta-base	125 M	57.39 $\pm$ 1.42	56.47 $\pm$ 1.36	21.69 $\pm$ 3.73	11.14 $\pm$ 3.52
roberta-large	355 M	59.08 $\pm$ 2.11	58.12 $\pm$ 1.93	24.12 $\pm$ 3.73	14.43 $\pm$ 3.24
gpt2-base	117 M	53.65 $\pm$ 1.63	53.61 $\pm$ 1.73	12.94 $\pm$ 2.27	9.67 $\pm$ 2.58
gpt2-medium	345 M	54.28 $\pm$ 1.87	54.31 $\pm$ 1.86	13.75 $\pm$ 2.71	9.54 $\pm$ 2.60
gpt2-large	774 M	61.56 $\pm$ 1.49	60.38 $\pm$ 1.87	23.32 $\pm$ 2.95	21.80 $\pm$ 3.71

Table 2: **Embedding network.** The effect of using raw embedding or their  $t$ -SNE projection for different transformer models. Models are evaluated 10 times using 1 trained model (ratios multiplied by 100). Larger transformer models achieve a higher triplet gen. ratio than smaller models and applying  $t$ -SNE does not change this performance much, except on T5 where it increases. This is not the case for the KNN ratio. We adapt T5-3B as our machine kernel, since it shows the best performance.

	TGR ( $\uparrow$ )	KNNGR ( $\uparrow$ )	SNR ( $\downarrow$ )	Agreements ( $\uparrow$ )	Disagreements ( $\downarrow$ )	Precision ( $\uparrow$ )	Recall ( $\uparrow$ )
Random	75.47 $\pm$ 1.10	16.98 $\pm$ 4.53	2.98	11132	13110	7.62	8.53
Distance	68.41 $\pm$ 1.56	31.18 $\pm$ 3.78	0.47	16302	7998	37.81	40.85
Top-k	59.86 $\pm$ 1.64	20.00 $\pm$ 4.54	0.68	16187	8181	37.64	43.58
Distance-Rnd	77.13 $\pm$ 1.43	40.86 $\pm$ 4.27	0.69	15599	8703	32.13	35.35
Oracle	91.71 $\pm$ 1.59	58.17 $\pm$ 2.51	0.17	24368	0	100.0	100.0

Table 3: **Sampling strategies.** All models apply the T5-3B embedding network and are evaluated 10 times (Ratios multiplied by 100). Note that the Oracle has access to the ground truth labels. The Top-k, Distance, and Distance-Rnd sampling methods all achieve high precision/recall, however, the Distance-Rnd has higher TGR and KNNGR than the other methods, suggesting that the embeddings space better captures the local structure. Hence we select this strategy for human annotators.

## Evaluation Metrics

We use similar metrics as van der Maaten and Weinberger (2012) to measure the quality of the learned embedding. The Triplet Generalization Ratio (**TGR**) describes the fraction of ground truth triplets that are violated by the learned embedding. Given the number of possible triplet combinations are very large we instead sample a subset of 1000 possible ground truth triplets for this metric. The K Nearest Neighbour Generalization Ratio (**KNNGR**) captures how well local structure is preserved. Since the number of local clusters is unknown after training, we sample 70% of the data and train a KNN on it and measure how many of the last 30% fall into the correct clusters to get a measure of locality. The Signal-to-Noise Ratio Distance (**SNR**) (Yuan et al. 2019) measures the similarity of comment embeddings. Similarly, we compute statistics about the triplets gathered from the workers and the ground-truth annotation of the comments through three metrics: **Triplet agreement**, **precision**, **recall**, **weighted precision**, **weighted recall**. The Triplet agreement computes how many of the sampled text excerpts belong to the narrative of the anchor. The precision and recall measure the consistency with the ground truth narratives. These are computed per narrative and then averaged. In their weighted counterparts, the average is weighted by the number of text excerpts in each narrative.

## Results from playback simulation

Across our synthetic experiments, we found three key ingredients to obtain embeddings of higher quality. Firstly, we

found that using a modern sentence transformer, such as the 3B parameter T5 model (Raffel et al. 2020), was crucial for initially embedding the sentences in PAPER, before running SNaCK. Table 2 compares embeddings with different networks. We found that a T5-3B Transformer gave the best embedding by measuring the triplet generalization loss. T5-3B performs better than T5-11B, despite being trained on the same data. A similar observation can be made in other benchmarks (Tensorflow Hub 2022) on which this model has been evaluated, indicating that size alone may be insufficient to determine the best embedding network.

Secondly, the sampling strategy to gather the triplets used in SNaCK is important. Table 3 shows SNaCK with different sampling techniques. We found that Distance-Rnd worked best, since it has a good compromise between exploiting the text similarities and exploring the solution space. This means it is able to present annotators with the more relevant triplets, than a method like Random. Furthermore, this sampling strategy was more robust to the hyperparameters found in SNaCK. We refer to the Appendix for ablation results on SNaCK hyperparameters.

We also investigate how the amount of labeled data affects the sampling strategies. Figure 4 shows the trained embedding improves when increasing the size of training data. This is the case for all sampling strategies. In all experiments the synthetic worker has access to both the ground-truth label of the sentences and using the distance between their embeddings, when selecting the most similar sentences to the anchor.

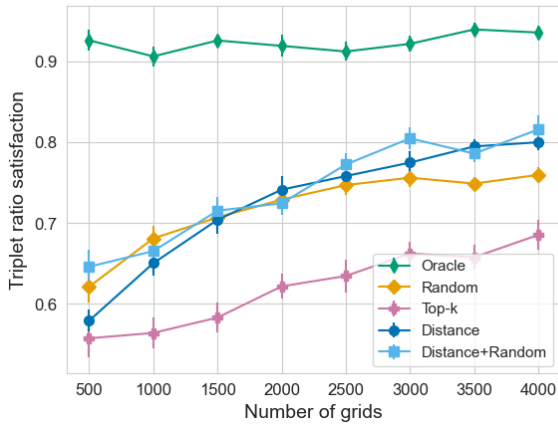


Figure 4: **Sampling strategy.** The triplet ratio satisfaction as a function of training data for different sampling strategies. We find that Distance-Rnd performs slightly better than Distance.

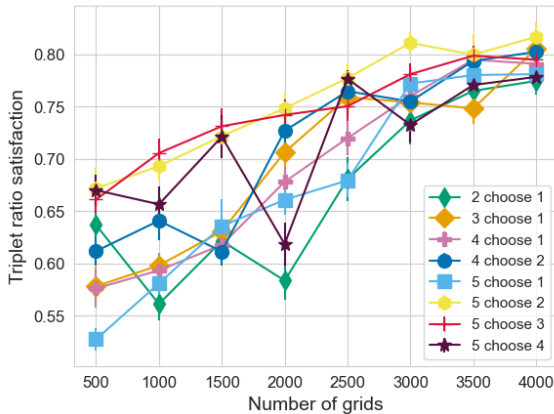


Figure 5: **Number of positive / negative examples.** Triplet ratio satisfaction as a function of the amount of text available and the number of clicks. The best setup is 5 choose 2.

Lastly, we explored how the number of sentences  $n$  and number of forced choices  $k$  affects the performance. Figure 5 shows that with the Distance-Rnd sampling strategy, presenting the synthetic worker with 5 sentences and asking it to choose 2 worked the best. Given that human workers cannot process text in parallel, increasing the number of sentences would not have the same benefits as in visual annotations (Wilber, Kwak, and Belongie 2014; White, Palmer, and Boynton 2018; Chang, Furber, and Welbourne 2012). With these consolidated observations of the hyper-parameters and design choices from the play-back simulation in hand, we can proceed to collect labels from human annotators.

## Human Annotators

The play-back simulation revealed several insights, but the synthetic workers differ from human annotators in several aspects. We now proceed to test our pipeline using human annotators. Figure 6 displays the overall flow of the data

collection. Before the workers can accept our HIT, we ask them to take a pre-test, consisting of five multiple-choice questions where one sentence is shown and they have to select the best match from two sentences. If the worker passes four out of the five questions they are permitted to work on our HITs. A worker is shown grid consisting of an anchor and a list of five text excerpts (see Figure 6). The anchor is randomly sampled from the 600 sentences and the five comments are sampled according to the Distance-Rnd sampling strategy, which we found to work the best in the play-back simulation. We ask the worker to select the two persons who would likely be on the same debate team as the anchor person, resulting in two debate teams with three persons each. The worker was paid \$1 per HIT, where each HIT contains 12 grids. For each HIT we include one *catch trial*, i.e., a grid designed to be particularly easy to solve as we compose the five sentences two with the same narrative as the anchor and three with irrelevant narratives. In order to get a richer similarity representation, and to examine the quality of the annotators, we also deploy *sentinel examples*. These examples help us track whether an anchor belongs to a specific narrative. We insert these as to verify if the annotator agrees with our list of narratives. We refer to the Appendix for the catch trial and sentinel example agreement results.

After gathering the data, we train SNaCK for 100k epochs. Across all experiments, we collected 2880 grids, yielding around 20,000 triplets. Collecting this data cost \$480. In our setup with one anchor, five candidates of which two must be selected, we found that the average worker spends around 3 minutes and 36 seconds to complete a HIT. However, the time to complete a HIT varies widely between workers: the fastest worker answered a HIT in 2 minutes, while the slowest used 23 minutes.

**Triplet data visualization.** The collected triplet annotations that have passed the catch trials are shown in two *circos plots* (Krzywinski et al. 2009). Figure 7a illustrates the connection from the anchor to the selected answers (i.e., anchor to positive) and Figure 7b shows the connections from the anchor to sentences that were not clicked (i.e. anchor to negative). In both figures, we show a histogram of the number of times a connection is made to the specific anchor, and the color identifies the narrative of the most popular connection to that anchor. As such, the ideal scenario would be that the colors in the histogram match the narrative colors in Figure 7a and that they do not in Figure 7b. Figure 7a shows that some of the histogram colors match the class colors and there is a trend that they similarly fall within their four super categories, thus revealing the polarisation between the pro-paper towel and pro-hand dryer contingents.

Table 4 shows several statistics of the selected HITs that passed the catch trials in our mturk experiment. We notice that despite requiring catch trials to ensure annotations of high quality, there is still a large proportion of triplets where annotators select an answer that does not share the same narrative as the anchor. This is also reflected in the precision and recall ratios. This highlight how challenging the task at hand actually is, where even human annotators produce noisy labels.

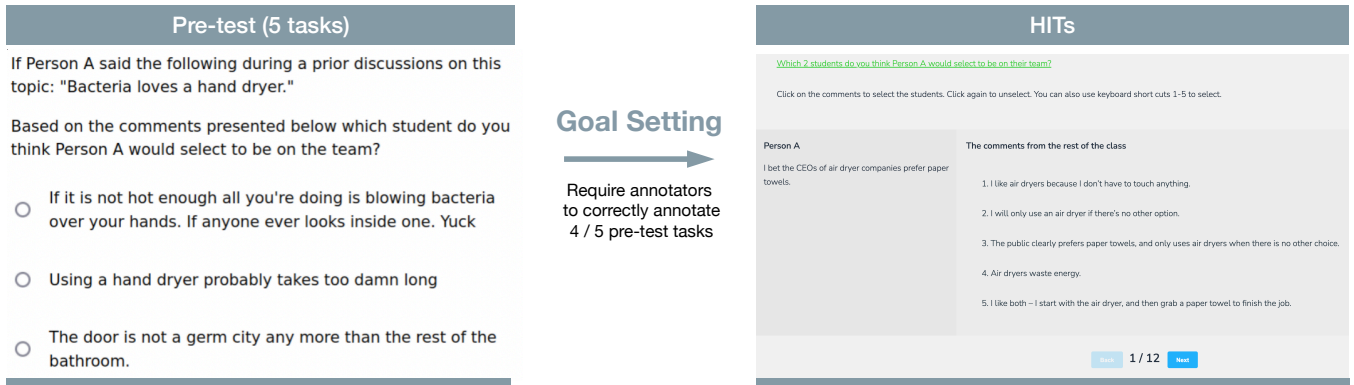


Figure 6: **Workflow for annotators.** Annotators are selected based on a multiple-choice pre-test that consists of five questions of which they must answer a minimum of four correct. The selected annotators are then asked to select the two best matching statements for the anchor. We use these selections to form triplets.

	Agreements (↑)	Disagreements (↓)	Precision (↑)	Recall (↑)	Weighted Precision (↑)	Weighted Recall (↑)
Random Annotator	3093	4455	9.75	9.75	38.91	40.71
Human Annotator	3447	4107	15.97	15.73	43.61	47.93

Table 4: **Statistics of annotations.** Overall there is a trend of having a low agreement, precision, and recall indicating that the annotations are noisy. The triplets were selected based on annotators that passed all catch trials. This highlights that the task at hand is challenging even for human annotators.

## Experiments

**Baselines.** We compare the SNaCK embeddings with several popular unsupervised topic models, namely LDA (Blei, Ng, and Jordan 2003), methods using pre-trained embeddings networks (Sia, Dalmia, and Mielke 2020; Thompson and Mimno 2020), such as BERT and T5, and a mixture of these inspired from (Steve Shao 2022). For LDA and mixed models, we follow the standard protocol (Sia, Dalmia, and Mielke 2020) and tokenize the text using NLTK (Bird, Klein, and Loper 2009), lowercase the tokens, remove stop-words, punctuation, digits, and URLs, and transform words into their stem versions and fix typos. We then convert these tokenized sentences into a document-term matrix to be used for LDA with 32 topics. To visualize in 2D, we run  $t$ -SNE on top of the document-term matrix. Recent work on topic models (Sia, Dalmia, and Mielke 2020) suggests that traditional topic models can be replaced with clustering of 2D projections of deep sentence embeddings. We explore this using different transformers followed by different projections such as  $t$ -SNE (Van Der Maaten 2014) and UMAP (McInnes, Healy, and Melville 2018).

## Results

Figure 8e shows that the simple LDA baseline does not discover the prevailing narratives. This is not surprising, since LDA is known to struggle when the amount of data per topic is limited. Furthermore, the prevailing narratives are heavily context-based, which word co-occurrence based methods such LDA do not handle. On top of that comes the plentitude of sarcasm, irony, and humor that language models are known to struggle with, thus doing LDA on top of deep fea-

tures from language models remains ineffective (Figure 8 (f, g)). This is also evident when projecting the T5 or BERT embeddings into the low dimensional embeddings space using either UMAP or  $t$ -SNE (Figure 8 (a)-(d)). In contrast, Figure 8h shows that incorporating human annotated triplets into the representation highlights interesting clusters that obey the crystalized narratives.

To better visualize this, Figure 9 shows the obtained SNaCK embedding (left) and zooms into a region in the embedding space (right), where we display the input sentences for several embeddings. We highlight that SNaCK manages to find local clusters, and although some clusters have mixed narratives, the text emphasizes that they are related. For instance, the largest cluster in the zoomed region revolves around maintenance, whereas the cluster at the top of the zoom discusses management. Similarly, the cluster to the right focuses on the environmental costs. These clusters highlight that the combination of human and machine kernels can lead to embeddings that discover the underlying narratives from online discussions.

These visual observations are backed up with quantitative experiments. Table 5 shows that the SNaCK and UMAP-T5 achieve the highest triplet generalization and k-NN ratio compared to the other baselines. The SNaCK embeddings further achieve a lower SNR than UMAP-T5, suggesting a better representation. We note that both SNaCK and UMAP-T5 have higher SNR than  $t$ -SNE-T5, suggesting that on average positive pairs are closer for  $t$ -SNE-T5 than for SNaCK or UMAP. This is caused by the projection of  $t$ -SNE-T5 which maps sentences to a plane with a range from -5 to 5 for both axes, while the SNaCK method project points to a plane with



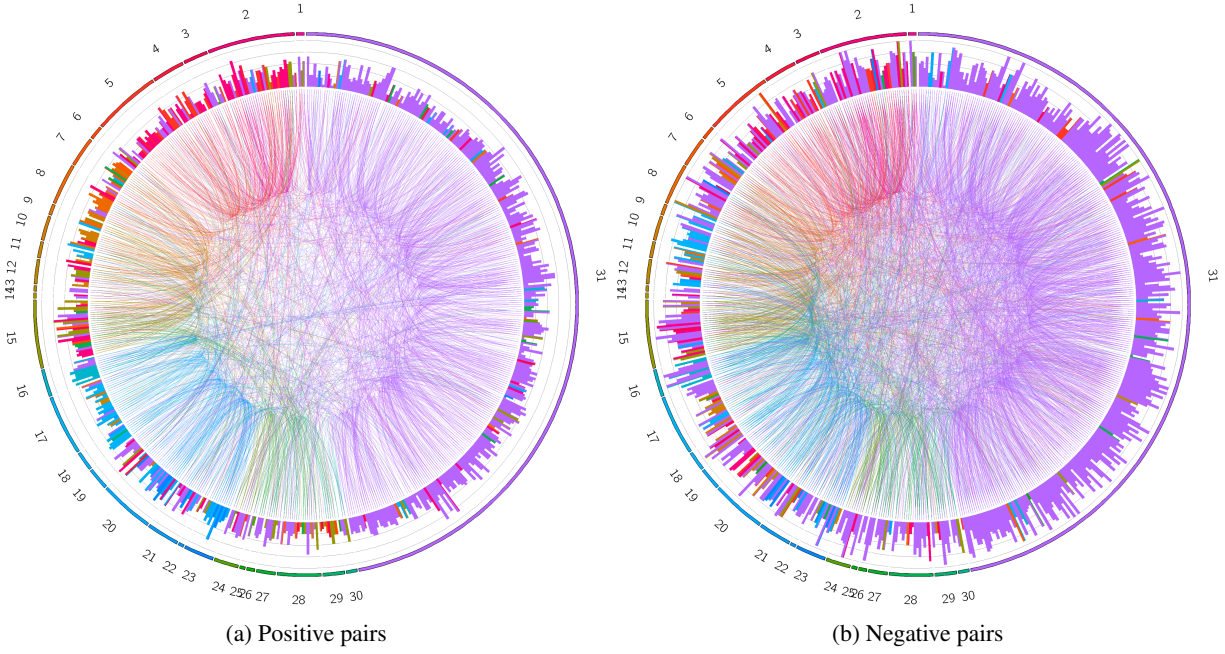


Figure 7: **Visualisation of human annotations.** Each line represents a positive (a) or negative (b) human annotation for an anchor. The histograms in the circumference describe the number of incoming connections. The color of the histogram describes the class of the majority of incoming classes and the color of the lines describes the ground truth class of the anchor. If the color of the histogram matches the above class color, then the pair belongs to the ground truth class, and if the colors differ they do not. The numbers above the class color indicate the individual narrative classes. In (a) the red and blue links show that the anchor and selected answer sometimes share the same class. More generally speaking a trend can be identified in which narratives revolving around favoring paper towels (red colors) are linked together, which is similarly true for narratives favoring the air dryer (blue colors). In (b) the colors of the histogram and an above color circle do not match indicating a mismatch between the class of the anchor and answers that were not selected. This is reflective of the workers' ability to distinguish text originating from different classes from each other.

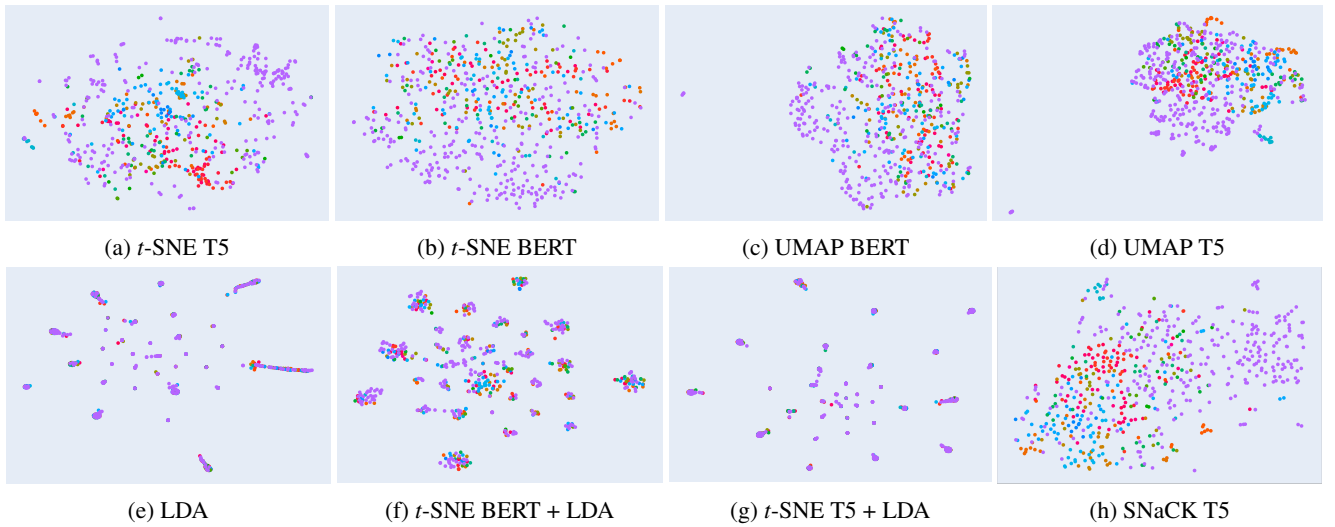


Figure 8: 2D visualizations using different encoders and embedding projections. Sentences are coloured according to the crystallised narrative they belong to using the colors from Figure 3. Despite showing more local structure in Figure e-g the quality of the embedding is lower as shown in Table 5. Figure h illustrates the transition from the initial  $t$ -SNE embedding as shown in Figure a to the SNaCK embedding by supplying human annotations.

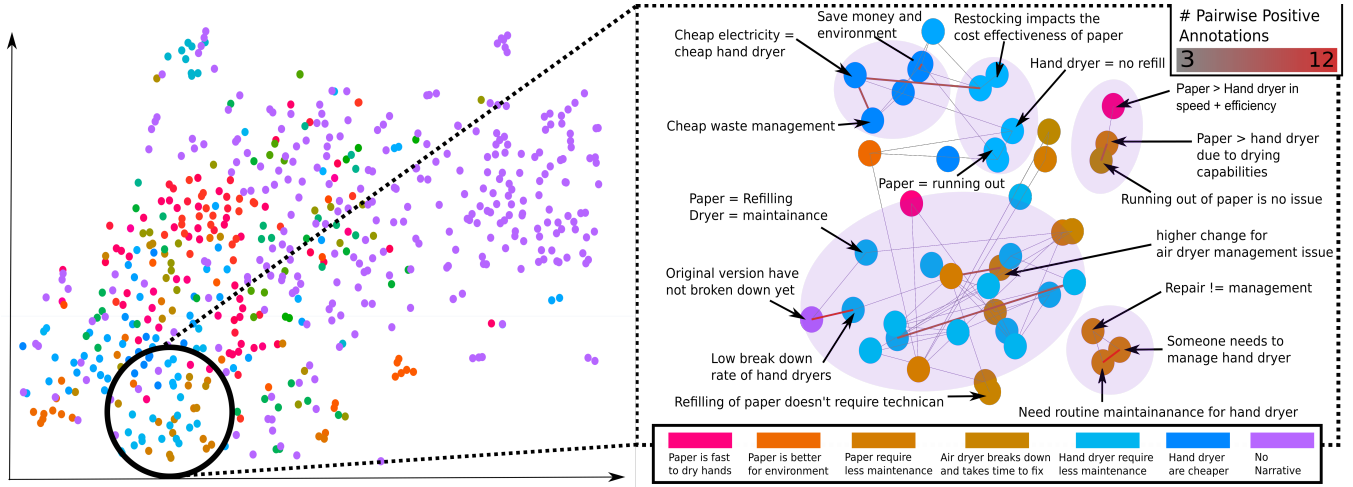


Figure 9: Zoom in on the SNaCK embedding. Relations chosen by human annotators are visualized as edges, which are colored according to the number of annotations (gray = 3, red = 12). Related terms are grouped, either due to similar class or discussion families within yellow circles. Six such families represent the complicated nature and are shown in the inset on the right.

an axis range from -40 to 40 for both axes, thus yielding greater distance between points, resulting in higher SNR.

Method	TGR( $\uparrow$ )	KNGR ( $\uparrow$ )	SNR ( $\downarrow$ )
<i>t</i> -SNE-BERT	55.33 $\pm$ 1.55	14.30 $\pm$ 2.63	2.59
<i>t</i> -SNE-T5	58.93 $\pm$ 2.28	31.05 $\pm$ 3.24	0.47
UMAP-BERT	54.39 $\pm$ 1.32	15.91 $\pm$ 2.71	2.49
UMAP-T5	61.44 $\pm$ 2.61	33.44 $\pm$ 4.25	1.48
<i>t</i> -SNE-LDA	53.34 $\pm$ 0.51	7.31 $\pm$ 1.42	3.82
<i>t</i> -SNE-BERT-LDA	54.01 $\pm$ 2.47	8.17 $\pm$ 3.01	3.93
<i>t</i> -SNE-T5-LDA	52.56 $\pm$ 1.14	9.56 $\pm$ 3.54	3.75
SNaCK-T5	67.61 $\pm$ 1.13	33.11 $\pm$ 3.07	1.17

Table 5: **Discovery of prevailing narratives.** All models are evaluated 10 times using 1 trained model (Ratios multiplied by 100).

## Conclusion and Discussion

In this work, we advocate for the necessity to model the unfalsifiable claims that weave through online discussions on social media. We cast this problem as a metric learning task, where we aspire to cluster unfalsifiable claims into a subset of crystalized narratives. To study this task, we present PAPPER, a dataset, based on hand drying in public restrooms, suitable to study and evaluate methods for narrative discovery. We find that recent, large transformer models are unable to discover the prevailing narratives. We demonstrate that by combining machine and human kernels, we can learn a representation that better captures the structure of the narratives. We emphasize that finding the prevailing narratives is a very challenging task, requiring an understanding of context, humor, and sarcasm, which is exemplified by low precision among human annotators. We, therefore, hope that our dataset will facilitate future research to better understand and discover the prevailing narratives in online discussions.

**Limitations and Future Work.** In this paper, we focused on narratives related to hand drying in public restrooms. We emphasize that a similar procedure could be performed on other topics, such as cryptocurrencies, maternity leave of female sports stars, or elections in the US to reveal interesting, prevailing narratives on these topics.

We highlight that the presented sampling strategies are simple and the results are biased due to using heuristic based workers. Since we found that the sampling strategies are important for high information gain per triplet annotation we believe more sophisticated sampling methods should be explored, such as using a classifier (Jia et al. 2021b) to recommend sentences to annotators. These methods should recommend sentences that are related to the anchor to distinguish the difficult cases from each other and ensure that we avoid sampling trivial or redundant examples for a worker to read.

Caution should be used about the implication of our results as the current metrics do not take into account the hierarchical structure of the labels, e.g., clustering two sentences with “Air dryers blow germs around the room” and “Paper towels are more hygienic”, as labels will be incorrect in our evaluation, although the first is a subset of the latter. Thus, our evaluation metric is too conservative and evaluation methods that take this hierarchical structure into consideration should be explored to consolidate our findings.

A direction of future work is to explore the narratives in a geographical setting. Narratives related to sports stars or cryptocurrencies would likely show different distributions of narratives depending on culture and governmental policies. We believe associating narratives with geomarkers that directly guide us to selecting specific crowd workers with cultural understanding would improve the discovery of new narratives. In addition to geographical information, modeling the users with collaborative filtering or recommender systems would likely also improve performance as narratives supported by certain users will correlate.

## References

- Agarwal, S.; Wills, J.; Cayton, L.; Lanckriet, G.; Kriegman, D.; and Belongie, S. 2007. Generalized Non-metric Multi-dimensional Scaling. In Meila, M.; and Shen, X., eds., *Proceedings of the Eleventh International Conference on Artificial Intelligence and Statistics*, volume 2 of *Proceedings of Machine Learning Research*, 11–18. San Juan, Puerto Rico: PMLR. URL <https://proceedings.mlr.press/v2/agarwal07a.html>.
- Al-Dayel, A.; and Magdy, W. 2021. Stance detection on social media: State of the art and trends. *Information Processing & Management* 58(4): 102597. ISSN 0306-4573. doi:<https://doi.org/10.1016/j.ipm.2021.102597>. URL <https://www.sciencedirect.com/science/article/pii/S0306457321000960>.
- Augenstein, I. 2021. Towards Explainable Fact Checking.
- Bird, S.; Klein, E.; and Loper, E. 2009. *Natural language processing with Python: analyzing text with the natural language toolkit*. ” O’Reilly Media, Inc.”.
- Blei, D. M.; Ng, A. Y.; and Jordan, M. I. 2003. Latent Dirichlet Allocation. *J. Mach. Learn. Res.* 3(null): 993–1022. ISSN 1532-4435.
- Branson, S.; Wah, C.; Schroff, F.; Babenko, B.; Welinder, P.; Perona, P.; and Belongie, S. J. 2010. Visual Recognition with Humans in the Loop. In *ECCV*.
- Carenini, G.; and Cheung, J. C. K. 2008. Extractive vs. NLG-based Abstractive Summarization of Evaluative Text: The Effect of Corpus Controversiality. In *Proceedings of the Fifth International Natural Language Generation Conference*, 33–41. Salt Fork, Ohio, USA: Association for Computational Linguistics. URL <https://aclanthology.org/W08-1106>.
- Chang, Y.; Furber, S.; and Welbourne, S. 2012. ”Serial” effects in parallel models of reading. In *Cogn Psychol.*, 267–291. doi:10.1016/j.cogpsych.2012.01.002.
- Churchill, R.; and Singh, L. 2021. The Evolution of Topic Modeling. *ACM Comput. Surv.* ISSN 0360-0300. doi:10.1145/3507900. URL <https://doi.org/10.1145/3507900>. Just Accepted.
- de Arruda, H. F.; da Fontoura Costa, L.; and Amancio, D. R. 2016. Topic segmentation via community detection in complex networks. *Chaos* 26 6: 063120.
- Devlin, J.; Chang, M.-W.; Lee, K.; and Toutanova, K. 2019. BERT: Pre-training of Deep Bidirectional Transformers for Language Understanding. In *Proceedings of the 2019 Conference of the North American Chapter of the Association for Computational Linguistics: Human Language Technologies, Volume 1 (Long and Short Papers)*, 4171–4186. Minneapolis, Minnesota: Association for Computational Linguistics. doi:10.18653/v1/N19-1423. URL <https://aclanthology.org/N19-1423>.
- Forbes, M.; Hwang, J. D.; Shwartz, V.; Sap, M.; and Choi, Y. 2020. Social Chemistry 101: Learning to Reason about Social and Moral Norms. In *Proceedings of the 2020 Conference on Empirical Methods in Natural Language Processing (EMNLP)*, 653–670. Online: Association for Computational Linguistics. doi:10.18653/v1/2020.emnlp-main.48. URL <https://aclanthology.org/2020.emnlp-main.48>.
- Gencheva, P.; Nakov, P.; Márquez, L.; Barrón-Cedeño, A.; and Koychev, I. 2017. A Context-Aware Approach for Detecting Worth-Checking Claims in Political Debates. In Mitkov, R.; and Angelova, G., eds., *RANLP*, 267–276. INCOMA Ltd. ISBN 978-954-452-049-6. URL <http://dblp.uni-trier.de/db/conf/ranlp/ranlp2017.html#GenchevaNMBK17>.
- Gui, L.; Leng, J.; Pergola, G.; Zhou, Y.; Xu, R.; and He, Y. 2019. Neural Topic Model with Reinforcement Learning. In *Proceedings of the 2019 Conference on Empirical Methods in Natural Language Processing and the 9th International Joint Conference on Natural Language Processing (EMNLP-IJCNLP)*, 3478–3483. Hong Kong, China: Association for Computational Linguistics. doi:10.18653/v1/D19-1350. URL <https://aclanthology.org/D19-1350>.
- Hassan, N.; Arslan, F.; Li, C.; and Tremayne, M. 2017. Toward Automated Fact-Checking: Detecting Check-Worthy Factual Claims by ClaimBuster. In *Proceedings of the 23rd ACM SIGKDD International Conference on Knowledge Discovery and Data Mining*, KDD ’17, 1803–1812. New York, NY, USA: Association for Computing Machinery. ISBN 9781450348874. doi:10.1145/3097983.3098131. URL <https://doi.org/10.1145/3097983.3098131>.
- Jadon, M. K.; and Pareek, A. 2016. A method for Automatic Text Summarization using Consensus of Multiple Similarity Measures and Ranking Techniques. In *Proceedings of the 13th International Conference on Natural Language Processing*, 137–143. Varanasi, India: NLP Association of India. URL <https://aclanthology.org/W16-6318>.
- James Harris. 2022. The periodic table of storytelling. <https://jamesharris.design/periodic/>. Accessed: 2022-03-22.
- Jaradat, I.; Gencheva, P.; Barrón-Cedeño, A.; Márquez, L.; and Nakov, P. 2018. ClaimRank: Detecting Check-Worthy Claims in Arabic and English. In *Proceedings of the 2018 Conference of the North American Chapter of the Association for Computational Linguistics: Demonstrations*, 26–30. New Orleans, Louisiana: Association for Computational Linguistics. doi:10.18653/v1/N18-5006. URL <https://aclanthology.org/N18-5006>.
- Jia, M.; Wu, Z.; Reiter, A.; Cardie, C.; Belongie, S. J.; and Lim, S. N. 2021a. Exploring Visual Engagement Signals for Representation Learning. *2021 IEEE/CVF International Conference on Computer Vision (ICCV)* 4186–4197.
- Jia, M.; Wu, Z.; Reiter, A.; Cardie, C.; Belongie, S. J.; and Lim, S.-N. 2021b. Intentionomy: a Dataset and Study towards Human Intent Understanding. *2021 IEEE/CVF Conference on Computer Vision and Pattern Recognition (CVPR)* 12981–12991.
- Krzywinski, M. I.; Schein, J. E.; Birol, I.; Connors, J.; Gascoyne, R.; Horsman, D.; Jones, S. J.; and Marra, M. A. 2009. Circos: An information aesthetic for comparative genomics. *Genome Research* doi:10.1101/gr.092759.

109. URL <http://genome.cshlp.org/content/early/2009/06/15/gr.092759.109.abstract>.
- Lewis, M.; Liu, Y.; Goyal, N.; Ghazvininejad, M.; Mohamed, A.; Levy, O.; Stoyanov, V.; and Zettlemoyer, L. 2020. BART: Denoising Sequence-to-Sequence Pre-training for Natural Language Generation, Translation, and Comprehension. In *Proceedings of the 58th Annual Meeting of the Association for Computational Linguistics*, 7871–7880. Online: Association for Computational Linguistics. doi:10.18653/v1/2020.acl-main.703. URL <https://aclanthology.org/2020.acl-main.703>.
- Li, Y.; and Caragea, C. 2019. Multi-Task Stance Detection with Sentiment and Stance Lexicons. In *Proceedings of the 2019 Conference on Empirical Methods in Natural Language Processing and the 9th International Joint Conference on Natural Language Processing (EMNLP-IJCNLP)*, 6299–6305. Hong Kong, China: Association for Computational Linguistics. doi:10.18653/v1/D19-1657. URL <https://aclanthology.org/D19-1657>.
- Liu, Y.; Ott, M.; Goyal, N.; Du, J.; Joshi, M.; Chen, D.; Levy, O.; Lewis, M.; Zettlemoyer, L.; and Stoyanov, V. 2019. RoBERTa: A Robustly Optimized BERT Pretraining Approach. *ArXiv abs/1907.11692*.
- McInnes, L.; Healy, J.; and Melville, J. 2018. UMAP: Uniform Manifold Approximation and Projection for Dimension Reduction. *ArXiv e-prints*.
- Mikolov, T.; Chen, K.; Corrado, G. S.; and Dean, J. 2013. Efficient Estimation of Word Representations in Vector Space. URL <http://arxiv.org/abs/1301.3781>.
- Miller, T. 2019. Explanation in artificial intelligence: Insights from the social sciences. *Artificial Intelligence* 267: 1–38. ISSN 0004-3702. doi:<https://doi.org/10.1016/j.artint.2018.07.007>. URL <https://www.sciencedirect.com/science/article/pii/S0004370218305988>.
- Moody, C. E. 2016. Mixing Dirichlet Topic Models and Word Embeddings to Make lda2vec. *ArXiv abs/1605.02019*.
- Page, R. 2018. *Narratives Online: Shared Stories in Social Media*. Cambridge University Press. doi:10.1017/9781316492390.
- Paszke, A.; Gross, S.; Massa, F.; Lerer, A.; Bradbury, J.; Chanan, G.; Killeen, T.; Lin, Z.; Gimelshein, N.; Antiga, L.; Desmaison, A.; Kopf, A.; Yang, E.; DeVito, Z.; Raison, M.; Tejani, A.; Chilamkurthy, S.; Steiner, B.; Fang, L.; Bai, J.; and Chintala, S. 2019. PyTorch: An Imperative Style, High-Performance Deep Learning Library. In Wallach, H.; Larochelle, H.; Beygelzimer, A.; d'Alché-Buc, F.; Fox, E.; and Garnett, R., eds., *Advances in Neural Information Processing Systems* 32, 8024–8035. Curran Associates, Inc. URL <http://papers.neurips.cc/paper/9015-pytorch-an-imperative-style-high-performance-deep-learning-library.pdf>.
- Perona, P. 2010. Vision of a Visipedia. *Proceedings of the IEEE* 98: 1526–1534.
- Proper Media, LLC. 2022. TV Tropes. <https://tvtropes.org/pmwiki/browse.php>. Accessed: 2022-03-22.
- Radford, A.; Wu, J.; Child, R.; Luan, D.; Amodei, D.; and Sutskever, I. 2019. Language Models are Unsupervised Multitask Learners. In *Technical report, OpenAI*. URL [https://cdn.openai.com/better-language-models/language\\_models\\_are\\_unsupervised\\_multitask\\_learners.pdf](https://cdn.openai.com/better-language-models/language_models_are_unsupervised_multitask_learners.pdf).
- Raffel, C.; Shazeer, N.; Roberts, A.; Lee, K.; Narang, S.; Matena, M.; Zhou, Y.; Li, W.; and Liu, P. J. 2020. Exploring the Limits of Transfer Learning with a Unified Text-to-Text Transformer. *Journal of Machine Learning Research* 21(140): 1–67. URL <http://jmlr.org/papers/v21/20-074.html>.
- Schmidt, A.; and Wiegand, M. 2017. A Survey on Hate Speech Detection using Natural Language Processing. In *Proceedings of the Fifth International Workshop on Natural Language Processing for Social Media*, 1–10. Valencia, Spain: Association for Computational Linguistics. doi:10.18653/v1/W17-1101. URL <https://aclanthology.org/W17-1101>.
- Sennrich, R.; Haddow, B.; and Birch, A. 2016. Neural Machine Translation of Rare Words with Subword Units. In *Proceedings of the 54th Annual Meeting of the Association for Computational Linguistics (Volume 1: Long Papers)*, 1715–1725. Berlin, Germany: Association for Computational Linguistics. doi:10.18653/v1/P16-1162. URL <https://aclanthology.org/P16-1162>.
- Sia, S.; Dalmia, A.; and Mielke, S. J. 2020. Tired of Topic Models? Clusters of Pretrained Word Embeddings Make for Fast and Good Topics too! In *Proceedings of the 2020 Conference on Empirical Methods in Natural Language Processing (EMNLP)*, 1728–1736. Online: Association for Computational Linguistics. doi:10.18653/v1/2020.emnlp-main.135. URL <https://aclanthology.org/2020.emnlp-main.135>.
- Speer, R.; Chin, J.; and Havasi, C. 2017. ConceptNet 5.5: An Open Multilingual Graph of General Knowledge. In *AAAI'17: Proceedings of the Thirty-First AAAI Conference on Artificial Intelligence*, AAAI'17, 4444–4451. AAAI Press.
- Steve Shao. 2022. Contextual Topic Identification: Identifying meaningful topics for sparse Steam reviews. Medium. <https://blog.insightdatascience.com/contextual-topic-identification-4291d256a032>. Accessed: 2022-06-10.
- Tamuz, O.; Liu, C.; Belongie, S.; Shamir, O.; and Kalai, A. T. 2011. Adaptively Learning the Crowd Kernel. In *Proceedings of the 28th International Conference on International Conference on Machine Learning*, ICML'11, 673–680. Madison, WI, USA: Omnipress. ISBN 9781450306195.
- Tan, B.; Qin, L.; Xing, E.; and Hu, Z. 2020. Summarizing Text on Any Aspects: A Knowledge-Informed Weakly-Supervised Approach. In *Proceedings of the 2020 Conference on Empirical Methods in Natural Language Processing (EMNLP)*, 6301–6309. Online: Association for Computational Linguistics. doi:10.18653/v1/2020.emnlp-main.510. URL <https://aclanthology.org/2020.emnlp-main.510>.



- Tensorflow Hub. 2022. Generalizable T5-based dense Retrievers (GTR). <https://tfhub.dev/google/gtr/gtr-xl/1>. Accessed: 2022-06-10.
- Thompson, L.; and Mimno, D. 2020. Topic Modeling with Contextualized Word Representation Clusters. doi: 10.48550/ARXIV.2010.12626. URL <https://arxiv.org/abs/2010.12626>.
- Van Der Maaten, L. 2014. Accelerating T-SNE Using Tree-Based Algorithms. *J. Mach. Learn. Res.* 15(1): 3221–3245. ISSN 1532-4435.
- van der Maaten, L.; and Weinberger, K. 2012. Stochastic triplet embedding. In *2012 IEEE International Workshop on Machine Learning for Signal Processing*, 1–6. ISBN 978-1-4673-1024-6. doi:10.1109/MLSP.2012.6349720.
- Van Horn, G.; Aodha, O. M.; Song, Y.; Cui, Y.; Sun, C.; Shepard, A.; Adam, H.; Perona, P.; and Belongie, S. 2018. The iNaturalist Species Classification and Detection Dataset. In *Computer Vision and Pattern Recognition (CVPR)*. Salt Lake City, UT. URL <https://vision.cornell.edu/se3/wp-content/uploads/2018/03/1916.pdf>, <https://vision.cornell.edu/se3/wp-content/uploads/2018/03/1916-supp.pdf>.
- Van Horn, G.; Branson, S.; Farrell, R.; Haber, S.; Barry, J.; Ipeirotis, P.; Perona, P.; and Belongie, S. 2015. Building a bird recognition app and large scale dataset with citizen scientists: The fine print in fine-grained dataset collection. In *2015 IEEE Conference on Computer Vision and Pattern Recognition (CVPR)*, 595–604. doi:10.1109/CVPR.2015.7298658.
- Von Ahn, L.; Maurer, B.; McMillen, C.; Abraham, D.; and Blum, M. 2008. reCAPTCHA: Human-Based Character Recognition via Web Security Measures. *Science* 321(5895): 1465–1468.
- White, A. L.; Palmer, J.; and Boynton, G. M. 2018. Evidence of Serial Processing in Visual Word Recognition. In *Psychol Sci.*, 1062–1071. doi:10.1177/0956797617751898.
- Wilber, M.; Kwak, I.; and Belongie, S. 2014. Cost-Effective HITs for Relative Similarity Comparisons. *Proceedings of the AAAI Conference on Human Computation and Crowdsourcing* 2: 227–233. URL <https://ojs.aaai.org/index.php/HCOMP/article/view/13152>.
- Wilber, M. J.; Kwak, I. S.; Kriegman, D. J.; and Belongie, S. J. 2015. Learning Concept Embeddings with Combined Human-Machine Expertise. *2015 IEEE International Conference on Computer Vision (ICCV)* 981–989.
- Wu, Y.; Schuster, M.; Chen, Z.; Le, Q. V.; Norouzi, M.; Macherey, W.; Krikun, M.; Cao, Y.; Gao, Q.; Macherey, K.; et al. 2016. Google’s neural machine translation system: Bridging the gap between human and machine translation. *arXiv preprint arXiv:1609.08144*.
- Yuan, T.; Deng, W.; Tang, J.; Tang, Y.; and Chen, B. 2019. Signal-To-Noise Ratio: A Robust Distance Metric for Deep Metric Learning. In *Proceedings of the IEEE/CVF Conference on Computer Vision and Pattern Recognition (CVPR)*.
- Yus, F. 2021. *Smartphone Communication. Interactions in the App Ecosystem*. ISBN 9781032060668. doi:10.4324/9781003200574.
- Zappavigna, M. 2015. Searchable talk: the linguistic functions of hashtags. *Social Semiotics* 25(3): 274–291. doi: 10.1080/10350330.2014.996948. URL <https://doi.org/10.1080/10350330.2014.996948>.

## Appendix

The aim of our work is to investigate the complex narrative landscape hidden behind social media posts, and to lay the groundwork for the research in this domain. Such research can foster the development of systems to identify harmful posts and to reduce social media abuse and misinformation. In our work we proposed to explore narratives revolving around hygiene in public restrooms introducing a new textual dataset. In the supplemental material, we provide the following items that shed further insight on these contributions:

- Details for reproduce our results (Experimental details)
- Information about data collection process (Dataset Creation Details)
- Data analysis (Dataset Analysis)
- Illustrative annotation examples (More Examples from PAPER 🍷)

## Experiment Details

### Experimental setup

**Model details** In this section, we describe our Sentence transformer model T5, as well as their training procedures in detail. We use the same hyperparameters as in the study of Raffel et al. (2019).

**Architecture** To extract an embedding from our sentences, we use a T5 (Raffel et al. 2020) transformer model, while similar to BERT (Devlin et al. 2019) but T5 was pretrained on the Colossal Clean Crawled Corpus dataset (750 GB) and trained using a variety of tasks including translation, question answering, and classification.

The text input consists of a sequence of tokens, provided by the wordpiece tokenizer. (Wu et al. 2016; Sennrich, Hadrow, and Birch 2016) These tokens are surrounded by two special tokens,  $[CLS], w_1, \dots, w_T, [SEP]$ .

The body of our Transformers consist of an encoder and decoder, each with 24 attention layers, where each layer consists of a self-attention mechanism, optional encoder-decoder attention, and a feed-forward network. The feed-forward networks in each layer consist of a dense layer with an output dimensionality of  $d_{ff} = 16,384$  followed by a ReLU nonlinearity and another dense layer.

The “key” and “value” matrices of all attention mechanisms have an inner dimensionality of  $d_{kv} = 128$  and all attention mechanisms have 32 heads. All other sub-layers and embeddings have a dimensionality of  $d_{model} = 1024$ .

Finally, the global representation for a sentence is obtained by the pooled representations for the text modality, i.e we extract processed token with the same index as the  $[CLS]$  token.

**Training details** We train our models on a single NVIDIA 3060 GPU. We reimplement the SNaCK algorithm in PyTorch (Paszke et al. 2019) as the older version was written

in Cython or python 2 and wasn’t capable of using modern GPU support.

We follow SNaCK and use SGD using the initial momentum of  $\beta = 0.5$  and final momentum of  $\beta = 0.8$ . We switch to the final momentum parameter after 20 gradient steps. The learning rate is set to 1.

We follow SNaCK and  $t$ -STE and implement early exaggeration, additional weighting of the  $t$ -STE loss increasing with the number of triplets, we also employ the momentum hack as introduced in the original  $t$ -SNE paper.

We make our own optimizer as the weighting of the losses as done in SNaCK is made on the gradient level and not on the losses, however unlike the original implementation of SNaCK we leave the option of switching between this special SGD optimizer and the standard ones in PyTorch but where we do the weighting on the losses.

Running SNaCK algorithm using 10k triplets for 100k iterations takes around 15 minutes. The parameter sets giving the best performance in our synthetic setup is used for our experiments involving MTurks.

### Hyper parameters

**SNaCK loss** Given that our loss function  $C_{SNaCK} = \lambda C_{SNE} + (\gamma) C_{STE}$  consist of two hyper-parameters, we conducted grid search for  $\lambda$  with the range  $\{0.0, 2.5, 5, 10, 25\}$  and  $\gamma$  with the range  $\{0.5, 0.25, 0.1, 0.025, 0.0\}$  as shown in Figure 10.

We set  $\lambda = 5$  and  $\gamma = 0.1$  in the end, in which the order of magnitude is consistent with the parameters used in previous work (Wilber et al. 2015). We set the perplexity equal to 30 after initial experimentation.

### Identifying sampling technique

To quantify which type of sampling strategy should be used for human annotators we investigate the effect of utilising 4 different sampling strategies (Random, Oracle, Distance, Top-k and Distance-random).

We analyse the sampling strategies based on the triplet generalisation ratio with a given hyper parameter pair  $(\gamma, \lambda)$  as well as triplets made from 300 synthetic HITs (around 4k triplets). The experimental results are shown in Figure 10.

All results should however be carefully considered as they are intertwined with the synthetic workers, thus the worker always knows the ground truth label of every sentence. A real MTurker doesn’t have such information and as such we will stick to the Distance + Random approach for the real experiments.

**By hyperparameter free methods** Of the sampling strategies that themselves doesn’t have any hyperparameters are: Random, Oracle and Top-k. Although  $k$  in Top-k might seem like a hyperparameter it is always set to be the maximum number of sentences in a HIT.

As such the method relies on a KD-tree (similar to the other distance methods), but will however only consider the

TSNE	Distance					Distance + 1 random					Top-k					Oracle					Random				
	0	0.1	0.5	0.25	0.025	0	0.1	0.5	0.25	0.025	0	0.1	0.5	0.25	0.025	0	0.1	0.5	0.25	0.025	0	0.1	0.5	0.25	0.025
0-	52.3	76.8	74.5	76.8	78.0	56.3	80.0	82.3	82.3	82.0	51.7	59.8	60.5	58.2	62.2	50.0	90.2	94.2	91.7	92.8	50.7	80.2	80.0	83.0	81.8
2.5-	58.3	68.0	74.5	77.3	79.0	62.8	81.5	81.5	84.2	83.5	66.0	54.8	57.3	58.0	59.3	61.5	88.5	91.0	92.5	92.7	64.2	84.5	81.7	81.2	83.5
5-	64.7	66.3	65.5	77.7	67.8	64.8	67.3	75.2	76.7	79.5	63.5	58.0	62.8	65.2	57.0	61.2	74.7	85.8	91.0	92.3	58.0	71.3	77.8	86.5	86.0
25-	61.7	71.0	64.8	74.7	75.2	60.0	73.8	82.3	81.5	83.3	66.2	59.5	57.8	59.8	60.5	58.8	88.3	95.0	92.5	91.2	61.0	84.2	84.3	82.7	80.7
50-	62.5	64.5	64.7	70.3	67.3	64.5	65.0	64.5	69.8	76.0	64.8	64.2	68.2	56.7	57.3	63.2	71.5	78.2	82.8	85.7	61.2	69.8	72.8	80.3	81.2

Figure 10: Ablation study measure triplet generalization ratio of 25 different hyperparamters and sampling techniques using synthetic workers. The Oracle method outperforms all other methods as it is only trained on triplets from our ground truth. Surprisingly both the Random and distance + random based method seem to behave the same way, despite using different heuristics.

$k$  most similar sentences, according to the KD-tree, and will therefore not change as we only consider 1 HIT configuration (5 choose 2 for instance). The other strategies; random and oracle, either sample triplets completely at random or sample a positive and negative example according to the class of the anchor.

**Neighbouring strategies** Based on creating neighbouring information by applying a kd-tree on the learning embedding we can design different strategies that uses this information. First we simply pick the top 5 nearest neighbours.

Secondly we sample from the top  $k$  nearest neighbours based on the distance from the anchor. As such  $k$  can be much larger than the number of sentences shown in the HIT and we wish to investigate if there is a benefit of choosing one value of  $k$  over another.

Formally, given a the number of nearest neighbours  $k$  which resulting embedding will give the best clusters? The larger the value of  $k$  the more samples can be considered and the less likely it will be to select nearby datapoints as shown in Figure 11.

Additionally one can also apply a mix of multiple strategies. We tried the KNN using distance based sampling with 1 random element, we find that including one random sampling will ensure that we visiting far away datapoints that may be outliers of the anchor class. Similarly we also ensure that if a cluster of datapoints of the same class exists not all of the datapoints will be shown and thereby ruin the already formed cluster.

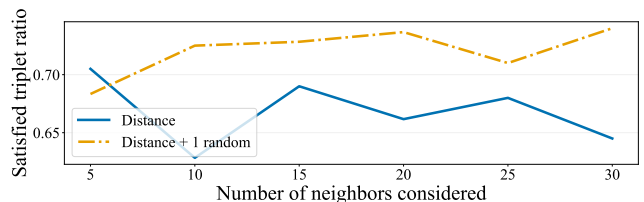


Figure 11: Effect of increasing the number of neighbours considered when sampling points proportionally to their distance from the anchor. In general, the triplet ratio peaks at  $k = 30$ ,  $k \in \{5, 10, 15, 20, 25, 30\}$ . Y-axis is a ratio from 0 to 1.

**Recall and Retrieval scores** As mentioned in the main text a single average across classes is reported, however since the recall and retrieval scores was calculated per class we report these numbers in Table 6 as other ways of aggregating the numbers could have been used (such as weighting the numbers by elements in the class).

## Dataset Creation Details

Given the inherent fine grained nature of narratives, one challenge we are facing is that how to collect reasonable labels in an effective manner.

The authors first search for posts on reddit regarding *hand dryer paper towels* on <http://www.pushshift.io> and read through the posts and select those that are related to discussions on hygiene in public restrooms. Given the limited size of the dataset the authors read through all of the text and select the narrative of the sentences if they have any.

This approach is both time-consuming and highly dependent on the expertise of our annotators. However given the universality of the topic the authors read through all of the text and selected text fragments of comment which would appear at least twice in the dataset and that expresses a narrative within the specified taxon.

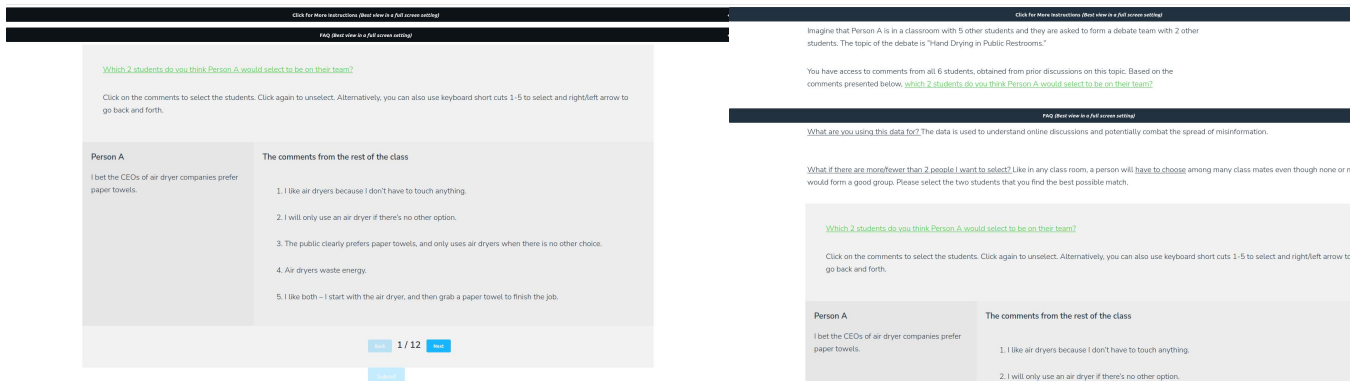


Figure 12: Annotation interface. present a setting in which the workers imagine that they are high school students. The workers are presented We present a story to the workers to put them into the mindset of the imagined user who want to post the image presented. left: Main annotation page, with probe text and 5 texts displayed side-by-side. (b) Collapsible instruction on the top of the interface.

Given the sentences we adopt a *game with a purpose* approach to keep annotators engaged and let them focus on the "compatibility" of text pairs regarding a fictional debate team.

For our HIT we use relative similarity comparison in batch using a list or one column grid format following (Wilber, Kwak, and Belongie 2014).

The annotation task is to select which two sentences on the right would align with the statement to the left. Note that the resulting labels represent the *perceived* shared narrative amount the sentences: the viewer's opinion of the shared narrative of the sentences. This section provide more details on the dataset acquisition process.

## Annotation interface

Similar to (Jia et al. 2021b; Van Horn et al. 2015; Von Ahn et al. 2008) we try to design our annotation approach to keep users engaged.

We follow (Jia et al. 2021b) and design an interface that displays a probe sentence and a list of 5 sentences.

The Amazon Mechanical Turk workers are asked to select two sentences that would be in agreement with the probe statement on the left.

Notably the subject also encounters such a setup as a qualification test before processing to the actual HIT as shown in Figure 6.

In both the pre-test and the HIT is a splash screen, where the subject followed a 3-step procedure before starting the annotation as illustrated in Figure 13:

- *Step 1:* The subject are introduced to the main idea of the task and are shown a comic to show the concept of the debate team and selection of students (Figure 13 A)
- *Step 2:* Then, the subject is introduced to the notion of similar and different statements from different students, as well as an explanation as to why these are different.(Figure 13 B)
- *Step 3:* Finally, the subject is being shown an example of an answer to a HIT using real data.(Figure 13 C)

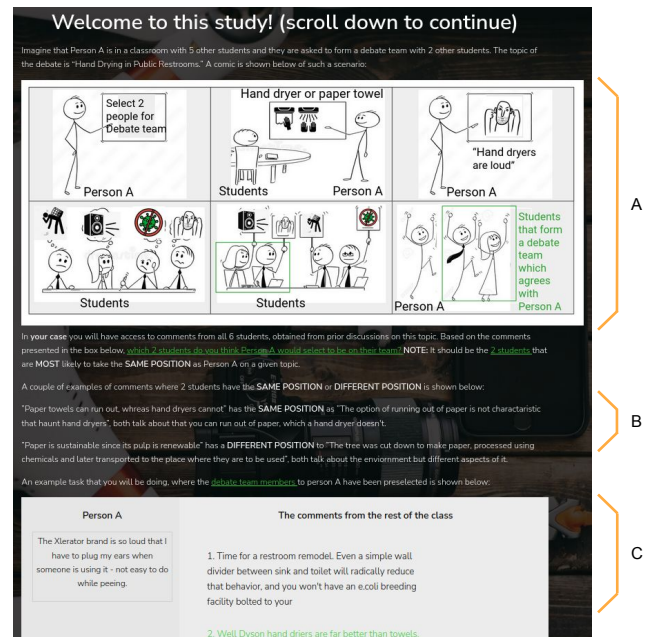


Figure 13: Splash screen. A: subjects are shown a comic of student A making a statement and trying to find students who are likely to take the same side as student A. B: based on the above description and comic, textual examples of what makes statements similar and different are illustrated. C: The actual HIT is finally shown with real data as well as an answer to which students student A should pick

Continuing from (Figure 13 C) is the main annotation interface as shown in Figure 12 . This page has a collapsible section on top of the interface that display instructions. The probe text on the left is always kept shown on the screen throughout scrolling up and down the page.

Since human motives are inherently abstract to understand, we provide a narrative, which is shown below, for the annotators so they could focus on the swapability of images. The narrative presents a story for the workers, which



	Precision	Recall
Class 1	0	0
Class 2	34.57	31.46
Class 3	3.12	3.12
Class 4	13.89	8.77
Class 5	25	19
Class 6	0	0
Class 7	38.89	46.67
Class 8	22.22	21.05
Class 9	20	19.05
Class 10	22.73	31.25
Class 11	4.55	4.76
Class 12	13.64	7.14
Class 13	12.5	12.5
Class 14	0	0
Class 15	16.15	17.65
Class 16	48.21	58.70
Class 17	37.93	26.19
Class 18	21.43	23.68
Class 19	3.57	2.44
Class 20	15	13.95
Class 21	2.38	1.75
Class 22	0	0
Class 23	25	16.67
Class 24	12.5	10.42
Class 25	0	0
Class 26	5	14.29
Class 27	5.56	2.38
Class 28	16.67	10.96
Class 29	5.56	3.85
Class 30	0	0
Class 31	69.11	80.02

Table 6: Precision recall score for SNaCK in the mturk experiment. Class 32 and 33 excluded as they are only super-categories but didn’t manifest in the actual comments.

bring them to the scenario of the imagined user who want to post the image presented on the left. We also provided example selections inside the collapsible instructions and the welcome splash page (see Fig. 12(b)).

Annotation narratives: Imagine that Person A is in a classroom with 5 other students and they are asked to form a debate team with 2 other students. The topic of the debate is “Hand Drying in Public Restrooms. In your case you will have access to comments from all 6 students, obtained from prior discussions on this topic. Based on the comments presented in the box below, *which 2 students do you think Person A would select to be on their team?*” NOTE: It should be the 2 students that are MOST likely to take the SAME POSITION as Person A on a given topic.

We used 5 sentences per text anchor, 12 grids per HITs, including 1 catch trials, and sometimes 1 sentinel example. We only use annotation results that pass at least 1 part of the catch trial.

## Sentence selection

**Candidate sentences** Our goal is to fetch relevant sentences from online discussions forums like Reddit. Each sentence comes from a subset of posts that are found using

the pushshift search engine <http://www.pushshift.io> on Reddit regarding the query *hand dryer paper towels*, and have been read by the authors to ensure that we do not select any NSFW, banned, or quarantined subreddits. Each sentences of pushshift has a list of associated keywords, produced by an online API *praw*. We use the above mentioned query to query posts from pushshift. A total of 200 posts were fetched using this query and 5 posts were selected based on their appropriate content.

## Annotators management

To ensure quality, we restrict access to MTurks who pass our qualification task as shown as the first and second step in Figure 6. Additionally we design two tasks to check the performance of the MTurks. The first is catch trials that is in a similar format to that of the qualification test. Second we create sentinel examples to check if the annotators agree on the narrative of the anchor.

Every annotator is obliged to take our qualification test in order to get access to our annotation task. The purposes of qualification test are two folds: firstly, to help us to select qualified workers who understand that we are creating debate teams based on similar viewpoints on the same topic. This setup is chosen specifically to avoid creating unintentional polarization by calling it narratives. Secondly, we wish to help workers get familiar with the content that they are likely to encounter during our annotation task.

We show a total of 5 questions during our qualification test to the potential annotator, as illustrated the first step in Figure 6. Aside from passing at least 4 out of the five questions, it is necessary to have completed 100 HITs before as well as having a quality score of above 95 %. Additionally we carefully curate a triplet pair (a probe text and two options) where the answer is shown and an explanation given as to why these match. We specifically selected texts that are within the same topic, such as environmentalism, but have different narratives.

## Sentinel example annotation

We additionally inserted some sentinel examples for the MTurks to select, when asking them to identify similar sentence. The sentinel examples are inserted according to a poisson process and are always chosen to be the textual description of the anchor class. We found that MTurks were more likely to select the sentinel examples than the sentences belonging to the same class of the anchor. This further demonstrate the MTurks are able to identify correct narratives using our *game with a purpose* approach. Yet in general MTurks tend to miss some of the labels.

## Catch trial and sentinel example statistics

A total of 240 HITs were completed on our mturk campaign. Each Hits consists of 12 grids of which 1 was always a catch trial and 58 grids was assigned to our sentinel example experiments. The answers from these grids doesn’t appear in our triplet training data.

Of the 240 catch trials only 49.16 % answers passes both catch trials in the grid and 90.82 % passes at least one. All of the grids was answered by persons who passed the pre-test.

Similarly of the 58 grids that where assigned a sentinel example 44.82 % of responses included the actual narrative, indicating that the workers doesn't always think that the crystallised narrative is most similar to the anchor and possibly that the anchor isn't always enough to decipher the actual narrative.

## Hygiene Taxonomy

Table 7 lists the detailed taxonomy and explanation for each intent class. We also note that these classes are always a subset of their 4 respective superclasses: *For paper towel*, *Against paper towel*, *others* and *irrelevant*.

## Dataset Analysis

In this section, we analyze the properties of the dataset, as shown in table 8 and forward, in more detail.

### Dataset statistics

Fig. 7a shows the label distribution of whole training data, over 30 classes and 4 super categories. It shows there is class imbalance in our dataset, which is the property of datasets in the real world (Van Horn et al. 2018).

### Lexical statistics

We fetch the accompanying text description with the images found on the website. These descriptions are generated by a deep-learning based API and verified by human. We report the lexical (word-level) statistic of the dataset. Specifically, the top words occurred in the descriptions of validation images are presented. Table 8 shows frequent non-stopping words per class, shedding light on the properties of the images. Although the descriptions can be heavily biased, Table 8 illustrates that, as they should, the occurrences of image objects and properties are relatively balanced across all the classes, indicating that most of the frequent words are not necessarily directly predictive of the intent label.

## More Examples from PAPYER

To demonstrate more details of our dataset, we pick 1 example from each super category.

Target: "Look what is sitting at the bottom of that Dyson dryer....bacteria soup"
Option 1: "I think Mythbusters showed that the air driers do a better job of spreading that bacteria all around in the air, so fuck other people, I guess."
Option 2: "So the Dyson Airblade is an overpriced bacteria spreader...fantastic"
Option 3: "In contrast, bacteria love reproducing inside of hand drying machines because of the moisture, warm air, and darkness."
Option 4: " Air dryers blows germs around the room "
Option 5: "Her mouth is probably dirtier than the dryer. So she is boosting the dryer is immune system."

Figure 14: Example with super category: *For paper towels*

Target: "How does the dyson airblade compare?"
Option 1: "This is old news now, would be interesting what the results from the newer dyson jet dryers are like."
Option 2: "Anyone have a study that compares new air dryers like the Dyson Airblade?"
Option 3: "Depends what type of dryers. Anything made before the Dyson Airblade was shit."
Option 4: "What about those air blade dryers?"
Option 5: "Except for the Dyson ones. Nothing can live in those things cause they blow so hard"

Figure 15: Example with super category: *For hand dryer*

Target: "Im absolutely positive that it is cheaper only because people get frustrated and leave with damp hands."
Option 1: "It is slimy and it smells bad. Especially liquid/foamy soap. Im fine with a bar in the shower; usually the smell isnt too offensive. But I hate the idea of my hand smelling soapy for hours. I avoid it when I can."
Option 2: "I used to think washing my hands in really hot water would help. Turns out they can take water hotter than you can for longer than you can. You can handle soap much better than them though."
Option 3: "wait... soap disgusts you? Huh?"
Option 4: "This sounds wrong but I dont know enough about bacteria to refute it "
Option 5: "It is a good question, I sort of remember the biggest bacterial difference was based on drying method - not washing method. It probably depends on the type of soap and how it is dispensed though."

Figure 16: Example with super category: *Other*

<b>Class</b>	<b>Descriptions</b>
1	P: Paper towels have uses beyond drying hands
2	P: Paper towels are more hygienic
3	P: Paper towels can protect your hands when opening the door
4	P: Air dryers circulate fecal matter throughout the bathroom
5	P: Air dryers blows germs around the room
6	P: Paper towels can wipe your hands clean
7	P: Air dryers are loud
8	P: Paper towels are better for the environment
9	P: Air dryers waste energy
10	P: Paper towels require less maintenance
11	P: Air dryers can break down and take a long time to fix
12	P: Paper towels are better than air dryers
13	P: Hand dryers are pushed by Big AirBlade
14	P: Paper towels are cheaper
15	P: Air dryers take too long to dry your hands.
16	H: Paper towels are pushed by Big Paper
17	H: Air dryers require less maintenance
18	H: Paper towels can run out
19	H: Air dryers are more hygienic
20	H: Air dryers are better for the environment
21	H: Paper towels are waste of paper
22	H: Air dryers are faster at drying your hands
23	H: Air dryers are cheaper
24	O: Air dryers and paper towels are equally hygienic if you wash you hands well
25	O: Using your cloths to open the door prevents you from getting germs on your hands
26	O: Hand sanitizers are just as good as towels or dryers
27	O: Drying your hands using your pants is similar to using paper towels or air dryer
28	O: DYSON hand dryers are better than other hand dryers or paper towels
29	O: Wet hands are better air dryers
30	O: The restroom door is filled with bacteria and one should avoid touching it
31	N: Irrelevant
32	H: Air dryers are better than paper towels
33	O: Other narratives that appeared in the discussions

Table 7: The taxonomy for our PAPER dataset. P stands for paper towel narrative, H for Hand dryer narrative, O for Other narrative and N for No narrative.

Class	Sentences
0	Nah. The autoflush toilets can flush while you are sitting on them
1	Drape a piece of toilet paper over the sensor and remove when finished'
2	Connoisseur de fÃ©calisation.
3	i always do this, i hate when my ass gets sprayed with toilet water. why not just wire up a foot pedal you could tap to flush.
4	Because sadly people have no aim of sense of right and wrong and it would get peed on constantly
5	And they wouldn't use it anyways. The point of the sensor is to flush when those people don't.
6	The automated sinks never want to run water for me. I get so mad standing there with soap in my flailing hands trying to get it to run.
7	My boss (black) told me that they only see colored folks as he laughed exiting the bathroom after easily washing his hands while I tried endlessly to wash my hands.
8	hat was a good first day at work.
9	man i miss this show
10	HA! It all makes sense now. :p That would be hilarious.
11	I'm pretty partial to the floor switches for sinks
12	I have no idea what that is. Is it like the pump sinks where you have to push on it?
13	It's just a lever on the floor that turns the water on when you step on it.
14	I used to work at a place that had those. It was great.
15	You have to curse at it for a while.
16	Aw damn. So you're telling me there is a password?
17	Yeah, the password is 'FUCKING FUCK! GOD DAMMIT! *kick* FUCK!
18	Yeah, but then he's going to touch the bathroom door and enter your place of work with you, touching everything from keyboards to coffee pots to pizza.
19	You can't avoid Oi! Nasty Joe
20	I saw foot pedal operated faucets. That's awesome.
21	It's to reduce the cleaning and stocking necessary.
22	Basically, I hereby declare that no one is allowed to complain about the lack of attended toilets unless they are seriously able to consider whether they would do toilet cleaning as a job themselves.
23	While you're all planning your careers as astronauts and engineers - don't forget that you think toilet cleaning to be beneath you, and that your talents would be wasted doing it, yet you want someone to do it
24	Depends what type of dryers. Anything made before the Dyson Airblade was shit.
25	The Dyson Airblade is still shit, it may "dry" your hands better than some traditional hand dryers, but it's still very unsanitary.
26	But I was responding to a comment about waste and restocking. They save a lot of paper. There is a trade off I agree
27	The trade off is the same as with traditional hand blowdriers, trading sanitation for paper waste (no one ever accounts for the wasted energy), but it's just not a justified trade off when the point is to clean your hands
28	Airblades are just as unsanitary as traditional hand blowdriers.
29	Older dryers are much less efficient, so the traders off is not the same
30	I recall reading a study referenced in the book How Bad are Bananas regarding carbon and pollution in various product cycles that a paper towel was more efficient if you used just one, if you used more than one then a dryer would be more efficient. And this was taking into account the entire life cycle.
31	if you used more than one then a dryer would be more efficient. And this was taking into account the entire life cycle.
32	Since Dyson airblades are many more times efficient than existing dryers, then it's clear that using a Dyson is much more efficient
33	Dyson claims 18 pairs of hands per one sheet of paper. And yes, we do have to factor in environmental aspects because we have limited and dwindling resources and we're pumping carbon into the atmosphere at frightening rate.
34	At the end of the day we're always exposed to germs - and whether they are in the air or simply on the door handle when someone hasn't washed their hands at all, washing your hands frequently is the best technique fit limiting contact.
35	You wrote that entire rant either intentionally without refuting my point that the efficiency is pointless without sanitation, or you didn't read my response.
36	All of these articles everywhere are based on one study that Dyson refutes. They cite another study, which I provided links to above.
37	Of **course** Dyson refutes them. Like Phillip-Morris did for decades with cigarettes. Always trust that less biased party.
38	Is it more likely that this sole research group is trying to bring Big Airblade, or that Dyson is self-interested? Occam's Razor says number 2.
39	Ok. But one study that's a bit sketchy is being pushed into every news source there is is.
40	One could argue that it was promoted by a competitor. I've looked at the Dyson study, do you care to have a look at the other?
41	Cause no one wants to be walked in on?
42	.....not the stall doors
43	I'd rather have a door that opens outward so I can push it open with my foot.
44	I don't mind drying my hands with the dryers, but how the hell am I supposed to turn off the water and open the door to get out without a paper towel?
45	I remember Nikki Sixx from Motley Crue talking about this exact thing on the radio last year. Said he would throw paper towels on the ground near the door if there wasn't a trash can near.
46	That's me.
47	Health educator here. This is my biggest pet peeve about public bathrooms there needs to be more sanitary door opening systems. If everything else can be automatic...
48	If they weren't 30 fucking dollars, I'd buy several dozen of them and install them everywhere I frequent free-of-charge.
49	This is why the paper towels are replaced with hand dryers.
50	As the person who used to have to clean your mess, but had no authority to make any change, yet was yelled at for having dirty bathrooms by other guests, fuck you.

Table 8: Processed textual dataset part 1



Class	Sentences
51	In my experience there wasn't really any place to put a trash can that wouldn't block the door/entry way in some way, unless it was a small trash can like one you'd use in your car.
52	In which case, it wouldn't have served its purpose long, would have needed to be checked/cleared multiple times during high traffic times, and so would have pulled manpower away from where we needed it in order to keep the bathrooms clean and safe
53	I mentioned it to the manager to see if we could determine a solution and he said the same thing so no trash can was placed near the door since the value didn't outweigh the cost.
54	So I didn't want to encourage using towels for drying hands, followed by getting more towels to open the door
55	I'm glad I'm not the only one that does this
56	Nurse (student) here. We usually use our elbows. If I'm alone and my hands are full I sometimes use my foot. Or keep paper napkins or something close
57	I despise this! Now that it's getting to be winter, and the weather is a lot drier where I live, I get bloody noses wearily often.
58	So when I'm bleeding all over myself, and I rush into a bathroom it pisses me off so much when there are no paper towels to staunch my bleeding face
59	Uhhh toilet paper?
60	Always an option, but it just seems more sanitary grabbing paper towels over tp.
61	People grab pt after washing their hands, but people grab tp after touching their ass. Especially considering its an open wound and you're jamming it in a body orifice.
62	Just pull it along the roll. People don't grab toilet paper and then carefully roll it back up again perfectly. You know when you get to an untouched portion. Don't be silly"
63	But what if someone's wet poo soaked in from the side?
64	Then don't use it.
65	*But what if the gross germy poo creatures climbed deeper into the tp and spread their spores and reproduced get their icky ickiness all up in there and then I touch it and die?*" This is how these people seem to me
66	These assholes don't even realise that every time they touch a door handle they're exposing themselves in god knows what - and they are still surviving
67	Well, due to the fact I'm in a college dorm and each bathroom has only two stalls, they're usually occupied and I don't exactly feel comfortable barging in to grab toilet paper
68	Yup. I don't use them. My hands get shaken off and stay damp.
69	I am usually wearing a dress that I don't really want to get wet. (I live in a hot climate and it's all dresses and occasionally Capri pants for me.) Plus then I have handprints on my dress.
70	Maybe they're cream
71	This is good advice.. Except if you wear khakis or other light pants like most of the population - then drying your hands with your pants makes you look like you pee'd yourself...
72	Why not just use it? Why would you rather have wet hands?
73	I don't really know. I just hate the way they make my hands feel so much.
74	Because they'd rather have clean hands, that is the point of washing them, is it not?
75	That's like saying "I don't flush, because it spreads germs. You know flushing blows shit all over the place, right?
76	But who gives a shit? We've been doing it for years. You may get sick, you'll probably be fine. That's why we have immune systems
77	Letting my hands dry normally for a whole 2 minutes isn't close to comparable with not flushing because the flush is not sanitary.
78	I flush where I can, and that's why you wash your hands after you flush. Taking reasonable steps, and avoiding blow dryers is a pretty reasonable step to take.
79	I have strict views on handwashing due to my work, managing handwashing procedures for major food production facilities and studying food safety makes me anal for seemingly small details regarding handwashing,
80	Makes sense.
81	What you're suggesting is not reasonable by any stretch
82	No, it's absolutely reasonable when it doesn't require more work, just education.
83	It's pretty common knowledge that hand dryers in bathrooms are not sanitary. Are you arguing otherwise?
84	Stop breathing air too, there might be germs.
85	You're not very bright are you? I'm so far from a germaphobe, washing your hands doesn't make you a germaphobe, it makes you not disgusting.

Table 9: Processed textual dataset part 2

Class	Sentences
86	But feel proud, you couldn't even be hired for an unskilled worker in one of facilities. That's an impressively low bar to go under.
87	Typing so many words may injure your fingers. Also make sure you wear gloves, they keyboard may have germs too. Be safe, bro.
88	Yup. Definitely unhireable.
89	I have my own small business and a cushy consultant job where I do little while make good money.
90	Guess I'll do just fine while you are too timid to even dry your hands
91	I get paid to (in part) tell people smarter than you to wash their hands so companies can produce and prepare safe and wholesome foods
92	Brags about being a consultant, is triggered someone says the word expert.
93	Are you sure you're not the one with phobias?
94	You are welcomed to make fun of me being a consultant. In fact, someone already did.
95	Oh, and you're asking for basic interviewing techniques and advice 3 months ago. Nice business and consulting job you got there, congrats
96	Huh? If you gonna troll, at least read ALL my history, and you'd know I have worked multiple jobs, started many businesses and I interview for EVERY job I get contacted for on LinkedIn.
97	Try better next time. In fact, if you go far back enough, you'd see I have mentioned I sprinkle wrong info on all my reddit accounts to make it difficult to doxx me.
98	Good try, guvernah. Try harder next time
99	I don't want to doxx you, you're just a loser on Reddit who has a high percentage chance of having his own poop on his hands.
100	And exactly the type of loser who doxxes people which is self evident in your doxxing paranoia to add to your other phobias.
101	Glad you can be a tough guy and hurl insults on the internet to feel good about yourself.
102	Even if I am the biggest loser, that won't make you a better person.And oh, if I knew how to doxx, that'd be great. I'll pay you if you can teach me
103	Clearly you're really above it, starting the insults first because you were upset someone said the commonly known fact that bathroom blowdryers aren't sanitary.
104	muh triggers Include hand towels, hands free of poop, yourself, and I'm sure much, much more
105	Yeah 'cause that means I have to use my shirt to open the door instead of a paper towel
106	Very much so. I avoid the public bathrooms at the building I work in cause they have hand dryers and the staff ones have paper towels
107	If I can I also avoid public restrooms that I know only have hand dryers. Now if they have both, that's some dedication.
108	I only like it when its a DYSON brand hand dryer,those things are awesome
109	The airblades? Those are sweet.
110	Yup,those airblades are fancy lookin
111	Nothing worse than the cheap imitation brands tho.
112	You can stand there for 5 minutes and your hands still wont be dry.
113	And it's always a shitty blow dryer that is on its last limb.
114	I'm so old I remember when those dryers first became a thing.
115	The equivalent of what would nowadays be a meme, the instruction tags were often modified: 1. Push button 2. Rub hands under warm air. 3. Wipe hands on pants.
116	Receive bacon!!!!
117	As someone who works in a place with hand dryers only. It's so us employees don't have to deal with assholes leaving paper towels everywhere.
118	Our bathrooms also don't have doors and our faucets get wiped down regularly throughout the day.
119	Yeah it sucks I've had to go and use the toilet seat cover paper to open doors cause of exactly this
120	TIL I apparently don't care nearly as much about germs in bathrooms as the average redditor.
121	The worst thing is that these places tend to have the way-underpowered hand dryers, like an asthmatic baby is blowing on your hands.
122	Whereas, the places that actually do have paper towel dispensers seem to usually also have those awesome overpowered hand dryers. You're either getting nothing, or way too much.
123	I guess the naysayers in this thread have never come across a Dyson Airblade. Better than paper towels
124	Better than paper towels. False.
125	I just use half a roll of their toilet paper to simulate paper towels.
126	Not as good but it makes me feel better by punishing them for forcing my hand.
127	That'll show 'em
128	I hate it the other way around because 80% of the time the paper is empty
129	Haha! You should visit Japan. Public Restrooms often don't have anything to dry your hands with
130	I find they are incredibly effective... at transferring any water on my hands directly onto my glasses.
131	I just wipe my hands on my trousers and leave.
132	I can never but my hands in those without touching sides, which defeats the purpose of washing
133	Very much. I'd rather dry my hands on my clothing than use a hand dryer.
134	It's OK when those really nice ones are there because I like those but any other hand dryer needs paper towels to match it.
135	I get kinda annoyed, but then I think about the environmental benefits of not using tons of unnecessary paper and just wipe my hands on my pants.
136	Paper is 100% sustainable. Paper that's made today is made from young, plantation-grown trees that are re-planted after, just like food crops.
137	It's actually pretty good for the environment compared to burning fossil fuels to run those hand dryers.
138	Oh really? Shit, didn't know that. Thanks
139	The high powered ones are okay but the old ones serve no purpose at all because the air coming out might as well be you blowing on your hands.
140	Those ones with hand sanitizer only.
141	Yeah, as a person with chronic sweaty palms this is more than mildly infuriating
142	I use them to blow fresh air into my pants
143	Ugh it's the worst. I can't stand not being able to completely dry my hands.
144	here's only hand dryers on my campus minus a few spots here and there. But going back home to a bathroom with a wash towel is gonna be the best
145	At my school, all the faucets are automatic, so I can't change the temperatures which are always blistering cold or scalding hot

Table 10: Processed textual dataset part 3

Class	Sentences
146	This in combination with the door swinging into the restroom is my worst nightmare.
147	Dark, enclosed, warm. Check . Bacteria loves a hand dryer.
148	If it's not hot enough all you're doing is blowing bacteria over your hands. If anyone ever looks inside one. Yuck
149	I HATE air driers. First, all they do is make my fingers freezing cold for several hours, while leaving them moist
150	Second, soap helps get rid of germs by making them very slippery so you can wipe them off *en masse*. Without the paper towel, you're missing out on the germ removal part of the process."
151	Using a paper towel is the fastest, most effective way to dry your hands and remove surface bacteria
152	Third, I need a paper towel *anyway* to open the door, so I might as well dry my hands with it first.
153	Fourth, the loud noise they make overloads me and freaks me out.
154	OH MY GOD YES!
155	I agree with you but doesn't data show that hot air hand dryers are better for sanitation? Or is that just a myth
156	You are correct in the terms that it is a myth.
157	On the subject of myths, Mythbusters made an episode and proved that these hand dryers simultaneously spread the harmful microbes into the air while drying your hands.
158	Using towels also left less microbes on their hands after wash.
159	Well then. Now I will be even more frustrated when I don't see paper towels
160	Have you ever seen that gross cloth towel system that is always nasty/dirty in some public restrooms?
161	I've never seen the cloth towel thing anywhere other than high-end locations, where there's a nice clean pile and then a fancy laundry basket for the used ones.
162	No, this is like a circle of cloth that is partially inside a dispensing box. I searched "cloth public washroom dispenser"...you will see it.
163	Huh, interesting. I've never seen those. That seems pretty gross
164	Very. Very gross.
165	Here at Eastern Europe have I never seen such things, at public premises we always have the disposable kind of towels.
166	The cloth towel thing isn't actually a circle. It's a big roll that feeds out into the space you use and back onto an empty roll.
167	It's like a film reel. I do agree that it's still gross, though. I don't know how clean that cloth was when they loaded it, unless it's obviously new. (Though it never is.)
168	Nursing student here: hand dryers are nasty nasty.
169	This makes more sense than what I thought I previously heard where the dryer spews bacteria out on your hands, it's not like what comes off your hands is going back into the dryer
170	Yes, with the rare exception of those dryers that you put your hands *inside* and move them up and down. Those are cool.
171	No, they aren't. Sometimes called Airblade which blows the water up my sleeves. Also who names something I stick my hands in ""blade"?
172	'what about wiping them on my pants?
173	'Your pants are a conveniently warm, moist environment for me to wipe my hands on.
174	"sounds hot, what's your number?
175	'Taiwan, is that you?
176	'Taiwan numbah wan!
177	'He was number one...
178	'867-5309 Pls rspnd.
179	'I got it
180	'I got your number on the wall"
181	867-5309
182	'My number is "No".
183	'¿to wipe my hands in. FTFY
184	'But you have to stick your hands *inside*.
185	'Depends on how clean your pants are.
186	'As prescribed, I only wash my jeans once a month or so...
187	'Jeans dont actually need to be washed, unless you actually get something on them, in which case you actually want to spot clean the area than the whole pants. But then I noticed you said "as prescribed" so gg
188	'Woosh
189	'Oh, I just reply to random comments with "woosh" sometimes.
190	'I thought you just had a funny way of telling me to wash them... ;-)
191	What the fuck, Chris?
192	What about not pissing on my hands?
193	It says in the article that that's a viable option.
194	I agree, we should all clean our hands by wiping them on c4stiel's pants
195	It is quite clear that Reddit is full of wise asses like me. Someone else always posts my idea first. Good to be among like minded friends.
196	Wasnt the study that discovered that funded by Scott towels?
197	Next you're gonna tell me Brawny squanches their customers with subliminal propaganda!
198	They just look in their squanch and squanches whatever they're squanching
199	I love it
200	Holy fuck, my high school history teacher had a poster of this on her wall. Always cracked me up.
201	I've got it in my bathroom.
202	The stuff left on your hands after either air-drying or towel-drying is the harmless stuff that's found everywhere on your skin anyway. The point of air dryers was never to reduce the bacterial count on your hands. It was to reduce the use (and waste) of paper.
203	I was looking for this. Who gives a shit about bacteria on your hands? Wash your hands then touch your face; congratulations, you've got a ton of bacteria on your hands, and it doesn't matter.
204	The bacteria floating around a bathroom air dryer are the same type on your face?
205	Yes. Fecal bacteria are everywhere, including all over you, right now. Hand-washing is about parasites and viruses, which are not hiding inside bathroom air dryers. Oh, and I guess if you actually got poop on your hands you'd want to wash that off too. Quantity matters with bacteria; a poop smear is kind of a big deal, but not imperceptible bits flying through the air.

Table 11: Processed textual dataset part 4

Class	Sentences
206	¿a poop smear is kind of a big deal Not to be confused with a pap smear”
207	The FDA cares a LOT.
208	While mostly true, this comment is misleading to the extent it suggests that soap specifically targets ”problematic” bacteria while leaving behind harmless bacteria.
209	It’s possible, but there’s also the benefit of literally removing any potential left over dirt with a towel (or any medium really) vs a dryer. That’s the real benefit.
210	Mythbusters also did an episode on this, and they got similar results. I don’t remember if their numbers were the same though
211	They’ve found that 1) it will matter if you wash hands without soap. Soap which they used killed everything. 2) both dryer and towel reduced number of bacteria, but towel did much better. Dryer - by 23%, towel by 71%
212	Jamie noted that when people used hand dryer, their hands were more wet comparing to paper towel.
213	Would anyone actually ever opt to use the hand dryer over using paper towels if they’re available? Shit takes forever and they usually aren’t timed long enough.
214	The Xlerator brand is so loud that I have to plug my ears when someone is using it - not easy to do while peeing.
215	YES. Those things are louder than the machinery rooms on USN warships.
216	When I have to use them, I’m constantly getting my hands close enough to trip the sensor, immediately moving them like two feet away, then they shut off and I move my hands back up to trip the sensor again and then immediately back down again, etc. Fucking pain in the ass.
217	Totally agree on them being obnoxious even out in the dining area, too. There are two tables in one of my favorite local joints that I refuse to be seated at, because of those dryers.’
218	They are loud in the afternoon as well.
219	Depends if you’re using one of the shitty old-style dryers, or one of the new high-powered ones that dry your hands in seconds. And people opt to use them because they reduce paper waste.
220	Looking at you, fucking World-Dryer.
221	I like those. I think they’re called Air Blades or something.
222	depends on whether you’re using one of the old-style dryers, or one of the new ones that generates literally ear-destroying decibel levels if you get your hands within 18 inches of the vent”
223	***FUCK*** those things. They’re so damn loud even sitting at a restaurant table NEAR the bathroom is irritating as hell.
224	I always use the dryer because I love the way my hands feel after. They get all smooth feeling. You have to rub your hands together and wait til they’re actually completely dry. So nice. For a long time I never used the dryers but then one day I discovered what I’d been missing out on and never went back.
225	I don’t use them even if there aren’t paper towels. I’ll go back to a stall and use a bunch of TP instead. Those air dryers are damn near useless and a waste of time.
226	You sound like you are too dumb to make it through life.
227	’re dumb”, said ”/u/IdontReadArticles”.
228	Well that’s gross. Those poor people who only use hand drier to save the environment are getting a ton more bacteria on their hands haha
229	Obviously Scott towels paid them off too
230	Fucking Big Paper Towel eh?
231	Paper companies are huge. GP, for instance, is also owned by the EVIL Koch Brothers.... Scary!
232	Even if so, that doesn’t make it wrong. It just means we have to pay extra attention to their methods and rigor and preferably have someone else repeat the study (which should be done anyway). Conflicts of interest to not disqualify science.
233	It does not, but we don’t know if they did other studies that showed results that did not cater to their marketing needs. Pharmaceutical companies pull that shit all the time, they hide unfavorable studies from publication and put gag orders on scientists in their employ.
234	¿Conflicts of interest to not disqualify science. No, but its reasonable to be more skeptical when its industry funded.
235	Which is exactly what /u/sixblackgeese said.
236	The person you’re responding to already said that...¿It just means we have to pay extra attention to their methods and rigor and preferably have someone else repeat the study’
237	That was exactly his point.
238	It’s necessary in all situations, to varying degrees.
239	Also it’s interesting to note I have never seen an air dryer in the hospital I was in for a few weeks. In fact when certain procedures were being done they didn’t want a lot of air moving around so the bacteria wouldn’t collect on my newly disinfected skin.
240	¿ Conflicts of interest to not disqualify science.True, but in the modern world where most people don’t have time, inclination, or knowledge to read science papers and thoroughly disprove them, conflicts of interest like this should be red flags that allow a layperson to make a quick assessment of the likelihood that the research is solid. In this case such a strong conflict of interest should make people very very wary of this research.
241	My brother did an experiment in middle school where they tested bacterial cultures from washed hands 1. with soap 2. without soap 3. dried with paper towels 4. air dried and the paper towel dried hand samples cultured fewer bacteria. Yes, its anecdotal and it’s middle school science but I tend to believe it.
242	It’s a good question, I sort of remember the biggest bacterial difference was based on drying method - not washing method. It probably depends on the type of soap and how it is dispensed though.
243	Not Scott towels, but an equally questionable source. There’s no research that proves things either way, but most hand dryer manufacturers don’t hire idiots to engineer equipment, so I suspect their internal surfaces are rather inhospitable to any bacteria (copper alloys, super hot coils, etc).
244	Studies funded by corporations always have an obvious agenda and obviously want the results to favour them. So they’re going to have bias and potential skew the data. I don’t trust sponsored studies. Too many bad angles.
245	Were you expecting it to be funded *and then published* by hand drier manufacturers? The studies that get published are published by people with vested interest in the study’s conclusion.
246	And yet the observation is both valid and intuitive
247	Do you have real life hulk hands?
248	Child of Atom!
249	It’s rare that I laugh while browsing but this got me pretty good. I admire your enthusiasm.
250	Well I thought it was a funny not meant to be taking serious jab.

Table 12: Processed textual dataset part 5

Class	Sentences
251	It's neither..
252	If that comment of his was meant to be serious he's an asshole, If it's not it's just a poor joke That's slightly offensive.
253	Nah. It's just dumb. If anyone is offended by something that dumb... They, themselves, are fucking morons.
254	Am I allowed to be offended for someone else?
255	That's a useless exercise. How do you know they will be offended? Why can't they be offended or not offended themselves?
256	Some people are too privileged to realize when they should be offended. only kidding don't hurt me
257	Shrug emoji
258	I just pee on my hands and leave.
259	Not bad.. you go to the bathroom and you relieve yourself and clean your hands all in the same step.
260	You could just shove your hands in your pants and let wee-wee run free wherever you happen to be. Clean hands, clean pants, clean floor, happy bladder. Do it around engineers and they'll applaud your ingenuity.
261	I bet they'll want to shake my hand in respect
262	I am not an expert by any means but I do believe this stop's the burning.
263	This stop is the burning?
264	Must be from California
265	At UCLA, they teach us to wash our hands after we piss. At USC, we just piss on our hands.
266	Why is the dryer a moist environment?
267	Tests have shown that you'll have more bacteria on your hands from using the air dryer because you don't dry your hands as well as you would a paper towel
268	Glad I'm not the only one leaving the bathroom while cherishing the taste of the air.
269	How bad can it be though? It allowed Peter Pan to fly!
270	faith, trust, and fecal dust
271	Tap tap tap a Tinker Bell and out comes magic fecal dust!
272	...and tongue. LMAO
273	You feel self conscious because it's been 30 seconds and your palm is still wet and there's 5 guys waiting in line.
274	Bathroom air is probably moist.
275	Because people put their wet hands near it all day
276	Still wouldn't make it moist.
277	At least it would make the air directly under your hands moist. And that's the air that it sucks in to blow out. A family friend works for a air dryer company and showed if to me. If you look into some of them they are disgusting
278	Well that makes sense. Thanks for teaching me something.
279	Most of the time they blow hot air which can contain more water vapor.
280	But the bacteria that grow in a conveniently warm, moist environment are probably soft and weak. Their idea of "roughing it" is probably going without tea and crumpets. So it's easy for your immune system to take them out.
281	Now on the other hand, any bacteria strong enough to thrive in dry paper towels are probably going to be bad-ass, Spetznaz-type bacteria that can do a leaping somersault hatchet throw and kick your white blood cells' asses"
282	I'll take my chances with the blower
283	This sounds wrong but I don't know enough about bacteria to refute it
284	I know bacteria breeds when conditions are good, and can go dormant when they're not. I'm not entirely sure the types of bacteria, and their constitutions, will be different. It could be the exact same bacteria on the paper towels breeding in the dryer. I could be wrong, but I have no way of knowing.
285	Guess you'll need to start avoiding those commie napkins as well.
286	I prefer using hand towels to dry my hands mostly because I can use the towels to turn off the faucets and open doors without getting even more bacteria on my hands.
287	Hand dryer bacteria = British Paper towel bacteria = Russian Special Forces Got it edit:yayalorde made me learn something
288	Spetznas is russkie special forces
289	TIL, I will fix it.
290	Dont worry brother. Seal Team Six is hiding on the soap dispenser and is antibiotic resistant
291	What an awesome analogy. The hand sanitizer dispenser must be like the US Navy Seals approaching on speedboats in the middle of the night.
292	I feel like the spetznaz bacteria would also survive in the warm moist environment, so you'd be getting both, rather than just the weaker one.
293	This reminds me of the Buffalo Theory.
294	But in most cases **it doesn't matter**, because **our immune systems are resilient** enough to keep the numbers of these bacteria low. Furthermore, **the overwhelming majority of these bugs are fairly harmless.** They don't usually include the real nasties like salmonella, shigella, campylobacter, hepatitis A or B, the SARS coronavirus, or the virus that causes meningococcal disease."
295	Thank you. I was also wondering if you've already reduced the bacteria on your hands by washing them properly then adding 100 bacteria to the 100 that made it through the washing part would be doubling the bacteria, but it's not worth worrying about.
296	And yet noro virus is often best transmitted by fecal matter, which could have been easily cleaned with a good wash of the hands. Doctors didn't start washing their hands for no reason, it's because it saves lives. '
297	Washing your hands is what cleans them. How you dry them is a distant second. That's all I was trying to say.
298	What about the newer ones that dry your hands in ten seconds? This says it takes 50... Also ours at work also have some UV nonsense built in, I assume that is supposed to help..
299	Supposedly instead of increasing bacterial counts by 255% it increases them merely by 100%. So, much better than any hand-dryer, but still significantly worse than paper towels.
300	According to a towel-manufacturer sponsored study

Table 13: Processed textual dataset part 6



Class	Sentences
301	'I found the paper towel.
302	Someone should just make a paper towel that blows.
303	He says in there that he finds jet hand dryers hard to believe. He also handily pointed out that they make 'enormous noise'. Sounds like good sciencing to me
304	It's not the quantity of the bacteria that matters, it's what kind of bacteria it is. All bacteria are not harmful and many are very beneficial to us.
305	conveniently warm, moist environment" = the edges of the Dyson Hand Dryers that every single person is bumping their dripping, wet, bacteria-coated hands against as they move them clumsily up and down.
306	The ones they 'tested' in this study were not the newer dyson dryers that take 10 seconds, but older dryers that take almost a full minutes to dry.
307	Take 10 seconds? I guess until I give up and just wipe my hands on my shirt.
308	They don't take 10 seconds. They get the first bit of water off quicker, but after that they're arguably worse, since you can't spread out the water by rubbing your hands together.Regardless, death to hand blow dryers.
309	Look what's sitting at the bottom of that Dyson dryer...bacteria soup
310	WELCOME TO THE REAL WORLD
311	Sanitary on a macro level. No over flowing trashcans etc.
312	I used to think washing my hands in really hot water would help. Turns out they can take water hotter than you can for longer than you can. You can handle soap much better than them though.
313	Her mouth is probably dirtier than the dryer. So she's boosting the dryer's immune system.
314	Silly, there are no libraries on reddit.
315	Came into the comments to ask who the savages are that dry their hands on their hair. I'll leave now
316	I work in construction and regulatory have regularly swap out or move electric hand dryers and paper towel dispensers. Honestly, they are both always pretty nasty with all types shit growing on the back, inside and hard to clear areas. If you are so worried about drying your hands I would suggest that you bring your own paper towels and avoid either of the public drying options.
317	The energy necessary to actually dry your hands with one of those stupid hand dryers also HAS TO exceed the amount required to manufacture one paper napkin...
318	You'd also have to factor in shipping and disposal costs.
319	Well, that's literally the opposite of the case that's made about them. They are marketed as and purchased as a more sustainable alternative to paper towels.
320	In the long term, yeah, it is more sustainable.
321	I'm absolutely positive that it's cheaper only because people get frustrated and leave with damp hands.
322	I've tested this, it takes nearly a minute to get your hands as dry as a paper towel, and there's no way it's cheaper to run that than to just have a paper towel.
323	You are not using them properly.
324	Wood pulp contains cellulose, wood fibers, and lignin, biological glue holding the cellulose together. They are separated in pulp mills and the cellulose is used to make the paper towel and the lignin is burned in a recovery boiler to generate power. The pulp, which is a renewable resource, literally generates the power to turn itself into paper.
325	The blower on the other hand, uses utility power (mostly coal) to run the heater and the blower.
326	The paper towel is much better for the environment.
327	Know of anywhere I can read some stats about this?
328	The dryers that don't have a heater do have a smaller carbon footprint than paper towels. But with the bacteria they blow on your hands, you're better off just not drying them anyway.
329	I don't remember any details, but I read somewhere that the big problem with paper towels (and toilet paper, naturally) is that they (somehow) take an obscene amount of water to make.
330	As long as hand dryer bacteria are friendly, they are welcome to join my other trillion or so bacteria already living on me.
331	Is this why I'm the only one using them? I see people just walk out without drying if there is no paper towels.
332	Probably because it takes too damn long
333	I went to a new movie theater in town a few days ago and they have unheated hand dryers with really high pressure. They worked really well and it only took a few seconds. First time I ever seen them.
334	Who cares as long as my hands are dry.
335	Confirmed on Mythbusters.
336	Well Dyson hand driers are far better than towels, because the sound makes the bacteria deaf and they become harmless.
337	Mythbusters proved this all false. As long as you use soap there's no bacteria to blow around.
338	And this is why I'd rather dry my hands on my own cloths than use one of these things. A huge wad of toilet paper can work as well.
339	instructions unclear penis stuck in zip.
340	How to think you're making a difference, while making literally no important difference.
341	This is old news now, would be interesting what the results from the newer dyson jet dryers are like.
342	I have them at work but yep to come up with suitable experiment.
343	Even beyond the germophobe reasons, I hate not being able to wipe my hands. What if I get something sticky on them? You can't just rinse it off a lot of times; you need wiping action.
344	I hate places that only use air dryers, lke they do it for show to pretend they're so environmentally conscious, but I bet they just want to save a buck not buying paper towels.
345	I mean, saving paper is saving paper. There's certainly convenience in a paper towel, but air dryers are the way to go moving forward.
346	Saving a business or school money on paper towels is a plus but it'll certainly take a while for those savings to catch up to the cost of a single hand dryer.
347	Sustainability is a driving factor for a lot of groups, especially in low traffic areas.
348	People forget that much of the waste and such generated in the western world originates from public health concerns.
349	wastern Paging Dr. Freud
350	Gah! Frickin' mobile typing. I'll fix it.

Table 14: Processed textual dataset part 7

Class	Sentences
351	Wood pulp contains cellulose (wood fibers) and lignin (biological glue holding the cellulose together). They are separated in pulp mills and the cellulose is used to make the paper towel and the lignin is burned in a recovery boiler to generate power. The pulp, which is a renewable resource, literally generates the power to turn itself into paper. The blower on the other hand, uses utility power (mostly coal) to run the heater and the blower. The paper towel is much better for the environment."
352	Any towel manufacturer is going to use outside power as well, which would contain just as much coal power as anything else in the region. But bringing up coal power is a bit misleading in itself.
353	If. The college I work for just made a pretty sweeping change to air dryers, only after making an almost 100% switch to solar power.
354	I type paper towels vs air dryers into google and have a seriously difficult time finding anyone willing to claim or back up a claim that paper towels are somehow better for the environment in the short or long term.
355	for the next 20+ years, the majority of the power used for air dryers will be from from non renewable resources.
356	The dryers that don't have a heater do have a smaller carbon footprint than paper towels.
357	But with the bacteria they blow on your hands, you're better off just not drying them anyway.
358	The article you just posted compares the dyson airblade to **one single sheet** of *recycled* paper towel and finds the airblade has 1/5th the carbon footprint. That's extremely significant.
359	And, because it's making a comparison between air dryers and a single paper towel, that same article is also saying that old style air dryers are *as* efficient as **?* sheets of paper towels and ***more*** efficient than using 3 paper towel sheets.
360	I don't know many single paper towel users in this world, and with that in mind, I feel even more confident saying *all* air dryers are a more sustainable alternative to paper towels. And that is taking into account the environmental cost of energy production.
361	Number one, you're better of not washing your hands at all than washing them and drying with an air dryer.
362	If air dryers could even get to close to the level of sanitation of paper towels you could make an argument to install more heaterless air dryers.
363	And secondly, not all air dryers are dyson airblade models. The majority of them do have heaters, and they are worse for the environment than using paper towels, even if you need two of them
364	Number two, now we've come full circle. The two main studies that have made this claim were funded by a company named Scott (you may be aware of the product they sell) and a group called the European Tissue Symposium (can't imagine what interests they represent).
365	Now, as I mentioned in my previous comment, old style heated dryers are absolutely unsanitary and plenty of studies confirm that. I personally choose not to use them.
366	But, specifically, Dyson Airblades are NSF (National Sanitation Foundation) certified as sanitary, and are in fact the only air dryers with this certification. Most all industrial paper towel dispensers have the same certification. This is the same certification required for all equipment used in an industrial kitchen.
367	Two recycled paper towels and the air dryer have the same carbon footprint. Paper towels are a renewable resource, whereas the energy generated for the air dryer is not (mostly).
368	It's the renewable resource that makes paper better for the environment.
369	Did you know virgin fiber is better for the environment than recycled?
370	The trees grown reduce carbon dioxide and the lignin offsets the power to produce the paper.
371	So what then is the difference between a Dyson airblade and an old fashioned heated dryer as far as sanitation is concerned? Nothing. They both increase the bacterial count on your hands.
372	he dyson air dryer and it's equivalent are the most environmentally efficient hand drying method. Period.
373	Where are your sources? We are commenting on a study that very well documents how unsanitary air dryers are.
374	Cite sources showing air dryers are hygienically comparable to towels please? Towels are the winner here.
375	If the air dryer increases the amount of bacteria on your hands it is not even comparable to hand towels.
376	Carbon footprints are independent of the renewability (did I just make up a word?) of a resource. Pulp, recycled or not, is renewable and the majority of industrial power generation are not.
377	Air dryers are not an environmental friendly alternative to paper towels because they are not an alternative at all. They literally worse than not washing your hands.
378	Sure, I'd love to repeat the same arguments over and over again and have you not respond to a single one of them. Before I begin, I have to mention how much I love that "Where are your sources" has turned into "do my research for me" or "prove your point with sources so I don't have to do the same for mine." You have yet to refute anything I'm telling you and yet you keep spouting bullshit. The "best" alternative for the environment is to not dry your hands at all, but that isn't the world we live in and wet hands are considerably less hygienic (something you seemed to be very concerned with) as a damp breeding ground for bacteria. I am starting to understand your perspective, though. Once again, you are looking to the study we are commenting on as gospel (You remember, that same one we agreed was paid for by Scott paper towel company). So I was completely unsurprised when, after a few minutes of digging an...
379	wait... soap disgusts you? huh?
380	It's slimy and it smells bad. Especially liquid/foamy soap. I'm fine with a bar in the shower; usually the smell isn't too offensive. But I hate the idea of my hand smelling soapy for hours. I avoid it when I can.
381	Gross.
382	i think you may actually be a dog
383	I hate dogs more than I hate soap.
384	I've been downvoted for saying I don't use those gross hand driers for that reason. I go with dripping hands if there's no paper towels. Who's laughing now?
385	My hands are covered with skin, not cotton. They dry in less than a minute on their own. Dripping hands is what I go with as well.
386	Not to mention the old pants/shirt wipe expedites the process.
387	I just wash my dick in the morning, so I don't have to wash my hands.
388	Wonder how many hand dryers are in hospitals.
389	I have never seen one in a hospital around here. Always paper towels.
390	Most new hospitals now have built in faucets in every room for the nurses to wash their hands, dry with towels, sanitize, and wear gloves before touching the patient. I've never seen one with the hand dryers where it mattered, I have seen one in the public bathrooms though.
391	The bathrooms on the other floors with patient care areas have hand towels. Nearly all staff hate using the bathrooms with the dryers because it just feels wrong.
392	I guess if we're going to go the most germless route, the real question is, "with what do surgeons dry their hands?
393	Having OR experience, the surgeons I've assisted leave their hands wet or use a sterile towel and toss it away prior to putting on the sterile gloves.
394	I hate using the cotton paper to wipe my hands, it always breaks off and becomes more of a mess.
395	You're doing it wrong
396	Those hand dryers are only there to waste time until I just dry them on my pants anyway. Those things are useless
397	Anyone have a study that compares new air dryers like the Dyson Airblade?
398	I couldn't find a link to the scholarly work that inspired this article anywhere in the article. Do you have it OP?
399	Frankly, I am not surprised.
400	TIL the inside of hand dryers are moist.

Table 15: Processed textual dataset part 8

Class	Sentences
401	Whatever happened to that cloth role that we used to use in elementary school? Isn't that more eco friendly?
402	Sure, but probably the least good for preventing the spread of colds and stuff.
403	TIL it is possible to have -155% bacteria coverage over your hands.
404	Dyson masterrace
405	After you wash your hands isn't the bacteria count supposed to be pretty low anyways? So who cares if it's reduced by half or doubled?
406	I learnt this from Sheldon
407	How does the dyson airblade compare?
408	Sheldon cooper warned us about this years ago
409	Sounds interesting, but also something that I was probably better off not knowing
410	I can confirm! In my AP bio class, we swabbed and cultured various locations in the bathroom. The one with the most bacteria and the most virulent (gram negative) was the inside of the hand dryer. Truly disgusting.'
411	So the Dyson Airblade is an overpriced bacteria spreader...fantastic
412	My workplace is bad for this. The large set of toilets have got paper towel holders but never have paper towels in them and the single small toilet closer to where I work is filthy with no paper towels, no anti-bacterial soap and a really old hand drier. I tend to get sick a lot more when I'm working. I wonder if this is why. (I work 1 week on 1 week off)
413	always wet You're using it wrong. Go for the double-pull.
414	Lol...the only time I was ever FORCED to use one was at a high school I was visiting (it was in a really bad area...not a good high school) and that's the only thing they had in the bathroom. I would've likely been better off without washing at all, the entire towel was soaking wet. A rather gross experience.
415	Yikes. I always double-pull those, and sometimes have to triple pull, but that takes a lot of patience because you have to wait for the click each time. Maybe someone lazy just swapped the empty clean roll with the full dirty one in your case. That should be a crime.
416	The ones I'm speaking of were just a roll of towel...like linen towel. A big loop of maybe 8-10 feet of towel that was in a constant state of soaked. Might work well for a non-busy bathroom but not for a busy one.
417	I don't think they're widely used anymore...this was probably 15 or so years ago that I saw these in use. I'd sooner wipe my hands on my pants before use those again.
418	So that Dyson guy lied about it working properly.
419	Did they do this test in an existing bathroom with towels that have been collected floating butt germs?
420	I don't know if they're that much better but those Dyson AirBlade dryers have a Hepa Filter built in and are supposedly much more sanitary. They even have them know built right into the faucet.
421	Also, hand dryers suck compared to paper towels.
422	i effin hate hand dryers. they drive me nuts
423	What about normal towels? I can't stand this paper crap.
424	Can we just get over the fact that keeping our hands bacteria free is incredibly difficult and not really worth much in the end (albeit a few careers).
425	Freaking Tree Huggers tryna get us all sick.
426	What about those 'air blade' dryers?
427	Sheldon was right
428	Is the bacteria left from hand dryer pretty much harmless then?
429	I always hated hand dryers. Dryers are for hair not hands.
430	I saw this on big bang theory, I had no idea it was actually true...
431	They never work either. I like to wash my face off every time I wash my hands and it's impossible to dry off with a hand dryer.
432	Hey...Sheldon was right!
433	Except for the Dyson ones. Nothing can live in those things cause they blow so hard
434	I would think installing a simple UV light inside it would eliminate this.
435	So Sheldon was right?
436	The worst thing is on a road trip when every single rest stop has nothing but dryers.
437	Well it makes sense. But the concern for me with most hand dryer blowers is that they are weak and take too long for most people. I think a lot of folks simply don't wash their hands when that's the only drying option.
438	What about the really cool ones in costco?
439	Why would the inside of the dryer be moist?
440	Portable size hand sanitizers ftw
441	Yeah but how bad are these germs? Do they make you sick? They seem to be everywhere who cares
442	After reading this thread I'm electing to cut off my hands.
443	I fucking love bacteria.
444	Med student here. Don't be deceived - paper towels are far superior.
445	Because you can turn off the tap without touching it and open door handles without touching it - just use the paper towel.
446	Problem is waste. But in terms of cleanliness, single use paper towel continues to be the gold standard.
447	Dyson Hand Dryer.
448	I think Mythbusters showed that the air driers do a better job of spreading that bacteria all around in the air, so fuck other people, I guess.
449	It's a even warmer, moister bacteria factory than OP's mom.
450	Paper towels are largely bacteria free.

Table 16: Processed textual dataset part 9

Class	Sentences
451	When I go to Costco I don't use those Dyson dryers any more because I know most people end up rubbing their hands on either side of the hand slots and most don't really wash their hands properly, so god knows how much bacterial crap is on those.
452	Oh just dandy? ! So now we all have to carry around our own hand towels? !... sigh
453	I think recurring use of the same hand towel will give bacteria a nice environment to grow as well, using the dispensable paper towel may be the most hygienic option.
454	Please don't take this too seriously but er?...Go Fuck the Fuck off you little fucking Fuck faced fucker? !
455	Trying too hard.
456	A hand dryer will **never** beat paper towels in effectiveness or speed. I'm not going to argue that.
457	They are WAY cheaper to operate. Hand dryers cost about 0.02-0.18 cents per dry (in electricity) vs 1 cent per sheet for paper towels. So your hotel chain can go from spending \$1 million on paper towels a year down to (potentially) less than \$100K. That's huge.
458	They're much better for the environment. It's estimated that if 1 out of 2 Americans were to stop using paper towels, we would save upwards of 25,000 trees **A DAY**. Given global warming concerns, etc, I think this is an important thing to take into consideration
459	So, I'd argue if you value saving money for your business and saving the environment, a hand dryer would be the best choice.
460	The paper industry is one of the greenest industries in operation today.
461	Paper is highly recyclable and decomposes fast, and the trees we grow it with come from paper farms, not the rainforest or other precious sources of biodiversity. I don't think the environmental angle should be considered a significant factor in this argument.
462	I do agree that from the business owners perspective, the paper towel is inferior in the cost-effectiveness.
463	But still, as a hand drying device, it is superior to the automatic dryer.
464	I'd argue that the only people really making decisions on hand dryers are going to be businesses/hotels, etc because this isn't something we generally will have in our homes. With that said, I would argue the superior choice for them in this aspect is definitely going to always be the hand dryer because it's cheaper to operate, and results in less waste in the basket, etc.
465	So, with that said, when does cost effectiveness come into play with you? Are you only arguing from the user perspective and not the business perspective? If you're solely arguing from the former, than I really can't debate you.
466	You're forgetting about large, non-profit organizations: hospitals and universities. While concerned with cost and environmental impact, these organizations put public health foremost.
467	It's not just altruism or civic-mindedness: even minor, not remotely life-threatening outbreaks can be massively disruptive in health and/or education outcomes and labor costs.
468	These organizations choose paper towels, because they are more effective at drying hands, more likely to be used, and do not concentrate, gestate, and spew forth fecal bacteria as hand dryers have been found to do.
469	Do you have evidence that shows that hand dryers are a significant health risk? I understand they can harbor bacteria, but have there been studies where (for example) people using a hand dryers get sicker more often, etc, than people who use only paper towels? I'd like to see something like that if this is to be a convincing point.
470	Not so fast haha. Unfortunately you forgot your own statement of the problem. You gave the condition "in public bathrooms" and you used things such as "towel let's me not touch the door on the way out" as justification for your argument that paper towel is better. Therefore per your argument we are taking into account everything that goes into drying of hands in a public bathroom environment.
471	Cost/Environmental Impact(Due to High Foot Traffic)/Restocking/Availability all need to be considered as to how effective paper towels are versus hand dryers. Your paper towel has ZERO effectiveness if it runs out for example.
472	When we take these things into consideration the hand dryer is obviously superior for all intents and purposes since it never runs out and is cheaper.
473	If you want to modify your statement to, given a paper towel and a hand dryer the paper towel dries my hands faster and more effectively then yes you are probably correct.
474	I'm pretty sure that's what my whole assertion was. It's in the last sentence of the OP
475	That is incorrect. You're whole assertion definitely included more then just the last sentence and several other supporting points. I can confirm by scrolling up the page! But now I am just being cheeky.
476	There's a bathroom that I have to visit when we play baseball on the weekends. Of course, the bathroom is nothing fancy. It's in a ballpark. It's probably swept out once a year as far as cleaning goes. But the absolute most disgusting thing in that bathroom is the spot on the painted concrete wall directly below the hand dryer that is literally caked in brown sludge. Probably 3 square feet of the nasty that came off peoples hands *after* they washed them. Papertowels are not an option here, so I wipe my hands on my clothes every time.
477	Also maintenance to pick up all the used towels.
478	But if you value sanitation paper towels are *far* better.
479	In fact, using a hand dryer will probably cause you to end up with more bacteria on your hands than were present before you washed your hands!
480	There's a reason why in food service institutions, hand dryers are not allowed at employee handwash stations.
481	I find this a valid argument, but do we have evidence showing that perhaps people who frequent a hand dryer location gets sick/harmed more often than those only exposed to paper towels?
482	The study I linked in my previous post found that fecal bacteria were found deposited on the hands of people who used hand dryers (particularly hot air dryers, which are the worst offenders), and labeled the use of hand dryers as a public health threat as a result, as significant infections occur through the fecal-oral route.
483	Where did you get the cent per sheet figure?
484	Thank you for the source!
485	1. Go to any bulk ordering website (like alibaba) and you'll see that the unit price for paper towel rolls is about the same as the highest cost of one hand dry as you suggest. So paper towels win there.
486	Each year Americans plant 1.6 billion trees. Going by your math, we would only be saving about 9 million trees a year. A difference of 5% won't do much in the grand scheme when talking about global warming or the environment. So yeah, paper towels still reign supreme.
487	I don't understand the argument here. You one time buy a hand dryer and it quickly makes up its costs over the course of 10-15 years, during which time you need to be constantly replenishing and buying paper towels and disposing of those paper towels with waste management services (that you need to pay for)
488	The OP already stated the environmental argument isn't going to change his view, so anything to do with this angle is moot. But I agree it would be a relative drop in the bucket from a tree perspective.
489	Where do reusable towels, as commonly found in continental Europe, fit in terms of financial and environmental cost?
490	That's a good question. Would have to consider thought the cost of running washing machines to constantly clean the towels (water, electricity). I'm not sure what that comes out to.
491	Hands dryers blow water droplets around and aerosolize them. Not everyone washes thoroughly.
492	It only takes ones person spreading shit-borne disease through the air to get a few people sick and wash out those economic and environmental savings.
493	To know where the balance lies we would need to calculate the cost of the spread disease and the cost of the paper used. I bet the cost of the disease just from the doorknobs would be worse, with a hand dryer you can't use the paper towel to avoid touching the doorknob.
494	Paper towels can run out, whereas hand dryers don't.
495	If you use paper towels in a bathroom that isn't checked on often, it could be very possible that someone will not be able to dry their hands.
496	I've been to bathrooms without paper towels, but never one with a broken hand dryer.
497	That's a good point and while I do agree that this is a possible downside of the paper towel, in the event that both are available, the paper towel is always more effective. Edit: a word
498	Nah his argument is terrible. Running out isn't a paper towel issue, it's a management issue. Paper towels are still superior in this regard.
499	I have no real evidence available but you could look at germs associated with paper towels compared to hand blowers. So you may be dry but not clean? Just food for thought.
500	The fact paper towels need to be 'managed' makes it a paper towel issue. You don't need someone 'managing' the hand blower, it's just there.

Table 17: Processed textual dataset part 10

Class	Sentences
501	Of course you do need someone managing the hand blower. It's called repair when some idiot think they can put their weight on the hand blower and attempt to dry any other parts than their hands. (i.e. foot)
502	Also you need routine maintenance for hand blowers.
503	When a hand blower is down it's down for extended periods of time until a technician comes in. When paper towel runs out it takes 2 minutes to pull a new stack from the cupboard.'
504	Repairs does not equal management. Some idiot can rip the paper towel dispenser off the wall. The argument is symmetric, therefore moot to the point in question. Also hand dryers need maintenance a lot less frequently than paper towels need refilling.
505	Repair does not equal management Who's job do you think it is then to call/schedule for a mechanic to repair a hand dryer then?
506	How often do you see an idiot ripping a paper power dispenser off the wall in comparison to people breaking hand dryers? A broken paper towel dispenser can still function as a manual paper towel dispenser unless it's purposely broken in a way the opening is sealed.
507	In that case you can still put the paper towels on the counter and let people grab it manually.
508	Paper towels does not require any device for dispensing, but hand dryers absolutely need a machine to deliver it's function, this is another way paper towels are superior to hand dryers!
509	Point taken about hand dryers need a lot less maintenance than hand dryers; though the need for specific skills for hand dryer maintenance/repair means it has more downtime once it's down, whereas any idiot can open the cupboard and grab fresh paper towels themselves, so it's +1 for hand dryer and +1 for paper towels.
510	I've seen plenty of towel dispenser ripped open or torn off the wall because they were empty but some idiot found it empty, but thought there was one towel left and wrenched it open.
511	I've never encountered a broken hand dryer.
512	If we separate maintenance from management, then hand dryers need less maintenance, no management (aka refilling) and less often repairs.
513	Ugh, you're just repeating your past points and haven't addressed any of my replies...hand dryers may have one or two points that are better but paper towels are still have far more advantages that outweighs a hand dryer. It's still not enough to change my view enough I want to have hand dryers replacing paper towels in my office...
514	Which replies didn't I address. Your point seemed to be: * While towels need refilling, hand dryers need regular maintenance, to which I replied that you need to maintain a hand dryer a *lot* less than towels need refilling
515	Hand dryers break down, to which I replied towel dispensers also get broken. I also added my anecdotal accounts of how I've seen loads of broken dispensers, but never encountered a broken dryer.
516	But you said I didn't address your replies. This response instead implies I simply address your replies multiple times
517	Repeating someone's point isn't addressing it. Unless you say you're conceding and affirming my points, well then, fine, I'll take that.
518	1. Hand dryers do not need refilling, whereas towels do
519	Hand dryers do require maintenance, which could be considered equivalent to refilling, but is much less frequent
520	In my own personal experience, hand dryers are broken much less often that towel dispensers.
521	Both do need repairs, but hand dryers, it appears to me, less often. That's my stance.
522	Concession to this, but the refilling process is such a simplistic task it doesn't require a technician to do its advantage outweighs the lack of refill/maintenance a hand dryer has.
523	Also concession to this, but the same point about refilling being a task so simplistic that it still outweighs the advantage of a hand dryer.
524	My personal experience is opposite to this, but the ratio should not matter as a paper towels really do not require a dispenser to function, which makes it a plus 1 for paper towels
525	Thanks, it's been fun. Sorry for being a little frustrating in the middle.
526	We got better so it's a net good in the end :)
527	Dryers can break down and take longer to be fixed than it does for management to replace a roll of paper towels.
528	Those dyson hand air blade things are actually very dirty and need to be cleaned on a daily basis. If management doesn't clean them, fuck even just waving your hands in the air till they dry is a better option lol
529	At this point we'd need data on how much time hand dryers spend out of actions vs how much total time towel dispensers spend empty. But I'd assume that an empty dispenser probably gets 'ignored' for longer than a broken dryer (which would likely be raised immediately and happens less often)
530	As for the air blades, I assume you're talking about the version 1 with the U-shaped design? Sure, that's a design flaw, which is why the version 2 do away with that.
531	Yeah, but I have yet to see any places use those. The version 1's haven't broke down yet lol
532	lot of places around me use the ver2, having replaced non-airblades. Also, that would then support low break down rate of air dryers
533	Also, it probably should be noted that cleaning down hand dryers would be part of regular bathroom cleaning *anyway,* so wouldn't be exceptional maintenance specific to the device. Whereas refiling paper towels would be exceptional activity.
534	Yes, but while a management issue can screw up an air dryer, it has a far smaller chance of doing so than with paper towels.
535	If he presented you with a new perspective that made you concede your original view even a little bit, you should award him a delta.
536	The bathroom running out of towels is meaningless to the discussion. You can't use the absence of A when comparing A to B, because there is nothing for B to be compared to. OP is contending that A is superior to B, the absence of A doesn't come into the equation.
537	Paper towels are superior to dryers REGARDLESS if they run out because in terms of drying capabilities towels are in fact the better option
538	Furthermore there have been occasions where the dryer doesn't work and I've had to walk to another bathroom to dry my hands.
539	The possibility of running out is an inherent characteristic of paper towels, which is negative. Air dryers don't have this characteristic, and are therefore better in this regard.
540	If the speed of dispensing the "drying material" is relevant, even though it's a property of the plastic dispenser, then this argument is relevant too.
541	Because running out of something is an inherent characteristic of **everything** because we exist in a universe with entropy. It is irrelevant to refer to the absence of a thing as though that in some way says something negative about it. If I say I prefer lemonade over cola and then someone tells me that I might run out of lemonade, that doesn't change the fact that I still prefer lemonade. Of course towels get used up, that's what happens when you use disposable paper towels. If you're going to bring up the possibility of running out of paper towels, you ought to bring up the possibility of the hand dryer being broken. If X occurs between two objects (A and B) but you only use X in the instance of A and not B to make B look better than A, you're clearly not being fair.
542	Towels need to be replaced at least once a day (maybe upwards of ten if you're in a busy place).
543	The dryer could break, but with existing technology, it's unlikely that it will require maintenance several times a day.
544	The towel dispenser is guaranteed to require this, and is therefore more likely to be inconvenient, no?
545	Yeah but context is everything. What happens more often? Towels running out or the dryer being broken? Both are certainly possible, but this particular question has to do with probability.
546	The average user of a public bathroom would say towels are vastly better at drying hands than a dryer is.
547	The guy who gets paid to stock the towel dispenser, and the guy who pays for the towels, the other man's salary and the electricity bill of the building would argue that dryers are less costly and need less maintenance therefore are better than towels
548	If you can't take the "just slightly" larger picture into account, should we consider you to have any meaningful input on the issue? One would hope that administrators are taking effectiveness into account along with cost and employee morale, and that the end user would have some inclination to avoid waste and some consideration for staff."
549	removed
550	1. They're quicker by a very small margin. You're arguing over seconds, and it's not like these are seconds right at your job or whatever. If you leave a desk to use the bathroom, your hands will dry by the time you need them again. You're really arguing over a few seconds more of having dry hands for little to nothing

Table 18: Processed textual dataset part 11



Class	Sentences
551	Effectiveness is measured by time really, and that's part of I. Dry is dry though. It's not like your hands are going to retain water like a towel itself.
552	Why are you cleaning sinks like that? And, after using the auto dryer, I still have to touch the door to exit. This is a commonly held but bad belief. The door isn't germ city any more than the rest of the bathroom. And when you do make it out of the bathroom by doing that, you still have to touch absolutely everything else that people have also touched with the same hands.
553	Also, if you used an air dryer, you hosed your hands down with the combined fecal bacteria of everyone who used that bathroom before you, so I really wouldn't worry about the door.
554	Removed
555	And in all scenarios dryers are extremely loud, which scares my kids.
556	hey often jump if someone else engages the dryer and when they were younger they refused to use them because of noise.
557	Also a big + for flexibility of the towel - a need to wipe dry my kids face after they indulged on an ice cream and I cleaned the face with water is quite common. It is very hard to do it with a hand dryer.
558	I feel because of this all businesses that cater to children (like malls for example) should at least offer an option of a towel. But sadly a lot of them don't.
559	removed
560	paper towels are not a poop cannon
561	no way. i could glide my hands through those for longer than a minute and my hands are still at least kind of moist, they never *completely* dry the hand
562	The paper towels dry it all pretty much instantly
563	OP missed the main strength of paper towels: they are the most hygienic option.
564	Air dryers breed and expel fecal bacteria.
565	I will disagree with you on quickness. I've used the air blade dryer and while it's a cool piece of technology, I don't believe my hands have become sufficiently dry after just two passes. Basically all of the water accumulates at the ends of my fingers.
566	Plus, in thinking about my experience using paper towels in the place I use them most (my office restroom), I tear the towel off the dispenser and am immediately turning around and walking to the exit while simultaneously drying my hands. By the time I get to the exit where the trash can is, my hands are dry.
567	Yes, I like paper towels more, but if you run a business and people keep throwing paper towels in your toilet, you will continually have plumbing issues to deal with.
568	How many signs do you see in restrooms reminding people to throw paper towels in the trash, not the toilet? These business owners have had to call the plumber on occasion. That's why automatic hand dryers are better for business owners.
569	Time for a restroom remodel. Even a simple wall divider between sink and toilet will radically reduce that behavior, and you won't have an e.coli breeding facility bolted to your wall.
570	One major problem with paper towels is that you have to empty the paper basket *all the time*.
571	I don't think the door argument holds either, since you 1) Will have to touch at least one more door to get out of the building in most cases, and 2) Can use a part of your sleeve, shirt, or basically any piece of clothing to open the door. Also, in some cases you can use you elbow to push the handle, and push you back against the door.
572	If you haven't encountered one of the more modern hand dryers then paper towels are definitely superior but they do make them *powerful* now.
573	Why THE FUCK would you choose paper over air?! Does no one care about the environment?
574	I know this argument isn't about the environment but if nothing else makes you choose a hand dryer over paper towels, the environment SHOULD.
575	As culb77 already pointed out, air dryers were a bad idea from the start. They are poop cities complete with an airport with direct flights to your hands.
576	deleted
577	Paper towels are much *more* hygienic.
578	When you rub your hands with them, they physically remove bacteria and other contaminants from your hands.
579	In contrast, bacteria love reproducing inside of hand drying machines because of the moisture, warm air, and darkness.
580	Well then, I stand corrected. Thanks
581	Environmentally friendly would be the hand dryer, even though it's using electricity that might have been produced by coal.
582	The paper towel by using them your using: The tree that was cut to make the paper The factory, machines and chemicals used to chop, clean, pulp the paper and then process it into the towels. The fuel used to transport them from t he place they where bought to the place they are going to be used
583	The dryer you are using: The ore that was mined from the ground, the trucks, drills, machinery that was used to dig them out, transport them to a refinery.
584	Just as an addendum, having worked in multiple places that use paper towels, that shit gets thrown into a landfill, no recycling about it. Then consumers come along, use it a thousand times, maybe before it is discarded
585	Anyway, most people undo their hand washing as soon as they open the door when they hold the handle that everyone else has held, along with the people who didn't clean their hands.
586	Electricity is being produced all the time, for everything. Paper towels are being produced for a specific use and reason. Take away paper towels, you break a huge chain, take away hand dryers, the use of everything is still there.
587	Because hand dryers just materialize out of midair and have no chain associated with their manufacture. None at all. Glad to see there's such critical thought put into your response.
588	Just in case you didn't know, and regardless of what turns out to be more environmentally friendly, there's another thing you can do that makes a big difference: vigorously flick water off your hands first.
589	I always take a handkerchief with me, so I usually use that. If that is dirty I will use paper towels. If paper towels aren't available I use my undershirt.
590	I was at Mc Donalds once in the bathroom and washed my hands and wiped them on my shirt. This woman looked at me with disgust and I said 'those hand dryers blow so many germs on your hands you might as well just rinse them in the toilet before flushing'.
591	She went 'oh, really?' and I said, yeah... that's why I don't use the blowers. She washed her hands and wiped them on her shirt. Lol.
592	Yeah, that huge outbreak of disease due to hand dryers...
593	The risk of the dryer comes from the fact it circulates the water droplets off people's hands. Meaning, just walking past it, or being near it, puts you "at risk".
594	And that's how you get bladder infections. There's being careful, and then there's being too careful. Also, since having a kid, if I don't go pee the moment I feel that urge, I'm at serious risk of flat out pissing myself.
595	Also, since having a kid, if I don't go pee the moment I feel that urge, I'm at serious risk of flat out pissing myself. Hahahaha! Oh geez! That's gotta subside, right? Are there exercises you can do or something?
596	It's been seven years. It's not going away. I do kegals but it does fuck all. When I have to pee I have to pee now.
597	THIS!!!!
598	I would expect a hand drier. Especially depending on where the energy of it comes from
599	Considering the paper towels already exist and will be used by someone eventually even if you didn't use them, it probably dosnt matter but if you made your own paper towels each time you needed to dry your hands then a hand dryer would be more efficient.

Table 19: Processed textual dataset part 12