


Characteristics and Correlates of Word Use in Physician-Patient Communication

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Abstract

Background Numerous studies have described and evaluated communication in healthcare contexts, but these studies have focused on broad content and complex units of behavior. Growing evidence reveals the predictive power and importance of precise linguistic characteristics of communication.

Purpose This study aims to document characteristics, predictors, and correlates of word use within specific linguistic categories by physicians and patients during a healthcare visit.

Methods Conversations between patients ($n=145$) and their physician ($n=6$) were audio recorded, transcribed, and analyzed using Linguistic Inquiry Word Count software. Patients also completed questionnaires prior to and immediately following the visit and (for a subset of patients) at a follow-up visit, which assessed patients' demographics, how much they liked the physician, and self-reported adherence. Physicians completed a questionnaire following the initial visit that assessed the patient's health status, the physician's optimism regarding the upcoming treatment, and satisfaction with the productivity of the visit.

Results Patients and physicians differed in the extent of their word use in key linguistic categories, while also maintaining significant linguistic synchrony. Demographic characteristics and health status predicted variability in patients' and physicians' word use, and word use predicted key visit outcomes. Most notably, patients liked their physician more when

physicians used fewer negative emotion words and were less adherent when physicians used more singular first-person pronouns.

Conclusions These findings reveal patterns in the way physicians speak to patients who vary in their demographic characteristics and health status and point to potentially fruitful targets for linguistic interventions with both physicians and patients.

Keywords Physician-patient communication · Word use · Patient satisfaction · Adherence

Ineffective communication between physicians and their patients has serious consequences for patients, including psychosocial distress, unnecessary treatment, inadequate symptom management, and poor quality of life [1, 2]. Physicians also have good reason for concern, as poor communication on their part can erode patients' trust [3], comprehension of information provided during medical visits [4], and even adherence to treatment recommendations [5, 6]. The present study uses a novel approach to evaluate physician-patient communication. Although numerous studies have described and evaluated communication in healthcare contexts, these studies tend to take a "bird's eye view" of communication by focusing on broad content and complex units of behavior, e.g., [7]. The goal of the present study was to zoom in to the level of individual words used by patients and physicians to document characteristics and correlates of word use in a healthcare encounter. Specifically, the present study uses word use within well-established linguistic categories to assess core aspects of successful patient care: rapport (marked by pronoun use and language style matching); a focus on the patient's future, including treatment and recovery (marked by verb tense); emotional tone (marked by positive and negative emotion words);

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and collective processing of the medical situation (marked by cognitive process words).

Assessing Physician-Patient Communication

The long-standing focus on physician-patient communication has yielded a variety of methods for examining healthcare interactions, including checklists, self-report measures and rating scales, and interaction analysis systems, e.g., [7–10]. Although the methods commonly used to assess physician-patient communication provide an abundance of information, they focus on broad aspects of the content or tone of an interaction. Largely lacking are examinations of the more fine-grained characteristics of communication between patients and physicians, which can capture subtleties of communication that patients' reports and human coding might miss.

In fact, a growing body of evidence reveals the predictive power and importance of word use in various non-medical contexts, demonstrating that specific types of words can be indicators of the quality of close relationships [11, 12], deception [13], and even changes in mental and physical health [14]. Taking relationship closeness as an example, considerable evidence points to the use of first-person pronouns as a marker of interpersonal connectedness, such that use of plural pronouns ("we," "us") indicates greater connectedness than does the use of singular pronouns ("I," "me"). Typical approaches to detecting connectedness between physicians and patients would ask one or both parties to report their subjective perceptions on a questionnaire, or perhaps have trained coders rate their perceptions based on a recording or transcript of the interaction. However, both of these approaches fall victim to the many biases and errors endemic to subjective human judgments [15]. An approach that instead assesses the objective frequency with which each party uses plural and singular first-person pronouns avoids such bias in its assessment of interpersonal connectedness.

Analysis of Word Use Advances in technology have spurred the use of computer programs designed to evaluate the frequency of word use in various linguistic categories, most notably the Linguistic Inquiry and Word Count software LIWC [16]. This program allows for uniform and efficient evaluations of word frequency across functional and psychological dimensions of language such as pronouns and emotion words. Although the expansive LIWC dictionary contains 80 word categories relevant to commonly studied psychological variables of interest and derived from psychological theory [17, 18], the present study focuses on categories that have garnered consistent empirical support for their interpretive validity and that map onto core aspects of successful patient care. To this end, the present study will examine patients' and physicians'

use of first-person pronouns, verb tense, emotion words, cognitive process words, and language style matching.

First-Person Pronouns When physicians build rapport with their patients through supportive behaviors and a collaborative approach to healthcare, patients are more adherent to clinicians' treatment recommendations [19, 20] and are more satisfied with their medical visits [21]. Pronoun use, at its core, indicates the focus of the speaker's attention [22, 23], but pronouns can also reveal deeper aspects of the speaker or context. Relevant to physician-patient communication, use of plural first-person pronouns (we, us, our) tends to indicate a sense of interdependence and cohesiveness among the parties present, i.e., rapport [24–26]. Some research even suggests that pronoun choice can influence perceptions of interpersonal closeness, such that use of plural first-person pronouns can increase perceptions of closeness during an interaction, whereas singular first-person pronouns can decrease perceptions of closeness [27]. Thus, pronoun choice in healthcare contexts may reveal subtleties of interpersonal closeness and rapport among physicians and their patients.

Verb Tense The temporal focus of conversation between a physician and patient has important implications for patient outcomes. Most notably, studies have found that patients want their physicians to focus on treatment options, a future-oriented topic [28, 29]. Verb tense is the key indicator of temporal focus within a conversation [17], whether past (e.g., went, had, did), present (e.g., is, have, does), or future (e.g., might, ought, will) and thus can reveal whether the focus of physician-patient conversations is on treatment and other future-oriented topics or on past and present concerns such as medical history and current symptoms.

Emotion Words As a general rule, emotion words convey exactly what one would expect: Positive emotion words (e.g., love, nice, sweet) reflect a positive mood or mindset, negative emotion words (e.g., hurt, stress, pain) reflect a negative mood or mindset. Emotional tone in physician-patient interactions predicts an array of patient-related outcomes. When physicians demonstrate positive emotions via verbal and nonverbal behavior, patients trust their physicians more [30], demonstrate better recall for the information presented, are more satisfied, and better adhere to treatment recommendations [31]. Physicians can also use emotional tone to manage patients' distress, as verbal expressions of emotion can reflect an intentional effort on the part of the speaker to convey a positive or negative message, sometimes in an effort to strategically manage the emotions of the recipient [32].

Emotional language conveyed by patients may also be predictive of their outcomes. Patients' moods and emotions shape their preferences for care and treatment [33], and a recent study found that patients' emotional reactions to healthcare

visits predicted their intentions to adhere to the clinician's recommendations [34]. Together, studies of physician-patient communication and use of emotional language highlight the likely importance of emotion word use during healthcare visits.

Cognitive Process Words The dynamics of information exchange and processing during medical visits have implications for how patients perceive their physicians [35, 36] and for patient satisfaction and adherence [37, 38], and the subtleties of such processes are reflected in the language physicians and patients use [39]. The use of cognitive process words, as delineated in the LIWC software (e.g., think, because, should), reflects a process of sense-making or “puzzling through” an experience [18] that may be utilized by both patient and physician when making decisions together. Outside of the medical context, cognitive process words have been associated with physical health improvements in college students writing about traumatic events [40] or about coming to college [41], as well as in broad samples (e.g., inmates, medical students, unemployed professionals) writing about various challenging and traumatic events [42], supporting the idea that such words reflect productive cognitive processing.

Language Style Matching Rapport building between physician and patient is a key function of the medical interview [43]. Rapport building on the part of the physician, as demonstrated through socioemotional behaviors such as providing encouragement and conveying empathy, has been linked to greater patient satisfaction and better adherence [44]. The language used during a medical interview, and particularly the extent to which physicians' and patients' language use resemble each other (i.e., language style matching), may indicate the extent to which physicians and patients have built good rapport.

Analysis of language style matching takes into account the similarity in use of function words within a dyad in nine linguistic categories (e.g., pronouns, articles, conjunctions), thus capturing the extent to which two parties' language styles are “in sync” within an interaction. Research on language style matching has found that this characteristic of conversation develops naturally over the course of an interaction [45]. Language style matching has been associated with fluctuations in the quality of relationships as revealed in poetry and letters [12], with group cohesiveness in small group discussions among college students [46], and with social engagement in negotiations conducted in real time online [47], supporting language style matching as a good proxy of rapport.

Outcomes of Effective Physician-Patient Communication

In addition to documenting the characteristics of word use in healthcare encounters, the present study also examined whether patient outcomes are associated with word use in the key linguistic categories just described. We focused on two outcomes of importance to patients' well-being and health: satisfaction and adherence. As documented in the previous section, a large body of literature has examined links between physicians' communication skills and patient satisfaction and has identified beneficial behaviors, such as providing clear information and counseling, rapport building, and positive talk [31]. We extended this work to examine the linguistic characteristics of conversations that promote or diminish patient satisfaction, although we focused our measure on assessing how much patients liked the physician with whom they interacted to capture physician-specific reactions rather than evaluations of the care process as a whole. We also assessed physicians' satisfaction with the visit to capture success as perceived by both sides of the dyad.

Regarding adherence, a meta-analysis concluded that patients are more likely to follow physicians' recommendations when physicians communicated more effectively [6], and an earlier meta-analysis identified positive talk and providing information as behaviors that are particularly effective for promoting adherence [31]. As with satisfaction, we also included an analogue of adherence in a survey completed by physicians (optimism about the success of the recommended treatment) to fully explore the dyadic outcomes of word use in healthcare encounters.

Overview

The current study represents the first attempt to document the nature, predictors, and correlates of word use by physicians and patients during a pre-surgical consultation using the fine-grained analysis afforded by LIWC software.

Focusing on the linguistic categories described above, the study had three aims. First, this study compared patients' and physicians' word use to reveal differences in and relationships between word use within healthcare visits. We hypothesized that patients would use more singular first-person pronouns, past tense, and negative emotion words given the centrality of symptom reporting in most healthcare visits. In contrast, we hypothesized that physicians would use more plural first-person pronouns, future tense, positive emotion words, and cognitive process words given physicians' focus on forming treatment plans and encouraging adherence to them.

Second, this study examined demographic and health-relevant predictors of patients' and physicians' word use. This aim was largely exploratory, but we tentatively (and

optimistically) anticipated that physicians would use more productive linguistic styles (plural first-person pronouns, positive emotion words, cognitive process words) with more typically vulnerable patients (more severe condition, less healthy, older, less educated, ethnic minority, low health literacy). Although these hypotheses may seem counterintuitive, we reasoned that physicians may put forth additional effort toward effective and empathic communication with patients who pose more of a challenge by one definition or another.

Finally, this study examined relationships between word use and visit outcomes. We hypothesized that greater use of plural first-person pronouns (and less use of singular first-person pronouns), greater use of future tense, greater use of positive emotion words (and less use of negative emotion words), greater use of cognitive process words, and more language style matching would predict better visit outcomes.

The ultimate goal of the study was to identify linguistic categories that are particularly important for successful patient care, thus pointing toward opportunities for linguistic interventions in medical training.

Method

The data presented here are a subset of a larger study conducted at the Riverside County Regional Medical Center (RCRMC) General Surgery Clinic (Department of Surgery) between November 2011 and January 2013. For the purpose of the research questions at hand, this paper will focus on select information obtained before and after patients' pre-operative consultation and after surgery but just prior to their post-surgical consultation. We also narrowed our sample to participants who completed pre-operative questionnaires and whose consultation was successfully audio recorded and transcribed (see below for details). This study was approved by the Institutional Review Boards at the University of California, Riverside, and RCRMC.

Participants and Recruitment

Physicians ($n=6$; 100 % male) and their patients scheduled for a pre-operative surgical consultation during the study period ($n=145$ for the purpose of our analyses; 39.7 % women; 46.6 % Hispanic/Latino [ethnicity]; 80.8 % White/Caucasian [race]; $M_{\text{age}}=46.1$ years, $SD_{\text{age}}=12.2$ years, range 18–64 years) consented to participate in this study. Patients were eligible to participate if they were between 18 and 90 years of age and fluent in either English or Spanish (no patients were ineligible due to language constraints). However, patients who conversed with their physician in Spanish ($n=39$) were excluded from the present analyses because it was deemed inappropriate to analyze these conversations with software

developed for analysis of English speakers' word use. All physicians who saw patients in the General Surgery Clinic during the period of data collection (November 2011 through January 2013) consented to participate.

Patients were being evaluated for surgery for a variety of reasons, including hernia repair (42.7 %), removal of a mass of soft tissue (15.6 %), gallbladder removal (13.5 %), rectal or anal surgery (6.3 %), colon surgery (7.3 %), a biopsy (7.3 %), breast surgery (3.1 %), or a procedure other than those already listed (4.2 %). Although more than half the sample completed only high school (60.3 %), some reported they did not earn a high school diploma (21.4 %) and some earned a 2- or 4-year college degree (18.3 %). A majority of patients reported having some kind of health insurance coverage (82.5 %), although most were part of a local insurance program for low-income residents (65.8 %).

As reported below, our analyses account for the grouping of patients within physicians. However, patients were not evenly distributed across physicians. One physician saw 37 patients relevant to our analyses; one saw 32 patients; one saw 26 patients; one saw 13 patients; one saw 11 patients; and one saw 9 patients.

Measures

Data pertinent to the research questions at hand were obtained from three patient questionnaires: the first prior to the pre-operative consultation, the second immediately following the pre-operative consultation, and the third following surgery but before the post-surgical consultation with their physician. Although analyses in this paper do not use these questionnaires in their entirety, nor do they use all available questionnaires in the study, the full questionnaires are available upon request. Physicians also completed a survey at the conclusion of the pre-operative consultations. Additional methodological details are available in the other research published from this data set [48–50].

Patient Pre-operative Pre-consultation Survey Prior to meeting with their physician, patients indicated their health literacy with a single-item measure previously validated against the two most widely used health literacy assessment instruments [51, 52], ("How confident are you filling out medical forms by yourself?"; 1 = not at all, 10 = completely confident; $M=7.12$, $SD=3.34$). Patients also responded to items assessing demographic characteristics.

Patient Pre-operative Post-consultation Survey Immediately following the pre-operative surgical consultation, patients completed a second survey that assessed (relevant to this study) how much patients liked the physician with whom they had interacted ("How much do you like the doctor(s) you saw

today?"; 1 = strongly dislike, 10 = like very much; $M = 9.25$, $SD = 1.51$).

Physician Pre-operative Post-consultation Survey

Immediately following the consultation, physicians indicated their patients' scheduled surgery type, current physical health (1 = extremely sick, 7 = extremely healthy; $M = 5.42$, $SD = 1.24$), condition severity (1 = very mild, 7 = very severe; $M = 4.89$, $SD = 1.51$), expected surgical outcomes (1 = little or no improvement in quality-of-life, 7 = drastic improvement in quality-of-life; $M = 5.81$, $SD = 1.34$), and the overall visit quality (adapted from [53]; 1 = very unproductive, 7 = very productive; $M = 6.08$, $SD = 1.08$).

Patient Post-operative Pre-consultation Survey

Patients who returned for a post-surgical consultation responded to the third survey before the consultation began. Most relevant to this study are patients' responses to the General Adherence Scale, a five-item measure of adherence to physician treatment recommendations developed by RAND for the Medical Outcomes Study [54–57]; "Thinking about the time since your surgery, did you follow your doctor's suggestions exactly?"; "Generally speaking, how often since your surgery were you able to do what the doctor told you to do?"; "Did you find it easy to do the things your doctor suggested you do?"; "Thinking about the time since your surgery, did you have a hard time doing what the doctor suggested you do?"; "Were you unable to do what was necessary to follow your doctor's treatment plans?" 1 = none of the time, 5 = all of the time; $M = 3.90$, $SD = .75$). Earlier validation work confirms a weak correlation between responses on this measure and responses on an assessment of socially desirable responding [55].

A reliability analysis of all five items within our data, after reverse-scoring the two negatively worded items (i.e., items for which higher numbers on the original scale indicated less adherence), yielded a low Cronbach's alpha ($\alpha = .36$), which further inspection revealed to be diminished significantly by the two negatively worded items ("Thinking about the time since your surgery, did you have a hard time doing what the doctor suggested you do?" and "Were you unable to do what was necessary to follow your doctor's treatment plans?"). Removing these items increased internal reliability to an acceptable level ($\alpha = .75$), and thus only the three positively worded items were retained.

Procedure

Trained research assistants approached patients scheduled for a pre-operative surgical consultation as they waited to meet with their physician. After a brief introduction to the study, patients completed consent procedures, which allowed them to consent only to the questionnaires (32 % of the total patient

sample) or to both questionnaires and audio recording their visit. Patients who consented to participate completed the first survey on a tablet computer with the aid of a research assistant before the pre-operative consultation began. The researcher obtained consent to audio record the consultation between the physician and patient (both physician and patient had to consent for the audio recording to proceed). In some cases, it was not possible to obtain an audio recording of the pre-operative conversation between physician and patient (audio recordings were obtained from 145 English-speaking patients), and these cases were excluded from analyses due to the focus on word use during the consultation. Reasons for failing to obtain a recording include discomfort on the part of the patient or physician and technical difficulties. Patients then responded to the second survey once their pre-operative consultation ended. Physicians completed their survey at this time as well.

Patients who underwent surgery, attended their post-operative consultation in a timely fashion, and consented to continue participation responded to the third survey at the start of the post-operative visit, prior to seeing the surgeon again ($n = 143$, 35.5 % retention; 52 had useable audio recordings from the pre-operative visit and thus are included in our analyses). The primary reason for attrition was delay or cancellation of the plan for surgery, most often due to insurance or medical complications. Patients who did and did not return following surgery did not differ in any measure of interest nor did they differ in demographic characteristics.

Analyses

Recordings were transcribed by a professional transcriptionist for the purpose of word use analysis. Transcripts were then separated by speaker (patient or physician). The separated transcripts were then analyzed with Linguistic Inquiry and Word Count software LIWC [16]. LIWC calculates the number of words that fall into predefined linguistic categories in the standard LIWC dictionary in a segment of text, then converts them into percentages of total words in that segment. For example, a value of 4.7 in the "singular first-person pronouns" category indicates that 4.7 % of the total words in the text segment (i.e., either the patient's or physician's side of the conversation) were singular first-person pronouns. All analyses utilized these category percentages of total word use.

Although the standard LIWC dictionary is quite extensive, analyses focused on categories that have received significant validation in the broader literature. Specifically, analyses examined patients' and physicians' use of first-person pronouns (singular and plural), verb tense (past, present, and future), positive and negative emotion words, and cognitive process words (including causation, insight, discrepancy, tentative, and certainty words). Analyses also assessed total number of

words used by each speaker and language style matching. Language style matching is calculated by determining the degree of similarity in the frequency of each speaker's word use within nine key linguistic categories that capture use of function words (e.g., articles, conjunctions; see [46] for details). Descriptive statistics for these word categories and subcategories, by speaker, can be found in Table 1.

Analyses proceeded in four steps. First, paired samples *t* tests were conducted to compare the frequency of word use within each linguistic category between patients and physicians within each pre-operative consultation. That is, this analysis examined differences in word use between patients and physicians.

Second, bivariate correlations examined relationships between patients' and physicians' word use in each category during the pre-operative consultation. That is, this analysis examined synchrony (or asynchrony) in word use within the physician-patient dyad.

Third, a series of simultaneous multiple regression analyses were conducted to predict patients' and physicians' word use at the pre-operative consultation (separately) from various patient characteristics. Specifically, word use was predicted from patients' gender, age, educational attainment, ethnicity (Hispanic/Latino or not), and health literacy, simultaneously. Word use was also predicted from physician-rated health and condition severity (simultaneously). Due to the limited number of physicians in the study and their homogeneity on key demographic variables (all White or Asian, all male), we only examined patients' characteristics as predictors of word use.

Finally, a series of simultaneous multiple regressions predicted outcomes of the visit from patient and physician word use (simultaneously, and separately for each linguistic category). Specifically, physicians' and patients' pre-operative word use were entered as predictors of how much patients liked their physician as rated by the patient immediately following the pre-operative consultation, optimism about the surgery and the productiveness of the visit as rated by the physician immediately following the pre-operative consultation, and adherence as reported by patients when they arrived for the post-operative appointment.

Simultaneous multiple regression procedures were used rather than bivariate correlations in most analyses in an effort to capture the unique contribution of each speaker's word use (patient vs. physician). This approach also substantially reduced the total number of analyses and thus the risk of alpha inflation. For all analyses except those comparing frequency of word use between patients and physicians within a linguistic category, we accounted for the grouping of patients within physicians using the CLUSTER option in MPlus 7.2. This analytic step adjusted the standard errors to account for the non-independence of observations for patients who saw a particular physician. Specifically, the computation uses a "sandwich" procedure (the standard Huber-White procedure [58, 59] to calculate robust standard errors that do not assume independence between patients who saw the same physician, only between patients who saw different physicians. Table 1 presents intraclass correlations (ICCs) reflecting physician-level variability in word use by patients or physicians in the relevant linguistic category.

Table 1 Frequency of word use (percentage of total) within linguistic categories

	Base rates	Patients <i>M</i> (SD)	Physicians <i>M</i> (SD)	Paired <i>t</i> test			Correlation		ICC	
				<i>t</i>	<i>p</i>	<i>d</i>	<i>r</i>	<i>p</i>	Patient	Physician
Total words	394	366.11 (489.45)	499.45 (378.00)	2.80	.006	.25	.40	<.001	<.001	.018
Singular first-person pronouns	5.6	7.95 (3.53)	2.63 (1.40)	17.60	<.001	1.94	.10	.12	<.001	.126
Plural first-person pronouns	1.0	.36 (.75)	2.23 (1.62)	12.81	<.001	1.50	-.06	.61	<.001	.183
Past tense	4.5	3.98 (2.67)	1.84 (1.30)	10.77	<.001	.94	.46	<.001	<.001	.024
Present tense	13.7	11.43 (3.91)	13.62 (3.01)	5.92	<.001	.64	.17	.02	.021	.059
Future tense	0.9	.81 (.93)	1.71 (1.06)	8.56	<.001	.89	.18	.02	<.001	.123
Positive emotion words	2.7	7.87 (6.32)	4.51 (2.15)	6.18	<.001	.70	.09	.38	.008	.054
Negative emotion words	1.3	1.42 (1.38)	1.64 (1.08)	1.67	.098	.17	.25	.03	<.001	.002
Cognitive process words	7.3	13.83 (4.86)	17.57 (4.02)	7.38	<.001	.83	.08	.06	<.001	.251
Language style matching	N/A	.74 (.17)		N/A			N/A		<.001	

Note: $n = 133$ for all analyses. Language style matching scores are bounded by 0 and 1, with higher numbers representing greater matching. All word categories except total words and language style matching are reported in percentages of total word use. Significance tests (*p* values) for correlations reflect adjustment of standard errors to account for the clustering of patients within physicians. ICC indicates the intraclass correlation reflecting physician-level variability in word use by patients or physicians in the relevant linguistic category. Base rates are average frequencies from seven previous studies of word use in spoken language [15]

Results

Differences in Patients' and Physicians' Word Use

Table 1 presents the results of the paired samples *t* tests comparing the frequency of word use by patients and physicians in each linguistic category. Physicians used more total words, more plural first-person pronouns, more present and future tense, and more cognitive process words. In contrast, patients used more singular first-person pronouns, past tense, and positive emotion words. No significant difference emerged in patients' and physicians' use of negative emotion words.

Relationships Between Patients' and Physicians' Word Use

Table 1 presents bivariate correlations between patients' and physicians' word use in each linguistic category, adjusted for the clustering of patients within physicians. Patients' and physicians' total word use; use of past, present, and future tense; and negative emotion words were positively correlated. Use of singular and plural first-person pronouns, positive emotion words, and cognitive process words were not significantly correlated.

Predictors of Patients' and Physicians' Word Use

Demographic Table 2 presents the results of the simultaneous multiple regressions predicting patients' and physicians' word use (separately) from patient characteristics, adjusted for the clustering of patients within physicians. Turning first to demographic predictors, older patients used more plural first-person pronouns, more past tense, and fewer negative emotion words than younger patients, and their physicians used fewer negative emotion words and fewer cognitive process words than they did with younger patients. Female patients used more positive emotion words and fewer negative emotion words than did male patients; physicians used more plural first-person pronouns with female patients than with male patients (all physicians were male).

Hispanic patients used fewer plural first-person pronouns, less past tense, less future tense, more positive emotion words, and fewer negative emotion words than did non-Hispanic patients; physicians did not differ in their word use with their Hispanic and non-Hispanic patients. Patients who had completed more formal education used more plural first-person pronouns, less past tense, and more present tense, whereas their physicians used more singular first-person pronouns, fewer plural first-person pronouns, and less future tense. Finally, patients higher in health literacy used more past and future tense and had stronger language style matching with their physicians, and their physicians used more total words and less present tense.

Health Status Table 2 presents the results of the simultaneous multiple regressions predicting patients' and physicians' word use (separately) from patients' health status (patients' health and the severity of the relevant health condition, as rated by the physician, as simultaneous predictors), controlling for the clustering of patients within physicians. Of note, physicians' ratings of patients' health and the severity of their condition were not significantly correlated, $r(136) = .04$, $p = .65$. Physicians of healthier patients used more present tense, and healthier patients used more plural first-person pronouns and fewer negative emotion words. Physicians of patients with more severe conditions used more total words and less past tense and present tense, and patients with more severe conditions used more total words and more present tense and experienced more language style matching with their physicians.

Post-consultation Outcomes Associated with Patient and Physician Word Use

Table 3 presents the results of the simultaneous multiple regressions predicting outcomes of the consultation (patients' and physicians' responses to post-consultation questionnaires) from patient and physician word use, adjusted for the clustering of patients within physicians. Although we focus here on the well-validated categories of interest in this paper, interested readers can reference Table 4 to see findings for additional linguistic categories.

Beginning with feelings toward the physician, patients reported that they liked the physician they saw during the consultation more when that physician used fewer negative emotion words and when the patients themselves used fewer singular first-person pronouns and more past tense. Regarding adherence, at the start of the post-operative visit, patients reported greater adherence since the time of the surgery to the extent that both physicians and patients had used fewer singular first-person pronouns at the pre-operative visit and to the extent that patients had used less present tense at the pre-operative visit.

Finally, we examined physicians' perceptions of the upcoming surgery and the visit. Following the consultation, physicians reported greater optimism about the success of the upcoming surgery when patients had used more plural first-person pronouns and more present and future tense and when physicians had used *less* future tense. Physicians were also more optimistic when the dyad had experienced more language style matching. Physicians tended to rate the consultation as more productive when patients used fewer singular first-person pronouns and more plural first-person pronouns, more future tense, and more positive emotion words, but when physicians used *fewer* positive emotion words. Findings from all analyses are summarized in Table 5.

Table 2 Multiple regression analyses predicting word use from patient characteristics

	Patient-reported demographic characteristics					Physician-reported health status	
	Age	Gender ^a	Ethnicity ^b	Education	Health literacy	Health	Condition severity
Physician word use (<i>n</i> = 129)							
Total words	.07	-.02	-.07	.10	.13**	-.21	.23*
Singular first-person pronouns	.11	-.10	-.07	.21**	.05	-.04	-.15
Plural first-person pronouns	.08	.16*	.05	-.12*	-.03	.05	-.07
Past tense	.10	.04	<.01	-.15	.11	-.06	-.09*
Present tense	-.13	-.03	.07	.08	-.12**	.13*	-.22**
Future tense	.01	.10	-.09	-.11*	-.06	-.10	.09
Positive emotion words	.06	-.14	.02	-.02	-.07	-.21	-.03
Negative emotion words	-.23*	-.02	-.15	-.07	.01	-.04	-.05
Cognitive process words	-.20*	.03	-.08	-.01	-.15	.05	.13
Patient word use (<i>n</i> = 124)							
Total words	.19	-.02	.03	.06	.06	.03	.14**
Singular first-person pronouns	.04	-.09	-.08	-.12	.09	-.05	.12
Plural first-person pronouns	.20*	.05	-.13*	.20*	-.06	.11*	-.07
Past tense	.15*	-.03	-.06*	-.11**	.21**	-.11	.05
Present tense	.06	.01	-.04	.19*	-.05	.05	.11**
Future tense	.08	-.01	-.11**	.03	.20*	.16	.07
Positive emotion words	.05	.25**	.18*	.12	-.07	.22	-.08
Negative emotion words	-.28**	-.12*	-.15*	-.04	-.10	-.19**	.10
Cognitive process words	-.07	-.10	-.12	.10	.06	-.06	.04
Language style matching (<i>n</i> = 124)	.07	-.08	-.13	-.01	.31**	.03	.14**

Note: Estimates are standardized and control for all other predictors (all demographic simultaneously; health and severity simultaneously). Significance tests (*p* values) reflect adjustment of standard errors to account for the clustering of patients within physicians

***p* ≤ .01; **p* ≤ .05

^a 0 = male, 1 = female

^b 0 = Not Hispanic/Latino, 1 = Hispanic/Latino

Discussion

The goal of this study was to conduct the first fine-grained linguistic investigation of physicians' and patients' word use during the course of a healthcare encounter, with the ultimate and long-term goal of identifying fruitful avenues for linguistic interventions. Before discussing the primary findings, some attention to overall patterns in word use is merited. Table 1 reveals, for example, that singular first-person pronouns (I, me, my) are far more common in healthcare interactions than are plural pronouns (we, us, our), that present tense is more common than past or future tense, that positive emotion words are far more common than negative emotion words, and that cognitive process words are quite common. Taken together, these patterns tentatively suggest that conversations during healthcare visits are characterized by efforts to work through a problem (most likely the health issue that

prompted the visit) with a generally positive tone, focusing on the current state of affairs rather than the process that led to the health problem, and perhaps with little sense of connectedness between patient and physician.

The overarching patterns described here are not entirely unique to the healthcare context; in fact, similar patterns can be observed across a range of sources, samples, and settings. For comparison, Table 1 includes base rate information for the pertinent word categories across seven previous studies of word use in spoken language [16]. Most linguistic categories show marked similarity in overall frequency between those studies and ours, aside from greater-than-typical usage of positive emotion words and cognitive process words in our study.

Of course, these broad patterns mask considerable variability between the speech of patients and physicians. Patients and physicians differed on nearly every linguistic category of interest, but the largest differences emerged for first-person pronouns and past and future tense. As hypothesized, patients

Table 3 Multiple regression analyses predicting outcomes from physician and patient word use

	Patient-rated		Physician-rated	
	Liking for physician (<i>n</i> = 128)	Adherence (<i>n</i> = 43)	Optimism about surgery (<i>n</i> = 109)	Productiveness of the visit (<i>n</i> = 125)
Physician word use				
Total words	.03	.13	.07	.07
Singular first-person pronouns	.02	-.27**	-.06	-.08
Plural first-person pronouns	-.04	-.10	-.02	.15
Past tense	-.04	.11	-.08	-.09
Present tense	.01	.12	-.06	-.04
Future tense	-.01	-.09	-.28*	-.12
Positive emotion words	.07	-.15	-.19	-.27*
Negative emotion words	-.26*	-.04	-.10	-.07
Cognitive process words	.10	-.05	-.01	.03
Patient word use				
Total words	-.01	.06	.02	-.06
Singular first-person pronouns	-.08**	-.20*	.01	-.09*
Plural first-person pronouns	.01	.15	.12*	.13*
Past tense	.11*	-.04	-.02	-.02
Present tense	-.04	-.21**	.20*	.15
Future tense	.13	.18	.30**	.21*
Positive emotion words	.07	.18	.06	.20**
Negative emotion words	-.12	-.07	.05	-.02
Cognitive process words	-.02	-.01	-.01	-.03
Language style matching ^a	.10	-.02	.23*	.07

Note: Estimates are standardized and control for other party's word use. Significance tests (*p* values) reflect adjustment of standard errors to account for the clustering of patients within physicians

***p* ≤ .01; **p* ≤ .05

^a Results from bivariate correlations (*rs*)

tended to use more singular first-person pronouns, presumably while explaining their symptoms and their efforts to resolve the health concern, whereas physicians used nearly as many plural first-person pronouns as they did singular ones. This pattern suggests that physicians may view the care process as more of a “team effort,” in contrast to patients, who may be more focused on their personal health concerns. Consistent with this reasoning and with our hypotheses are the greater use of future tense by physicians than patients, which likely reflects their focus on the treatment ahead, and the greater use of past tense by patients than physicians, which likely reflects their focus on symptoms or health concerns.

Differences between physicians' and patients' language use may also reflect complex interpersonal processes associated with the social roles and emotional nuances of healthcare interactions. For example, lower social status is associated with greater self-focus and thus more use of first-person singular pronouns [60], which appears to be expressed in patients' language use as they presumably defer to physicians

as the medical “authority” regarding their condition and care. Furthermore, greater use of first-person plural pronouns may indicate efforts by physicians to create a sense of communal coping in hopes of alleviating patients' emotional distress when speaking of serious health issues and potential treatment [61].

Despite these differences, other analyses point to considerable synchrony between patients and their physicians. Language style matching is bounded between zero and one, with higher numbers indicating greater matching, and the average in the present sample was a whopping 0.74. Looking at the specific linguistic categories of interest for this study, patients' and physicians' total word use and their use of verb tense and negative emotion words were strongly correlated. Interestingly, patients' and physicians' use of positive emotion words were largely unrelated, suggesting that individual motivations might drive the injection of positive emotionality into the conversation, whereas negative emotionality is more likely to characterize the conversation as a whole. This pattern

Table 4 Multiple regression analyses predicting outcomes from additional word use categories

	Overall frequency (%)	Patient-rated		Physician-rated	
		Liking for physician (<i>n</i> = 128)	Adherence (<i>n</i> = 43)	Optimism about surgery (<i>n</i> = 109)	Productiveness of the visit (<i>n</i> = 125)
Physician word use					
6 Letter words	11.09	.04	.34**	.02	.03
2nd Person pronouns	5.62	.002	-.11	-.09	-.20**
Singular 3rd-person pronouns	0.25	-.08	.17	.11*	.01
Plural 3rd-person pronouns	0.63	.02	.26	.14*	.16
Conjunctions	7.60	.13	.17	.02	-.01
Articles	0.05	.07	-.30**	-.17	-.26*
Adverbs	7.40	.05	.22*	-.10	-.22
Prepositions	9.90	.13*	-.05	-.09	-.15*
Negations	1.85	-.08	-.09	.004	-.06
Numbers	1.38	.03	-.15	.26**	.17
Quantifiers	3.24	-.13	-.23	-.07	-.07
Patient word use					
6 Letter words	9.25	-.14*	.05*	.18	.06
2nd Person pronouns	2.44	.02	.02	.06	.16
Singular 3rd-person pronouns	0.49	-.14	.15	.15	.08
Plural 3rd-person pronouns	0.73	.05	-.20	-.03	.005
Conjunctions	6.17	.01	.25*	.12	.01
Articles	0.08	.07	.10	.06	.20**
Adverbs	6.65	.02	.10	.15	.02
Prepositions	7.55	.06	-.16	.12	-.07
Negations	3.96	.08*	.06	-.13	.01
Numbers	1.84	-.17	.18	-.09	-.22
Quantifiers	2.31	.02	-.27	-.09	-.04

Note: Estimates are standardized and control for other party's word use. Significance tests (*p* values) reflect adjustment of standard errors to account for the clustering of patients within physicians

***p* ≤ .01; **p* ≤ .05

may also reflect the typical focus on pathology rather than wellness in many healthcare encounters, which could relegate positive emotionality to a secondary or even superfluous role in medical communication.

The Role of Patient Characteristics

The age, ethnic, gender, and socioeconomic diversity of the present sample allowed for an examination of variability in word use across different types of patients. Some findings replicated investigations in non-medical contexts: Older patients used more plural pronouns and fewer negative emotion words [62], and female patients used more positive emotion words than did male patients [63]. More novel, however, were the findings regarding physicians' word use across patients. Our tentative hypothesis that physicians would use more productive linguistic styles with more vulnerable patients was supported in only a few cases (fewer singular and more plural

first-person pronouns with less educated patients, fewer negative emotion words with older patients), but the overwhelming lack of variability in physicians' word use across demographic groups may be its own good news. Physicians did not differ in their word use with Hispanic and non-Hispanic patients in any of the linguistic categories we examined, and they differed only in the number of plural first-person pronouns when speaking to male and female patients (despite that all of the physicians were male). One notable relationship was that between patients' health literacy and language style matching. It seems that patients who are particularly comfortable with medical contexts and terminology experience greater synchrony with their physicians, which could in turn enhance rapport and trust [12, 46].

Patients' health status also predicted word use, particularly among physicians. Perhaps unsurprisingly, physicians used more total words when talking to patients who were less healthy and whose conditions were more severe. Physicians

Table 5 Summary of findings

	Physician and patient use correlated?	Physicians and patients differ?	Predicted by...		Associated with...			
			Patient demographics?	Patient health status?	Liking the physician?	Adherence?	Physician's optimism?	Physician's rating of the visit?
Total words	✓	✓	✓ (Phys)	✓ (Both)				
Singular first-person pronouns		✓	✓ (Phys)		-✓ (Pat)	-✓ (Both)		-✓ (Pat)
Plural first-person pronouns		✓	✓ (Both)	✓ (Pat)			+✓ (Pat)	+✓ (Pat)
Past tense	✓	✓	✓ (Pat)	✓ (Phys)	+✓ (Pat)			
Present tense	✓	✓	✓ (Both)	✓ (Both)		-✓ (Pat)	+✓ (Pat)	+✓ (Pat)
Future tense	✓	✓	✓ (Both)				✓ (-Phys/+Pat)	+✓ (Pat)
Positive emotion words		✓	✓ (Pat)					✓ (-Phys/+Pat)
Negative emotion words	✓		✓ (Both)	✓ (Pat)	-✓ (Phys)			
Cognitive process words		✓	✓ (Phys)					
Language style matching	N/A	N/A	✓	✓			+✓	

Note: A checkmark indicates an effect significant at $p < .05$. “Phys” refers to physician word use in the relevant category; “Pat” refers to patient word use in that category; “Both” indicates that physician and patient word use in that category showed a significant effect. Positive and negative signs indicate the direction of the relationship

also tended to use more future tense and less present tense with sicker patients, likely reflecting a more urgent focus on the treatment ahead. Less intuitively, physicians used fewer positive emotion words with healthier patients, which suggests that physicians may be introducing positive language to soothe the concerns of their sickest patients. Also surprising was the relationship between the severity of patients' condition and language style matching, such that patients and physicians experienced more synchrony when the situation was more dire. Perhaps in these cases, patients felt that they and their physicians were united in their focus on treating the severe ailment, leading to greater synchrony.

We would note that the findings discussed thus far are largely descriptive and thus do not speak directly to the quality of care. However, word use both reflects and shapes interpersonal dynamics within an interaction, and thus differences and synchrony in word use between patients and physicians, as well as demographic and health-related predictors of word use, provide novel insights into typical and variable dynamics in healthcare interactions. For example, the fact that physicians use more plural first-person pronouns than patients likely reflects an important difference in mindset: Physicians, more than their patients, approach the interaction with a team mentality, and this sense of interdependence can increase both parties' perceptions of closeness [27]. Regarding predictors of word use, the fact that physicians used fewer negative emotion and cognitive process words with older patients may reveal a deep-seated tendency to brush past difficulties and problems

with these patients. Thus, our fine-grained linguistic approach to evaluating physician-patient communication has subtle but important clinical significance that might be missed in measures of patients' outcomes.

Visit Outcomes as Correlates of Word Use

Perhaps the most important contributions of the present study are the links between word use and visit outcomes, including how much patients liked their physician, patient-reported adherence, physicians' optimism about treatment effectiveness (treatment they themselves would soon provide), and physicians' satisfaction with the productivity of the visit. It is important to note that although outcomes were assessed after the visit, the study was correlational, rendering causal conclusions inappropriate. Thus, this discussion will focus on physicians' word use as it predicts patient outcomes and patients' word use as it predicts physician outcomes, thereby minimizing the likelihood of third variable explanations. These findings point most clearly to opportunities for linguistic interventions in medical training, the development and implementation of which can more definitively establish causal relationships.

Among the linguistic categories examined, only physicians' use of negative emotion words predicted patients' feelings toward the physician, such that patients liked the physician less when physicians used more negative emotion words. This finding may not be particularly shocking, but it nonetheless points to a relatively simple way physicians might

increase patients' satisfaction, thus increasing the likelihood of care continuity and reducing malpractice suits. This finding is consistent with research showing that physicians' interpersonal skills (e.g., concern for patients' feelings) are particularly predictive of patient satisfaction, more so than are efforts by the physician to provide clear and understandable information about patients' condition or treatment [64]. Importantly, patients' evaluations of their health and how much they liked the physician were unrelated, $r(344) = .03, p = .53$, so it is unlikely that physicians' use of negative emotion words is simply a proxy for more dire health circumstances.

A subset of patients who returned following surgery reported their adherence to the physicians' care recommendations. Although we did not inquire about the specific nature of the care recommendations, post-surgical care may require medication for pain or infection prevention, wound care, and follow-up calls or appointments. In our study, patients tended to report better adherence if their physician used fewer singular first-person pronouns at the pre-operative visit several weeks or months earlier. Again, this finding points to a potentially simple and cost-free opportunity for physicians: Use less "I" language, and patients might be more adherent. This finding clearly warrants replication, but it is consistent with earlier work demonstrating a link between use of plural pronouns and a sense of interdependence within dyads [26], as well as research showing an association between patients' sense of common understanding between them and their physician (e.g., regarding illness and treatment) and adherence to recommendations [64].

Finally, physicians' perceptions of the visit and the treatment ahead reflected patients' word use during the visit. Physicians were more optimistic about the success of treatment when patients used more plural first-person pronouns and more future and present tense during the visit, perhaps indicating a team mentality and focus on treatment (thus behaving more similarly to physicians themselves), and when they experienced more language style matching. Patients who want to instill a sense of optimism in their physician might do well to focus their side of the conversation on working together with the physician toward a treatment plan rather than perseverating on past complaints, and they might also try to "tune in" to physicians' conversational patterns. Physicians also rated the visit as more productive when patients focused on the future, as well as when patients used more positive emotion words and plural first-person pronouns (also fewer singular first-person pronouns). This pattern of findings paints a picture of the perfect patient from a physician's perspective: treatment-focused, positive and upbeat, and working as a united front with the physician.

Next Steps

Due to the novelty of our approach to evaluating physician-patient communication, the next step in this line of research should be to replicate the patterns reported here. This study examined just one type of healthcare visit (pre-operative consultations) in just one geographical location (Riverside County, California, USA) with just one sample of patients. Of course, the study also had many strengths. Audio recordings of healthcare visits are quite difficult to acquire, particularly in conjunction with self-reports from both patients and physicians, and many of the patients in this sample are among those most vulnerable to poor care due to socioeconomic disadvantages. Nonetheless, the novelty of our approach heightens the risk that the specific patterns of word use and patient outcomes revealed in this study may prove idiosyncratic once studies move beyond general surgical consultations with male surgeons in Southern California, or even unreliable across similar studies. However, we argue that our study is an essential starting point. Although rare, other databases of recorded healthcare visits do exist, and our study can inspire others to utilize such data for linguistic analysis to replicate and extend our findings.

Future research on word use in healthcare should also attempt to integrate the broader context of language into the interpretation of word use findings. For example, coding for semantic context could illuminate whether physicians' use of fewer negative emotion and cognitive process words with older patients is indeed reflective of less elaboration on problems and difficulties. Although the words people use when communicating are informative in their own right [18, 65], examining context in a targeted way can only facilitate understanding of the role word use plays in healthcare interactions. Moreover, focus not only on the words people choose but also how people choose to use them can begin to identify explanatory mechanisms of associations between word use and healthcare outcomes.

Nearly as important as replication and extension efforts will be efforts to develop and test linguistic interventions. Such interventions could target physicians, perhaps as part of medical training, or they could target patients as part of patient counseling programs or through various means of dissemination (e.g., websites, blogs, pamphlets). The present findings point to negative emotion words and pronoun use as potentially fruitful intervention targets for physicians and positive emotion words, verb tense, and pronoun use as fruitful targets for patients. Specifically, these linguistic categories are likely indicators (and perhaps promoters) of good rapport and efforts toward shared decision making.

Interventions have targeted both rapport and shared decision making [66]; however, our approach and findings reveal subtle ways that existing interventions could be modified and extended. In addition to training physicians how to provide effective support and training patients how to play a savvy role in their care, such interventions could also target the words that both parties use when interacting. Many interventions include modeling of specific behaviors and practicing new or underdeveloped skills, techniques shown to be effective even with complex interpersonal behaviors [67]. Similar techniques could also be successful in changing the words physicians and patients use. Although our study cannot definitively establish causal relationships between word use and patient outcomes due to its correlational nature, without preliminary studies like ours, interventionists would have little sense of where to begin in training physicians and patients to use more productive language in their interactions. Our findings highlight promising avenues for such interventions.

In sum, this study provides a foundation for future work examining physician-patient communication at the level of individual word use, an approach that can shed new light on the subtle linguistic properties that underlie psychosocial patient care.

Compliance with Ethical Standards

Conflict of Interest Authors' Statement of Conflict of Interest and Adherence to Ethical Standards Authors Angelica Falkenstein, Brandon Tran, Daniel Ludi, Afshin Molkara, Henry Nguyen, Arnold Tabuenca and Kate Sweeny declare that they have no conflict of interest. All procedures, including the informed consent process, were conducted in accordance with the ethical standards of the responsible committee on human experimentation (institutional and national) and with the Helsinki Declaration of 1975, as revised in 2000.

Ethical Approval All procedures performed in this study were in accordance with the ethical standards of both the Riverside County Regional Medical Center and University of California, Riverside Institutional Review Boards and with the full standards of the American Psychological Association.

Informed Consent Informed consent was obtained from all individual participants included in the study.

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