Words of Wisdom: Language Use Over the Life Span

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Two projects explored the links between language use and aging. In the first project, written or spoken text samples from disclosure studies from over 3,000 research participants from 45 different studies representing 21 laboratories in 3 countries were analyzed to determine how people change in their use of 14 text dimensions as a function of age. A separate project analyzed the collected works of 10 well-known novelists, playwrights, and poets who lived over the last 500 years. Both projects found that with increasing age, individuals use more positive and fewer negative affect words, use fewer self-references, use more future-tense and fewer past-tense verbs, and demonstrate a general pattern of increasing cognitive complexity. Implications for using language as a marker of personality among current and historical texts are discussed.

Ask any two people to tell the same story, and they will tell it differently. The facts may be virtually identical, but the words and word orders are bound to be unique. These differences in word use can reflect subtle differences in perspective or interpretation of the story. They may also point to differences in sex, social class, life experience, or basic personality. Word use can tell us far more than just the story; it is a window into the narrator's world.

That language is potentially diagnostic about a person's psychological state is not a new idea. Freud (1915/1989) argued that *parapraxes*, or slips of the tongue, betrayed people's deeper needs and motives. Other psychoanalytically oriented researchers, such as Gottschalk and Gleser (1969), posited that the phrasing of emotion-related thoughts provided valuable information about people's anxieties and conflicts. Sociolinguists and those who study semantics in linguistics, anthropology, and sociology have long believed that word use, inflection, accent, and other features of natural language convey people's social, economic, and psychological worlds (Eckert, 1999; Giles & Wiemann, 1993; Lakoff, 1987).

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The genesis of the linguistic approach discussed in this article began over 15 years ago when it was discovered that having people write or talk about emotional upheavals in the laboratory could ultimately affect their physical health. Across a large number of studies, participants who wrote about traumatic experiences for 3–5 days for 15–20 min per day evidenced better health than controls who were asked to write about superficial topics. These findings have been replicated across an impressive number of labs, cultures, and contexts (Lepore & Smyth, 2002; Pennebaker & Graybeal, 2001).

A computerized text analysis program called Linguistic Inquiry and Word Count (LIWC; Pennebaker, Francis, & Booth, 2001) was developed to determine what features of writing might predict health improvements. Like earlier approaches to computerized content analysis (Rosenberg, Schnurr, & Oxman, 1990; P. J. Stone, Dunphy, Smith, & Ogilvy, 1966), LIWC uses a word-count strategy whereby it searches for over 2,000 words or word stems within any given text file. The search words have previously been categorized by independent judges into over 70 linguistic dimensions, including standard language categories (e.g., articles, prepositions, pronouns), psychological processes (e.g., positive and negative emotion categories, cognitive processes such as use of causation words, self-discrepancies), relativity-related words (e.g., time, verb tense, motion, space), and traditional content dimensions (e.g., sex, death, occupation).

The LIWC approach has fulfilled its original promise. Among people who write about emotional topics, certain word categories reliably predict subsequent improvements in physical health. For example, individuals who use an increasing number of words suggesting causal thinking and self-reflection have visited physicians for illness at lower rates after participating in the experiment than those who do not use these word categories (Klein & Boals, 2001; Pennebaker, Mayne, & Francis, 1997). More recently, a study by Pennebaker and King (1999) found that the ways students use words in class assignments predict physical health, health-

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related behaviors (e.g., alcohol and cigarette use), and other outcomes (class performance, attitudes).

Of course, any approach to studying language is fraught with limitations (Pennebaker, Mehl, & Niederhoffer, 2003). The word-count approach cannot consider irony or sarcasm, nor does it consider context. Although context can be important for many studies of communication, such as in-group/out-group status, word count alone—irrespective of content—can capture important psychological and physiological consequences of linguistic choices. In a study of linguistic predictors of adjustment to bereavement, Pennebaker et al. (1997) analyzed interviews with gay men who had recently lost their partners to AIDS. Higher use of positive emotion words relative to negative emotion words was associated with maximal health benefits, whether the participants were saying, for example, "happy" or "not happy." To say that one is "not happy" appears to produce different health outcomes than to say that one is "sad." Although context may be important in determining exactly what a speaker means by the words he or she chooses, the act of choosing a particular word over its many synonyms can be telling on its own.

Given that word use is a reliable individual style, we can begin to assess how it changes over the life span. In recent years, personality and aging researchers have begun to report that people's self-reports of who they are gradually evolve as they get older (cf. Robins, Trzesniewski, Tracy, Gosling, & Potter, 2002). Much of this research has focused on people's levels of both positive and negative affect. Other work has branched into related areas of life such as people's changing social connections, time orientation, and cognitive abilities. These areas of change may be characterized by particular linguistic changes as well.

Age-Related Changes

Although it is beyond the scope of this article to review the enormous literature on age-related changes, there are particular areas of change across the life span that lend themselves to linguistic examination. Beginning with a brief description of stereotypes about aging, we discuss four important areas of age-related change: emotional experience and expression, identity and social relationships, time orientation, and cognitive abilities.

A variety of stereotypes exist about older individuals, including a set of negative characteristics such as lonely, selfish, sentimental, stubborn, withdrawn, rigid, bitter, and alone (Brewer, Dull, & Lui, 1981; Louis Harris and Associates, 1975; McTavish, 1971; Perdue & Gurtman, 1990), as well as the view that people undergo a noticeable decline in intellectual abilities as they age (Cornelius & Caspi, 1986; Ryan, 1992). Interestingly, most data contradict this diminished and unhappy view of aging people. For example, aging is associated with higher levels of conscientiousness, agreeableness, and adherence to norms (Helson, Kwan, John, & Jones 2002). Comparable findings using the Big Five measures of Extraversion and Neuroticism have been reported by Loehlin and Martin (2001) using adult samples of over 5,000 twin pairs from the Australian Twin Registry (see also the research of McCrae & Costa, 1990; McCrae et al., 1999).

It is also true that there exist positive stereotypes of aging, even in the youth-oriented culture of the United States. Older adults are stereotypically seen as gaining in wisdom and common sense (Hendrick, Knox, Gekoski, & Dyne, 1988), which is reflected in the definition used by Staudinger, Smith, and Baltes (1992) of *wisdom* as "good judgment and advice about important but uncertain matters of life" (p. 271). Wisdom is purported to come with age, accumulating in the middle and later years of life and based on experience, understanding of the variabilities of life, exposure to different contexts, and grasping the basic issues of life (Baltes & Smith, 1990; Clayton & Birren, 1980; Holliday & Chandler, 1986; Ryff, 1984). Although the theoretical definitions of wisdom differ between studies and researchers, the findings have been relatively consistent: Older individuals up to age 80 display greater or at least the same levels of wisdom as younger individuals (Smith & Baltes, 1990; Staudinger et al., 1992).

Positive and Negative Affect

In contrast to the stereotype that elderly people are bitter and unhappy, many researchers are discovering that aging does not produce decrements in positive emotions. Carstensen, Pasupathi, Mayr, and Nesselroade (2000) found no effect of age on positive emotional experiences in their sample of people ages 18–94. Furthermore, aging has been associated with increased experience of happiness (Carstensen, 1991, 1995; Carstensen & Turk-Charles, 1994; Labouvie-Vief & Blanchard-Fields, 1982; Mroczek & Kolarz, 1998). Several explanations for these findings have been offered. According to Carstensen's (1995) theory of socioemotional selectivity, as people grow older affect becomes more important in their lives, and they also become better able to regulate their emotions. A related explanation is that aging can reorganize the roles of affect and cognition and that this process of restructuring allows for greater cohesion, which produces better regulation of emotion (Labouvie-Vief & Blanchard-Fields, 1982). The outcome of this improved emotional regulation is a maximization of positive affect and minimization of negative affect.

There have been mixed findings on the experience of negative emotions across the life span. Using an experience-sampling strategy, Carstensen et al. (2000) discovered a curvilinear relationship between negative emotions and age, such that self-reported negative emotions drop across the life span until the age of 60 at which point they either remain constant or increase (depending on the analysis). Using Bradburn's (1969) Affect Balance Scale, Charles, Reynolds, and Gatz (2001) reported that negative affect declined across the life span, whereas positive affect was stable through middle age and evidenced a slight decline among older individuals.

The picture that emerges of people's self-reports of their emotional development across the life span is one of an ever more complex and richly differentiated emotional life, characterized by decreasing levels of negative affect and steady or slightly increasing levels of positive affect. Additionally, aging is associated with better emotional regulation. Although the self-reports of emotion and aging paint a very different picture than aging stereotypes, an analysis of the ways individuals use emotion-related words over the life span can provide additional information about emotional experience that go beyond people's self-perceptions of emotional experience.

Social Relationships and Self

Closely related to issues of emotionality, a number of studies have focused on developmental trends in social relationships and

identity. There is a robust finding in social gerontology that the sizes of social networks diminish as people age (cf. Lang & Carstensen, 1994). Both quantity and quality of social relationships have been found to be related to markers of successful aging (e.g., Carstensen, Isaacowitz, & Charles, 1999) and to quality of life in general. Although it may be true that older people often have smaller networks of social relationships than younger people, their relationships produce strong feelings of social integration. Additionally, older adults frequently report greater emotional investment in their relationships because they have relinquished their ties to more peripheral relationships. Among those people whose immediate family members are deceased or absent for other reasons, other socially intimate relationships—other family members or friends—fill the void (Lang & Carstensen, 1994). In contrast to the stereotype that aging is associated with loneliness, data actually suggest that young and middle-aged adults are considerably lonelier than elderly people (Larson, 1978; Revenson, 1986; Revenson & Johnson, 1984). Furthermore, older adults are more satisfied with the sizes of their social networks than younger adults (Lansford, Sherman, & Antonucci, 1998).

Linguistically, one's relation to self and others is found in the pronouns. In our work, use of first-person singular (*I*, *me*, *my*) has typically been negatively correlated with use of first-person plural (*we*, *us*, *our*) among individuals writing about emotional topics (Pennebaker & King, 1999). Indeed, use of first-person singular has been found to correlate with elevated suicide rates (Stirman & Pennebaker, 2001; L. D. Stone & Pennebaker, in press) and, among college students, with self-rated depression (Rude, Gortner, & Pennebaker, in press). Across numerous studies, use of first-person plural as well as references to other people has served as a measure of social integration (Pennebaker & Graybeal, 2001; L. D. Stone & Pennebaker, 2002).

Within the developmental and aging literatures, there is a sense that social connection and social growth changes and, in some cases, diminishes with increasing age (e.g., Carstensen et al., 1999). If this is true, it could be hypothesized that aging generally is related to drops in references to other people. The work by Labouvie-Vief, Chiodo, Goguen, Diehl, and Orwoll (1995) suggests that self-references (first-person singular pronouns) would display a curvilinear relationship with age.

Time Orientation

Within the aging literature, a particularly intriguing approach has been suggested by Carstensen and her colleagues (e.g., Carstensen et al., 1999), indicating that how individuals perceive time is associated with social and emotional adjustment. For those who perceive themselves as having a limited future, there is a shift in their orientation toward more restricted social goals. More open-ended or future-oriented time perspectives encourage knowledge-related goals, which include a broader network of friends (see also Danner, Snowdon, & Friesen, 2001). Of course, there are large individual differences in how individuals of all ages approach time, but Carstensen et al. (1999) suggested that, on average, one would assume that older individuals would tend to focus more on the past than the future—relative to younger samples. If true, corresponding markers of verb tense should be seen among the oldest participants: more past tense usage and less future tense. Indeed, references to time altogether should diminish, particularly among the oldest participants.

Cognitive Abilities

In contrast to the life wisdom stereotype, perhaps the most pervasive stereotype of aging assumes that people's cognitive abilities increase through their 20s and then gradually diminish after about age 40 (cf. Horn & Cattell, 1967). Objective measures of cognitive complexity among healthy adults drop slightly after about age 60 (Baltes, 1998; Schaie, 1994). By the age of 81, all measured domains have dropped by 1 standard deviation. However, there is virtually no decline in verbal ability from age 25 to age 88 (Schaie, 1994). In a series of lab studies of memory processing and retention, Hess and his colleagues discovered a relationship between memory and script-relevant information. Although younger and older adults did not differ in reading speed or recall for script-relevant information, the older adults displayed poorer recall for atypical actions (Hess, Donley, & Vandermaas, 1989; Hess & Tate, 1992).

Whereas most studies that examine cognitive changes in adulthood have been based on task performance rather than self-reports, very few have explored natural language markers of cognitive ability over the life span. The exceptions have been projects by people such as Susan Kemper (1990; Kemper, Greiner, Marquis, Prenovost, & Mitzner, 2001). In analyzing narratives of diaries of people in the mid-1800s or the autobiographical sketches of nuns living in the 1900s, she has found that narratives become somewhat more complex over the life span with gradual drops in judge-rated grammatical complexity and idea density over time. On the basis of these literatures, it is anticipated that specific language patterns associated with aging and cognitive complexity will be curvilinear, peaking in midadulthood. However, the strength of verbal abilities across the life span suggests that certain linguistic categories (e.g., word length, sentence length) would display a linear relationship.

Sampling Considerations

Much of the personality literature has tended to tap people's self-perceptions or self-theories of who they are. Intuitively, these findings confirm positive stereotypes that aging brings about a more balanced, thoughtful, and less emotionally tangled life—in short, wisdom. Indeed, much of the evidence cited in this article supports the idea of greater cognitive complexity, emotion regulation, and maturity as concomitants of aging. Less clear is how these potential personality changes are reflected in the ways people talk and write. That is, does aging affect the ways people use emotional or cognitive words? Are there other linguistic features that tap one's worldview that might not be captured using a self-report methodology?

A related question concerns the problem of cohort effects. Virtually all important self-report personality research has been conducted over the last 70 years. As various authors have acknowledged, any cross-sectional analysis of personality—wherein, say, 30-year-olds are compared with 60-year-olds—may find differences that reflect collective changes in cultures. That is, virtually everyone born after 1975 in all countries was influenced by television early in life; most adults born before 1945 were not. Any

cross-sectional personality differences may reflect cultural changes as much as developmental processes. Even developmental studies wherein the same participants have been repeatedly measured over the course of their lives (e.g., Charles et al., 2001; Vaillant, Meyer, Mukamal, & Soldz, 1998) must deal with the same problem of the collective evolution of a culture—or at least cultural shifts in the last 70 years.

The Current Projects

In this set of projects, we adopted a methodology that allowed us to move beyond self-reports of personality and provided a strategy to examine selected individuals' writing styles across their lives in a variety of time periods that predate most systematic research in personality. In the first of two overlapping research projects, text samples from over 3,000 individuals ranging in age from 8 to 85 who participated in emotional disclosure studies were subjected to LIWC analyses. All participants wrote or spoke about either emotional upheavals that they had experienced or about superficial events as part of controlled laboratory experiments. The second study examined the collected works of 10 famous authors of plays, novels, or poetry across their professional lives. For each author, we sought to learn how the various text dimensions present in their published works changed as a function of their age.

These projects, which were inherently inductive in focus, examined selected dimensions of language provided by the LIWC program that are relevant to the personality and aging relationships: emotional processes, social and identity concerns, time orientation, and cognitive complexity. Using both correlational and analysis of variance strategies, we sought to evaluate the degree to which changes in language—both linear and curvilinear (i.e., quadratic)—covaried with the age of the participants.

On the basis of previous literatures, the following hypotheses were made:

Hypothesis 1: Aging should be associated with drops in negative affect words and slight increases in positive affect words.

Hypothesis 2: To the degree that individuals reduced their social networks with aging, a general drop was predicted in the use of social words and first-person plural pronouns. The relationship between aging and self-references (i.e., first-person pronouns) was hypothesized to be curvilinear.

Hypothesis 3: If aging is associated with a greater concern with the past relative to the future, we anticipated that linguistic shifts from future to past tense would be apparent with increasing age. References to time altogether were expected to diminish, particularly among the oldest subjects.

Hypothesis 4: Finally, if the self-report data on cognitive complexity extends to language, we predicted that older ages would use fewer cognitively complex words in their narratives. Specifically, a curvilinear relationship between cognitive markers (cognitive mechanisms and causal, insight, and exclusive words) and age was expected. Because verbal ability does not decline dramatically until very late in life (Schaie, 1994), markers of verbal ability, including the use of large words, were not expected to show changes over time.

Study 1: The Disclosure Project

Method

Participants. Writing samples or transcripts from spoken interviews were collected from 3,280 participants from 45 separate studies. The common feature of all studies was that the investigators were studying individuals who were disclosing emotional events or experiences in their lives. The studies were conducted by 21 separate laboratories at 17 different universities in the United States (40 studies), New Zealand (4 studies), and England (1 study). Sixteen of the studies were from the first author's lab; the remaining 29 were conducted under the auspices of other investigators.

Of the studies, 32 were traditional emotional disclosure experiments wherein participants were randomly assigned to write about either a traumatic or emotional topic or, for control participants, about superficial topics, such as plans for the day (cf. Pennebaker, Mayne, & Francis, 1997). For each of these 32 experiments, essays from both experimental (n = 1,239) and control (n = 877) participants were analyzed. Sex was available for 1,164, or 55% of the sample. Approximately 58.2% (n = 678) of the participants were female, and 41.8% were male. There was a slight trend for older participants to be female, $r(1164) = .06$, $p < .05$.

The remaining 15 studies were nontraditional in one of two ways. Three studies used an interview format, in which participants (N = 326) freely responded orally to an interviewer's questions. Approximately 90.8% of the participants in the interview studies were female (n = 296). In the other 12 nontraditional studies, all participants (N = 809) were instructed to write about an emotional event or experience. In these studies, sex was available for only 39.8% of the sample; 93.8% were female (n = 302). The distribution of sex across experimental condition and age is shown in Table 1.

In the overall sample, age of participants was available, either directly or indirectly, for 94% of the participants and averaged 23.8 years (SD = 12.6; range = 8–85). In approximately 30% of the cases, ages were entered using the sample average. Hence, if participants were all introductory psychology students from traditional universities (such as the University of Texas), and individuals' ages were not available, a mean of 18.3 years (if first semester) or 18.8 years (if second semester) was entered for all students for the particular study. In the nontraditional disclosure projects, sex of participants was available for 1,812, or 56.1% of the overall sample. Approximately 70% (n = 1,298) of the participants were women. Overall, there was a slight trend for older participants to be women, $r(1693) = .085$, $p < .01$.

Across the various studies, participants provided an average of 2.72 text samples of approximately 423 words, or a total of 1,151 words per

Table 1
Age Distribution of Participants in Disclosure Studies, by Condition and Sex

	Condition						
	Emotional			Control			
Age	Male	Female	Missing	Male	Female	Missing	Row total
Missing	38	131	44	1	13	0	227
8–14	28	44	131	35	32	126	396
15–24	169	345	868	127	159	257	1,925
25–39	31	407	0	27	29	0	494
40–54	23	68	0	24	17	0	132
55–69	15	29	0	16	2	0	62
70+	8	19	5	1	3	8	44
Column total	312	1,043	1,048	231	255	391	3,280

participant. The entire corpus, then, is based on over 3.8 million words. As discussed below, linguistic analyses were averaged across each participant's writing sample such that each participant represented only one aggregated text sample.

Data preparation. Each text sample for each participant was analyzed separately using the LIWC program, yielding the percentage of words that fit into each of the LIWC categories. Although the default LIWC program computes 74 output variables, only 14 that were relevant to our hypotheses were retained for the current study. Specifically, our analyses included the following variables: positive and negative emotions; first-person singular and first-person plural pronouns; social references; time-related words; past-tense, present-tense, and future-tense verbs; big words (larger than six letters); cognitive mechanisms; and causal, insight, and exclusive words.

Because the number of text samples varied from 1 to 16 samples per person, LIWC scores were averaged across participant resulting in one set of LIWC analyses for each participant within any given study. A master file was created such that each line of data referred to a single participant's average LIWC scores along with each participant's age, sex, and study characteristics.

Results

The underlying assumption of the current project is that aging can affect word usage in both a linear as well as a curvilinear fashion. The initial analyses simply correlated the participants' ages with the various LIWC dimensions in order to establish the basic linear relationships. These analyses were first computed on the entire sample, collapsing across experimental condition. As can be seen in Table 2, 10 of the 14 simple correlations are statistically significant, with the mean absolute correlation with age averaging $\pm .08$.

One difficulty in interpreting the simple correlations is that most of the 14 language variables are significantly correlated with sex, experimental condition (emotional vs. nonemotional disclosure), and mode of disclosure (writing vs. talking)—all of which were modestly related to age. Indeed, the mean absolute correlation between the 14 language variables and sex was $\pm .12$; women, for example, used far more first-person singular pronouns ($r = .21$), social words ($r = .20$), and past-tense verbs ($r = .20$) than men. Not surprisingly, writing topic was strongly related to language use, with the mean absolute correlation between the 14 language variables and experimental condition averaging $\pm .33$. Participants disclosing emotional topics were more likely to use positive ($r = .31$) and negative ($r = .49$) emotion words as well as cognitive words ($r = .61$) than controls. Finally, whether participants wrote or talked was linked to language use as well (mean absolute $r = \pm .13$).

To control for the effects of sex, condition, and mode of expression, 14 separate forced-entry multiple regressions were computed using each of the language variables as dependent measures and substituting means for missing data. After entering sex, condition, and mode of expression in the first step, both the linear and quadratic age variables were entered. Note that the quadratic age effect was calculated as the absolute difference from the age of 40. Hence, high numbers for the quadratic effects are associated with very young or very old ages. All regression equations were highly significant ($ps < .001$), with Fs ranging between 51 and 392.

As can be seen in Table 2, 12 of the 14 linguistic variables evidence significant linear associations with age, and 8 of the 14 had significant quadratic correlations. Consistent with our hypotheses, aging was associated with greater use of positive emotion words and with a lower use of negative emotion words. Both self-references and references to other people drop with age. In addition, there is a movement away from past-tense verbs and an

Table 2
Linear and Curvilinear Associations Between Linguistic Inquiry and Word Count Variables and Age

Variable	Examples	Simple r	Standardized β[a]	
			Linear β	Quadratic β[b]
Emotional state				
Positive emotions	*happy, nice*	.05**	.12**	.14**
Negative emotions	*angry, ugly*	−.04**	−.05**	−.01
Social and identity				
First-person singular	*I, me, my*	−.13**	−.14**	−.02
First-person plural	*we, us, our*	−.12**	−.13**	.19**
Social references	*friend, talk, woman*	−.01	−.13**	.08**
Time orientation				
Time-related words	*clock, hour, soon*	−.19**	−.10**	.06**
Past-tense verbs	*was, went, ate*	.04**	−.16**	.01
Present-tense verbs	*am, see, goes*	−.02	.04*	.06**
Future-tense verbs	*will, shall*	.00	.14**	−.02
Cognitive complexity				
Big words (> 6 letters)	*pontification*	.13**	.26**	−.03
Total cognitive words	*think, doubt, recall*	.15**	.07**	−.09**
Causation	*because, reason*	.01	.02	−.04
Insight	*realize, think*	.12**	.11**	−.06**
Exclusive	*but, exclude*	.16**	−.03	−.06**

Note. $N = 3{,}087$.
[a] Standardized betas from full regression model, controlling for sex, writing/talking, and condition. [b] Curvilinear (quadratic) effect of age using the absolute value of the difference from age 40.
* $p \leq .05$. ** $p \leq .01$.

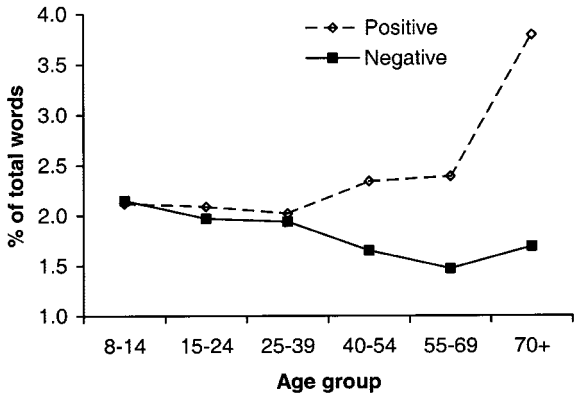

Figure 1. Use of positive and negative emotion words across the life span.

increasing use of present- and future-tense verbs with increasing age. Finally, most cognitive complexity dimensions exhibit positive associations with age.

Because of the small sample size at the end of the age range (70+ years) and the lack of literature-based predictions about the language of preadolescents (8–14 years), we reanalyzed the language variables using a restricted age range (15–69 years). The correlation between the standardized linear betas for the full and restricted sets was $r(14) = .54$, $p < .05$, and the correlation between the standardized quadratic betas was $r(14) = .18$, $p = .55$. The strength of the correlation of linear betas suggested that our findings were not merely due to the language of the very young and very old participants. The lack of significance in the quadratic beta correlation is not surprising, because we were examining the effect of aging; eliminating the ends of the range should eliminate a quadratic effect, if one exists. Therefore, we report our findings based on the full age range.

A more detailed analysis of the language variables can be seen in Figure 1 and Table 3. As is apparent in Figure 1, use of emotion words is startlingly different as a function of both valence and age. Both the quadratic and linear trends are significant for positive emotion because of their disproportionate increase in the later years of life. Indeed, participants 70 years of age and older used positive emotion words at almost twice the rate of younger individuals.

Table 3 depicts the means of the various LIWC dimensions broken down by age. As can be seen, the most striking quadratic effect is for first-person plural pronouns. Specifically, use of "we" words is highest among individuals younger than 14 and people over the age of 70. Closer inspection of the cell means suggests that most of the other quadratic effects are due to subtle deviations from the linear effects.

Discussion

As predicted, aging was associated with drops in negative emotion words and increases in positive emotion words. The magnitude of the increase in use of positive emotion words from ages 55–69 to age 70+ was somewhat surprising. However, the rise in positive emotion language is consistent with the literature describing an increase in positive affect with age. The decrease in use of negative emotion words was modest, although significant, and offered linguistic support for the findings in the aging literature describing a slight decline in negative affect associated with aging.

Our predictions for social and identity language received mixed support. We did find the hypothesized linear relationship between aging and first-person plural and social words; however, there was a quadratic component of both categories, indicating an increase in later life in the use of social language. This pattern is most notable in the first-person plural category. Our predicted curvilinear rela-

Table 3
Adjusted Language Means for Linguistic Inquiry and Word Count Variables

Variable	Age group					
	8–14	15–24	25–39	40–54	55–69	70+
Social and identity						
First-person singular	11.76_{a}	10.07_{b}	10.84_{c}	10.15_{d}	9.11_{c}	7.95_{c}
First-person plural	1.81_{a}	0.80_{b}	0.86_{b}	0.68_{b}	0.70_{b}	1.23_{c}
Social references	10.95_{a}	8.36_{b}	8.52_{c}	7.77_{b}	7.94_{b}	7.31_{b}
Time orientation						
Time-related words	6.25_{a}	$4.93_{b, d}$	$5.18_{c, d}$	$5.04_{b, d}$	$4.81_{b, c, d}$	$4.43_{c, d}$
Past-tense verbs	8.81_{a}	6.33_{b}	7.23_{c}	5.72_{b}	5.27_{b}	4.62_{b}
Present-tense verbs	$10.16_{a, d}$	$10.21_{b, d}$	9.52_{c}	$11.18_{b, d}$	$11.34_{a, b, d}$	$10.97_{a, b, d}$
Future-tense verbs	0.79_{a}	$1.14_{b, e}$	1.02_{c}	$1.36_{d, e}$	$1.39_{d, e}$	$1.47_{b, d, e}$
Cognitive complexity						
Big words (> 6 letters)	9.95_{a}	13.39_{b}	12.63_{c}	13.26_{b}	14.92_{d}	17.13_{e}
Cognitive mechanisms	5.53_{a}	$7.31_{b, d}$	$6.87_{b, d}$	$6.96_{c, d}$	$7.21_{b, c, d}$	$6.86_{b, c, d}$
Causal	0.84_{a}	$1.10_{b, e}$	$0.99_{c, d, e}$	$0.93_{c, d, e}$	$0.99_{c, d, e}$	$1.04_{b, c, d, e}$
Insight	1.40_{a}	$2.28_{b, d}$	$1.97_{c, d}$	$2.24_{b, c, d}$	$2.42_{b, c, d}$	$2.38_{b, c, d}$
Exclusive words	3.35_{a}	$3.98_{b, e}$	3.75_{c}	$3.53_{d, e}$	$3.50_{b, d, e}$	$3.17_{d, e}$
n	406	1,935	504	142	70	46

Note. All means are adjusted for sex, experimental condition, and writing versus talking. The cell adjusted means refer to mean percentage of total words within the texts. Means with different subscripts within any given row differ significantly at $p < .05$.

tionship with self references (i.e., first-person singular pronouns) was not supported. The data revealed a significant linear relationship, with use of these pronouns sharply declining over the life span.

The time orientation findings partially supported our hypotheses. Overall, individuals showed decreasing use of time-relevant words. Counter to the hypotheses, there was a decrease in past-tense and increase in future-tense verbs over time, indicating a shift in focus over the aging process. As people age, they appear to be more anchored in the present and future.

Finally, the linguistic markers of cognitive complexity offered mixed support for the hypotheses. The use of total cognitive words and insight language changed in ways consistent with predictions. However, the pattern of use for total cognitive words suggested that individuals did not decline in their use of these words from age 25 onward. This is interesting in light of the self-report findings suggesting that individuals decrease in their cognitive complexity over time. Although there were no changes in the use of causation words over time, an increase in insight words and a curvilinear relationship with exclusive words were apparent. These patterns may reveal the gaining of wisdom as aging people describe their greater understanding of their own experiences and their worlds. The linguistic marker of verbal ability, big words, showed a linear relationship with aging. In fact, the increases were quite dramatic, particularly between the last two periods, ages 55–69 and 70+.

Because this project was conducted in cross-sectional fashion, it was important to determine whether the findings would hold up within individuals across their own life spans. As an exploratory test of the findings in the Disclosure Project, a similar study was conducted on a longitudinal sample. The second study, the Author Project, examined the collected published works of 10 prominent British and American writers. The purpose of the Author Project was to learn if language use among the authors changed over the course of their lifetimes in ways consistent with those found in the Disclosure Project.

Study 2: The Author Project

Method

Participants. The works of 10 prominent authors were selected for inclusion in the study. The selection of authors was made prior to any analyses resulting from the Disclosure Project. The primary bases for inclusion were as follows: The collected works of the primary genre of the author were available from online sources (e.g., Project Gutenberg [www.promo.net/pg/]); the group of authors spanned a wide age period in our efforts to minimize cohort effects; male and female and British and American authors were represented; and the authors' published careers spanned a significant part of their lives. As can be seen in Table 4, the final group of authors included an equal number of men and women, four novelists, four poets, and two playwrights. Although several of the authors wrote more than one genre (e.g., Shakespeare wrote both plays and poetry), only their most prominent genre was analyzed. Of the works included in the analyses, each author averaged over 903,000 words, resulting in a corpus of over 9 million words.

The dating of the various works was generally based on when they were written rather than published. If, according to authoritative sources (e.g., Graves & Ward, 1999; Wells & Taylor, 1987), the author took 3 years to complete a given work, it was dated as the median of the 3 years. In many cases, the actual timing of the writing could not be determined, in which case, the year of publication was set as the writing date.

Data preparation. The works of the novelists and playwrights were analyzed separately by book or play. In the case of poetry, works of Millay, Wordsworth, and Yeats were analyzed by books of poems or, as in the case of Graves, by poems written in a given year. Each work, then, was subjected to LIWC analyses.

Results

Two broad approaches were adopted in exploring the author data set. The first was correlational. That is, we initially examined the simple linear relationships between language use and age. The correlational strategy allowed us to determine the degree to which age was generally related to each of the LIWC dimensions and, at the same time, provide a sense of the strength of these effects. The second approach focused on a regression strategy. Using a regres-

Table 4
Characteristics of Authors Chosen for the Author Project

Author	Nationality	Sex	Life span	Productive years	Genre	Analyzed works (*n*)	Words per work (*M*)	Aging coefficient correlation
Louisa May Alcott	United States	F	1832–1888	1854–1886	Novels, stories	19	40,273	−.05
Jane Austen	England	F	1775–1817	1787–1817	Novels, stories	13	68,120	.23
Joanna Baillie	Scotland	F	1762–1851	1789–1827	Plays	20	18,921	.60**
Charles Dickens	England	M	1812–1870	1836–1870	Novels	15	257,777	−.23
George Eliot	England	F	1819–1880	1859–1876	Novels, stories	10	157,751	.63*
Robert Graves	England	M	1895–1985	1910–1975	Poetry	100	1,689	.18†
Edna St. Vincent Millay	United States	F	1892–1950	1917–1947	Poetry	21	3,850	.72**
William Shakespeare	England	M	1564–1616	1591–1613	Plays	37	22,975	.03
William Wordsworth	England	M	1770–1850	1785–1847	Poetry	64	6,074	.37**
William Butler Yeats	Ireland	M	1865–1939	1889–1939	Poetry	34	2,217	.40*

Note. For most novels, stories, and plays, each work was analyzed separately. For poetry, a work was defined by the various poems written within a given year. Exceptions include poems or collections that were known to have been written over several years, which were entered as separate text files. The aging coefficient correlations are within-subject simple correlations between each author's age and the aging coefficient and were based on the regression weights from the Disclosure Project (see text). F = female; M = male.
† $p \leq .08$. * $p \leq .05$. ** $p \leq .001$.

sion equation drawn from the findings in the Disclosure Project, we created an aging coefficient in order to examine relationships among language and aging across the authors' life spans.

Correlations between age and language use. Whereas the preliminary analyses for the Disclosure Project were based on traditional between-subjects approaches wherein each participant provided one data point, the Author Project involved analyses of the authors' collected works over the course of their careers. The Author Project, then, allowed us to assess how language use changes in a within-subjects fashion. For each author, LIWC analyses were available for each work. The LIWC scores for each work were then correlated with the age at which the work was written, separately for each author. So, for example, the age at which Shakespeare wrote each of his 37 plays was correlated with the LIWC variables from each play. This strategy yielded a set of 14 LIWC–age correlations for each of the 10 authors.

The means of the within-author correlations for each of the 14 LIWC variables were computed and then were subjected to single-sample *t* tests to evaluate if each mean was significantly different from zero. As can be seen in the second column of Table 5, five (35.7%) of the 14 correlation means were significantly different from zero ($p < .05$, $df = 9$).

Closer inspection of Table 5 indicates that 12 of the 14 Disclosure Project correlations were in the same direction for at least one condition. Of these 12 LIWC dimensions, the authors' correlations were in the same direction as both columns 64% of the time. Interestingly, simple correlations among the variables in Table 5 indicate that the authors' mean correlations were themselves correlated significantly with the experimentals column of Disclosure Project means, $r(12) = .57$, $p = .03$. In short, the patterns of aging and word use are moderately consistent across two very different groups and paradigms.

Table 5
Correlations Between Word Categories and Age

LIWC category	Author Project	Disclosure Project	
		Experimentals	Controls
Emotional state			
Positive emotions	.06	.22*	.05
Negative emotions	−.12	−.20*	.14*
Social and identity			
First-person singular	−.26*	−.18*	−.18*
First-person plural	.03	−.01	−.27*
Social references	−.08	−.22*	−.10*
Time orientation			
Time-related words	−.17	−.15*	−.17*
Past-tense verbs	.08	−.20*	−.22*
Present-tense verbs	.09	.05	.03
Future-tense verbs	.22*	.19*	.10*
Cognitive complexity			
Big words (> 6 letters)	.10	.35*	.36*
Total cognitive words	.27*	.06	.25*
Causation	−.07	−.02	.11*
Insight	.21*	.10*	.26*
Exclusive	.25*	−.07*	.08*
n	10	1,204	863

Note. The correlations from the Disclosure Project are all between-subjects analyses correlating each of the Linguistic Inquiry and Word Count (LIWC) dimensions with age. Correlation coefficients for the Author Project are mean within-author correlations between each author's age and the LIWC analyses from the author's work. The means of the correlations across the 10 authors were then tested against the hypothesis that the mean did not differ from zero, using a single-means *t* test. Significance levels for the Author Project are based on 2-tailed tests, where $df = 8$. The experimental and control columns refer to participants who were in a controlled experiment where they were randomly assigned to write about emotional or superficial topics.
* $p \leq .05$.

Did the authors as a group show similar patterns of correlations across the 14 LIWC dimensions? To answer this question, the correlation matrix of the 10 authors was inverted to allow us to compute the interauthor reliability of the LIWC–age correlations. Across the 10 authors, Cronbach's $\alpha = .60$. Only 1 author, Charles Dickens, showed a slightly divergent pattern; excluding his data increased the alpha to .63. Even including Dickens, it is intriguing that such different authors generally exhibited comparable age–LIWC correlations.

Comparing language use across the Disclosure Project and Author Project. Given the findings from the Disclosure Project, it was possible to determine the degree to which each of the 10 authors evidenced a general age-related pattern of word use across their writing careers. From the Disclosure Project data, a forward-entry logistic regression was computed, predicting adjusted age (controlling for sex, condition, and writing vs. talking) on the basis of the 14 LIWC categories. This logistic regression produced a set of beta weights predicting adjusted age, and the model was significant, $F(14, 3087) = 22.08$, $p < .01$. Returning to the Author Project, the LIWC variables were standardized within author, multiplied by the beta weights obtained from the logistic regression, and summed to create a prediction equation that yielded an aging coefficient. This coefficient was then correlated with age (within author), with larger correlations signifying greater usage of language in an age-typed manner.

As seen in the far right column of Table 4, 6 of the 10 authors exhibited the same pattern of language use associated with aging that was found in the Disclosure Project. Only Alcott, Austen, Dickens, and Shakespeare showed no significant changes in age-related language use across their life spans. Indeed, only 1 author—Dickens—displayed a nonsignificant pattern in the opposite direction. In some cases, the relationships were quite remarkable. The strong correlations seen in the works of Millay and Eliot, in particular, suggest that these women used language in age-typed ways, despite the fact that their genres, nationalities, and the centuries in which they wrote differed.

General Discussion

The ways individuals use language change over the course of their lives. Whether famous authors are expressing themselves through their published work or research participants are writing about traumatic experiences or plans for the day, people exhibit consistent changes in their linguistic styles as a function of their ages. Before exploring the implications of the findings, it is important to consider alternative explanations.

One concern—at least for the Disclosure Project—is that the pool of participants clearly changed from study to study. Whereas most of the 15–39-year-old participants were college students, those under 15 years were drawn from public or private schools where their options for participating were limited. Similarly, the oldest groups were healthy volunteers drawn from studies dealing

with people in Elderhostels, community centers, or large companies. Those in the oldest age groups were likely better educated and healthier than the rest of their cohort who did not participate, although those data were not available to us. Obviously, these factors were not relevant for the Author Project, which may explain some of the weaker and more inconsistent effects. It should be emphasized, however, that the pattern of most of the important linear effects was not attributable to any given age group.

The patterns of effects for the four hypothesis-relevant categories address many of the psychological issues relevant to aging. An increasing number of personality studies based on self-reports have found that measures of neuroticism and negative affect decrease with age (e.g., Carstensen et al., 2000). Although the effect sizes were generally small, the current data sets support these observations. As individuals get older, they use fewer negative emotion words and more positive emotion words. Although not significant for the Author Project, these patterns are striking for the Disclosure Project samples.

The social and identity findings are more complex and, in many ways, richer. Recent studies in our lab have found that use of first-person singular is associated with depression (Rude et al., in press) and suicide proneness (Stirman & Pennebaker, 2001; L. D. Stone & Pennebaker, in press). Indeed, use of the word *I* indicates that a person is psychologically more attached to his or her topic and, at the same time, more self-focused. The consistent drop in first-person singular in the current study may reflect all of these processes. That is, with increasing age, people are better able to detach themselves from their writing topics. In the current study, increasing age is highly related to drops in the use of first-person singular across all samples. The characters in Jane Austen's novels and the topics of Wordsworth's poetry show the same drops in "I" words that we see in experimental and control participants writing samples over time.

Oddly consistent with the reductions in the use of first-person singular are the corresponding lower levels of references to other people. On the surface, this is consistent with the disengagement theory of aging (Cumming & Henry, 1961). However, the patterns of means in the Disclosure Project suggest that this is a general trend starting at age 25. It may simply reflect that earlier in their lives, people are more tightly bonded with others, spend more time with others, and define themselves as part of a relationship. As with the use of "I" words, increasing age may simply reflect a greater independence and focus toward the external world. The one deviation from this pattern is the increasing use of first-person plural among the oldest age group in the Disclosure Project. This may reflect Lang and Carstensen's (1994) observation about the richness of close relationships among people who are most healthy in approaching old age.

The time orientation findings were among the most consistent with the literature and were unexpected, in terms of the stereotypes of aging. Counter to many cultural stereotypes, older participants used more future-tense and fewer past-tense verbs. Indeed, the future-tense findings were significant for both the Disclosure Project and the Author Project. These effects were consistent across all age categories, such that the youngest participants made the most references to the past and the fewest to the future. An equally telling effect concerned the participants' general references to time—words such as *day*, *clock*, and *minute*. The youngest participants appeared to be the most concerned with time and the oldest the least concerned.

Within the cognitive complexity category, the majority of effects emerged in ways that would be predicted by previous research on aging and information processing. From childhood and early adolescence, all markers of cognitive complexity increase appreciably. However, the elevated changes in most cognitive categories remain relatively stable between ages 15 and 69. In the oldest age group, slight declines are apparent from the earlier years. Keep in mind that the late-life drops on most of the cognitive language variables are relatively small and undoubtedly reflect the relatively healthy and educated samples from the study's samples. In line with Schaie's (1994) finding that verbal ability remains stable into old age, we found that the use of big words (six letters or more) increased significantly across all categories for the experimental participants. The famous authors did not show the same pattern, but this may be due to their already strong language skills from the beginning of their published writing careers.

The use of both cross-sectional and longitudinal data in the present studies adds to the credibility of the language patterns. Although there were similar findings in some dimensions, such as first-person singular pronouns and insight words, other categories were dissimilar. For example, neither of the social categories (first-person plural pronouns and social references) was significantly correlated with age in the Author Project. This may simply reflect a difference in topic, but it may also be suggestive of real cohort differences in some parameters. An opportunity to analyze years of natural language use within individuals could shed light on these questions. Nevertheless, the Author Project provides promising evidence that many of the patterns we found in our cross-sectional data may be replicated in other longitudinal samples. Furthermore, the significance and magnitude of many of the correlations between predicted age and the authors' ages were quite striking, indicating that the combination of linguistic patterns uncovered in the cross-sectional data are tapping something unique to the aging process.

Beyond the specific findings, this research project is most valuable in simply demonstrating that language use can serve as a proxy for personality and developmental processes that bypass the usual concerns of self-reports. Most effects hold up irrespective of writing topic or, in the Author Project, years when the participants wrote their works. This is not to say that writing topic or cultural factors do not affect word usage—they obviously do. However, with enough writing samples, researchers can begin to discern a picture of important psychological factors that change over time.

Perhaps the most promising application of the text analysis approach is that it allows researchers to explore personality and social processes of individuals, groups, and even cultures in other times and places. This is not a new approach—Martindale (1994) and others have used text analysis to study novels, speeches, and poetry to explore the creativity of societies. Nevertheless, with increasingly sophisticated text analytic methods, we can begin to study the personality and psychological dynamics of both historical and contemporary speakers and writers in almost frighteningly subtle ways.

One of the biggest challenges for linguistic personality researchers will ultimately be in deciding which of the many language dimensions are most important in revealing psychological states and processes. Much of the current LIWC-based system is inher-

ently crude in that LIWC categories reflect the perceptions of English-speaking psychologists, linguists, and college-student judges living in the United States in the early 1990s. In the years to come, a significant rethinking is needed of the ways words are used and how their usage ties to psychologically interesting variables.

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