Tell-Tale Words: Linguistic Cues Used to Infer the Expertise of Online Medical Advice

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Abstract

This article analyzes the linguistic cues used by naïve perceivers to assess the expertise of online medical advice. We develop a theoretical framework of linguistic correlates to perceived expertise and test it on a corpus of 120 online medical advice messages, written by either medical doctors or laypersons. Linguistic Inquiry and Word Count (LIWC) analyses show that messages were perceived as more expert if they contained more words (an indicator of uncertainty reduction), fewer I-pronouns and anxiety-related words (indicators of psychological distancing), and more long words and negations (indicators of cognitive complexity). These linguistic cues explained over a third of the variance in expertise ratings. Although unaware of the author of each message, perceivers were able to discern between messages written by doctors versus laypersons. However, only long words were helpful in making this distinction. Results advance the literature on linguistic correlates of psychological processes.

Keywords

expertise, linguistic cues, online medical advice, LIWC, health communication

Health websites such as WedMd.com, MedHelp.com, and NetWellness.com provide users with a wealth of information about medical conditions, and also enable them to request personalized advice via discussion forums. These websites are easy to access, low in cost, and anonymous, in contrast to doctor's appointments, which tend to be short in duration, difficult to procure, costly, and non-anonymous (Anderson, Rainey,

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& Eysenbach, 2003; Kivits, 2004). For these reasons, health websites have become extremely popular: Eighty-eight percent of Internet users visit them and they tend to do so first thing after experiencing a health concern (Harris Interactive Poll, 2010).

Despite this popularity, online health information has its risks. Chief among them is the difficult nature of assessing advice givers' trustworthiness (Eysenbach, 2007; Sillence, Briggs, Harris, & Fishwick, 2007). Advice-givers' trustworthiness can be conceptualized along two dimensions: (a) expertise, or their subject-specific knowledge and competence and (b) benevolence, or their willingness to be helpful and act ethically (see Mayer, Davis, & Schoorman, 1995). On online medical forums, advice-givers generally have no motive to be malicious or deceptive and can therefore be presumed to be benevolent. However, their expertise is an issue of great concern. Are they trained physicians? Are they knowledgeable and competent? Many online forums permit anyone to post advice, regardless of their background, training, and experience. In fact, research shows that a majority of online health information is *not* authored by medical professionals (see Eastin, 2001).

Given the grave consequences of following the wrong medical advice, research has taken a keen interest in understanding how people assess advice-givers' expertise. Findings reveal that, by and large, advice-seekers are concerned with the quality of online advice, but they have a hard time ascertaining it (Eysenbach, 2007; Pant et al., 2012; Sillence et al., 2007): They do not pay attention to indicators of credibility (Morahan-Martin, 2004) and ignore message characteristics, such as the inclusion of statistics, testimonials, quotations, and external references, that may indicate its expertise level (Rains & Karmikel, 2009).

In this article, we argue that there exists a previously unexamined, yet important source of information that people rely on when assessing online advice-givers' expertise: *linguistic cues*. Specifically, we propose that the linguistic *style* in which messages are written affects their perceived expertise. Additionally, we investigate whether the linguistic cues utilized by perceivers are related to online medical advice-givers' actual expertise, operationalized here as whether they are certified medical doctors or users lacking medical credentials (henceforth referred to as laypersons).

In our analysis, we draw on Brunswik's (1956) lens model, which argues that cues in the environment serve as lenses through which individuals infer others' psychological states, such as their personality (Back, Schmukle, & Egloff, 2011), depression (Mehl, 2006; Rodriguez, Holleran, & Mehl, 2010), and, in our case, medical expertise. According to the model, cue utilization refers to the cues used by perceivers to infer others' states; cue validity refers to the cues that are in fact correlated with others' states; and functional achievement refers to the extent to which utilized cues overlap with valid cues. Stated in lens model terms, our research is then concerned with cue utilization (i.e., what linguistic cues do perceivers use to infer the expertise of online medical advice?) and functional achievement (i.e., to what extent are the linguistic cues utilized by perceivers valid—i.e., indicative of advice-givers' actual expertise?).

This research aims to make a series of theoretical contributions. First, we note that there exists a robust body of research on how psychological constructs, such as

deception, personality traits, and social status, are reflected in language use (see Chung & Pennebaker, 2007, 2012, for reviews). We propose to extend this research to perceptions of expertise, a previously unexamined psychological process, and we develop a theoretical framework to this effect. Second, we investigate how message *receivers* utilize linguistic cues as they make social judgments—an important extension to the existing literature, which has predominantly focused on how message *senders'* internal processes are reflected in language use (see Larrimore, Jiang, Larrimore, Markowitz, & Gorski, 2011, and Toma & Hancock, 2012, for exceptions). In lens model terms, we advance current research by shifting focus from cue validity to cue utilization. Finally, we aim to contribute to the field of health communication by investigating how *linguistic* properties of health messages, a previously unexamined topic, affect their interpretation.

Psychological Processes and Linguistic Cues

As mentioned earlier, an ample literature has demonstrated that linguistic cues are valid indicators of speakers' psychological states, such as deceptiveness (e.g., Hancock, Curry, Goorha, & Woodworth, 2008; Newman, Pennebaker, Berry, & Richards, 2003; Van Swol, Braun, & Mallhotra, 2012), depression (Rude, Gortner, & Pennebaker, 2004; Stirman & Pennebaker, 2001), social status (Kacewicz, Pennebaker, Davis, Jeon, & Graesser, 2014), personality traits (Oberlander & Gill, 2006; Pennebaker & King, 1999), gender (Newman, Groom, Handelman, & Pennebaker, 2008), and mental health (Considein, Krivoshekova, & Magai, 2012). The linguistic cues that reveal these psychological processes fall into two categories (Pennebaker, Booth, & Francis, 2007). The first is *function words*, which are relatively content-free parts of sentence (e.g., pronouns, articles, prepositions, and negations) that serve to bind sentences together, but do not convey much meaning in and of themselves (Chung & Pennebaker, 2007). The second is words that reflect social and psychological concerns, such as affect (e.g., "happy," "worried"), cognitive processes (e.g., "know," "insight"), and sensory processes (e.g., "see," "hear," "feel"). While the latter convey more meaning than the former, both categories are similar in that they indicate the speaker's *style* of communication. Consider the following sentences: "Yeah, maybe you're right" and "I cautiously agree with your position." Both convey the same meaning, but they do so in a completely different style. The first speaker appears casual and laid-back, whereas the second is more formal and self-focused. These differences are conveyed through stylistic linguistic cues. For instance, long words ("cautiously") may be associated with formality. Similarly, the use of first-person pronouns ("I") by the first speaker, as opposed to the second speaker's use of second-person pronouns ("you"), denote the former's focus on oneself.

In sum, by focusing on stylistic differences, this research has argued that *how* people talk, more so than what they say, reflects their underlying psychological processes (Chung & Pennebaker, 2007, 2012). For simplicity, we henceforth refer to the linguistic cues that reflect the style of communication as *linguistic cues*.

Linguistic Cues to Perceived Expertise: Hypotheses

While research has established that linguistic cues are valid indicators of psychological constructs, only a handful of studies have started to show that these cues are also utilized by perceivers (e.g., Larrimore et al., 2011; Rodriguez et al., 2010). Following their lead, we also propose that perceivers attend to linguistic cues in order to infer others' expertise.

We argue that perceivers experience a set of psychological needs related to the context (i.e., medical advice) and goals of the task at hand (i.e., inferring expertise), and that they attend to linguistic cues that meet these needs. In brief, perceivers should experience needs for (a) uncertainty reduction, because they lack the necessary information about medical conditions and hence consider information-rich sources as more expert; (b) message concreteness, such that they can process the information easily; (c) psychological distancing, a marker of the advice-giver's objectivity; and (d) cognitive complexity, a marker of the advice giver's depth of reasoning. We elaborate on these propositions below.

Uncertainty Reduction. Uncertainty reduction theory (Berger & Calabrese, 1975) proposes that people dislike uncertainty, because it implies that they lack control over a given situation. Consequently, they feel more comfortable and trusting once uncertainty has been reduced. At an interpersonal level, individuals are postulated to experience more trust, liking, and rapport toward strangers (i.e., highly uncertain communication partners) the more information they gather about them (Berger, 1979).

Seeking online medical advice is a situation riddled with uncertainty, for several reasons. First, advice-givers in anonymous online forums are strangers. Second, the average person's level of knowledge about medical issues is limited (Hurley, Miller, Costalas, Gillespie, & Daly, 2001). Third and relatedly, individuals go online to seek advice precisely because they do not know how to handle the situation at hand and are presumably already troubled by uncertainty. It follows, then, that advice-seekers in this context will develop more positive interpersonal impressions, including perceived expertise, toward advice-givers who can reduce uncertainty.

At the linguistic level, uncertainty reduction can be accomplished by providing longer, and therefore more information-rich, messages. The claim that longer messages reduce uncertainty and therefore elicit more trust and positive impressions in online contexts has received strong support. Writers of longer messages were perceived as more trustworthy in online dating profiles (Toma & Hancock, 2012), peer-to-peer lending websites (Larrimore et al., 2011), consumer-to-consumer selling sites (i.e., eBay; Flanagin, 2007), and Facebook profiles (Toma, 2014). Hence:

> **Hypothesis 1:** Online medical advice messages that are lengthier (i.e., contain a higher word count) will be perceived as more expert.

Concreteness. Individuals should also ascribe greater expertise to advice-givers who can express themselves in a clear and easy-to-understand manner. One characteristic

of messages that has been shown to facilitate information processing is concreteness (Paivio, 1991; Paivio & Clark, 1986). Concrete language is familiar and accessible, because it represents contextualized and detailed representations of objects (Doest, Semin, & Sherman, 2002; Schwanenflugel & Stowe, 1989; Seifert, 1997). In contrast, abstract language can be obscure and difficult-to-follow (Elsbach, 2004). Extant research has identified two linguistic cues to concreteness: articles (i.e., "a," "an," and "the")and quantifiers (e.g., "many," "few," "a lot"). Articles signal an upcoming concrete noun (Tausczik & Pennebaker, 2010), whereas quantifiers provide specific details regarding situations, objects, and people (Larrimore et al., 2011). The notion that articles and quantifiers, as indicators of concreteness, are correlated with perceived benevolence and expertise has received support in both peer-to-peer lending sites (Larrimore et al., 2011) and online dating profiles (Toma & Hancock, 2012). By the same token, they should be associated with greater perceived expertise in an online medical advice context, particularly because medical issues are complex and therefore achieving understanding can be difficult to begin with:

> **Hypothesis 2:** Online medical advice messages that contain more concrete language (i.e., more articles and quantifiers) will be perceived as more expert.

Psychological Distancing. In a medical context, experts are expected to conduct themselves in an objective, detached, and unbiased manner. Hence, individuals seeking online medical advice should be more likely to trust advice-givers who cultivate a professional and objective style of communication, rather than those who make themselves the focus of communication and appear embroiled in their own personal experiences. This psychological distancing, or separation between the advice-giver and the advice-seeker, has been shown to manifest itself linguistically by a decrease in first-person (i.e., "I") pronouns. Simply put, fewer I-pronouns denote less of a focus on one's own personal experiences. Indeed, research shows that a focus on oneself, induced by looking at oneself in the mirror (Davis & Brock, 1975) or by being depressed (Rude et al.,2004), increases the usage of I-pronouns (e.g., "I," "me," "myself," "my"). Similarly, liars consistently use fewer I-pronouns in an effort to psychologically distance themselves from their deceptions (e.g., DePaulo et al., 2003; Newman et al., 2003).

Another marker of psychological distancing in this context should be a decrease in negative emotionality—specifically, anxiety-related words. Indeed, objective and psychologically detached advice-givers should not display signs of anxiety, an emotion that is antithetical to clear-headed thinking. In fact, advice-seekers generally hope to alleviate their own anxiety by seeking online advice. Therefore, anxiety-related words should aggravate, rather than calm, advice-seekers' preexisting worries, and should raise red flags about advice-givers' objectivity, and, in turn, their expertise. Hence:

> **Hypothesis 3:** Online medical advice messages that contain markers of psychological distancing (i.e., fewer I-pronouns, fewer anxiety-related words) will be perceived as more expert.

Cognitive Complexity. It almost goes without saying that, in judging expertise, advice-seekers should value depth of thinking and reasoning in advice-givers' messages. Linguistically, this depth of thinking is illustrated by markers of cognitive complexity (Slatcher, Chung, Pennebaker, & Stone, 2007). Research has identified several such markers. First, negation words ("no," "not," "never") have been argued to demonstrate sophisticated thinking because they are specific and precise (Hancock et al., 2008), and because they differentiate between what belongs to a category and what does not, a cognitively complex task (Slatcher et al., 2007; Toma & Hancock, 2012). Second, words that are longer than six letters (henceforth referred to as long words) demonstrate an erudite vocabulary and ease in conveying complicated concepts (Tausczik & Pennebaker, 2010). Hence:

> **Hypothesis 4:** Online medical advice messages that contain more markers of cognitive complexity (i.e., more negations and long words) will be perceived as more expert.

Usefulness of Linguistic Cues to Perceived Expertise

The next question of interest concerns functional achievement: To what extent are the linguistic cues utilized by perceivers valid? That is, are the linguistic correlates of *perceived* expertise related to the advice-giver's *actual* expertise? Research on online health information suggests that people are poor judges of the reliability of online sources. In one study, when naïve community members were given health information written by either highly credible national organizations or generic webpages, they rated both as equally trustworthy (Bates, Romina, Ahmed, & Hopson, 2006). Research also shows that people are extremely poor deception detectors, partly because they implicitly trust others (Bond & DePaulo, 2006). One study that examined linguistic correlates to trustworthiness shows that, with the exception of word count, these cues were *not* related to message writers' actual trustworthiness (Toma & Hancock, 2012).

While this cognate body of research suggests that functional achievement should be low, it also highlights the possibility that some linguistic cues may be correctly utilized. As previously mentioned, Toma and Hancock (2012) found that word count, a linguistic cue utilized by perceivers, was in fact associated with the message's actual trustworthiness. Similarly, it is likely that trained medical doctors do have a more erudite and sophisticated vocabulary (as illustrated by long words) than untrained advice-givers, due to their advanced education. Hence, we ask:

> **Research Question 1:** Are the linguistic correlates of *perceived* expertise associated with the online medical advice's *actual* expertise?

Present Study

These hypotheses were tested using a sample of online advice written by verified medical doctors (i.e., high in expertise) or laypersons (i.e., low in expertise) on

medhelp.org, a highly trafficked medical website. The messages' linguistic features were extracted using Linguistic Inquiry and Word Count (LIWC), a text analysis software that counts words and automatically assigns them to the hypothesized categories. Then, naïve observers rated each message's expertise, without being aware of its source. The linguistic cues extracted by LIWC were correlated both with judges' ratings (to assess cue utilization) and with the message's actual expertise (to assess functional achievement).

Method

Participants and Design

Participants ($N = 361$; 82 men, 257 women; age: $M = 20.21$, $SD = 1.48$) were undergraduate students at the University of Wisconsin-Madison, who were compensated with extra-credit in their Communication courses.

The study was conducted via an online questionnaire, in which participants were randomly assigned to examine 16 online medical advice messages and asked to rate their expertise. Half of these messages were authored by medical doctors and the other half by laypersons. However, participants were unaware of the author of each piece of advice.

For each participant, randomization software extracted a subset of 16 messages from a corpus of 120 messages (see below). Each message was presented individually, with the survey questions below the advice text. For clarity, the medical condition to which the advice pertained (e.g., allergies, dermatology) was indicated before each message.

Stimuli

To maximize external validity, actual medical advice messages were downloaded from www.medhelp.org and used as stimuli in the research design. This website was selected because it contains medical advice written by both medical doctors and laypersons, thus enabling us to address our research questions. Moreover, the website is highly trafficked and influential. Medhelp.org was founded in 1994 and has more than 12 million unique visitors each month. The website claims to be "the world's largest health community" and is partnered with reputable institutions such the Cleveland Clinic, National Jewish, Partners Health, and Mount Sinai. Its stated purpose is to help individuals "take control over their health and find answers to their medical questions."

The main feature of MedHelp.org is its forum, where visitors ask health-related questions. Two types of forums are available: "Medical Support Communities," where laypersons offer advice, and "Ask the Doctor," where verified medical doctors provide advice. Verified doctors are indicated by an "MD" title that links to a profile, and by a caduceus badge. For each medical doctor included in our sample, we ran Google searches to confirm their medical affiliation and credentials, and thus ensure that the advice they provided was in all likelihood expert.

While the two forums discussed earlier are distinct, they contain similar categories of disease and health conditions, and are presented side by side on the website. Both advice-seekers' questions and advice-givers' responses are publicly available.

The stimuli were advice messages posted on these two forums. Sixty advice messages written by medical doctors were collected, and another 60 written by laypersons. These 120 stimuli were collected in the chronological order of their posting (starting with the most recent one) during a 1-month time period. The pieces of advice pertained to a range of medical conditions commonly discussed on the site, such as allergies, dermatology, and diabetes. Stimuli where the author clearly identified him/herself as a medical doctor (e.g., "as a doctor, I recommend . . .") or as a layperson (e.g., "I am familiar with this disease because I had it") were not included in the corpus. Examples of stimuli can be found in the appendix.

All 120 messages in the corpus were rated. Each message was rated, on average, 44.03 times (*SD* = 1.35).

Linguistic Cues

Linguistic Inquiry and Word Count (LIWC; Pennebaker et al., 2007) was used to extract the linguistic features of each stimulus. This text analysis software operates by comparing the words in a text against its internal dictionary of 4,500 words and then assigning them to one or several of its 76 linguistic categories. These categories include function words (e.g., articles, pronouns), and words related to sociopsychological processes (e.g., anxiety). It is possible for one word to be assigned to multiple categories. For instance, "without" is both an exclusive word and a preposition.

Each stimulus was converted into an individual text file and run through LIWC. For each stimulus, LIWC produced an output indicating word frequencies for each of its 76 categories. Word frequencies are expressed as a percentage of the total number of words contained in the stimulus. For instance, a frequency of 6.5 for articles in a stimulus containing 200 words indicates that there were 13 articles within that stimulus. See Table 1 for descriptive statistics about the linguistic categories included in this study.

In our analyses, we report the effects of individual linguistic cues (e.g., I-pronouns, anxiety-words) instead of combining them into composite indexes (e.g., psychological distancing), so as to enable direct comparisons between the present findings and existing literature, that also reports the effects of individual cues (e.g., Larrimore et al., 2011; Toma & Hancock, 2012). Additionally, much research shows that linguistic correlates to the same psychological construct sometimes operate in opposite directions than hypothesized across different contexts. For instance, liars use more words in synchronous contexts (Hancock et al., 2008), but fewer words in asynchronous contexts (Toma & Hancock, 2012). Given that composite indexes may obscure these operations by averaging across various linguistic categories, we considered it more prudent to report the effects of individual linguistic cues.

Table 1. Counts and Percentages of Words in LIWC Categories.

Dimension	Abbreviation	Example	# LIWC words	Mean	SD
Word count	WC			138.95	91.182
Words captured by LIWC	Dic.			83.70	5.32
Long Words	Sixltr			21.05	7.13
I-Pronouns	I	I, me, mine	12	1.47	1.86
Negations	Negate	No, never, not	57	1.60	1.47
Anxiety	Anx	Worried, nervous	91	0.52	0.93
Articles	Article	A, an, the	3	6.53	3.1
Quantifiers	Quant	Few, many, much	89	2.62	1.75

Note. LIWC = Linguistic Inquiry and Word Count. # LIWC words refers to the number of words per category in the LIWC dictionary. Mean refers to the mean percentage of words in each category present in our stimuli. Word count is expressed as a raw number.

Dependent Measures

Participants were instructed to carefully read each of the 16 stimuli they were assigned. Afterwards, they were asked to rate the expertise of each stimulus using two measures: (a) This message seems trustworthy to me (1 = *completely disagree*; 7 = *completely agree*) and (b) If I suffered from this condition, I would be willing to follow the advice offered in this message (1 = *completely disagree*; 7 = *completely agree*). Only two items were used because perceived expertise is a construct with high face validity, and because it was important that participants do not experience fatigue when rating the 16 messages (see Toma & Hancock, 2012, for a similar procedure).

Participants were only shown the text of the advice, without any additional information (e.g., who wrote it, when it was posted, etc.).

Other Measures

Participants reported their basic demographics (age, gender, ethnicity) and major. They also rated their general knowledge of medical information from 1 (*very low*) to 7 (*very high*). Results show that participants' self-reported level of medical knowledge ($M = 3.34$, $SD = 1.24$) was below the midpoint of the scale.

Results

The LIWC dictionary captured, on average, 83.70% ($SE = 0.49\%$) of the words contained in the stimuli. There was no difference between the length of doctors' ($M = 140.23$; $SE = 9.20$) and laypersons' advice ($M = 137.67$; $SE = 13.89$), $t(118) = 0.15$, *ns*.

As mentioned earlier, the online medical advice pertained to several medical conditions. The medical condition variable was dummy-coded and entered as a covariate in all the analyses reported below. However, it did not reach significance in any of the

analyses, indicating that the message's perceived expertise was not affected by the medical condition to which it referred, and that perceivers' ability to distinguish between messages authored by medical doctors or laypersons did not differ by medical condition. For this reason, we drop this variable from the analyses.

Perceived Expertise

Recall that participants rated the expertise of stimuli using a two-item scale. These two items were highly correlated (α = .97) and were averaged into a *perceived expertise index*. The index was normally distributed (*M* = 4.01, *SE* = 0.07, *Mdn* = 4.11, *min* = 2.20, *max* = 5.52).

The midpoint of the perceived expertise index (i.e., 4) was used to split stimuli into high or low perceived expertise categories. The split revealed that 53 stimuli (44.17%) were perceived as low in expertise and 67 (55.83%) as high in expertise. The midpoint, rather than the median, of the perceived expertise scale was used to perform the split in order to determine whether participants had a tendency to find more messages expert than not expert, thus displaying a bias toward evaluating messages positively (see Toma & Hancock, 2012, for a similar procedure). Results show that, unlike in traditional deception detection studies where people tend to believe most messages are true (i.e., they display a truth bias), participants in this study did not show a bias toward rating the messages as more expert.

Linguistic Cues to Perceived Expertise

The first goal of this project was to investigate perceivers' utilization of linguistic cues when they evaluate the expertise of online medical advice. It was hypothesized that linguistic cues pertaining to uncertainty reduction processes (i.e., word count), concrete language (i.e., articles and quantifiers), psychological distancing (i.e., I-pronouns, anxiety-related words), and cognitive complexity (i.e., long words, negations) would be associated with perceived expertise.

To test these hypotheses, a regression model was built with the perceived expertise index as the dependent variable and all the above-mentioned linguistic cues as predictors. The model fit the data well, $F(7, 112) = 10.15$, $p < .001$, and explained 35% of the variance in the dependent measure ($R = 0.62$, $R^2 = 0.39$, $R^2_{adj} = 0.35$). All the linguistic predictors reached statistical significance, except for the concreteness indicators (i.e., articles and quantifiers). Additionally, negations had the opposite effect than predicted, with more negations decreasing, rather than increasing, perceived expertise (see Table 2).

To obtain a more accurate estimation of model fit and of the coefficients of the significant predictors, the model was revised by removing the nonsignificant predictors. The revised model, including word count, long words, I-pronouns, negation words, and anxiety words as predictors, fit the data well, $F(5, 114) = 13.70$, $p < .001$, and retained its high explanatory power, accounting for 35% of the variance in the

Table 2. Linguistic Predictors of Perceived Expertise: Multiple Regression Coefficients.

	LIWC category	Standardized β	t	p
Original model				
Uncertainty reduction	Word count	0.27	3.59	<.001
Concreteness	Articles	0.05	0.66	.51
	Quantifiers	−0.11	−1.37	.18
Psychological	I-pronouns	−0.25	−3.21	<.001
distancing	Anxiety	−0.18	−2.31	.02
Cognitive complexity	Long words	0.19	2.26	.03
	Negations	−0.29	−3.67	<.001
Revised model				
Uncertainty reduction	Word count	0.25	3.33	.001
Psychological	I-pronouns	−0.25	−3.29	.001
distancing	Anxiety	−0.21	−2.75	.007
Cognitive complexity	Long words	0.24	3.04	.003
	Negations	−0.28	−3.62	<.001

Note. LIWC = Linguistic Inquiry and Word Count.

Table 3. Classification of Online Medical Advice as High Versus Low in Expertise by Judges.

		Perceived expertise	
		Low (*n* = 53)	High (*n* = 67)
Actual expertise	Laypersons (*n* = 60)	40 (66.7%)	20 (33.3%)
	Medical doctors (*n* = 60)	13 (21.7%)	47 (78.3%)

dependent measure ($R = 0.61$, $R^2 = 0.38$, $R^2_{adj} = 0.35$). All the predictors were statistically significant (see bottom panel of Table 2).

As predicted, long words were significantly associated with perceived expertise, arguably because they represent a more sophisticated vocabulary (see Table 2). However, one distinct possibility is that the use of medical terminology, rather than of long words in general, drives this effect, since medical terms tend to be long. While the LIWC dictionary does not include medical terms, it does include two related linguistic categories that are useful in addressing this possibility: health-related words and Dictionary words. The latter indicates how many words in a text were captured by the LIWC dictionary. Since many medical terms are not captured by LIWC, the Dictionary linguistic category should be inversely related to perceived expertise if the effect is driven by medical terminology. To test this possibility, we entered both health-related words and Dictionary-words in the regression model described earlier. Neither reached significance ($β = −.07$, $p = .45$ for health; $β = .04$, $p = .52$ for Dictionary), suggesting that it is long words in general, rather than medical terms, that perceivers use to infer expertise.

Usefulness of the Linguistic Cues to Perceived Expertise

The second goal of this project was to assess whether the linguistic cues to *perceived* expertise were also cues to *actual* expertise (i.e., had functional achievement). Specifically, are linguistic cues to perceived expertise useful in discerning between a medical advice message that is high in actual expertise (i.e., written by a medical doctor) or low in actual expertise (i.e., written by a layperson), even when perceivers are unaware of the provenance of the text?

In addressing this research question, the first issue that needs to be considered is how accurate participants were in assessing the expertise level of the online medical advice. An independent sample *t* test shows that stimuli written by medical doctors were judged as more expert ($M = 4.32$; $SE = 0.08$) than stimuli written by laypersons ($M = 3.69$; $SE = 0.09$), $t(118) = 5.24$, $p < .001$, Cohen's $d = 0.96$. Similarly, a point–biserial correlation showed that the perceived expertise index was significantly related to the advice-givers' expertise level ($r = -0.44$, $p < .001$). Together, these results indicate that participants' perceptions of expertise were relatively accurate, with doctors rated as more expert than laypeople, even though the participants did not have any information about the author of the advice.

The next question of interest concerns the role of linguistic cues to perceived expertise in correctly judging the expertise level of online medical advice texts. To answer this question, the linguistic cues to perceived expertise (i.e., word count, I-pronouns, negations, anxiety words, and long words) were entered in a logistic regression with actual expertise (high: doctors vs. low: laypeople) as the dependent measure. The logistic regression model fit the data well, $\chi^2(5) = 46.50$, $p < .001$, and correctly classified 81.7% of the medical advice texts. For texts written by medical doctors, the accuracy rate of the model was 83.3%, and for texts written by laypeople it was 80%. This model significantly outperforms chance ($p < .01$), indicating that perceived linguistic cues are useful in determining the accuracy of medical information online, even when it is unknown who the source of the medical advice is.

Despite its high accuracy, the linguistic regression shows that only long words were a significant predictor and therefore useful in differentiating between doctors and laypersons as the authors of the medical advice (see Table 4). Word count, negations, I-pronouns, and anxiety words were not useful in correctly assessing the source of an online medical advice message as expert or not, even though these predictors were used by judges. When the nonsignificant predictors were removed from the analyses, the model fit the data well, $\chi^2(1) = 43.11$, $p < .001$, and retained a high overall accuracy rate of 79.2%. For texts written by medical doctors, the accuracy rate of the model was 81.7%, and for texts written by laypeople it was 76.7%. As before, long words was a significant predictor ($\beta = -0.22$, $SE = 0.04$, $p < .001$). These analyses show that only one linguistic category, long words, could distinguish between online medical texts written by medical doctors and laypersons, with very high accuracy, and therefore demonstrated functional achievement. Independent sample *t* tests confirm that medical doctors' advice contained a substantially higher number of long words ($M = 24.96\%$; $SE = 0.64$) than laypersons' ($M = 17.15\%$, $SE = 0.88$), $t(118) = 7.16$, $p < .001$, Cohen's $d = 1.32$.

Table 4. The Use of Linguistic Cues to Perceived Expertise to Predict Actual Expertise: Logistic Regression Coefficients.

LIWC category	β	SE	p
Original model			
Word count	−0.001	0.002	.51
Long words	−0.21	0.04	<.001
I-pronouns	0.21	0.15	.16
Negations	0.12	0.16	.45
Anxiety	−0.18	0.26	.49
Revised model			
Long words	−0.22	0.04	<.001

Note. LIWC = Linguistic Inquiry and Word Count.

Discussion

This study used Brunswik's (1956) lens model to investigate whether linguistic cues, or elements of language that reflect a speaker's style of communication, are (a) utilized by perceivers to infer the expertise level of online medical advice and (b) demonstrate functional achievement, or are related to the advice-giver's actual expertise (i.e., medical doctor or layperson). Results reveal that perceivers utilized a small set of linguistic cues (i.e., word count, I-pronouns, anxiety words, long words, and negations) to ascertain advice-givers' expertise. These cues had strong predictive value, accounting for over a third of the variance in perceived expertise. However, only one of these cues (i.e., long words) was useful in distinguishing between messages written by expert sources (i.e., medical doctors) from nonexpert ones (i.e., laypersons), indicating that the functional achievement of the cues utilized by perceivers was low. These findings have important theoretical and practical implications.

Extant literature has shown that an array of psychological constructs (e.g., deception, personality, depression) are reflected into linguistic cues. The present study is the first to extend this literature to perceived expertise, a critically important psychological assessment. Indeed, evaluating expertise is essential in medical, financial, managerial, and political contexts, and particularly on the Internet, where it is often difficult to ascertain message writers' credentials.

We developed a theoretical framework that links linguistic cues with perceived expertise, by arguing that perceivers utilize cues depending on their psychological needs. These needs are context-and goal-dependent. In the medical advice arena, we first theorized that perceivers would experience a potent need for uncertainty reduction, because medical conditions are riddled with uncertainty (which is why advice is necessary in the first place), and advice-givers are unknown entities. Longer messages, that met the need for uncertainty reduction, would then be associated with greater expertise. This hypothesis received strong support. In fact, message length had the single greatest impact on perceived expertise. This study, in conjunction with prior

work that has similarly found associations between word count and trustworthiness (in online dating, peer-to-peer lending, EBay, and Facebook), provides compelling evidence that message length is an important correlate to perceived expertise in online environments where people are evaluating strangers.

Second, we predicted that online medical advice-seekers would value message concreteness as an indicator of expertise. Prior research has argued that message concreteness, as denoted by an increased use of quantifiers and articles, facilitates message processing and therefore increases perceived trustworthiness (Larrimore et al., 2011; Toma & Hancock, 2012). This hypothesis was not supported. One possibility is that indicators of concreteness are interpreted differently by online medical advice-seekers than by Internet users in other contexts. For instance, quantifiers (e.g., "few," "many," "lots") contain an element of imprecision, where exact quantities are not specified. Online medical advice-seekers may desire more precise statements. A sentence such as "take a few pills" may be viewed as less expert than "take one pill a day," even though it contains more quantifiers. Future research is necessary to elucidate the utilization of concreteness indicators in various online contexts.

Third, we hypothesized that psychological distancing between the advice-giver and receiver is desirable in a medical context, since this distance ensures that the advice-giver is objective. We predicted that psychological distancing would be illustrated linguistically by a decrease in first-person pronouns and in anxiety words. This hypothesis received strong support, indicating that advice-givers who demonstrated a lack of focus on personal experiences and an avoidance of emotions antithetical to clear thinking were more positively evaluated.

Fourth, we hypothesized that advice-givers who demonstrated depth of thinking and reasoning would be perceived as more expert. Depth of thinking is denoted linguistically by markers of cognitive complexity, such as long words and negations. This hypothesis received mixed support. The usage of long words in general (not necessarily long words that convey medical concepts) was associated with expertise, presumably because they indicate a sophisticated vocabulary and ease in conveying complex concepts. However, negations were inversely associated with perceived expertise. Prior studies have argued that negations denote cognitive complexity because they are helpful in making distinctions, such as whether something belongs in a category or not—a cognitively complex task (Abe, 2011; Pennebaker & King, 1999). However, in the present context it is possible that negations simply reflected a negative tone, which advice-seekers found undesirable. Indeed, overcoming illnesses requires a positive mind frame, which is why negativity (as indicated by an increased use of negations) might have elicited distrust. Future research is necessary to understand the association between negations and perceived expertise.

In sum, together with prior work by Larrimore et al. (2011) and Toma and Hancock (2012), the present study demonstrates that, just as linguistic cues validly indicate speakers' underlying psychological states, they are also utilized by perceivers to form impressions. It is notable that both the present study and Toma and Hancock (2012) found that very large proportions of variance were explained by linguistic cues—35% and 48%, respectively, suggesting that language use powerfully shapes impressions of

expertise and trustworthiness, and that that the utilization of linguistic cues in contexts in which expertise is important should be a fruitful avenue for future research.

The final goal of this study concerned the accuracy of expertise perceptions. Much research has demonstrated that people are poor deception detectors, performing no better than chance (Bond & DePaulo, 2006). However, perceivers in our sample were accurate at gauging the expertise of medical advice messages, correctly classifying texts produced by medical doctors as expert and texts produced by laypersons as not expert. This could be the case because deception detection is a narrow and specific task, where perceivers need to make a dichotomous decision—is the text true or false? Conversely, perceived expertise is a more global judgment that involves processing larger amounts of information than a single utterance. Individuals may be better at making global assessment that do not hinge on simple true–false decisions.

Despite this level of accuracy, the linguistic cues utilized by perceivers to ascertain the messages' expertise were largely incorrect, in the sense that they did not distinguish between messages written by medical doctors and laypersons. One notable exception emerged: long word, which had a 79% accuracy rate in categorizing the message source as a medical doctor of layperson. This substantial effect is highly encouraging, suggesting that certain linguistic cues can be usefully attended to in making expertise decisions. Overall, however, in Brunswik's (1956) lens model terms, the cues utilized by perceivers to gauge expertise achieved little functional achievement.

This study also informs the growing literature on how health consumers evaluate the expertise of online health information. Research to date has overwhelmingly focused on how trustworthiness perceptions, including expertise and benevolence, are affected by contextual factors, such as website and design features (Metzger, Flanagin, Eyal, Lemus, & McCann, 2003, Robins, Holmes, & Stansbury, 2010). To the best of our knowledge, no research to date has investigated the association between linguistic characteristics of the message and perceived expertise. Given the substantial effect sizes uncovered in this study, we argue that an important avenue for theorizing in this area is to incorporate linguistic factors in the models that predict the reception and interpretation of online health messages. For instance, future research should investigate the relative weight of linguistic cues compared with structural and design features, such as third-party endorsement, clear identification of the authorship of a message, and so on. Do linguistic cues to expertise override the importance of these other indicators, or are the linguistic cues overpowered by them?

On the practical front, this research has numerous applications. First, the findings are directly relevant to those who are in a professional position to convey medical advice. Patient-centered communication is considered essential in medicine, but there is little agreement on exactly what practices defines it and how to measure it (Epstein et al., 2005). For some, the answer to better health communication is simplified language (Doak, Doak, & Root, 1996; McGee, 1999; Root & Stableford, 1998; Schwartzberg, Van Geest, & Wang, 2005). Here we provide insights for patient-centered communication by identifying particular features of language that affect how much trust patients put in a message. These linguistic features are measureable factors that can be taken into account when designing patient-centered messages. Additionally,

results cast a new light on the idea that simplified communication is desirable. While simple language may be effective in some situations, it may hamper the perceived expertise level of the message, thus potentially undercutting the likelihood that the advice will be followed.

Second, the results of this study are important for practitioners who need to communicate with constituents online. Healthcare professionals have been incentivized to communicate with patients online by the growth of social media platforms (Saleh et al., 2012). In this context, it is possible that medical doctors will present themselves and their information in a more personal or laid-back manner, as social media invites certain expectations of self-presentation, including informality (D'Angelo & Van Der Heide, in press). However, as this research indicates, it is important that doctors maintain a professional writing style, since this writing style affects how expert their message is perceived.

Finally, this research is relevant to the phenomenon of online health scams. These scams, or "miracle cure peddling quack," have been remarkably successful on the Internet (Vasconcellos-Silva, Castiel, Bagrichevsky, & Griep, 2011; Whalberg, 2007). When presented only through email and low-tech websites, devoid of cues to credibility, the health messages produced by these fraudulent sources are often successful. This research provides insight into why such messages are successful—it is not only structural cues that matter online: When written the right way, a message could be deemed as expert regardless of its actual content. Thus, one path to producing better health consumers may be to warn them about their own biases.

Limitations and Additional Avenues for Future Research

This study has several limitations that should be addressed by future research. First, the participants in this study did not in fact suffer from medical conditions, but simply imagined how they would evaluate online health advice if they were ill. While this procedure is common in the literature, it is important that future research triangulates these findings with real patients. Second, participants in this study evaluated only the textual component of the online advice. In real-life practice, advice-seekers have access to more information than just the text of the advice, including its source, the website where it is posted, and so on. Future research should investigate how linguistic cues to expertise are used in conjunction with this additional information. Third, future research should investigate whether the linguistic cues identified here are used consciously or not. Function words such as negations and pronouns are usually processed unconsciously (Chung & Pennebaker, 2007), but it is possible that perceivers pay conscious attention to long words or the length of the message.

Conclusion

Perceptions of expertise are essential in the social arena, and as this research demonstrates, they are heavily influenced by linguistic styles. Understanding how to use language to come across as expert is essential not only for health practitioners and

consumers, but also for politicians reaching out to audiences or team members working together. We believe this is an important arena for research development.

Appendix

Examples of Online Medical Advice

Dermatology Advice #1 (written by verified medical doctor). Melasma is a dark skin discoloration found on sun-exposed areas of the face. This is a very common skin disorder. It is often associated with the female hormones estrogen and progesterone. Sun exposure is also a strong risk factor for melasma. It is particularly common in tropical climates.

Creams containing tretinoin, kojic acid, and azelaic acid have been shown to improve the appearance of melasma. Chemical peels or topical steroid creams may sometimes recommended. Melasma often fades over several months.

Dermatology Advice #2 (written by layperson). I am not sure about what the dots are, but I do suggest you be very careful with the cortaid. Hydrocortisone can cause eye damage if it gets in the eye because it is a steroid. though I doubt it would happen, getting hydrocortisone in your eyes may cause blindness. so, please tell him to be careful!

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