

Not Just Depressed: Bipolar Disorder Prediction on Reddit

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Motivation

How does everyday language reflect basic social and personality processes?

Motivation

How does everyday language reflect our mental health?

Motivation

Can text and emotion analysis help with bipolar disorder detection?

Overview

- 1 Introduction
- 2 Dataset
- 3 Bipolar Disorder Prediction
- 4 Feature Analysis
- 5 Emotion Analysis

Mental health & language

The Mental Health issue

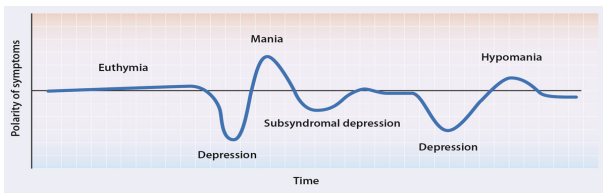
- Up to 27% of Europe population suffer or have suffered from some kind of mental disorder (WHO, 2017; Wykes et al., 2015)
- 35–50% go undiagnosed

Language analysis for deeper understanding and early detection of illnesses:

- Depression (Rude et al., 2004; De Choudhury et al., 2013), anxiety (Shen and Rudzicz, 2017), PTSD (Coppersmith et al., 2015), schizophrenia (Benton et al., 2017), bipolar disorder (Kramer et al., 2004)

Bipolar Disorder

- Uncontrolled changes in mood and energy levels
- Manic and depressive episodes
- Recurrent phases that differ in intensity and duration



Why is research on bipolar disorder important?

- Affects more than 60M people worldwide
- High suicide rate (more than 6%)

Reddit: a gold mine for user-generated text

Reddit

- One of the largest social media sites in the world
- User anonymity
- Wide range of topics



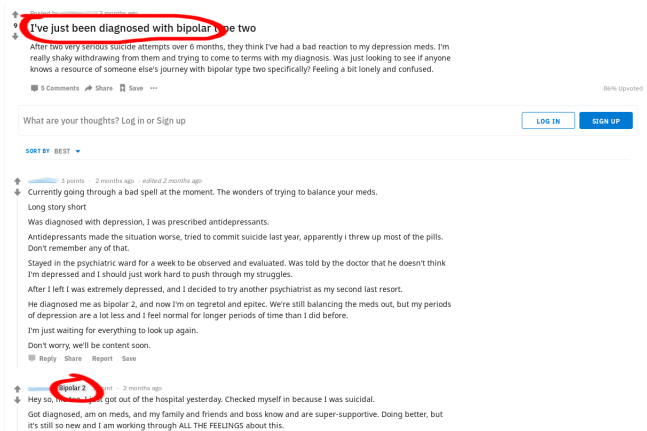
Self-reported mental disorders

- Bipolar-related subreddits: *bipolar*, *bipolar2*, *BipolarReddit*, *BipolarSOs*, *bipolarart*
- Search for “*I am diagnosed with bipolar*” in user’s comments
- Inspect users’ *flairs* (following Gjurković and Šnajder, 2018): “*Bipolar*”, “*BP1*”, etc.

9 I've just been diagnosed with bipolar type two

Got diagnosed, am on meds, and my family and friends and boss know and are super-supportive. Doing better, but it's still so new and I am working through ALL THE FEELINGS about this.

Self-reported Bipolar Disorder



The screenshot shows a Reddit thread. The top post, by user 'Bipolar 2', has its title 'I've just been diagnosed with bipolar type two' circled in red. The post text describes a user's experience with depression, suicide attempts, and a recent diagnosis of bipolar type 2. Below this is a comment by user 'Bipolar 2' (also circled in red) that provides more details about the diagnosis and the user's current state. The interface includes standard Reddit elements like up/down votes, comments, shares, and login/sign up buttons.

I've just been diagnosed with bipolar type two

After two very serious suicide attempts over 6 months, they think I've had a bad reaction to my depression meds. I'm really shaky withdrawing from them and trying to come to terms with my diagnosis. Was just looking to see if anyone knows a resource of someone else's journey with bipolar type two specifically? Feeling a bit lonely and confused.

5 Comments Share Save

86% Upvoted

What are your thoughts? Log in or Sign up

LOG IN SIGN UP

Bipolar 2

Currently going through a bad spell at the moment. The wonders of trying to balance your meds.

Long story short

Was diagnosed with depression, I was prescribed antidepressants.

Antidepressants made the situation worse, tried to commit suicide last year, apparently I threw up most of the pills. Don't remember any of that.

Stayed in the psychiatric ward for a week to be observed and evaluated. Was told by the doctor that he doesn't think I'm depressed and I should just work hard to push through my struggles.

After I left I was extremely depressed, and I decided to try another psychiatrist as my second last resort.

He diagnosed me as bipolar 2, and now I'm on tegretol and epitec. We're still balancing the meds out, but my periods of depression are a lot less and I feel normal for longer periods of time than I did before.

I'm just waiting for everything to look up again.

Don't worry, we'll be content soon.

Reply Share Report Save

- Compiled a **control group** to represent general Reddit population

Dataset pruning

Cleaning the dataset:

- Removed all comments on bipolar-related subreddits, as well as on the general *mentalhealth* subreddit
- Removed all comments that had “*bipolar*” or “*BP*” in them
- Keep only users with > 1000 words left resulting in **~3.5k bipolar users**

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Parallel work by Cohan et al. (2018): gathered 36k users labeled with 9 mental disorders

Topical Categories

- Additional topic **bias reduction**
- Manually grouped top ~400 subreddits in the categories below:

Category	# bipolar	# control
Animals	397	898
AskReddit	1797	2767
Gaming	489	1501
Jobs and finance	293	586
Movies/music/books	502	1606
Politics	332	2445
Religion	264	700
Sex and relationships	948	1000
Sports	156	785
All	3488	3931

Feature Extraction

(1) Psycholinguistic features:

- **LIWC** (Pennebaker et al., 2015) – classify the words into dictionary-defined categories (syntactic, topical, psychological features)
- **Empath** (Fast et al., 2016) – based on neural embeddings (200 manually curated categories)

(2) Lexical features – tf-idf weighted bag-of-words

(3) Reddit user features – post/comment ratio, *#gilded* posts, *ups-downs*, time intervals between comments

Results

- Binary classification task
- Models: SVM, Logistic Regression, Random Forest
- 10x5 nested cross-validation

	Acc	F1
MCC	0.529	–
Random	0.546	0.453
SVM	0.865	0.853
LogReg	0.866	0.849
RF	0.869	0.863

Per-category results

* two-sided t-test, $p < 0.001$

	MCC	Our models
Animals	0.693	0.807*
AskReddit	0.606	0.856*
Gaming	0.754	0.777*
Jobs and finance	0.665	0.752*
Movies/music/books	0.761	0.817*
Politics	0.880	0.882*
Religion	0.724	0.784*
Sex and relationships	0.513	0.801*
Sports	0.832	0.837

Feature Analysis

Feature	Bipolar μ	Control μ
pronoun	16.87	14.86
ppron	10.69	8.66
i	5.84	3.38
article	5.88	6.55
health	0.96	0.50
feel	0.69	0.48
power	2.11	2.58
bio	2.65	1.90
Authentic	52.65	32.92
Clout	48.51	58.03

In line with previous research on depression: Personal pronoun /
(Stirman and Pennebaker, 2001; Rude et al., 2004)

Per-category analysis

Feature	Authentic	i	health	feel	power	bio	article
Animals	+	+	+	+	+	+	+
AskReddit	+	+	+	+	+	+	+
Gaming	+	+					+
Jobs	+	+	+	+	+	+	+
Movies	+	+	+	+	+	+	+
Politics	+	+	+	+		+	+
Religion	+	+	+	+	+		+
Sex	+	+	+	+	+	+	+
Sports	+	+		+			

+ signals significant difference in feature value between bipolar and control group

Emotion-expressive words analysis

LIWC emotion-related categories

Feature	Bipolar μ	Control μ
affect	6.415	6.074
posemo	3.899	3.442
negemo	2.432	2.569
anxiety	0.367	0.266
anger	0.818	1.128
sad	0.455	0.363

User-level emotion variance

- Split comments of 100 users (of both groups) with more than 100K words into **monthly chunks**
- Calculate LIWC features for each month and compute their **standard deviations**

User-level emotion variance

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	Bipolar	Control	p-value
posemo	0.00272*	0.00166	0.00272
negemo	0.00583*	0.00379	0.00583
anxiety	0.00765*	0.00627	0.00765
anger	0.01745	0.01422	0.01745
sadness	0.00695*	0.00572	0.00695

* $p < 0.01$; averages of SDs in the use of emotion-expressive words

Wrapping up

Conclusion

- preliminary study of bipolar disorder
- benchmark classification results (86% accuracy)
- psycholinguistic and emotion-related feature analysis

Future work

- Detect manic and depressive episodes – compare to clinical depression
- Deep learning for prediction

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Thank you!

LIWC vs Empath vs tf-idf

	LIWC	Empath	Tf-idf	All
SVM	0.837	0.782	0.865	0.838
LogReg	0.841	0.819	0.866	0.862
RF	0.829	0.825	0.869	0.869

Topical categories 1

Animals: cats, Dogtraining , dogs, Aquariums, AnimalsBeingJerks;

AskReddit: AskReddit, IAmA, todayilearned, CasualConversation, Showerthoughts;

Gaming: gaming, DotA2, PS4, pcmasterrace, Games;

Jobs and finance: wallstreetbets, Economics, personalfinance, Frugal, TalesFromRetail;

Mental disorders: depression, Drugs, ADHD, mentalhealth, SuicideWatch;

Movies/music/books: movies, books, Music, harrypotter, BigBrother;

Politics: politics, Libertarian, PoliticalDiscussion, SandersForPresident, Conservative;

Topical categories 2

Religion: Christianity, atheism, islam, exmuslim,
DebateReligion;

Sex and relationships: relationships, AskWomen,
TwoXChromosomes, actuallesbians, childfree;

Sports: nfl, nba, clevelandcavs, MMA, olympics.

Insignificant features

Colon	Colons
Period	Periods
achieve	win, success, better
WPS	Words/sentence
quant	Quantifiers
see	view, saw, seen
differ	Differentiation
ipron	Impersonal pronouns
motion	arrive, car, go
hear	listen, hearing
compare	greater, best, after
netspeak	btw, lol, thx
