

Well-Being Depends on Social Comparison: Hierarchical Models of Twitter Language Suggest That Richer Neighbors Make You Less Happy (Supplemental Material)

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Cross Correlations

We computed correlations between all of happiness and socio-demographic items, as seen in Table 1. We see similar patterns: both income and education are associated with increased well-being.

| | Education | Age | Gender | Happiness |
|-----------|-----------|-----|--------|-----------|
| Income | .39 | .61 | -.25 | .49 |
| Education | - | .29 | -.11 | .24 |
| Age | | - | -.12 | .49 |
| Gender | | | - | -.15 |

Table 1: Cross correlations of Twitter estimates

Additional Experiments

In Table 2 we show the full results of Task 3.

Replication with Survey Data

In addition to the Twitter analysis discussed in the main paper we also applied similar analyses to a survey data set (i.e., survey based well-being and income). For the individual level data, we used the Gallup Sharecare Well-Being Index. This is a large, national health and well-being survey which has been used to study regional trends in happiness and well-being (Lawless and Lucas 2011; Rentfrow, Mellander, and Florida 2009; Jaidka et al. 2020). Approximately 500 surveys were completed every day in 2013-2016 and 1,000 surveys were completed daily between 2009-2012. The survey consists of a telephone interview using a dual-frame random-digit dial methodology that included cell phone numbers from all 50 US states. The community level data for this analysis is identical to the county level US Census data used in the Twitter analysis.

Individuals: Gallup Data We limited our sample to those participants who reported age, gender, income, education and well-being items. Each participant answered the following well-being (happiness) question: “Did you experience

happiness yesterday?”. We limit our analysis to counties with at least 100 Gallup responses, resulting in 2,015,088 users across 1,984 counties. Note that these counties are identical to those used in the Twitter analysis.

Table 3 shows the results of Task 1 applied to the Gallup survey data. Results show a similar pattern to the Twitter analysis: relative differences in income (i.e., lower individual income relative to their community’s) predicts lower happiness.

References

- Jaidka, K.; Giorgi, S.; Schwartz, H. A.; Kern, M. L.; Ungar, L. H.; and Eichstaedt, J. C. 2020. Estimating geographic subjective well-being from Twitter: A comparison of dictionary and data-driven language methods. *Proceedings of the National Academy of Sciences*.
- Lawless, N. M.; and Lucas, R. E. 2011. Predictors of regional well-being: A county level analysis. *Social Indicators Research* 101(3): 341–357.
- Rentfrow, P. J.; Mellander, C.; and Florida, R. 2009. Happy states of America: A state-level analysis of psychological, economic, and social well-being. *Journal of Research in Personality* 43(6): 1073–1082.

| Topic | R_c^2 | R_m^2 | Individual Income | | Community Income | |
|--|---------|---------|-------------------|-------|------------------|-------|
| | | | β | t | β | t |
| fucking, fuck, shit, hate, stupid, retarded, bitch, pissed, omfg, kidding | .149 | .127 | -.356 | -806 | .059 | 16.6 |
| shit, holy, fuck, fucking, piece, bull, load, fuckin, ton, outta | .191 | .167 | -.408 | -955 | .032 | 8.91 |
| lmao, omg, lmfao, funny, hahaha, rofl, hahahaha, hilarious, hahahah, hahahahaha | .140 | .116 | -.339 | -771 | .024 | 6.69 |
| haha, ;d, ahaha, ;d, aha, (:, lolz, ;p, ;), lmao | .098 | .084 | -.289 | -644 | .028 | 9.68 |
| im, gunna, soo, prolly, todays, atleast, whos, comming, tomorrow, pumped | .073 | .064 | -.253 | -554 | .030 | 12.6 |
| omg, omfg, freaking, soooo, wtf, ahhhhh, ahhhh, ahhhhhh, freakin, ahhhhhh | .060 | .050 | -.223 | -487 | .033 | 13.7 |
| hate, stupid, --, >, <, gah, ugh, friggin, effin, sigh, grr | .096 | .083 | -.288 | -631 | .024 | 8.75 |
| im, dont, anymore, idk, confused, whats, wont, isnt, alot, honestly | .213 | .199 | -.446 | -1060 | .015 | 5.41 |
| dont, somthing, belive, ill, wont, realy, ther, didnt, ive, untill | .125 | .111 | -.333 | -747 | .019 | 6.69 |
| school, ugh, homework, sucks, boring, : (, bleh, ughh, --, sigh | .096 | .089 | -.298 | -662 | .021 | 9.71 |
| dad, mom, parents, brother, told, sister, dad's, son, dads, step | .041 | .031 | -.176 | -378 | .035 | 14.1 |
| cute, baby, adorable, puppy, sooo, aww, soo, he's, soooo, awww | .093 | .088 | -.298 | -661 | .020 | 11.6 |
| smoke, weed, thinks, high, drunk, likes, drink, smoked, blunt, lying | .071 | .065 | -.255 | -560 | .020 | 9.90 |
| mom, yrs, wanna, house, years, leave, annoying, lose, mommy, mom's | .064 | .059 | -.244 | -536 | .021 | 11.9 |
| < 3, ;), ily, babe, boyfriend, par, besties, bestie, =), xoxo | .079 | .058 | -.241 | -531 | .021 | 6.11 |
| dc, ac, washington, va, philly, heading, nyc, trip, boston, ny | 0.075 | 0.050 | 0.211 | 469 | 0.048 | 13.2 |
| pm, free, saturday, tickets, center, event, interested, march, st, join | 0.183 | 0.179 | 0.420 | 988 | 0.023 | 12.8 |
| government, economy, tax, budget, pay, taxes, country, income, benefits, obama | 0.152 | 0.146 | 0.378 | 875 | 0.021 | 10.7 |
| money, support, donate, donations, raise, haiti, charity, fund, donation, cancer | 0.109 | 0.106 | 0.322 | 727 | 0.022 | 13.7 |
| meeting, conference, staff, student, council, meetings, board, attend, group, center | 0.189 | 0.184 | 0.426 | 1004 | 0.015 | 8.74 |
| great, job, guys, amazing, crew, awesome, show, cast, proud, congrats | 0.085 | 0.081 | 0.281 | 621 | 0.023 | 13.7 |
| paper, research, finished, final, presentation, project, thesis, finish, assignment, due | 0.092 | 0.086 | 0.289 | 6356 | 0.021 | 10.6 |
| government, freedom, rights, country, thomas, political, democracy, liberty, america, society | 0.141 | 0.135 | 0.365 | 837 | 0.016 | 8.17 |
| canada, game, hockey, gold, usa, win, team, canadian, olympics, won | 0.073 | 0.058 | 0.236 | 517 | 0.024 | 8.23 |
| english, history, ap, spanish, schedule, classes, honors, algebra, science, lunch | 0.049 | 0.044 | 0.205 | 444 | 0.027 | 14.2 |
| skills, management, business, learning, information, research, communication, engineering, development, technology | 0.121 | 0.115 | 0.337 | 758 | 0.016 | 8.44 |
| group, greatest, join, picture, mother, photos, news, title, gift, cartoon | 0.080 | 0.076 | 0.273 | 605 | 0.019 | 11.5 |
| human, beings, nature, spiritual, experience, compassion, sense, existence, reality, universe | 0.093 | 0.087 | 0.292 | 651 | 0.017 | 8.55 |
| event, events, current, planning, main, activities, unfortunate, series, attend, details | 0.098 | 0.096 | 0.308 | 688 | 0.016 | 12.7 |
| amount, large, amounts, ridiculous, massive, increase, small, directly, maximum, population | 0.063 | 0.060 | 0.242 | 530 | 0.020 | 13.6 |
| game, football, beat, tigers, auburn, win, alabama, state, sec, texas | 0.133 | 0.079 | 0.280 | 637 | -0.053 | -9.91 |
| game, duke, butler, beat, basketball, lets, state, kentucky, wins, michigan | 0.070 | 0.042 | 0.206 | 452 | -0.030 | -7.78 |
| ready, weekend, start, week, packed, begin, tackle, rested, refreshed | 0.032 | 0.010 | 0.081 | 174 | -0.067 | -18.8 |
| chicago, headed, heading, trip, tn, tennessee, leaving, visit, ohio, orleans | 0.059 | 0.035 | 0.183 | 407 | -0.025 | -6.89 |
| church, sunday, service, pastor, worship, christian, youth, praise, bible, prayer | 0.035 | 0.021 | 0.146 | 3134 | -0.024 | -8.37 |
| weekend, ready, week, friday, gif, hurry, glad, enjoy, relax, goodness | 0.021 | 0.013 | 0.115 | 244 | -0.028 | -12.9 |
| tech, ga, georgia, atlanta, ne, columbus, atl, virginia, florida, texas | 0.062 | 0.031 | 0.174 | 3867 | -0.018 | -4.32 |
| football, team, season, game, play, players, league, sports, fantasy, player | 0.082 | 0.070 | 0.266 | 587 | -0.011 | -4.39 |
| game, football, tonight, watch, play, basketball, hockey, boys, season, homecoming | 0.053 | 0.035 | 0.188 | 408 | -0.015 | -4.79 |
| north, south, carolina, korea, dakota, heading, florida, korean, beach, avenue | 0.078 | 0.046 | 0.216 | 474 | -0.013 | -3.19 |
| god, jesus, christ, lord, spirit, sin, holy, bible, romans, father | 0.024 | 0.007 | 0.079 | 169 | -0.035 | -11.2 |
| strength, overcome, faith, challenges, strong, trials, courage, obstacles, stronger, power | 0.022 | 0.017 | 0.130 | 278 | -0.017 | -9.31 |
| ready, today, bring, summer, tomorrow, whos, soooooo, heck, ahhhhhh, looong | 0.019 | 0.004 | 0.044 | 93.3 | -0.050 | -16.8 |
| fair, county, state, science, rides, craft, valley, orange, booth, career | 0.059 | 0.035 | 0.189 | 407 | -0.011 | -3.11 |
| win, lose, game, losing, winning, bet, loose, loses, streak, wi | 0.033 | 0.025 | 0.159 | 339 | -0.013 | -5.96 |
| ain't, gonna, andy, nothin, gon, heather, y'all, i'ma, somebody's, comin | 0.154 | 0.106 | -0.314 | -717 | -0.074 | -14.6 |
| don't, give, care, anymore, frankly, advice, act, personally, shy, offended | 0.176 | 0.160 | -0.396 | -920 | -0.040 | -13.4 |
| guess, lol, dang, gotta, sigh, kinda, hmm, idk, forgot, stuff | 0.191 | 0.147 | -0.378 | -887 | -0.042 | -8.66 |
| bed, lay, sleep, head, tired, rest, bout, laying, lying, wake | 0.122 | 0.110 | -0.325 | -729 | -0.048 | -17.9 |
| i'm, don't, mess, i've, that's, i'll, cuz, i'ma, whoa, messing | 0.155 | 0.145 | -0.376 | -866 | -0.038 | -15.7 |
| wanna, don't, stay, touch, hear, lonely, babe, undo, blew, stole | 0.263 | 0.254 | -0.500 | -1235 | -0.028 | -12.2 |
| da, mi, wit, dnt, meh, bout, sum, tha, bt, dis | 0.190 | 0.112 | -0.332 | -769 | -0.040 | -6.22 |
| don't, anymore, bother, won't, worry, care, doesn't, reason, didn't, point | 0.167 | 0.149 | -0.382 | -881 | -0.033 | -10.3 |
| don't, care, anymore, honestly, pretend, act, bother, stare, else's, cared | 0.152 | 0.131 | -0.359 | -817 | -0.035 | -10.2 |
| bout, thinkin, talkin, goin, talking, wat, sittin, gettin, somethin, worried | 0.164 | 0.107 | -0.323 | -738 | -0.038 | -7.01 |
| hurt, feelings, ignore, person, hurting, adore, apologize, locker, realize, they've | 0.119 | 0.091 | -0.299 | -669 | -0.040 | -10.1 |
| aint, nothin, shit, cuz, doin, gotta, somethin, ain't, gon, bout | 0.206 | 0.147 | -0.380 | -894 | -0.030 | -5.43 |
| y'all, doin, yeah, hey, todd, how's, swear, livin, hows, drake | 0.098 | 0.047 | -0.207 | -457 | -0.054 | -10.3 |
| won't, i'll, don't, leave, give, promise, forget, hold, it'll, regret | 0.099 | 0.087 | -0.290 | -646 | -0.038 | -14.5 |
| don't, understand, people, doesn't, they'd, broken, expect, everything's, honestly, types | 0.151 | 0.136 | -0.366 | -839 | -0.030 | -10.2 |

Table 2: Open vocabulary results. Top fifteen topics for each quadrant of positive/negative sign for individual/community income coefficients. We show the 10 highest weighted words in each topic, Duplicate topics removed; ordered within quadrant by product of the magnitude of each income coefficient; all models significant at $p < .05$ after Benjamini Hochberg FDR correction.

| Model | R_c^2 | R_m^2 | Individual Income | | Community Income | |
|-------------------------------------|---------|---------|-------------------|------|------------------|--------|
| | | | β | t | β | t |
| i_I | .019 | .017 | .131 | 158 | - | - |
| i_C | .003 | .000 | - | - | .022 | 14.39 |
| $i_I + i_C$ | .021 | .018 | .135 | 99.0 | -.015 | -10.90 |
| $i_I + a_I + g_I$ | .020 | .018 | .134 | 159 | - | - |
| $i_I + a_I + g_I + e_I$ | .020 | .018 | .130 | 144 | - | - |
| $i_I + a_I + g_I + i_C$ | .021 | .018 | .138 | 100 | -.016 | -10.91 |
| $i_I + a_I + g_I + e_I + i_C$ | .022 | .018 | .134 | 94.8 | -.016 | -11.26 |
| $i_I + a_I + g_I + e_I + i_C + e_C$ | .022 | .018 | .133 | 97.6 | -.012 | -6.16 |

Table 3: Gallup estimates of Well-being across *U.S. counties*. Models include individual income i_I , age a_I , gender g_I and education e_I and community income i_C and education e_C .