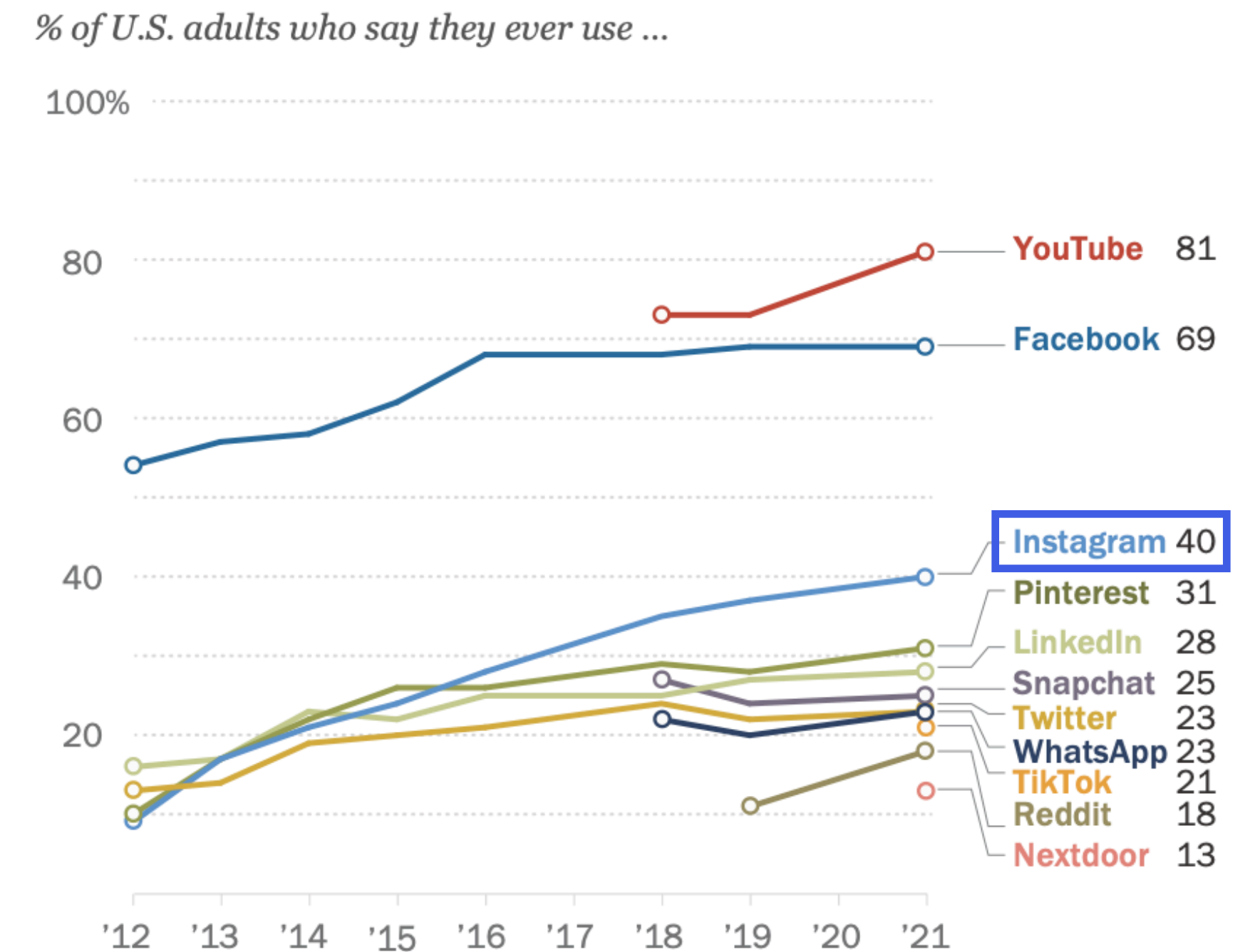# Instagram photos reveal predictive markers of depression

Andrew G. Reece and Christopher M. Danforth (2017)

Instagram photos reveal predictive markers of depressi⦿n

- Motivated by previous successful works in predicting depression through social media

- Precursor work on detecting psychiatric disorders based on psychological data encoded in *visual social media*

- The importance of Instagram

  - 71% of 18-29 (Auxier and Andersen, 2021)

  - Highest prevalence of adults with a major depressive episode among individuals aged 18-25 (NIMH, 2019)

% of U.S. adults who say they ever use ...

YouTube 81
Facebook 69
Instagram 40
Pinterest 31
LinkedIn 28
Snapchat 25
Twitter 23
WhatsApp 23
TikTok 21
Reddit 18
Nextdoor 13

Survey of U.S. adults conducted Jan.25-Feb.8, 2021.
(Auxier and Andersen, 2021)

Hypotheses

1. Instagram posts made by individuals diagnosed with depression can be reliably **distinguished** from posts made by healthy controls, using only **measures extracted computationally** from posted photos and associated metadata.

2. Instagram posts made by depressed individuals **prior to the date of first clinical diagnosis** can be reliably distinguished from posts made by healthy controls.

3. a) **Human ratings** of Instagram posts on common semantic categories can **distinguish** between posts made by depressed and healthy individuals. b) Human ratings are **positively correlated** with computationally-extracted features.

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Instagram
extracted features
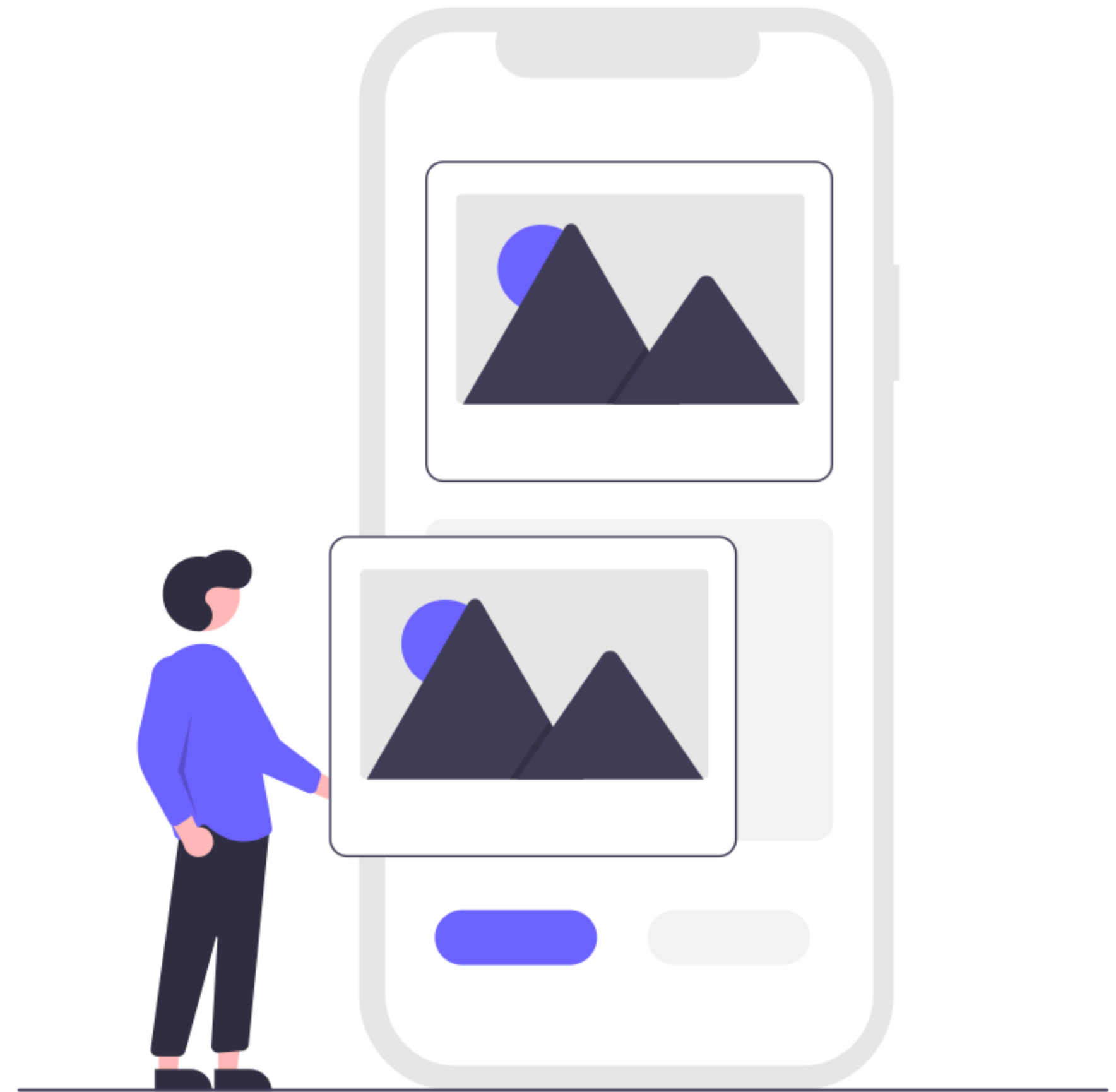
Dataset

○ **Collection**

- Crowdsourced using MTurk

- Separate surveys for both groups to ensure inclusion criteria

  - Active Instagram use, no history of depression

  - Date of diagnosis, CES-D

- Instagram username and history

- App embedded in the survey

○ **Quality and size**

- Selected crowdworkers

- 166 Instagram users (71)

- 43,950 photographs (24,811)

- User-days units: 24,713 (13,230)

○ **Safety and privacy concerns**

- Strict anonymity impossible

- No data with personal identifiers published

Features extracted

○ **Instagram activity**

- total posts per user, per day

○ **Community reaction**

- number of comments and likes

○ **Social activity level**

- number of human faces

○ **Image analysis**

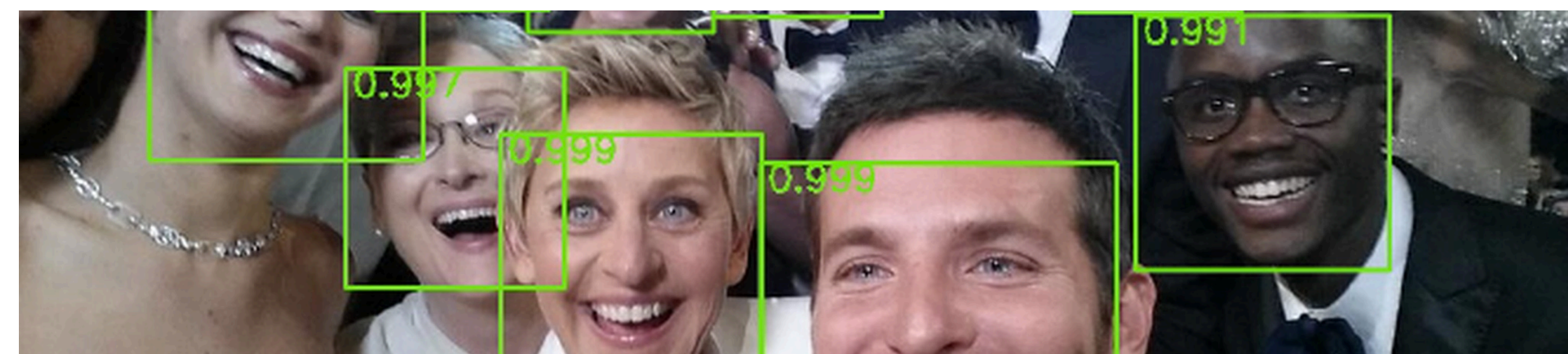- pixel level average for Hue, Saturation, and Value (HSV)

- filter

Insta Add. @raphaelsilva

940 122 J'aime

zidane Hace 19 años : El principio de una nueva aventura muy especial ! Hala Madrid !

Afficher les 8 123 commentaires

Screenshot from Instagram. @zidane

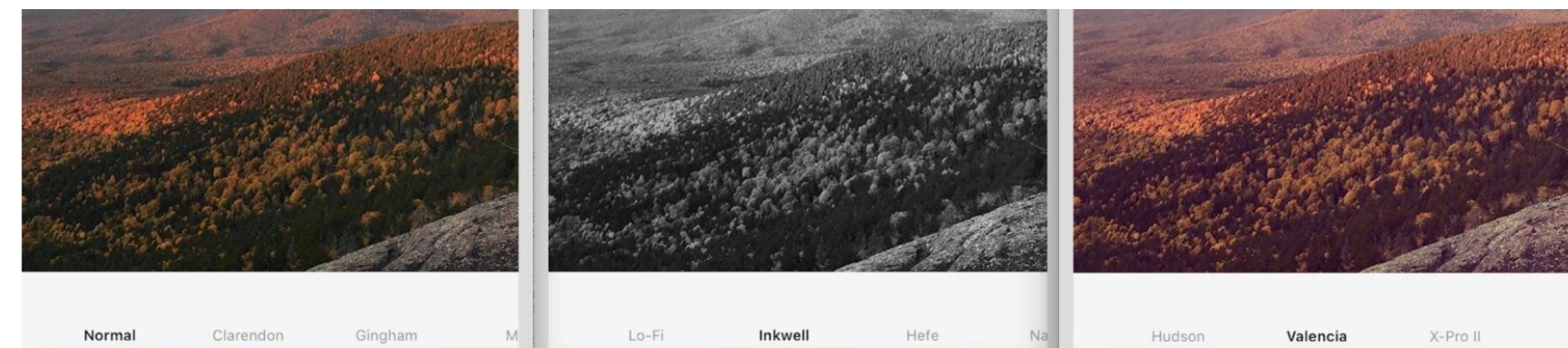*Face detection algorithm. ©Farfade, S.S., Saberian, M. & Li, J.-L.*

Figure S8 extracted from Supplementary Information. Normal, Inkwell, Valencia.

Models and statistical framework

○ **Models**

- Two separate models (pre-diagnosis, all-data)

- Strength of individual predictors

  - Logistic regression
    (`MCMCLogit` from `MCMCpack`, in R)

- Predictive capacities

  - Suite of supervised ML algorithms

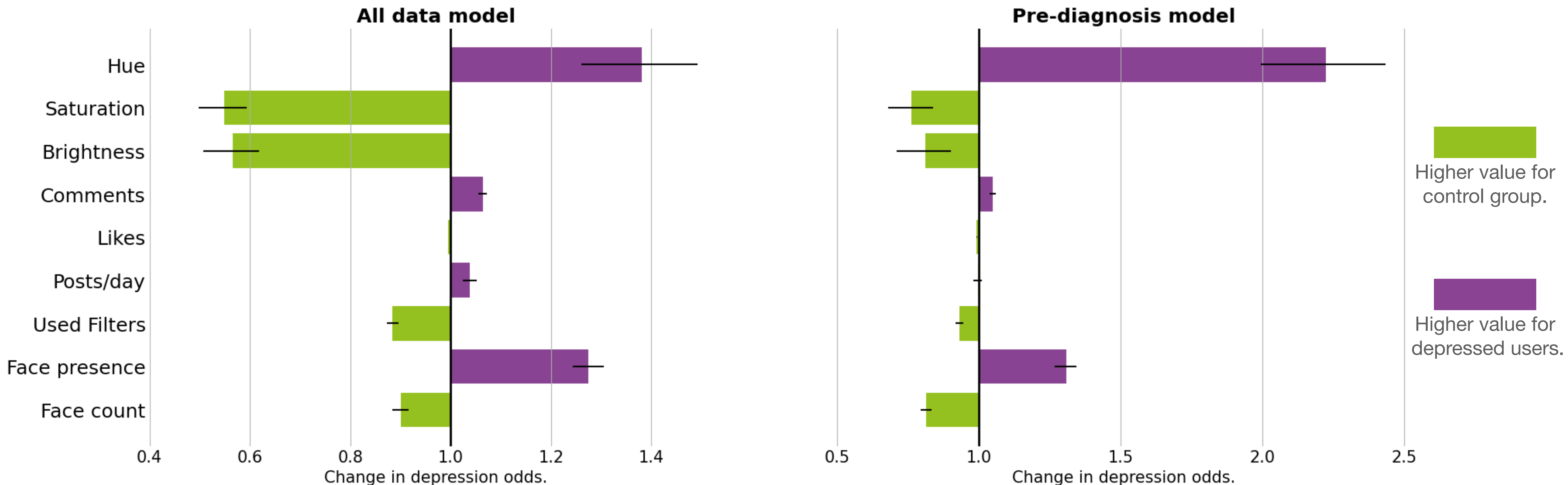 - 100-tree Random Forest classifier

○ **Statistical**

- Bayesian logistic regression with uninformative prior

- Evaluation of the models:

  - Precision

  - Recall

  - Specificity

  - Negative predictive value

  - F1 scores

Predictive power of individual features

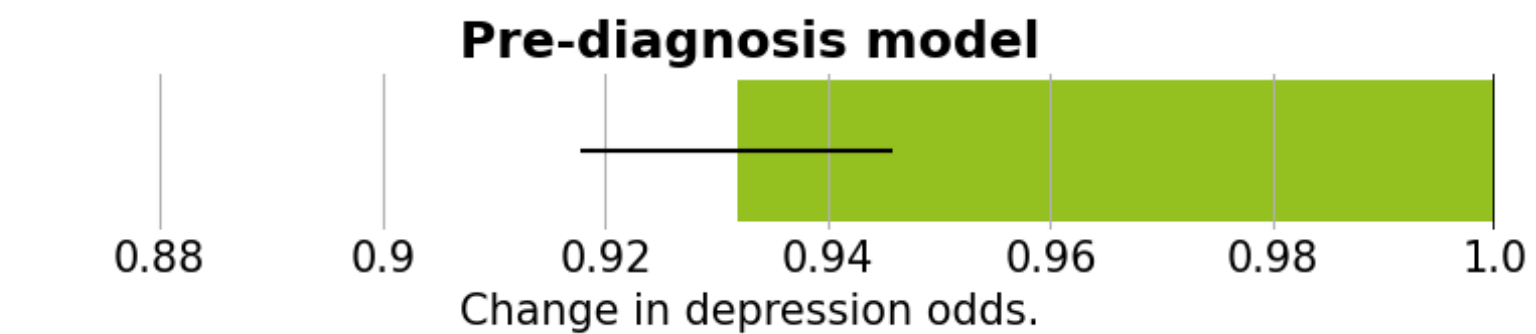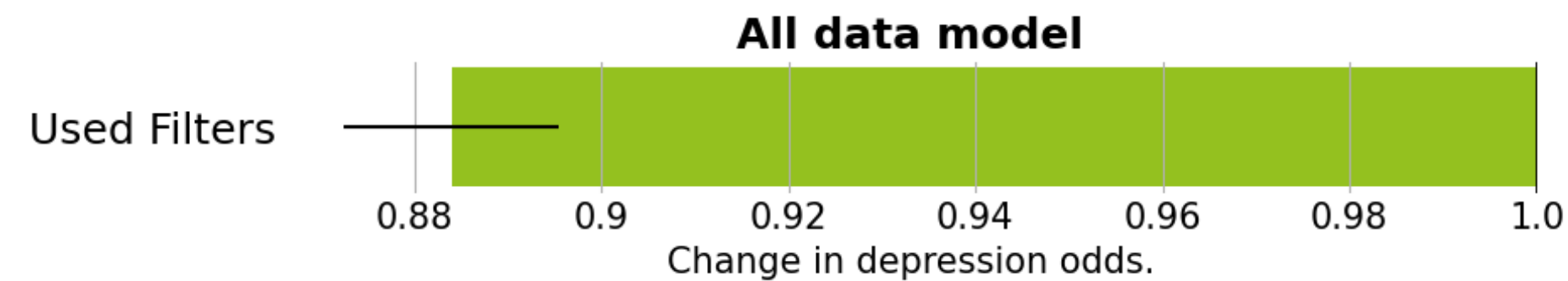Changes in odds obtained from logistic regression coefficients.

N = 24 713

N = 18 513

Rebuilt from Figure 2.

Filters

All data model

Used Filters

0.88 0.9 0.92 0.94 0.96 0.98 1.0
Change in depression odds.

Pre-diagnosis model

0.88 0.9 0.92 0.94 0.96 0.98 1.0
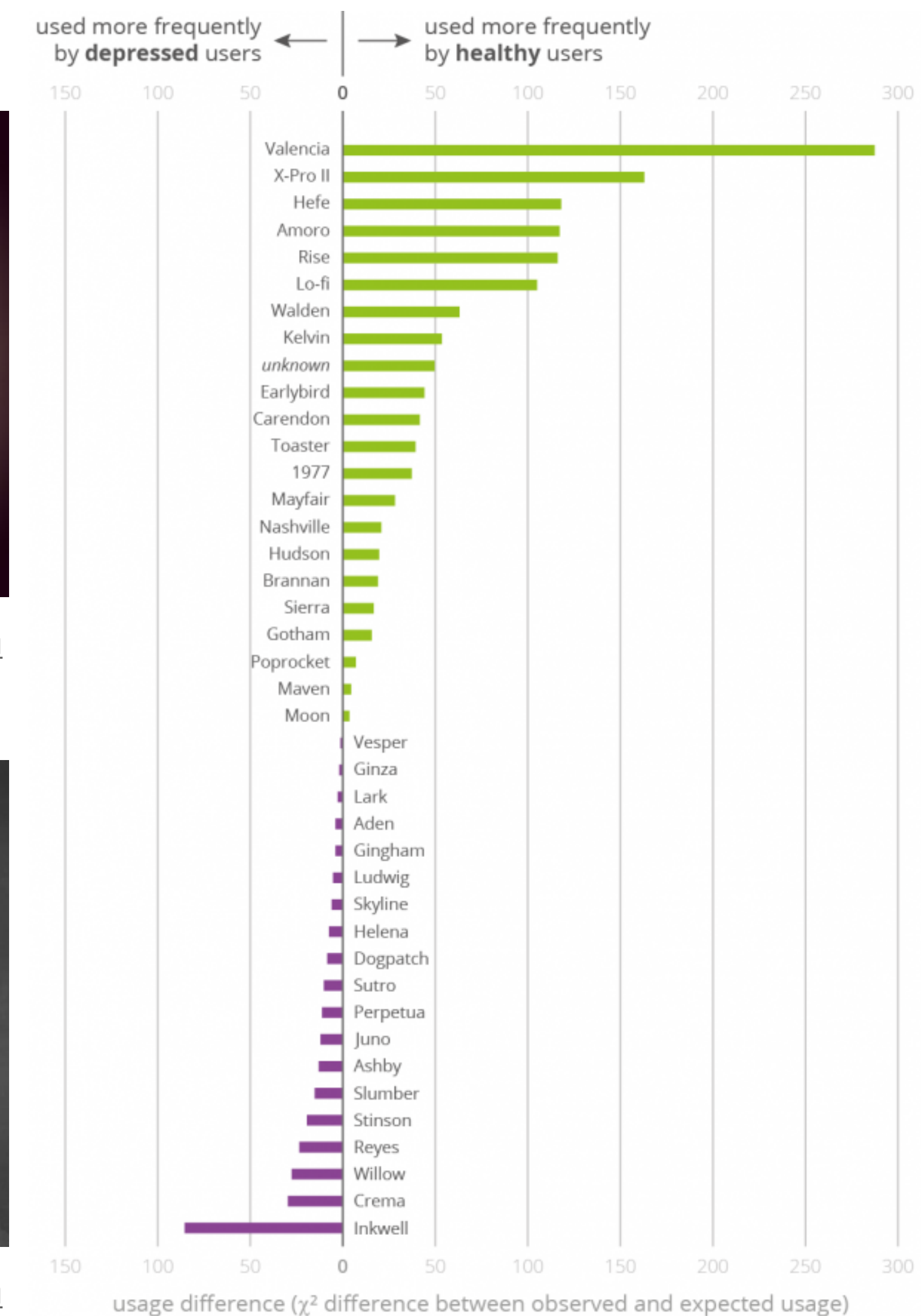Change in depression odds.

- Healthy participants were more likely to apply a filter

- Filters were used differently by healthy and depressed participants (assessed by a χ^2 analysis)

  - Valencia (lightens tint)

  - Inkwell (black-and-white)

Valencia ©filterfakers.com

Inkwell ©filterfakers.com

used more frequently by **depressed** users ← | → used more frequently by **healthy** users

150 100 50 0 50 100 150 200 250 300

Valencia
X-Pro II
Hefe
Amaro
Rise
Lo-fi
Walden
Kelvin
unknown
Earlybird
Carendon
Toaster
1977
Mayfair
Nashville
Hudson
Brannan
Sierra
Gotham
Poprocket
Maven
Moon
Vesper
Ginza
Lark
Aden
Gingham
Ludwig
Skyline
Helena
Dogpatch
Sutro
Perpetua
Juno
Ashby
Slumber
Stinson
Reyes
Willow
Crema
Inkwell

150 100 50 0 50 100 150 200 250 300
usage difference (χ² difference between observed and expected usage)

©Koen Van den Eeckhout
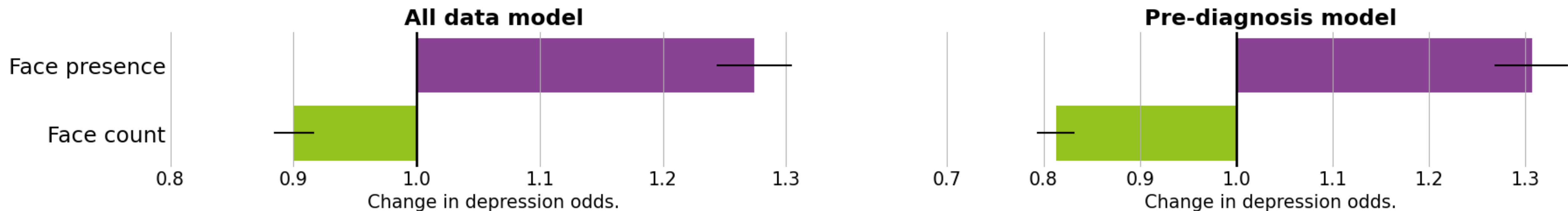
Social activity level

- Traditional studies had outlined reduced social interactivity as an indicator of depression

- Depressed users share experiences in smaller social settings

  - More photos containing at least one face

  - Higher average face count per photo

Community reaction and activity

- Posting frequency had no predictive power in the Pre-diagnosis model but higher posting frequency is a marker of depression in the All-data model

- Likes and comments show opposite directions

  - More liked

  - More commented
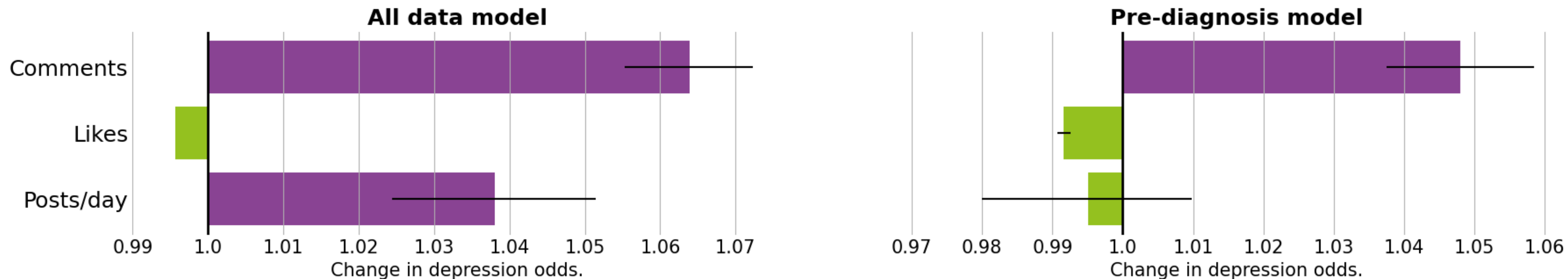
Comparison with general practitioners

Table 1 Comparison of accuracy metrics for All-data and Pre-diagnosis model predictions

	Mitchell et al. μ	All-data $\mu(\sigma)$	Pre-diagnosis $\mu(\sigma)$
Recall	0.510	0.697 (0.008)	0.318 (0.012)
Specificity	0.813	0.478 (0.012)	0.833 (0.010)
Precision	0.42	0.604 (0.009)	0.541 (0.009)
Negative Predictive Value	0.858	0.579 (0.008)	0.665 (0.006)
F1	0.461	0.647 (0.003)	0.401 (0.008)

Table 1.

Human
rated features

Dataset

○ **Collection**

- Crowdsourced using MTurk

  - Random selection of 20 photographs

  - Rated by at least 3 different raters

  - No information on source provided

- Approximately 30% rated (N=13 184)

  - Depressed sample: selection within one year of the date of first diagnosis, 100 posts prior to the diagnosis

  - Healthy sample: 100 most recent posts
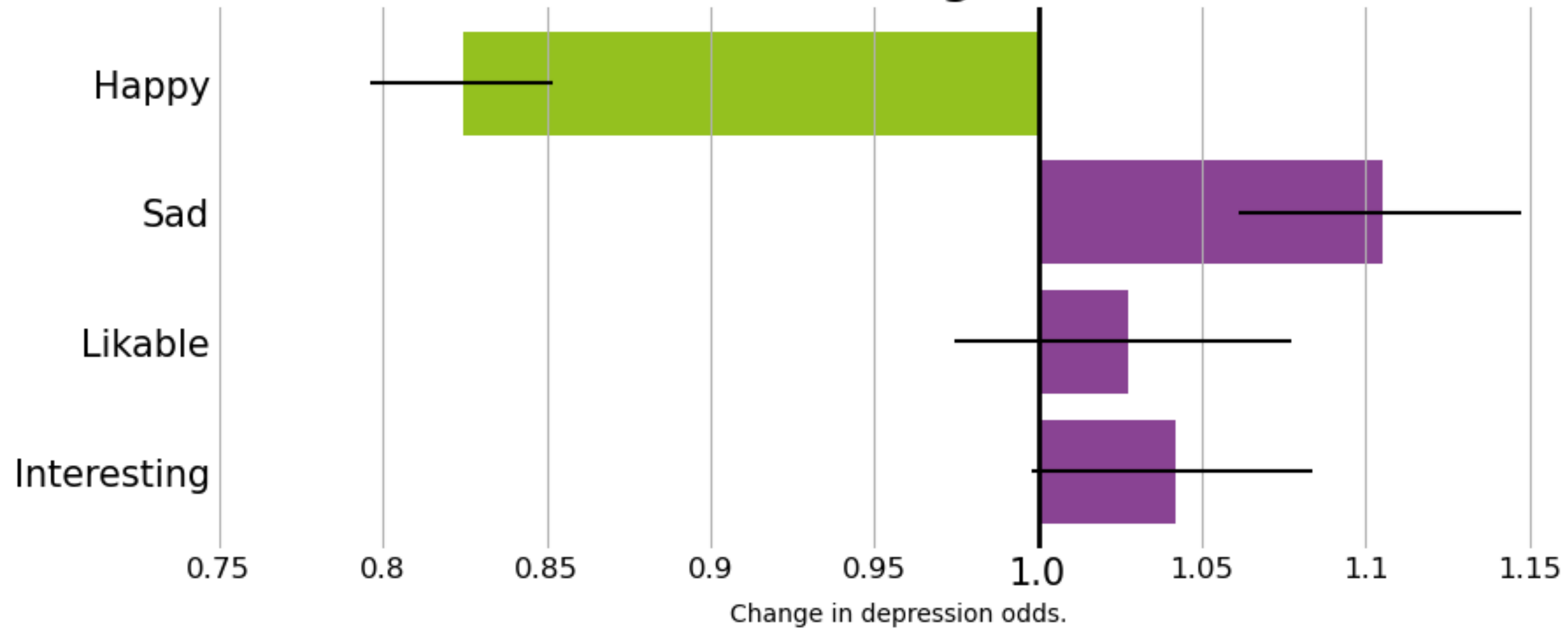
○ **Ratings**

- On a continuous scale from 0 to 5

  - Happy

  - Sad

  - Likable

  - Interest

- Good inter-rater agreement

Results

Human ratings model

Change in depression odds.

Built from Table S4 of Supplementary Information.

Correlation

- Strong correlation with one another

- Few to no correlation with computational features

	Happy	Sad	Likable	Interest.
Sad	-.41			
Likable	.79	-.29		
Interesting	.53	-.09	0.77	
Hue	.02	-.02	-.01	-.03
Saturation	.02	-.07	-.02	-.04
Brightness	.05	-.04	.04	.03
Posts	-.02	.04	-.01	.02
Comments	.00	.02	-.02	-.03
Likes	.04	-.02	.05	.06
Has filter	.03	.00	.02	.01
Has face	.16	.05	.06	.00
Face count	.25	-.10	.11	.02

Table S7 extracted from Supplementary Information

Conclusion

Hypotheses

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In one sentence

« major changes in individual psychology are transmitted in social media use, and can be identified via computational methods. »

Presented paper

Reece, A. G., & Danforth, C. M. (2017). Instagram photos reveal predictive markers of depression. *EPJ Data Science*, *6*(1), 15. DOI: 10.1140/epjds/s13688-017-0110-z

Benchmark

Mitchell, A. J., Vaze, A., & Rao, S. (2009) Clinical diagnosis of depression in primary care: a meta-analysis. *The Lancet, 374*(9690), 609-619. DOI: 10.1016/s0140-6736(09)60979-5

Related / extended works

Huang, Y., Chiang, C. F., & Chen, A. (2019). Predicting Depression Tendency based on Image, Text and Behavior Data from Instagram. *Proceedings of the 8th International Conference on Data Science, Technology and Applications*, 32–40. DOI: 10.5220/0007833600320040

Statistics

Auxier, B., & Anderson, M. (2021, April 7). *Social Media Use in 2021*. Pew Research Center: Internet, Science & Tech. https://www.pewresearch.org/internet/2021/04/07/social-media-use-in-2021/

National Institute of Mental Health. (2019, February 1). *Major Depression*. NIMH. https://www.nimh.nih.gov/health/statistics/major-depression.shtml

Visualization

Eeckhout, K. V. D. (2018, March 31). *Improving your graph: a case study - Koen Van den Eeckhout*. Medium. https://koenvandeneeckhout.medium.com/improving-your-graph-a-case-study-190b2d4a22c1

Thank you