

Social Psychological and Personality Science

The Language of Religious Affiliation: Social, Emotional, and Cognitive Differences

Journal:	<i>Social Psychological and Personality Science</i>
Manuscript ID	Draft
Manuscript Type:	Original Manuscript
Keywords:	Religion, Language, Well-being, Social Media, Linguistic Analysis
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Abstract

Religious affiliation is an important identifying characteristic for many individuals and relates to numerous life outcomes, including health, wellbeing, policy positions, and cognitive style. Using methods from computational linguistics, we examined language from 12,815 Facebook users in the US and UK who indicated their religious affiliation. Religious individuals used more positive emotion words ($r = .278; p < .0001$) and social themes such as family ($r = .242; p < .0001$), while non-religious people expressed more negative emotions like anger ($r = -.427; p < .0001$) and categories related to cognitive processes, like tentativeness ($r = -.153; p < .0001$). Non-religious individuals also used more themes related to the body ($r = -.265; p < .0001$) and death ($r = -.247; p < .0001$). The findings offer directions for future research on religious affiliation, specifically in terms of social, emotional, and cognitive differences.

Keywords: religious affiliation, language analysis, social media, well-being

The Language of Religious Affiliation: Social, Emotional, and Cognitive Differences

Religion is a ubiquitous part of human life. While W.E.I.R.D. (western, educated, industrialized, rich, and democratic) countries are generally becoming more secular, around 77% of the U.S. population remains religious (Pew, 2015). Moreover, over eighty percent of the world's population identifies with some type of religion – a trend that appears to be on the rise (Pew, 2012). Religious affiliation is associated with meaningful life outcomes; in general, those with a religious affiliation (compared to those who define themselves as agnostic or atheists) tend to have better health (Koenig, 2004), higher well-being (Joseph, Linley, & Maltby, 2006; Lewis & Cruise, 2006; Pargament, 2002), and longer life (McCullough, Hoyt, Larson, Koenig, & Thoresen, 2000; Powell, Shahabi, & Thoresen, 2003). The question is no longer whether religious affiliation relates to life outcomes, but how.

A growing number of studies have investigated potential psychological mechanisms linking religious affiliation and life outcomes. Given the starkly different metaphysical pictures of reality proposed by religious and non-religious belief systems, it should come as little surprise that religious affiliation is associated with a number of psychological differences. Religious affiliation correlates with more agreeable and conscientious personalities (Saroglou, 2002) and more self-control (McCullough & Willoughby, 2009). Religious affiliation also correlates with prosocial behavior (Shariff & Norenzayan, 2007), marital stability (Mahoney, Pargament, Tarakeshwar, & Swank, 2001), and better health-related behaviors (e.g., Strawbridge, Shema, Cohen, & Kaplan, 2001). Religious belief influences identification with certain political issues, such as abortion (Minkenberg, 2002). Religious individuals have been shown to tend towards a

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3 more intuitive—as opposed to analytical—thinking style (Gervais & Norenzayan, 2012). In
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6 general, religious affiliation is a widely measured variable that predicts a number of
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8 outcomes of psychological interest and is emerging as a variable of particular interest to
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10 well-being research.

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12 Behavioral differences associated with religious affiliation also appear in online
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14 environments. By analyzing language from social networking sites, computer algorithms
15
16 can predict individuals' religious affiliations with a high degree of accuracy (Chen,
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18 Weber, & Okulicz-Kozaryn, 2014; Kosinski, Stillwell, & Graepel, 2013; Nguyen & Lim,
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20 2014; Wagner, Asur, & Hailpern, 2013). For example, one study examined language
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22 differences underlying the polarization between Islamist and secular groups in Egypt
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24 during the so-called “Arab Spring,” identifying, among many other factors, the different
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26 media outlets preferred by each group (Weber, Garimella, & Batayneh, 2013). A study by
27
28 Ritter, Preston, & Hernandez (2013) compared linguistic differences between Christians
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30 and Atheists on Twitter, a popular online social networking site. The authors report that
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32 Christians used a greater number of positive emotions words (e.g. “love,” “nice”) and
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34 words related to social connectedness (e.g. “mate,” “friend”) while Atheists used more
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36 negative emotion words (e.g. “hurt,” “nasty”) and words related to cognitive processes
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38 (e.g. “think,” “consider”).
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46 Unlike self-report surveys, language posted on social media sites such as
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48 Facebook and Twitter offer more spontaneously generated language data potentially
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50 relevant to a person's personality, thoughts, attitudes, and behaviors. Analyzing language
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52 data from these platforms has been shown to predict traits like personality (e.g., Kern et
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54 al., 2014a; Schwartz et al., 2013a), age (Kern et al., 2014b), and gender (Park et al.,
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2016), among other factors (Kosinski, Stillwell, & Graepel, 2013). Analysis of language from social media works about as well as other methods of evaluation for outcomes including personality (Park et al., 2015), life satisfaction (Schwartz et al., 2013b) and heart disease (Eichstaedt et al., 2015). Notably, the words that most correlate with these outcomes can potentially illustrate how aspects of how these constructs reveal themselves in natural language. Words, phrases, and linguistic themes that differentiate religious versus non-religious affiliations can provide insights into the kinds of topics that people from these groups tend to express more or less of.

Analyzing social media language data can follow either top-down theory-based approaches or bottom-up data-driven approaches (Kern et al., in press). Ritter and colleagues (2013), in their study of religious affiliation on Twitter, used a top-down approach, in which they tested a few pre-selected language categories. This approach limited their opportunity to discover other linguistic correlates of religious affiliation unanticipated *a priori*. A particular benefit of data-driven approaches is the possibility identifying topics (language clusters) and patterns that arise from the data itself, potentially yielding greater coverage of the links underlying religious affiliation and other life outcomes. The Ritter et al. (2013) study also only had an assumed religious affiliation; user religious affiliation was extrapolated based on identifying users who followed updates from either Christian or Atheist leaders, as actual religious affiliation was not available, as it is in this study.

In the present study, we analyzed differences in language use between people who reported religious or non-religious affiliations on Facebook using two forms of computational linguistic methods. First, replicating Ritter et al.'s top down approach, we

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2
3 used the Linguistic Inquiry and Word Count program (LIWC; Pennebaker, Francis, &
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5 Booth, 2001) to test whether their findings would generalize to a different online context
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7 (i.e., Facebook rather than Twitter) with participants who self-reported their religious
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9 affiliation (rather than assuming affiliation). Extending this method further, we also used
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11 Differential Language Analysis (DLA; Schwartz et al., 2013a), a bottom-up data-driven
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13 approach, to examine words, phrases, and topics associated with religious and non-
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15 religious affiliation.
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20 21 22 **Method** 23

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25 The source of our language and religious affiliation data was Facebook, a popular
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27 online social networking website (Duggan & Smith, 2013). Specifically, we used data
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29 from the *MyPersonality* application, which asked Facebook users to consent to allow
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31 researchers to analyze their written online posts and other self-reported information
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33 (Kosinski, Stillwell, Graepel, 2013). The MyPersonality application was available from
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35 2007-2012 and these authors can be reached through www.MyPersonality.org (Kosinski,
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37 Matz, Gosling, Popov, & Stillwell, 2015).
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41 The sample was comprised of MyPersonality participants who wrote at least
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43 1,000 words across their statuses and had written an answer in the Facebook “religion”
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45 prompt. Most participants were from the USA (87%) and UK (11%). Of the total 12,815
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47 participants, 10,359 were considered “religious” (Christian, Hindu, Muslim, and
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49 Buddhist), and the majority of religious individuals were Christian (8,913). This
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51 ‘Christian’ category contained 2,426 self-identified Catholics, 1,118 Baptists, 336
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53 Lutherans, 219 Pentecostals, 265 Methodists, 248 Protestants, and 4,301 users who
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3 identified simply as Christians. The rest of the sample (2,456) was “non-religious,” which
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5 included 1,219 self-identified Atheists and 1,237 Agnostics. These figures are generally
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7 representative of the religious and non-religious landscape of the US population.
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Procedure

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12 We began by tokenizing Facebook posts (Potts, 2011) to extract words (including
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14 misspellings of common words), punctuation, and emoticons, as well as two and three-
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16 word phrases (see Kern et al., in press and Schwartz et al., 2013a, for detailed
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18 methodology).
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25 Using a top-down approach, we first examined linguistic differences between
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27 religious and non-religious users using LIWC (2007 version, Pennebaker et al., 2007).
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29 LIWC includes numerous pre-defined categories (e.g., positive emotion, including words
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31 such as “happy”, “joy”, and “love”), and counts the number of times words from each
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33 category are used. The program then provides the relative frequency of each language
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35 category (i.e., frequency adjusted by the total number of words). Replicating Ritter et al.,
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37 (2013), we tested whether those with a religious affiliation used more positive emotions
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39 and social words, and fewer cognitive process words, by correlating, using logistic
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41 regression, each category score with a single binary-coded religious affiliation variable.
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43 We also explored whether other LIWC categories differentiated the two groups.
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49 Next, using a bottom-up approach, we compared the language of religious
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51 individuals to non-religious individuals using Differential Language Analysis (DLA).
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53 DLA takes an atheoretical approach, as it is not limited by researcher-created categories,
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55 allowing for a more transparent view of the words that differentiate the two groups. First,
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3 we correlated users' religious or non-religious identification against all the 1-to-3 word
4 phrases they had written to examine the most positively and negatively associated words
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6 with being religious or non-religious on Facebook. We used a set of previously created
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8 topics (Schwartz et al., 2013a) derived through a clustering algorithm called Latent
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10 Dirichlet Allocation (LDA) to create topics of semantically-related clusters of co-
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12 occurring words (Blei, Ng, Jordan, 2003). We then correlated users' religious or non-
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14 religious identification with LDA topics. In accordance with the precedent set in our
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16 previous work (Schwartz et al., 2013a), the number of topics was set to 2,000 (see also
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18 Kern et al., in press for rationale).
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25 As age and gender impact word use (Pennebaker & Stone, 2003; Kern et al.,
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27 2014b; Park et al., 2016), we controlled for these demographics in all analyses by
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29 included them as covariates in logistic regression. In accordance with conventional
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31 linguistic analysis reporting, we used a p value of $p < .05$, after adjusting for multiple
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33 comparisons using Simes' (1986) multi-test correction, as a heuristic for identifying
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35 potentially meaningful correlations.
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41 Results

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43 For religious individuals, *religion* was the most correlated LIWC category ($r =$
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45 .283; top words include “devil”, “blessing”, and “praying”), providing some face validity
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47 to our approach. Replicating Ritter et al.'s (2013) findings with Twitter, individuals with
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49 a religious orientation were more likely to use words belonging to *positive emotion* ($r =$
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51 .278; e.g. “love,” “good,” “happy”) *family* ($r = .242$; e.g. “mothers”, “uncle”, “aunt”), and
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53 *social* ($r = .189$; e.g. “speaking,” “we,” “they,”) dictionaries. Non-religious individuals
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were more likely to use words in *anger* ($r = .427$; e.g. “hate”, “lying”, “sucks”) *negative emotion* ($r = .317$; e.g. “bad”, “hate”, “cried”), and *cognitive processes* ($r = .085$; “expected”, “figured”, “barely”) categories. Exploring other LIWC dictionaries, non-religious individuals were also more likely to use words in the *swearing* ($r = .402$; e.g. “piss”, “screw”, “heck”), *body* ($r = .265$; “heads”, “neck”, “chest”), and *death* ($r = .247$; e.g. “die”, “dead”, “died”) categories. For non-religious individuals, the cognitive category *insight* was also significant ($r = .085$; e.g. “figured”, “noticed”, “reasons”). Other significantly correlated categories are summarized in Table 1.

Table 1

Linguistic Correlates of Religious (Christian, Muslim, Buddhist, Hindu) and Non-Religious (Atheist, Agnostic) Affiliations

Linguistic Category	Representative Words	r	p
Religion	hell, jesus, soul, holy	0.283	< .0001
Positive Emotion	love, like, good, happy	0.278	< .0001
Family	family, mom, son, mother	0.242	< .0001
Social processes	you, we, who, they	0.189	< .0001
First person plural	we, our, let's, us	0.182	< .0001
Friends	honey, mates, mate, bud	0.123	< .0001
Second person	you, your, ya, you'll	0.107	< .0001
Achievement	better, first, best, lost	0.082	< .01
Certainty	all, never, ever, always	0.080	< .01
Humans	man, person, girl, boy	0.079	< .01
Insight	know, think, feel, thought	-0.081	< .01
Feel	feel, hard, hot, feels	-0.082	< .01
Function	the, to, i, a	-0.088	< .01
Sexual	love, ass, loves, fuck	-0.090	< .01
Aux Verb	is, be, have, are	-0.097	< .001
Past tense	was, got, had, been	-0.099	< .001
See	see, looking, look, saw	-0.100	< .001
Adverbs	so, just, now, back	-0.129	< .0001
Perception	see, feel, looking, look	-0.140	< .0001
Prepositions	to, of, in, for	-0.146	< .0001
Tentativeness	if, or, some, hope	-0.153	< .0001

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Numbers	one, first, two, once	-0.167	< .0001
Money	free, check, worth, spend	-0.171	< .0001
Space	in, on, at, up	-0.185	< .0001
Article	the, a, an, a lot	-0.203	< .0001
Bio	love, life, heart, sick	-0.220	< .0001
Ingest	eat, water, eating, wine	-0.234	< .0001
Death	die, dead, died, alive	-0.247	< .0001
Body	heart, head, face, ass	-0.265	< .0001
Negative Emotion	bad, hate, miss, loss	-0.317	< .0001
Swear	hell, ass, fuck, crap	-0.402	< .0001
Anger	hate, hell, fuck, crap	-0.427	< .0001

Note. P values are corrected for multiple comparisons using Simes' (1986) method.

Linguistic analysis using Differential Language Analysis (DLA) between religious and non-religious individuals resulted in a similar pattern of findings. The 75 most distinctive words and phrases are visualized in Figure 1. The religious group shows numerous religious words (“church”) and positive emotion (“love”) as well as social words (“family”) are also apparent, as are words suggesting gratitude (“blessed”, “thank”, “thankful”). The non-religious group shows many swear words (“fucking”) as well as words related to drug use (“drunk”) and death (“dead”). Additionally, the analysis of language associated with non-religious individuals showed words that have been associated with a more nuanced cognitive style (“apparently,” “possibly,” “thinks”).

Religious DLA

social relationships, but they recognize them, talk about them, and value them. Gratitude is apparent in several topics. In contrast, LDA topics associated with non-religion are coarser, involving cursing (including taking the Lord's name in vain). There is also language indicative of the processing of unexpected information (strange, unusual, odd) and forming conclusions (discovered, found, realized), reflecting a more analytic attitude and approach to the world.

Religious LDA Topics



$r = 0.184$

$r = 0.174$



$r = 0.174$

$r = 0.157$

Non-religious LDA Topics



Figure 2. Statistically significant topics differentiating those with a religious affiliation (top) versus non-religious (bottom). The larger the word, the more prevalent the word is in the topic, the colors are random (see Schwartz et al., 2013)

Discussion

Comparison of the language used by religious and non-religious individuals on the Facebook social media platform revealed several significant differences. Replicating Ritter et al.'s (2013) study of Twitter users, religious individuals tended to use more positive emotion and social themes, whereas non-religious individuals used more negative emotion and cognitive themes. Non-religious individuals also swore more often,

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3 and discussed death, the body, and sex more frequently than religious individuals.

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5 Extending these findings using a bottom up data driven approach revealed additional
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8 insights. For example, the language of religious individuals was more prosocial in nature
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10 and involved expressions of appreciation for family and other social relationships.

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12 A number of studies find positive associations between religion and well-being
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14 (e.g., Lewis & Cruise, 2006; Levin & Chatters, 1998; Myers, 2000; Seybold & Hill,
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16 2001). Emmons & Crumpler (2000) describe a conspicuous emphasis on the positive
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18 emotion of gratitude in religious groups and gratitude has been correlated with
19
20 religiousness (Emmons & Kneezel, 2005). Fredrickson (2002) theorizes that positive
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22 emotions may mediate the observed relationship between religion and well-being. The
23
24 origin of greater positive emotion expressed by religious individuals is not clear, though
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26 some research suggests it may derive from increased levels of social support from
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28 religious communities (Salsman, Brown, Brechting, & Carlson, 2005). The language
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30 itself supports this perspective, as words associated with religious individuals tended to
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32 reflect social themes and gratitude.
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39 The inverse finding, that non-religious individuals experience more anger and
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41 negative emotions, has also been observed in previous research (Kimble & McFadden,
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43 2003). Pargament (2002) argues that religion can support coping strategies through a
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45 process that includes healthy regulation of negative emotion. Also, religious people
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47 report less anxiety (Inzlicht, McGregor, Hirsh, & Nash, 2009), which may generalize to
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49 fewer negative emotions in general. In addition, it has been observed that individuals who
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51 do not believe in God may not be as likely as those who are religious to engage in certain
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53 cognitive strategies that are known to lift mood (Buffone, Gabriel, & Poulin, 2016).
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However, it is also possible that religion merely exerts a social pressure that discourages the verbal expression of negative emotion while promoting the verbal expression of positive emotion. That is, religion may encourage people to present a more positive façade, despite whatever emotions are actually being experienced. One study examining this topic, however, found that religious individuals do not appear to repress negative emotions (Bullard & Park, 1998). Discrepancies between the feeling and expressing of emotion is a fundamental issue in linguistic analysis (and self-report in general), and, perhaps, particularly salient in the study of religion.

A core pathway through which religion may influence well-being and health outcomes is through positive social relationships. Well-being benefits of religious group membership have been described in previous research (Ysseldyk, Matheson, & Anisman, 2010) and social cohesiveness may mediate some of the well-being benefits of religion (Salsman, Brown, Brechting, & Carlson, 2005). Diener and Seligman (2002) suggested that the relationship between religion and well-being can be almost entirely explained by its correlation with higher quality relationships. Graham and Haidt (2010) argue that the benefits and maybe even the evolutionary origins of religion reside in its ability to foster closer social bonds.

The language used by religious individuals was not only social in nature, but reflected an appreciation for others. Gordon and colleagues (2012) suggest that gratitude helps maintain positive romantic relationships, in that feeling appreciated motivates one to work harder at maintaining the relationship, in turn helping the partner to feel appreciated and motivated to hold on to the relationship as well. A similar way of responding to other relationships might help develop a strong social network, which

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3 provides a sense of belonging and connectedness, as well avenues for social support
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6 when needed.
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8 The finding that non-religious affiliation is associated with linguistic markers of
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10 cognitive processes has likewise been observed in previous research. Gervais and
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12 Norenzayan (2012) found that the tendency to engage in analytic thinking to override
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14 initial, intuitive responses to critical thinking puzzles correlates with atheism. This is
15
16 supported by a number of findings that suggest religious belief may supervene on several
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18 intuitive cognitive processes, such as anthropomorphism and the tendency to perceive
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20 intentionality (Boyer, 2008; Barrett, 2000; Bloom, 2012). If non-religious affiliation
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22 involves engaging in analytic forms of reasoning to override more intuitive beliefs, then
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24 this may help explain the correlation between linguistic categories related to cognitive
25
26 processes and non-religion.
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31 The finding that non-religious individuals swear more and use sexual words more
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33 frequently may have to do with religious taboos against mentioning such topics (Jay,
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35 2009). Previous linguistic analysis studies have found that those who are less agreeable
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37 swear more often (Yarkoni, 2010), and as religious individuals are more agreeable, this
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39 personality trait could help explain the relationship. Similarly, the finding that ingestion
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41 and body categories are correlated with non-religion may involve more mention of
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43 “sensual” topics (i.e., drinking). Many studies have found that religion is associated with
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45 reduced drug and alcohol use (Wallace & Forman, 1998), for example, which may help
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47 to explain the reduced mention of these topics.
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52 A less obvious finding is the relationship observed between non-religious
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54 individuals and mentions of words related to death. To investigate this further, we
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3 examined which specific words within the LIWC “Death” category were driving the
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5 result, identifying several key words: “die”, “dead”, “died”, “dying”, “war”, and “alive”.
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8 Within these mentions, the topic of death arose in a wide range of capacities spanning not
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10 only literal but figurative references to death. For instance, in addition to references to
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12 specific people dying, death-related words were also frequently used in hyperbole, jokes
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14 and chain posts, social problems involving mortality, and technology (objects ceasing to
15
16 work). In general, the topic of death appears to be more frequently discussed by non-
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18 religious Facebook users in a variety of contexts. This also might be explained by
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20 religious taboo. It may be that, like sexual topics and swearing, death is also seen as a
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22 vulgar or “profane” topic. Another theory often raised in the context of mortality salience
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24 is “terror management theory” (Greenberg & Arndt, 2011), which argues that people seek
25
26 out means to avoid dwelling on death. However, it is unclear how the theory applies in
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28 this instance. It could be that religion guards against mortality salience, thus obviating the
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30 need to discuss death while also providing a boon to psychological well-being. On the
31
32 other hand, previous research has shown that priming people with thoughts about death
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34 increases God beliefs (Norenzayan & Hansen, 2006). Further unpacking this and the
35
36 other language findings remains a task for future work.
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44 Language is used as an unobtrusive marker of attitudes and in-the-moment
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46 thoughts and behaviors. It is possible that due to self-monitoring and image management,
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48 words reflect socially expected language, rather than actual attitudes and beliefs.
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51 Religious individuals might be more cognizant of monitoring their language in socially
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53 appropriate ways, as reflected by a lower use of swear words, discussing sexuality, and
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55 reduced use of other somewhat socially taboo topics, like death. While self-monitoring
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3 does occur, studies suggest that people do portray their real personalities online (Kern et
4 al., 2014a), so the observed differences may reflect more than mere self-censorship.
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10 **Limitations and Future Directions**

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12 This study was limited in several ways. First, participants provided their religious
13 affiliation but they did not indicate their degree of religiosity. The majority of individuals
14 were from the U.S., where people commonly claim a Christian orientation in name only,
15 but do not practice regularly. Future research might consider the degree of religiosity,
16 identifying differences between those for whom their belief system is central to their lives
17 as opposed to those who hold it as a peripheral concern. Cross-cultural differences might
18 also be considered, especially considering different religious traditions.
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29 There were also many more individuals with a religious affiliation than without.
30 This breakdown reflects average trends in religiosity, but the unbalanced sizes could
31 skew results toward the dominant group. Further, religion is a multi-dimensional
32 construct, including aspects such as affiliation, practices, rituals, and experiences. While
33 other linguistic studies have examined specific aspects of religion and spirituality, such as
34 experiences (Yaden et al., 2015; Yaden et al., 2016), future linguistic analysis studies
35 should examine convergences and differences between various aspects of religion.
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46 While this study reports quantitatively-derived correlations between linguistic
47 features and religious affiliation, interpretation of the meaning of these relationships is
48 necessarily qualitative in nature. The pattern of results maps onto other studies linking
49 religion with life outcomes, and identifies possible mechanisms such as sociability and
50 gratitude, but the processes involved are not directly tested. The correlates identified
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provide hypotheses that can be tested in future studies using different methodologies.

Conclusion

Links between religion and life outcomes are multifaceted and occur through the accumulation of attitudes and behaviors across the lifespan. Language used on social media provides one marker of daily behaviors. The language of religious individuals was positive and socially oriented, whereas non-religious individuals were colder and less concerned about others. Non-religious individuals also reference the body and death more often in addition to using words and themes indicative of a more nuanced cognitive style. While it is unclear whether this phenomenon results from a genuine difference in psychological orientation or linguistic norms enforced through social taboos, the content and magnitude of these differences warrants further investigation.

References

- Barrett, J. L. (2000). Exploring the natural foundations of religion. *Trends in Cognitive Sciences*, 4(1), 29-34.
- Blei, D. M., Ng, A. Y., & Jordan, M. I. (2003). Latent dirichlet allocation. *The Journal of Machine Learning research*, 3, 993-1022.
- Bloom, P. (2012). Religion, morality, evolution. *Annual Review of Psychology*, 63, 179-199.
- Boyer, P. (2008). Being human: Religion: Bound to believe? *Nature*, 455(7216), 1038-1039.
- Bullard, P. L., & Park, C. L. (1998). Emotional expressive style as a mediator between religion and health. *International Journal of Rehabilitation and Health*, 4(4), 201-214.
- Buffone, A., Gabriel, S., & Poulin, M. (2016). There But for the Grace of God Counterfactuals Influence Religious Belief and Images of the Divine. *Social Psychological and Personality Science*, 7(3), 256-263.
- Chen, L., Weber, I., & Okulicz-Kozaryn, A. (2014). US religious landscape on Twitter. In *Social Informatics* (pp. 544-560). Springer International Publishing.
- Diener, E., & Seligman, M. E. (2002). Very happy people. *Psychological Science*, 13(1), 81-84.
- Duggan, M., & Smith, A. (2013). Social media update. *Washington, DC: Pew Research Center*.
- Eichstaedt, J. C., Schwartz, H. A., Kern, M. L., Park, G., Labarthe, D. R.,

- 1
2
3 Merchant, R. M., ... & Weeg, C. (2015). Psychological language on Twitter
4 predicts county-level heart disease mortality. *Psychological Science*, 26(2),
5 159-169.
6
7
8
9
10
11 Emmons, R. A., & Crumpler, C. A. (2000). Gratitude as a human strength:
12 Appraising the evidence. *Journal of Social and Clinical Psychology*, 19(1),
13 56-69.
14
15
16
17
18 Emmons, R. A., & Kneezel, T. E. (2005). Giving thanks: Spiritual and religious
19 correlates of gratitude. *Journal of Psychology and Christianity*, 24(2), 140.
20
21
22
23
24 Fredrickson, B. L. (2002). How does religion benefit health and well-being? Are
25 positive emotions active ingredients? *Psychological Inquiry*, 13(3), 209-
26 213.
27
28
29
30
31 Gervais, W. M., & Norenzayan, A. (2012). Analytic thinking promotes religious
32 disbelief. *Science*, 336, 493-496.
33
34
35
36
37 Gordon, A. M., Impett, E. A., Kogan, A., Oveis, C., & Keltner, D. (2012). To have and to
38 hold: Gratitude promotes relationship maintenance in intimate bonds. *Journal of*
39 *Personality and Social Psychology*, 103, 257-274.
40
41
42
43
44 Graham, J., & Haidt, J. (2010). Beyond beliefs: Religions bind individuals into
45 moral communities. *Personality and Social Psychology Review*, 14(1), 140-
46 150.
47
48
49
50
51 Greenberg, J., & Arndt, J. (2011). Terror management theory. *Handbook of*
52 *Theories of Social Psychology*, 1, 398-415.
53
54
55
56
57 Inzlicht, M., McGregor, I., Hirsh, J. B., & Nash, K. (2009). Neural markers of
58
59
60

- 1
2
3 religious conviction. *Psychological Science*, 20(3), 385-392.
- 4
5
6 Jay, T. (2009). The utility and ubiquity of taboo words. *Perspectives on*
7
8
9 *Psychological Science*, 4(2), 153-161.
- 10
11 Joseph, S., Linley, P. A., & Matlby, J. (2006). Positive psychology, religion, and
12
13
14 spirituality. *Mental Health, Religion, & Culture*, 209-212.
- 15
16 Kern, M. L., Eichstaedt, J. C., Schwartz, H. A., Dziurzynski, L., Ungar, L. H.,
17
18
19 Stillwell, D. J., ... & Seligman, M. E. P. (2014). The online social self: An
20
21
22 open vocabulary approach to personality. *Assessment*, 21, 158-169.
- 23
24 Kern, M. L., Eichstaedt, J. C., Schwartz, H. A., Park, G., Ungar, L. H., Stillwell,
25
26
27 D. J., ... & Seligman, M. E. P. (2014). From “sooo excited!!!” to “so
28
29
30 proud”: Using language to study development. *Developmental Psychology*,
31
32
33 50, 178-188. <http://dx.doi.org/10.1037/a0035048>
- 34
35 Kern, M. L., Park, G., Eichstaedt, J. C., Schwartz, H. A., Sap, M., Smith, L. K., &
36
37
38 Ungar, L. H. (in press). Gaining insights from social media language:
39
40
41 Methodologies and challenges. *Psychological Methods*.
- 42
43
44 Kimble M.A., McFadden S.H. (2003). *Aging, spirituality, and religion: A*
45
46
47 *handbook*. Vol. 2. Minneapolis: Fortress Press.
- 48
49
50 Koenig, H. G. (2004). Religion, spirituality, and medicine: research findings and
51
52
53 implications for clinical practice. *South Med J*, 97(12), 1194-1200.
- 54
55
56
57
58
59
60 Kosinski, M., Matz, S. C., Gosling, S. D., Popov, V., & Stillwell, D. (2015).
Facebook as a research tool for the social sciences: Opportunities,
challenges, ethical considerations, and practical guidelines. *American*

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
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45
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47
48
49
50
51
52
53
54
55
56
57
58
59
60

Psychologist, 70(6), 543.

Kosinski, M., Stillwell, D., & Graepel, T. (2013). Private traits and attributes are predictable from digital records of human behavior. *Proceedings of the National Academy of Sciences*, 110(15), 5802-5805.

Levin, J. S., & Chatters, L. M. (1998). Religion, health, and psychological well-being in older adults findings from three national surveys. *Journal of Aging and Health*, 10(4), 504-531.

Lewis, C. A., & Cruise, S. M. (2006). Religion and happiness: Consensus, contradictions, comments and concerns. *Mental Health, Religion and Culture*, 9, 213-225.

Mahoney, A., Pargament, K. I., Tarakeshwar, N., & Swank, A. B. (2001). Religion in the home in the 1980s and 1990s: A meta-analytic review and conceptual analysis of links between religion, marriage, and parenting. *Journal of Family Psychology*, 15, 559-596.

McCullough, M. E., Hoyt, W. T., Larson, D. B., Koenig, H. G., & Thoresen, C. E. (2000). Religious involvement and mortality: A meta-analytic review. *Health Psychology*, 19, 211-222.

McCullough, M. E., & Willoughby, B. L. B. (2009). Religion, self-regulation, and self control: Associations, explanations, and implications. *Psychological Bulletin*, 135, 69-93.

Minkenbergh, M. (2002). Religion and public policy institutional, cultural, and political impact on the shaping of abortion policies in western democracies.

- 1
2
3
4
5
6
7
8
9
10
11
12
13
14
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17
18
19
20
21
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40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60
- Comparative Political Studies*, 35(2), 221-247.
- Myers, D. G. (2000). The funds, friends, and faith of happy people. *American Psychologist*, 55(1), 56.
- Nguyen, M. T., & Lim, E. P. (2014, July). On predicting religion labels in microblogging networks. In *Proceedings of the 37th international ACM SIGIR conference on Research & development in information retrieval* (pp. 1211-1214). ACM.
- Norenzayan, A., & Hansen, I. G. (2006). Belief in supernatural agents in the face of death. *Personality and Social Psychology Bulletin*, 32(2), 174-187.
- Pargament, K. I. (2002). The bitter and the sweet: An evaluation of the costs and benefits of religiousness. *Psychological Inquiry*, 13(3), 168-181.
- Park, G., Schwartz, H. A., Eichstaedt, J. C., Kern, M. L., Kosinski, M., Stillwell, D. J., ... & Seligman, M. E. (2015). Automatic personality assessment through social media language. *Journal of personality and social psychology*, 108(6), 934.
- Park, G., Yaden, D. B., Schwartz, H. A., Kern, M. L., Eichstaedt, J. C., Kosinski, M., ... & Seligman, M. E. (2016). Women are warmer but no less assertive than men: Gender and language on Facebook. *PloS One*, 11(5), e0155885.
- Pennebaker, J. W., Booth, R. J., & Francis, M. E. (2007). Linguistic inquiry and word count: LIWC [Computer software]. *Austin, TX: liwc. net*.
- Pennebaker, J. W., Francis, M. E., & Booth, R. J. (2001). Linguistic inquiry and word count: LIWC 2001. *Mahway: Lawrence Erlbaum Associates*, 71.

THE LANGUAGE OF RELIGIOUS AFFILIATION

24

1
2
3 Pennebaker, J. W., & Stone, L. D. (2003). Words of wisdom: language use over the life
4 span. *Journal of personality and social psychology*, 85(2), 291.
5
6

7
8 Pew Research Center (November 3, 2015). *U.S. Public Becoming Less Religious*.
9

10 Retrieved Sept 10, 2016 from Pew Research Center:

11 <http://www.pewforum.org/2015/11/03/u-s-public-becoming-less-religious/>
12

13
14
15
16 Pew Research Center (December 18, 2012). *The Global Religious Landscape*.
17

18 Retrieved Sept 10, 2016 from Pew Research Center:

19 <http://www.pewforum.org/2012/12/18/global-religious-landscape-exec/>
20

21
22
23 Potts C. *happyfuntokenizer* (Version 1.0) [computer software]. (2011). Retrieved
24

25 from: <http://sentiment.christopherpotts.net/code->
26

27 [data/happyfuntokenizing.py](http://sentiment.christopherpotts.net/code-)<http://sentiment.christopherpotts.net/code->
28

29 [data/happyfuntokenizing.py](http://sentiment.christopherpotts.net/code-)
30
31

32
33 Powell, L. H., Shahabi, L., & Thoresen, C. E. (2003). Religion and spirituality: Linkages
34 to physical health. *American Psychologist*, 58, 36-52.
35

36
37
38 Ritter, R. S., Preston, J. L., & Hernandez, I. (2013). Happy tweets: Christians are
39

40 happier, more socially connected, and less analytical than atheists on
41

42 Twitter. *Social Psychological and Personality Science*,
43

44 1948550613492345.
45
46

47
48 Salsman, J. M., Brown, T. L., Brechting, E. H., & Carlson, C. R. (2005). The link
49

50 between religion and spirituality and psychological adjustment: The
51

52 mediating role of optimism and social support. *Personality and Social*
53

54 *Psychology Bulletin*, 31(4), 522-535.
55
56
57
58
59
60

1
2
3 Saroglou, V. (2002). Religion and the five factors of personality: A meta-analytic
4
5 review. *Personality and Individual Differences*, 32(1), 15-25.
6
7

8
9 Schwartz, H. A., Eichstaedt, J. C., Kern, M. L., Dziurzynski, L., Ramones, S. M.,
10
11 Agrawal, M., ... & Ungar, L. H. (2013). Personality, gender, and age in the
12
13 language of social media: The open-vocabulary approach. *PloS One*, 8(9),
14
15 e73791.
16
17

18
19 Schwartz, H. A., Eichstaedt, J. C., Kern, M. L., Dziurzynski, L., Lucas, R. E., Agrawal,
20
21 M., ... & Ungar, L. H. (2013). Characterizing geographic variation in well-being
22
23 using tweets. In *Proceedings of the Seventh International AAI Conference on*
24
25 *Weblogs and Social Media (ICWSM)*. Boston, MA.
26
27

28
29 Seybold, K. S., & Hill, P. C. (2001). The role of religion and spirituality in mental
30
31 and physical health. *Current Directions in Psychological Science*, 10(1),
32
33 21-24.
34
35

36
37 Shariff, A. F., & Norenzayan, A. (2007). God is watching you priming God concepts
38
39 increases prosocial behavior in an anonymous economic game. *Psychological*
40
41 *science*, 18(9), 803-809.
42
43

44
45 Simes, R. J. (1986). An improved Bonferroni procedure for multiple tests of
46
47 significance. *Biometrika*, 73(3), 751-754.
48
49

50
51 Strawbridge, W. J., Shema, S. J., Cohen, R. D., & Kaplan, G. A. (2001). Religious
52
53 attendance increases survival by improving and maintaining good health
54
55 behaviors, mental health, and social relationships. *Annals of Behavioral Medicine*,
56
57 23(1), 68-74.
58
59

60
Wagner, C., Asur, S., & Hailpern, J. (2013, September). Religious politicians and

1
2
3 creative photographers: Automatic user categorization in twitter. In *Social*
4
5
6 *Computing (SocialCom), 2013 International Conference on* (pp. 303-310).
7
8 IEEE.

9
10
11 Wallace, J. M., & Forman, T. A. (1998). Religion's role in promoting health and
12
13 reducing risk among American youth. *Health Education & Behavior*, 25(6),
14
15 721-741.

16
17
18 Weber, I., Garimella, V. R. K., & Batayneh, A. (2013, August). Secular vs.
19
20
21 Islamist polarization in Egypt on twitter. In *Proceedings of the 2013*
22
23 *IEEE/ACM International Conference on Advances in Social Networks*
24
25 *Analysis and Mining* (pp. 290-297). ACM.

26
27
28 Yaden, D. B., Eichstaedt, J. C., Schwartz, H. A., Kern, M. L., Le Nguyen, K. D.,
29
30
31 Wintering, N. A., ... & Newberg, A. B. (2015). The language of
32
33 ineffability: Linguistic analysis of mystical experiences. *Psychology of*
34
35 *Religion and Spirituality*.

36
37
38 Yaden, D. B., Iwry, J., Slack, K. J., Eichstaedt, J. C., Zhao, Y., Vaillant, G. E., &
39
40
41 Newberg, A. B. (2016). The overview effect: Awe and self-transcendent
42
43 experience in space flight. *Psychology of Consciousness: Theory, Research, and*
44
45 *Practice*, 3(1), 1-11.

46
47
48 Yarkoni, T. (2010). Personality in 100,000 words: A large-scale analysis of
49
50
51 personality and word use among bloggers. *Journal of Research in*
52
53 *Personality*, 44(3), 363-373.

54
55
56 Ysseldyk, R., Matheson, K., & Anisman, H. (2010). Religiosity as identity:
57
58
59
60

THE LANGUAGE OF RELIGIOUS AFFILIATION

1
2
3
4
5
6
7
8
9
10
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Toward an understanding of religion from a social identity perspective.
Personality and Social Psychology Review, 14(1), 60-71.

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