Computer Assisted Qualitative Content Analysis

Topic Modeling + Curation = Scalability + Trustworthiness

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SurvAI Day, 7 October 2024

Warning: Some material in this presentation pertains to suicide and suicide prevention.

Suicide prevention resources

- National Suicide Prevention Lifeline: 988 / 1-800-273-8255 (TALK)
  - Veterans please press 1 to reach specialized support
  - Spanish: 1-888-628-9454
  - Deaf + Hard of Hearing: 1-800-799-4889
- Crisis Text Line: Text "HOME" to 741-741
- Online chat
  - https://suicidepreventionlifeline.org/chat/
- U.S. and worldwide
  - https://www.reddit.com/r/SuicideWatch/wiki/hotlines
  - This page provides information about phone and chat hotlines and online resources in the U.S. and worldwide

The challenge

- **Open-ends are a well-known problem in survey research:** language can yield extremely rich responses, including bringing to the surface aspects of a question or issue that the researcher might not have known to look for, but content analysis of text is *costly and labor-intensive*.

- **Computational methods are efficient and scalable**, but they are less widely used because it's hard to know if computational results are *trustworthy*.

How can you get an efficient and scalable analysis of open ends that produces categories you can trust?

Top down: looking for evidence through the lens of known categories/constructs/patterns

"[Despair], owing to some evil trick played upon the sick brain by the inhabiting psyche, comes to resemble the diabolical **discomfort** of being **imprisoned** in a fiercely **overheated** room. And because no breeze stirs this cauldron, because there is no escape from this **smothering confinement**, it is entirely natural that the victim begins to think ceaselessly of oblivion."

— Dr. Kay Redfield Jamison, *Night Falls Fast: Understanding Suicide*

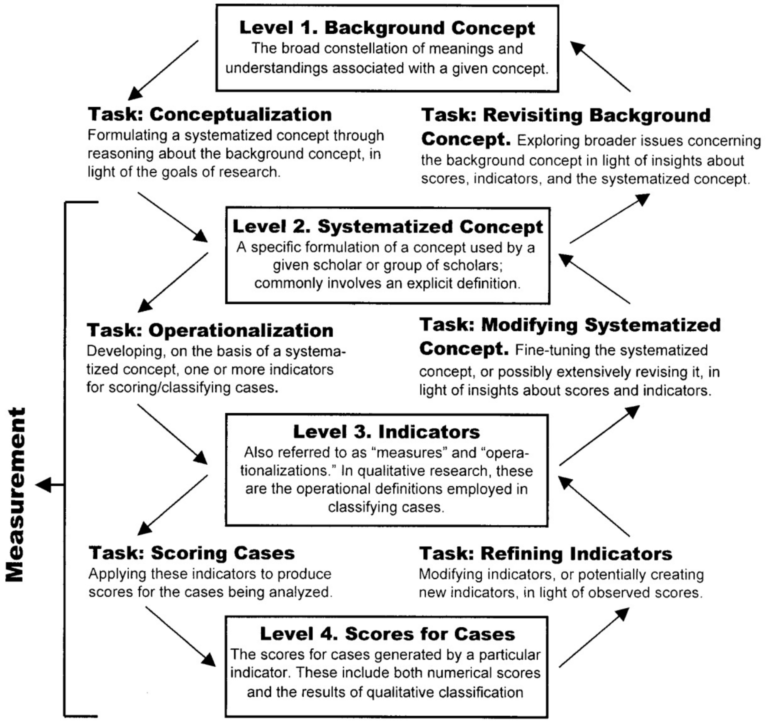
Entrapment

Schuck, Allison; Calati, Raffaella; Barzilay, Shira; Bloch-Elkouby, Sarah; Galynker, Igor (May 2019). "Suicide Crisis Syndrome: A review of supporting evidence for a new suicide-specific diagnosis". Behavioral Sciences & the Law. 37 (3): 223–239. doi:10.1002/bsl.2397.

Measurement Validity: A Shared Standard for Qualitative and Quantitative Research

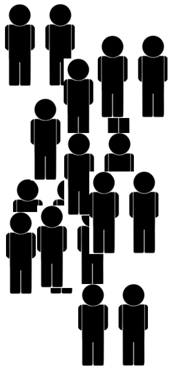
ROBERT ADCOCK and DAVID COLLIER *University of California, Berkeley*

FIGURE 1. Conceptualization and Measurement: Levels and Tasks



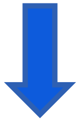
Working bottom-up

Linehan et al. (1983): Discovering implicit categories using principal components analysis



I care enough about myself to live.
I believe I can find other solutions to my problems.
I still have many things left to do.
I have hope that things will improve and the future will be happier.
I have the courage to face life.
It would hurt my family too much and I would not want them to suffer.
I would not want my family to feel guilty afterwards.
I would not want my family to think I was selfish or a coward.
My family depends upon me and needs me.
I love and enjoy my family too much and could not leave them.
I am afraid of the actual "act" of killing myself (the pain, blood, violence).
I am a coward and do not have the guts to do it.
I am so inept that my method would not work.
...

	Feature 1	Feature 2		Feature N
item 1	value 1	value 2		value N
item 2	value 1	value 2	...	value N
item 3	value 1	value 2		value N
item 4	value 1	value 2		value N
...				



PRINCIPAL COMPONENT ANALYSIS OF THE REASONS FOR LIVING INVENTORY (VARIMAX ROTATION)†

Factor	Item Number	Loading (Range)
1	5, 11, 1, 9, 2, 6, 3, 10, 15, 21, 17, 8, 18, 19, 24, 22, 7, 20, 4, 12, 14, 13, 23	.77—.45
2	38, 35, 36, 37, 41, 44*, 43*, 42*, 39	.79—.57
3	25, 29, 26, 28, 30, 31, 27	.76—.48
4	32, 33, 34	.86—.67
5	47, 45, 46, 48	.80—.41

Linehan, M. M., Goodstein, J. L., Nielsen, S. L., & Chiles, J. A. (1983). Reasons for staying alive when you are thinking of killing yourself: The Reasons for Living Inventory. Journal of Consulting and Clinical Psychology, 51, 276–286. https://doi.org/10.1037/0022-006X.51.2.276

Osman, Augustine, et al. "Factor structure and reliability of the Reasons for Living Inventory." *Psychological reports* 70.1 (1992): 107-112.

Working bottom-up

COLLEGE IS GREAT AS LONG AS I DO NOT HAVE TO GO TO CLASS OR LEAVE MY ROOM. I DO NOT LIKE GOING OUT ANYMORE EVEN THOUGH I USED TO LOVE IT. NOW I JUST WANT TO SIT IN MY ROOM AND PLAY ON MY COMPUTER OR SLEEP. I DO NOT EVEN LIKE TALKING ON THE PHONE. THINGS I USED TO ENJOY, LIKE PEOPLE, I DO NOT ANYMORE. THEN THERE ARE THE CLASSES. I HATE ALL OF MINE. I FEEL LIKE SUCH A FAILURE. EVERYONE TOLD ME THEY WOULD BE HARD, BUT THIS IS RIDICULOUS. I CANNOT BELIEVE ANYONE CAN PASS THESE. I TRY MY HARDEST BUT THAT NEVER SEEMS TO BE ENOUGH. I KNOW I COULD SPEND MORE TIME ON MY HOMEWORK BUT WHEN I AM WORKING ON IT I GET SO WORN OUT I CANNOT THINK ANYMORE. THEN I REGRET NOT DOING IT. BUT IT IS LIKE A VICIOUS CYCLE. I AM SO EXHAUSTED I CANNOT THINK SO I SLEEP, THEN I WAKE UP EXHAUSTED AND I DO NOT HAVE ENOUGH ENERGY TO GO TO CLASS. THEN I DO NOT KNOW HOW TO DO MY HOMEWORK AND I GET DISCOURAGED AND IT TAKES ME TWICE AS LONG TO DO, SO I GET SO EXHAUSTED THAT I CANNOT THINK! THIS IS SO FRUSTRATING I FEEL LIKE THERE IS NO ONE IN THIS UNIVERSITY THAT CARES THAT I HATE IT HERE. …

Working bottom-up

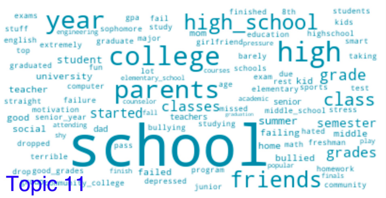
COLLEGE IS GREAT **AS LONG AS I DO NOT HAVE TO GO TO CLASS OR LEAVE MY ROOM**. I **DO NOT LIKE GOING OUT ANYMORE** EVEN THOUGH **I** **USED TO LOVE IT**. NOW I JUST **WANT TO SIT IN MY ROOM** AND PLAY ON MY COMPUTER OR **SLEEP**. I DO **NOT EVEN LIKE TALKING** ON THE PHONE. THINGS I **USED TO ENJOY**, LIKE PEOPLE, I **DO NOT ANYMORE**. THEN THERE ARE THE CLASSES. I HATE ALL OF MINE. I FEEL LIKE SUCH A FAILURE. EVERYONE TOLD ME THEY WOULD BE HARD, BUT THIS IS RIDICULOUS. I CANNOT BELIEVE ANYONE CAN PASS THESE. I TRY MY HARDEST BUT THAT NEVER SEEMS TO BE ENOUGH. I KNOW I COULD SPEND MORE TIME ON MY HOMEWORK BUT WHEN I AM WORKING ON IT I **GET SO WORN OUT** I CANNOT THINK ANYMORE. THEN I REGRET NOT DOING IT. BUT IT IS LIKE A VICIOUS CYCLE. I AM SO **EXHAUSTED** I CANNOT THINK SO I **SLEEP**, THEN I **WAKE UP EXHAUSTED** AND I **DO NOT HAVE ENOUGH ENERGY** TO GO TO CLASS. THEN I DO NOT KNOW HOW TO DO MY HOMEWORK AND I GET DISCOURAGED AND IT TAKES ME TWICE AS LONG TO DO, SO I GET SO **EXHAUSTED** THAT I CANNOT THINK! THIS IS SO FRUSTRATING I FEEL LIKE THERE IS NO ONE IN THIS UNIVERSITY THAT CARES THAT I HATE IT HERE. …

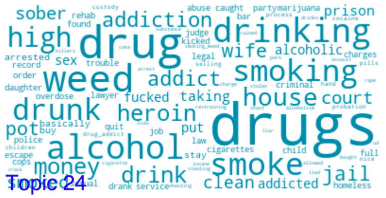
Working bottom-up with topic models

Discovering implicit categories using topic modeling (Blei et al. 2003)

	word 1	word 2		word N
item 1	value 1	value 2		value N
item 2	value 1	value 2	…	value N
item 3	value 1	value 2		value N
item 4	value 1	value 2		value N
…				

Topic 11	text
0.48050353	So, I'm a poor student (~2.8 GPA) at a good school. I've been talking to my college guidance counselor about colleges that I'd be able to get into ar
0.47767672	Today I skipped school.....Got yelled at by my parents. Got compared to one of my actual friends..... My dad basically called me worthless. I starte
0.45305499	Now matter how hard I try I don't think I can escape this depression. It all started over a fucking girl. Now I'm just seeing the negative side to ever
0.43119257	and I don't know what to, everyone including me expects me to go to college and now thanks to my shitty grades from my senior year I might not l
0.39189101	I just feel like every area of my life is falling apart. My personal and professional life leads to nothing but stress. My physical health is falling apart.
0.38730073	I'm considering suicide. I have struggled with depression and anxiety in the past, but right now I'm decently happy.I just dropped out of college, be





Example: Inferring population-specific categories from language

Notes	Valence	Regression value	Top 20 words
social engagement	p	-1.593	gar
social engagement	p	-1.122	n
social engagement	p	-0.89	pa
social engagement	p	-0.694	goo
high emotional valence	e	-0.507	hop
somatic complaints	n	-0.205	col
poor ego control; immature	n	0.177	yeah wow minute haha type funny suck mmm guess blah bore gosh ugh stupid bad lol hey
relationship issues	n	0.234	call talk miss phone hope mom mad love stop tonight glad dad weird stupid matt email any
homesick; emotional distress	n	0.34	home miss friend school family leave weekend mom college feel parent austin stay visit lot
social engagement	p	0.51	friend people meet lot hang roommate join college nice fun club organization stay social to
negative affect*	n	0.663	suck damn stupid hate hell drink shit fuck doe crap smoke piss bad kid drug freak screw cr
high emotional valence	e	0.683	life change live person future dream realize mind situation learn goal grow time past enjoy
sleep disturbance*	n	0.719	sleep night tire wake morning bed day hour late class asleep fall stay nap tomorrow leave n
high emotional valence	e	0.726	love life happy person heart cry sad day feel world hard scar perfect feeling smile care stro
memories	n	0.782	weird talk d… crazy ti
somatic complaints*	n	0.805	hurt type head stop
anxiety*	n	1.111	feel worry stress study tim
emotional discomfort	n	1.591	feel time reason depress m
homesick; emotional distress*	n	2.307	hate doe sick feel bad hurt

game play football team watch win…
music song listen play band sing hear…
party night girl time fun sorority meet…

sleep night tire wake morning bed day
hour late class asleep fall stay nap

Supervised LDA topics from undergraduate stream-of-consciousness essays identified by a clinician as most relevant for assessing depression. Supervision (regression) is based on Z-scored Big-5 scores for emotional instability (neuroticism).

Resnik et al., Beyond LDA: Exploring Supervised Topic Modeling for Depression-Related Language in Twitter. NAACL Workshop on Computational Linguistics and Clinical Psychology, Denver, CO, June 2015.

Example: Inferring population-specific categories from language

Notes	Valence	Regression value	Top 20 words
social engagement	p	-1.593	game play football team watch win sport ticket texas season practice run basketball lose so
social engagement	p	-1.122	music song listen play band sing hear sound guitar change remind cool rock concert voice
social engagement	p	-0.89	party night girl time fun sorority meet school house tonight lot rush drink excite fraternity
social engagement	p	-0.694	god die church happen day death lose doe bring care pray live plan close christian control
high emotional valence	e	-0.507	hope doe time bad wait glad nice happy worry guess lot fun forget bet easy finally suck fin
somatic complaints	n	-0.205	cold hot hair itch air light foot nose walk sit hear eye rain nice sound smell freeze weather
poor ego control; immature	n	0.177	yeah wow minute haha type funny suck hmm guess blah bore gosh ugh stupid bad lol hey
relationship issues	n	0.234	... ny
homesick; emotional distress	n	0.34	... lot
social engagement	p	0.51	... to
negative affect*	n	0.663	... cr
high emotional valence	e	0.683	... oy
sleep disturbance*	n	0.719	... e n
high emotional valence	e	0.726	... tro
memories	n	0.782	weird t... crazy time sad stuff funny haven happen bad remember day hate lot sca
somatic complaints*	n	0.805	hurt type head stop eye hand start tire feel time finger arm neck move chair stomach bother
anxiety*	n	1.111	feel worry stress study time hard lot relax nervous test focus school anxious concentrate pr
emotional discomfort	n	1.591	feel ti... reason depress ...
homesick; emotional distress*	n	2.307	hate doe sick ...

hurt type head stop eye hand start tire feel time finger arm neck move chair stomach

feel worry stress study time hard lot relax nervous test focus school anxious

Supervised LDA topics from undergraduate stream-of-consciousne... relevant for assessing depression. Supervision (regression) is base... instability (neuroticism).

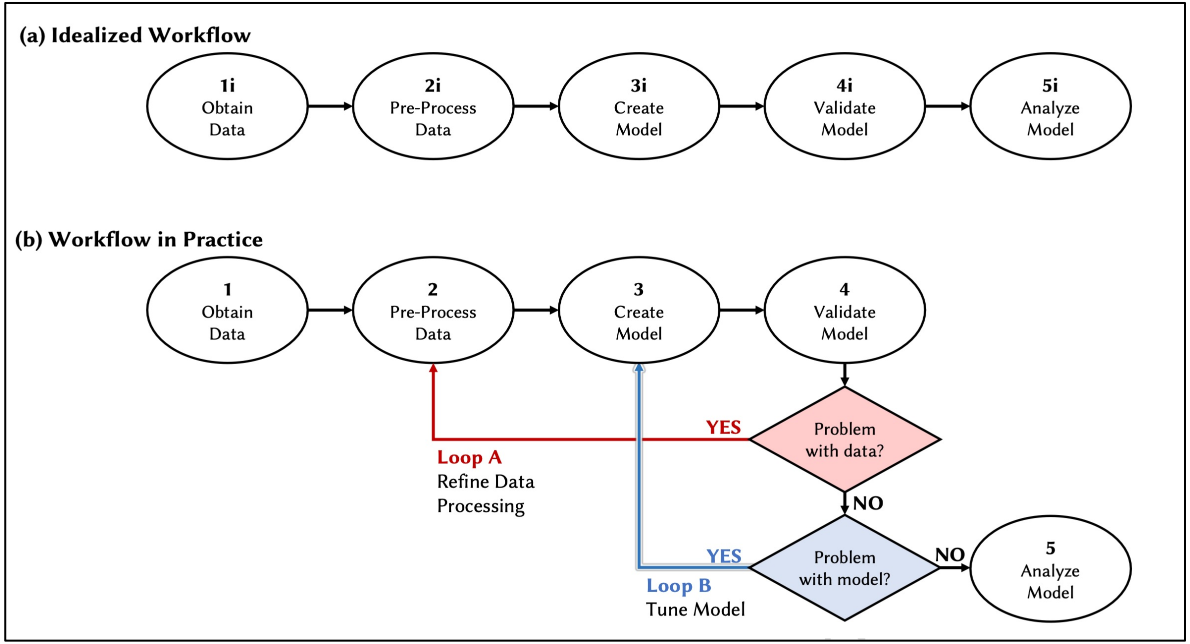
Resnik et al., Beyond LDA: Exploring Supervised Topic Modeling for Depression-Related Language in Twitter. NAACL Workshop on Computational Linguistics and Clinical Psychology, Denver, CO, June 2015.

Problem:

All computational models can produce garbage

"My Very Subjective Human Interpretation": Domain Expert Perspectives on Navigating the Text Analysis Loop for Topic Models

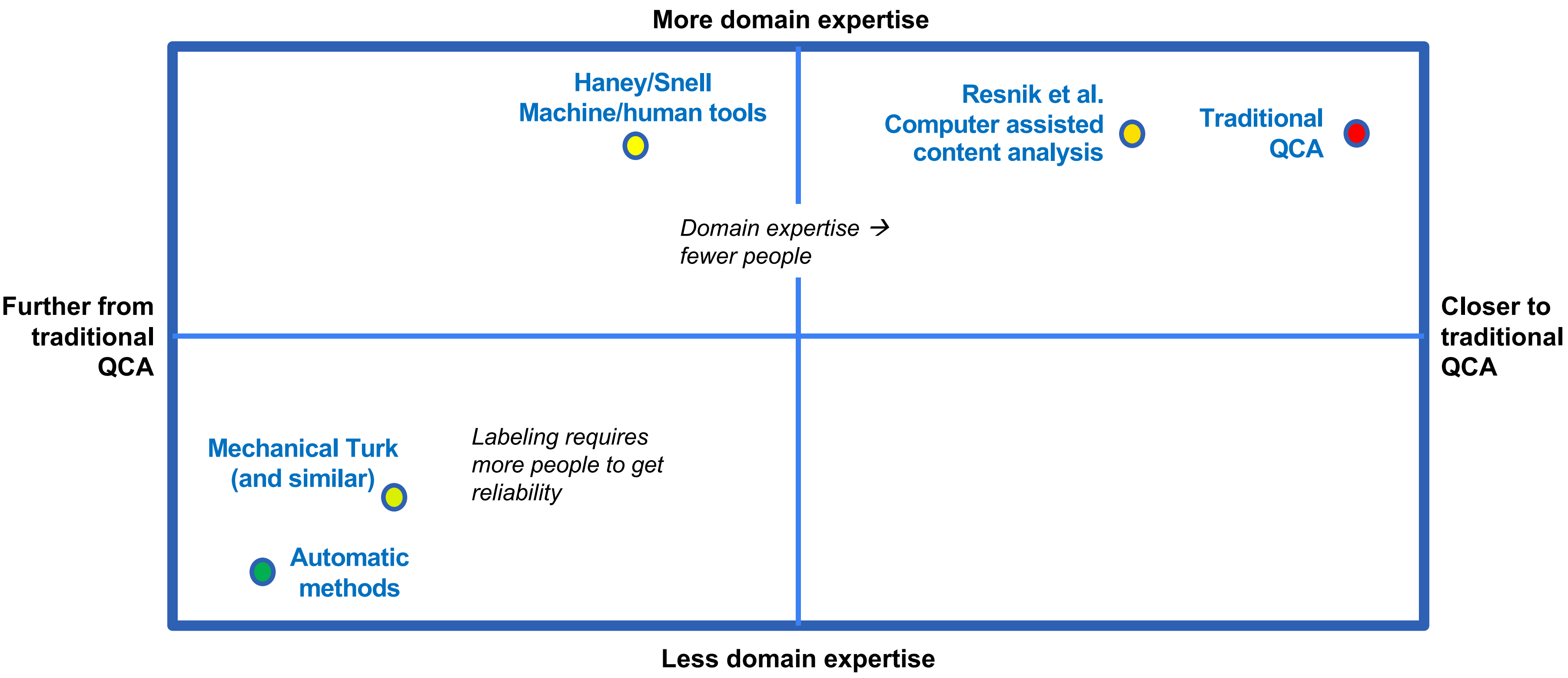
ALEXANDRA SCHOFIELD, Harvey Mudd College, USA
SIQI WU, Massachusetts Institute of Technology, USA
THEO BAYARD DE VOLO, Pitzer College, USA
ALFREDO GOMEZ, Carnegie Mellon University, USA
TATSUKI KUZE, Harvey Mudd College, USA
SHARIFA SULTANA, University of Illinois, Urbana-Champaign, USA



Automatically deciding if categories are good is hard: the case of topic models (LDA; Blei, Ng, and Jordan 2003)

- **Good models of categories should predict observed documents!**
  - Blei et al., 2003; Wallach, et al., ICML, 2009
- **Uh oh: that approach does a bad job matching human judgments.**
  - Chang, J., Gerrish, S., Wang, C., Boyd-Graber, J., & Blei, D. (NeurIPS 2009). Reading tea leaves: How humans interpret topic models.
- **Ok, here's an automated metric that correlates with human judgments!**
  - Lau, J. H., Newman, D., & Baldwin, T. (EACL 2014). Machine reading tea leaves: Automatically evaluating topic coherence and topic model quality. [NPMI]
- **Um, bad news: those fancy new neural topic models? Not really progress.**
  - Hoyle, A., Goel, P., Hian-Cheong, A., Peskov, D., Boyd-Graber, J., & Resnik, P. (NeurIPS 2021). Is automated topic model evaluation broken? the incoherence of coherence.
  - Hoyle, A., Goel, P., Sarkar, R., & Resnik, P. (EMNLP Findings, 2022). Are Neural Topic Models Broken?

A (partial) landscape of approaches



For NLP, encouraging longer responses matters a lot!

A. How did your activities change during the COVID-19 pandemic? How have your activities changed, if at all, since lockdowns have eased?

B. Please write a few sentences, or more if you'd like, telling us how you have managed the COVID-19 pandemic and associated lockdown measures. Include discussion of how your activities have changed, if at all, before, during, and since the pandemic.

Device	Question	Responses_A	Average_length_A	Responses_B	Average_length_B	Difference (chars)	Est difference (words)
Laptop or desktop computer	activities	437	151.99	420	274.62	122.63	20
Laptop or desktop computer	work	425	60.1	409	134.26	74.17	12
Laptop or desktop computer	symptoms	7	148.71	10	152.3	3.59	1
Laptop or desktop computer	vaccination	230	116.07	194	168.72	52.64	9
Laptop or desktop computer	needle_fear	439	72.17	437	78.94	6.77	1
Laptop or desktop computer	finances	437	95.41	375	124.97	29.56	5
Laptop or desktop computer	feedback	120	49.24	112	52.79	3.54	1
Mobile phone	activities	76	144.36	76	190.78	46.42	8
Mobile phone	work	74	64.57	72	110.5	45.93	8
Mobile phone	vaccination	39	100.03	45	101.73	1.71	0
Mobile phone	needle_fear	79	59.77	77	51.05	-8.72	-1
Mobile phone	finances	74	85.26	62	82.71	-2.55	0
Mobile phone	feedback	13	41.85	12	29.42	-12.43	-2
Tablet (with no separate keyboard)	activities	15	152.2	11	259.27	107.07	18
Tablet (with no separate keyboard)	work	15	63.4	10	79.4	16	3
Tablet (with no separate keyboard)	vaccination	9	193.11	4	76.25	-116.86	-19
Tablet (with no separate keyboard)	needle_fear	16	46.88	11	68.82	21.94	4
Tablet (with no separate keyboard)	finances	16	52.13	8	64.25	12.13	2
Tablet (with no separate keyboard)	feedback	4	84.75	1	14	-70.75	-12
Tablet (using a separate keyboard for typing)	activities	3	218.67	3	215.33	-3.33	-1
Tablet (using a separate keyboard for typing)	work	3	46.67	4	96	49.33	8
Tablet (using a separate keyboard for typing)	needle_fear	3	58	4	88.5	30.5	5
Tablet (using a separate keyboard for typing)	finances	3	105	3	106.67	1.67	0

TOPCAT
Topic-Oriented Protocol for Content Analysis of Text

Scalable codebook development guided by topic modeling

Minimal technological requirements:

MALLET: See Graham, S., Weingart, S., & Milligan, I. (2012). Getting started with topic modeling and MALLET. The Editorial Board of the Programming Historian. https://programminghistorian.org/en/lessons/topic-modeling-and-mallet

Excel

A PDF viewer

TOPCAT:
Topic modeling

Construct candidate models at multiple granularities
Fast-pass or more rigorous manual rating of topic quality
Selection of “starting point” model for curation

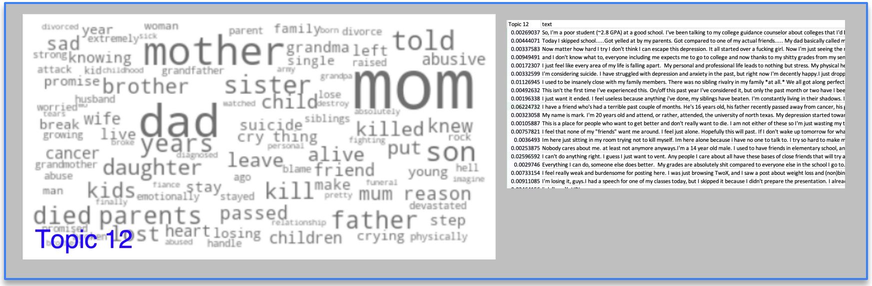
*Work in progress: automatic ranking of candidate models

docID	Topic 12	text
4888	0.639	… Decades ago I swore I would not make my parents look at me in a coffin. And I swore I would never leave my son fatherless. That is what kee
11853	0.632	I promised my dad I would never make him cry when I was like 3 years old. I am now 28 and will never break that promise.
8811	0.598	My best friend. We had just lost our mother (her birth mom, who treated me as her own), I knew she couldn't handle losing her and me too. S
13763	0.598	The though of my mother having to lose her youngest child. She is a strong woman but it would break her. My friend had only recently died ag
312	0.596	My mother lost a son 3 years ago I don't want her to lose another.
13453	0.561	My burning desire to not have my mom lose both her father and one of her sons to suicide. That woman has lost enough. I don't want her to tl
8937	0.554	I watched my best friend's mother had to be carried out of her son's funeral after he killed himself. I couldn't imagine doing that to my mom. I
1976	0.553	My little sister being left alone with my abusive parents
6558	0.553	Single mom here. Didn't want to leave my daughter alone.

Resnik, P., Goel, P., Hoyle, A., Sarkar, R., Hagedorn, J., Gearing, M., and Bruce, C. (2022). A Step-by-Step Protocol for Curation of Topic Models by Subject Matter Experts. Presented at Conference on New Directions in Analyzing Text as Data (TADA), New York City, October 6-7, 2022.

TOPCAT:
Curation by subject matter experts

Specific family members	People were VERY specific about which family members kept them alive. They said things like, "I did not want my MOM, SISTER, DAD, ETC., to blame themselves." "I did not want to leave my grandmother, kids, or siblings, etc. to be without care."



Protect my parents	Empathy for how this will impact one's parents, desire to spare them pain/devastation. "I couldn't do that to my mom/dad."

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TOPCAT
Curation by subject matter experts

4. Treating the column names of the document-topic spreadsheet (e.g. *Topic 1*, *Topic 2*, etc.) as a checklist, go through each one completing the following steps:

   a. Sort the spreadsheet by that topic's column in descending (*largest-to-smallest*) order.

   b. Set a timer for 120 seconds. This is simply to keep you from reading all the text responses in case they're interesting. You can use a cell phone, web browser or other timer. ("Siri [or Alexa], set a timer for two minutes!")

   c. Skim the text column for the top documents to get a sense of what kinds of responses are strong on this particular topic. Also look at this topic's cloud in the PDF. Jot down common words or ideas under Description in the notes spreadsheet (discussed in Step 3, above).

   d. You may find that documents you're looking at are about more than one topic. That's ok: you're not labeling documents here, you're looking at the documents to get a clearer understanding in your mind about what this column's topic is about.

   e. Consolidate the notes you took in the Description column and give the theme a brief label or name in the Name column. Replace the original column header in the document-topic spreadsheet (e.g. *Topic 1*) with your new label.

   f. If the topic you are reviewing contains responses that are consistently similar to another

A	D	AF
docID	Topic 3	text
3422	0.74	New comic books came out every week, and series' like Batman and Spider-Man will never end. So I might as well wait until after Wednesday.
4529	0.735	I'm looking forward to new episodes of my favorite tv shows. New movies I liked. When I was at the lowest in my life my favorite book series hadn't finish
12473	0.72	Honestly itÃ¢â,¬â„¢s whatever hobby I had coming up I could look forward to. Ã¢â,¬Å"Aw I wanna play that video game I have to stick around to play it,
7195	0.679	Movies and Video games. I lived in these fantasy worlds and always wanted to see the next addition to come out. Its seems silly but it was my thing
8181	0.679	It sounds stupid, but waiting for movies or books to come out. I'm waiting for WW84 and The Winds of Winter, are helping. Plus I have many books that I
5330	0.677	star wars and books. books are just a nice way escape from reality. star wars is one of the few things that are making me go forward.
10188	0.651	Not wanting to miss Zelda breath of the wild on Nintendo Switch basically when I heard about that game from the switch I was basically doing everything
5467	0.635	Sometimes, the only thing you feel like you're hanging around for is a video game that's coming out or a movie you wanna see. That's not a good longterm
2492	0.634	As stupid as it sounds, The Flash season 2 ended on a cliffhanger. I wanted to stick around and see how it panned out
16032	0.626	Sounds dumb but I wanted to watch the last season of Rick and Morty
4346	0.618	It sounds dumb, but Dungeons and Dragons (or tabletop RPGs in general). It was always an activity I could look forward to, and a social one to boot.
8745	0.607	Not being able to play the new video games. Sounds silly, but I donÃ¢â,¬â„¢t wanna miss out on my passion.
15145	0.607	I gotta see the ending of Berserk, One Piece... maybe a few more hxh chapters and 2b like sexbots.
4553	0.605	I know it's dumb, but finding out how some TV shows, manga and books plot would unroll. Funny thing most of them had shitty endings
8353	0.605	Man, everyone has these cool, noble reasons, and here I am just not wanting to miss out on new seasons of my favorite animes.. That's what's so cool abo
11601	0.605	Waiting for a good video game to come. Started with Rainbow Six Siege/Fallout 4, later Modern Warfare. Sometimes the distractions was all I really want
14290	0.602	Sometimes itÃ¢â,¬â„¢s the littlest things that keep you around. For me, it was new books, movies, and tv. I would keep a list of new books I wanted to rea
6515	0.593	IÃ¢â,¬â„¢m too much of a nerd. Before i would think, Ã¢â,¬Å"I have to see what happens in the next Star Wars movieÃ¢â,¬. Ironically I now hate those n
11635	0.593	I just wanted to see the avengers fight Thanos in the MCU. It sounds silly but having something to look forward to at all can be invaluable when youÃ¢â,¬

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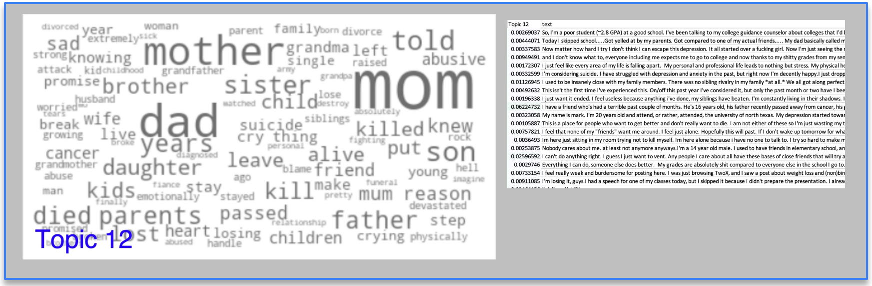
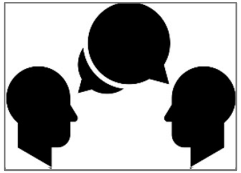
TOPCAT:
Consensus step

Specific family members	People were VERY specific about which family members kept them alive. They said things like, "I did not want my MOM, SISTER, DAD, ETC., to blame themselves." "I did not want to leave my grandmother, kids, or siblings, etc. to be without care."



Protect my parents	Empathy for how this will impact one's parents, desire to spare them pain/devastation. "I couldn't do that to my mom/dad."

"Consensus" SMEs



Not wanting to hurt specific family members

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Time for some fun!

- Let’s get dirty with some real data

https://tinyurl.com/topcat-tutorial