

LINGUISTIC COMPLEXITY OF ABSTRACTS AND TITLES IN HIGHLY CITED JOURNALS¹

CYNTHIA WHISSELL

Laurentian University

Summary.—The linguistic style and emotional tone of thousands of titles and abstracts was analyzed for articles appearing in psychology journals ranked among the top 5% of all cited journals in the social sciences for 1995. Citation status was predicted by several measures of linguistic complexity: punctuation in the title, use of rare words, and sentence length. Abstracts from the top 5% group as a whole were also characterized by complexity: abstractness, low use of functional words, use of rare words, and sentence length. Categories of journals differed in emotional tone in a manner consistent with their contents, suggesting different emotional experiences for readers. The process of abstracting is described as one involving a tradeoff between accuracy or depth of communication and clarity or breadth, with breadth being especially important in an era in which electronic methods of dissemination put abstracts within the reach of an increasingly larger group of researchers.

Literature research is partly driven by information available in electronic databases such as the American Psychological Association's PsycLIT (1997). Decisions to read a journal article are influenced by the style and contents of titles and abstracts available in the database consulted. According to Hartley (1994), some abstracts are extremely difficult to read and would better serve their purpose of succinct communication if they were simplified. It has been suggested that the style of academic writing as a whole is unnecessarily complex, hampering the process of communication rather than advancing it (Nida, 1992).

Statistics regarding citations compiled in the Social Sciences Citation Index (Institute for Scientific Information, 1996) measure the frequency with which articles published in scientific journals are cited by their intended audiences. Frequency of citation is a measure of the number of citations while Impact is a measure of current number of citations corrected for numbers of articles. Immediacy is a measure of latency of use: it reflects the proportion of articles in a journal that are referred to within the year of publication. Impact scores were consistent across years for psychology journals, and rejection and publication rates by the American Psychological Association successfully predicted Impact scores for many categories of psychology journals (Rotton, Levitt, & Foos, 1993).

¹Please address correspondence and reprint requests to Dr. Cynthia Whissell, Psychology Department, Laurentian University, Sudbury, Ontario, P3E 2C6 Canada.

Extreme care should be exercised in the interpretation of citation information. Although scores based on citation counts might be reliable, there is no evidence whatsoever to support the validity of such scores as measures of "good science" (Beckoff, 1989; Leydesdorff & Amsterdamska, 1990). It is safer to assume that scores based on citation counts are behavioral measures which describe social scientists (citers) than to presume that they are evaluative measures which describe authors and articles (citees; Brenner, 1997).

This study was performed to examine linguistic complexity in abstracts from highly cited psychology journals, to compare journals within the group with each other, and to compare abstracts from the group of journals as a whole to samples of prose with respect to linguistic complexity.

METHOD

The style of abstracts and citation statistics for the 24 psychology journals which ranked among the top 5% of all 1995 journals cited in the social sciences (Institute for Scientific Information, 1996) were compared with each other and with other samples of English prose from introductory psychology textbooks and from a broad corpus of 350,000 words. The top 5% journals had citation counts ranging from 16,146 to 2,269. Twenty-four of the 71 most cited journals were defined as psychology journals because they had the root word 'psych' in their title, because they were published by the American Psychological Association, or because they had been included in Feingold's (1989) broad sample of psychology journals. Frequency, impact, and immediacy of citation served as criteria in multiple regression analyses after Frequency had been submitted to a log (base 10) transformation to correct for extreme positive skew. The three measures of citation were significantly but not strongly intercorrelated ($r_s = .50$ to $.70$). Predictors were emotional and stylistic variables calculated with the help of a computer program (Whissell, 1996, 1997).

Abstracts and titles were downloaded from the American Psychological Association's PsycLIT database on Silver Platter (March, 1997) for all selected journals for the year 1995. Sentence length in number of words, the proportional use of rare words, how much the titles were punctuated, the proportion of numerals in the abstract, and the emotional tone of the abstract measured in terms of Pleasantness and Activation were assessed for each journal (Table 1). By definition, rare words were those with a frequency of zero in a reference corpus of hundreds of thousands of English words sampled from many media and sources (Whissell, 1998). Values for Pleasantness and Activation, which were derived from ratings of matched individual words in a database called the Dictionary of Affect (Whissell, 1996, 1997) did not address the denotive issue of accuracy but rather described the connotative emotional experience likely to be encountered by readers perusing abstracts.

TABLE 1
STYLISTIC INFORMATION FROM ONE-WAY ANALYSES OF VARIANCE OF ABSTRACTS OF 24 PSYCHOLOGY JOURNALS IN TOP 5%
OF ALL CITED JOURNALS FOR 1995, WITH JOURNALS LISTED IN DECREASING ORDER OF FREQUENCY OF CITATION*

Journal	% Title Punctuation	% Rare Words	% Numerals	Sentence Length	Pleasantness	Activation	% Common	Imagery
Journal of Personality & Social Psychology	18 ^H	26 ^L	4 ^L	22.9	4.23	3.89	36 ^H	1.03
Psychopharmacology	16	39 ^H	7 ^H	24.3	4.12 ^L	3.80 ^L	31 ^L	1.08
Psychological Bulletin	20 ^H	25 ^L	3 ^L	22.4	4.22	3.89	38 ^H	0.92 ^L
Journal of Consulting & Clinical Psychology	16	27 ^H	4 ^L	24.6	4.10 ^L	3.90	33	1.02
Child Development	15	30	6 ^H	23.6	4.33 ^H	3.90	34	1.32 ^H
Psychological Review	18 ^H	24 ^L	2 ^L	25.9 ^H	4.21	3.78 ^L	38 ^H	0.84 ^L
American Psychologist	23 ^H	27 ^L	5	20.0 ^L	4.24	3.87	35 ^H	0.94 ^L
Journal of Abnormal Psychology	16	28	4 ^L	22.1	4.04 ^L	4.02 ^H	33	1.23 ^H
Journal of Applied Psychology	16	27 ^L	4 ^L	25.5 ^H	4.21	3.90	36 ^H	0.97
Developmental Psychology	17	25 ^L	5	25.0	4.36 ^H	3.91	35 ^H	1.17 ^H
Psychological Medicine	16	29	5	25.0	4.21	3.79 ^L	35 ^H	0.96
Neuropsychologia	16	29	5	22.5	4.21	3.79 ^L	35 ^H	0.96
Journal of Experimental Psychology—Human Perception & Psychophysics	15	27 ^L	4 ^L	24.2	4.22	3.80 ^L	37 ^H	0.91 ^L
Journal of Experimental Psychology—Learning	16	25	4 ^L	21.8 ^L	4.16	3.75 ^L	36 ^H	0.95
Behavioral Neuroscience	13 ^L	34 ^H	4 ^L	25.1 ^H	4.18	3.80 ^L	36 ^H	0.89 ^L
Psychological Reports	16	29	6 ^H	22.0	4.16	3.82	35 ^H	1.20 ^H
Psychophysiology	14 ^L	33 ^H	5	24.5	4.18	3.91	33	1.27 ^H
				23.7	4.17	3.83	32 ^L	1.03

(continued on next page)

*Titles had a mean length of 12 words and abstracts a mean length of 127 words. A terminal punctuation (.) was inferred and added to all unpunctuated titles by the PsycLIT (APA, 1997) database. % Title Punctuation = (punctuation marks in title/words + punctuation marks) · 100. % Rare Words = (rare words/all words) · 100. % Numerals = (arabic numerals/words + numerals) · 100. Sentence Length = mean length in number of words and numerals. Pleasantness = mean pleasantness; scores from a population with a mean of 4, SD of 1. Activation = mean activation; scores from a population with a mean of 4, SD of 1. % Common = percent of all words that are common English words, especially functional words (prepositions, articles, etc.). Imagery = mean imagery; scores from a population with a mean of 1.32 and a SD of 1.27. L = the mean for this journal on this measure was three or more SEs lower than the over-all mean. H = the mean for this journal on this measures was three or more SEs higher than the over-all mean.

TABLE 1 (CONT'D)
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Journal	% Title Punctuation	% Rare Words	% Numerals	Sentence Length	Pleasantness	Activation	% Common	Imagery
Psychosomatic Medicine	14 ^L	32 ^H	5	23.4	4.10 ^L	3.91	32 ^L	1.14 ^H
Journal of Educational Psychology	17	24 ^L	4 ^L	22.4	4.40 ^H	3.95 ^H	34	1.12 ^H
Memory & Cognition	17	28	5	23.4	4.20	3.78	36 ^H	0.81 ^L
Psychopharmacology Bulletin	16	33 ^H	6 ^H	23.1	4.10 ^L	3.86	32 ^L	1.02
Perceptual and Motor Skills	15	29	6 ^H	22.4	4.23	3.85	34	1.16 ^H
Organization Behavior & Human Decision Processes	15	37 ^H	5	23.5	4.26 ^H	3.87	35 ^H	0.77 ^L
All Journals	16	29	5	23.4	4.20	3.86	33	1.03
SE	.6	.5	.17	.56	.02	.02	.4	.03
Eta ²	.07	.31	.17	.04	.08	.04	.13	.15

*Titles had a mean length of 12 words and abstracts a mean length of 127 words. A terminal punctuation (.) was inferred and added to all unpunctuated titles by the PsycLIT (APA, 1997) database. % Title Punctuation = (punctuation marks in title/words + punctuation marks) · 100. % Rare Words = (rare words/all words) · 100. % Numerals = (arabic numerals/words + numerals) · 100. Sentence Length = mean length in number of words and numerals. Pleasantness = mean pleasantness; scores from a population with a mean of 4, *SD* of 1. Activation = mean activation; scores from a population with a mean of 4, *SD* of 1. % Common = percent of all words that are common English words, especially functional words (prepositions, articles, etc.). Imagery = mean imagery; scores from a population with a mean of 1.32 and a *SD* of 1.27. L = the mean for this journal on this measure was three or more *SEs* lower than the over-all mean. H = the mean for this journal on this measures was three or more *SEs* higher than the over-all mean.

The Dictionary of Affect is a collection of over 4,500 words which have been rated by individuals on 7-point scales representing the two chief emotional dimensions of pleasantness and activation. When an abstract was analyzed, each word in it was matched to the Dictionary and the emotional ratings for matched words were used to describe the abstract. Abstracts including many inactive unpleasant words such as "depression" or "sadness" would receive low scores on both dimensions. Abstracts including many pleasant words such as "child" or "recovery" would receive high scores on the pleasantness dimension. The mean for both Dictionary dimensions is 4.00, and means reported in Table 1 are close to the population mean because they represent an average across many individual abstracts.

Two additional measures describing the group of highly cited journals were the use of 206 most-common English words including function words or articles, prepositions, conjunctions, and pronouns, such as "a," "to," "and," "it," and "the" (McDonald, 1997; Whissell, 1998) and concrete imagery which was calculated by matching words in the abstracts to people's ratings of the extent to which nouns create a "clear mental picture" for them.

Circulation figures, as estimated by the publisher, were available for the majority of journals ($n=21$). Because these data were skewed, they were also submitted to a log (base 10) transformation before further analysis.

GENERAL DESCRIPTION AND DISCUSSION

Relationship of Citation Variables to Linguistic and Emotional Variables

More than 3,000 abstracts and titles including more than 450,000 words were analyzed using the computer program. There were significant differences across journals for sentence length, use of numerals, Pleasantness, Activation, and the use of Rare Words (one-way analyses of variance, $F>6$, $p<.05$), with 4% to 31% of total variance being associated with journal (Table 1). Individual differences between journals may be assessed with the help of the standard errors included in Table 1. By a powerful criterion any difference equal to or greater than three standard errors represents a significant difference between individual means.

Journals with scores more than three standard errors above or below the over-all group mean are noted in Table 1 with a superscript. For example, journals whose abstracts resulted in unusually high pleasantness values were *Child Development*, *Developmental Psychology*, the *Journal of Educational Psychology*, and *Organization, Behavior, and Human Decision Processes*. Journals with abstracts scoring well below the over-all group in mean pleasantness were *Psychopharmacology*, the *Journal of Counseling and Clinical Psychology*, the *Journal of Abnormal Psychology*, *Psychosomatic Medicine*, and the *Psychopharmacology Bulletin*. Although they are not the particular focus

of this article, many differences recorded in Table 1 are worthy of further consideration in their own right. Several of these differences are actually represented in results of correlational analyses summarized in Table 2 below.

With mean values by journal of Pleasantness, Activation, title punctuation, use of numerals, sentence length, and use of Rare Words as the unit of observation, forced-entry multiple regression analyses were used to predict Impact, Frequency, and Immediacy. Imagery and the use of common and functional words were excluded from the predictions because they were deemed to overlap with rare words and activation, respectively (correlations in support of this decision are reported in Table 2). Seventy-six percent of the variance in Impact (adjusted $R^2 = .66$) was successfully predicted, with higher punctuation of titles, a higher use of rare words, and a lower use of numerals in the abstract as significant predictors of higher Impact. Fifty-nine percent of the variance in Immediacy was predicted (adjusted $R^2 = .44$) with increased sentence length and title punctuation as significant predictors. Punctuation in the title was the only significant predictor of the transformed Frequency (45% prediction, adjusted $R^2 = .25$). All citation measures were moderately and positively correlated with both title punctuation and a dummy variable of publication category (American Psychological Association, non-American Psychological Association). The conclusion that journals published by the American Psychological Association are cited more frequently (Feingold, 1989; Rotton, Levitt, & Foos, 1993) was confirmed.

Title punctuation, longer sentences, and the more frequent use of rare words are indicators of textual complexity within the abstract (Hartley, 1994; Nida, 1992). The main finding of this portion of the study was that even within an already select group, such measures were related to greater Impact and Immediacy of citations leading to the conclusion that abstracts in the journals of highest status were more complex and as a result probably more difficult to understand than those in the remaining journals. The use of numerals, which could be an indication of specificity or tangibility in journal abstracts, was inversely related to citation status in a predictive scheme.

Comparison of Abstracts to Other Texts

In comparison to 120 100-word samples randomly selected from several popular introductory psychology textbooks (Whissell, 1997), abstracts in all the highly cited journals were relatively Unpleasant ($4.20 < 4.47$; t test, $p < .01$) and relatively Inactive ($3.86 < 3.98$, $p < .01$). Abstracts contained almost twice as many rare words as the text samples (29% versus 15%, $p < .01$), and their sentences were slightly longer than those in introductory texts (23.3, 22.7, $p < .05$). For the relatively inexperienced reader, every third word in the type of abstracts sampled would be unfamiliar. Compared to a broad sample of English prose, abstracts were again less Pleasant ($4.20 < 4.42$) and

TABLE 2
INTERCORRELATIONS AMONG VARIABLES REFLECTING JOURNAL CATEGORY, CITATION STATUS, LINGUISTIC STYLE, AND EMOTIONAL CONNOTATION

	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Journal Category Dummy Variables (0 = no, 1 = yes)*																	
1	-.24	-.33	-.24	-.19	-.46	-.17	-.06	-.12	-.40	-.29	-.42	.35	.45	.75	-.52	.12	-.47
2		-.19	-.14	-.11	.38	.42	.80	.56	.77	-.06	.11	-.49	-.18	-.36	.49	-.34	.35
3			-.19	-.15	-.10	-.37	-.31	-.24	.17	-.50	.00	.04	-.21	-.12	.33	-.30	-.44
4				-.11	.12	.02	-.06	.11	.02	-.38	.71	.10	.12	-.25	-.06	.46	.34
5					.30	.25	.09	.20	.04	.49	-.44	-.20	.03	-.10	-.27	.20	.53
6						.41	.52	.54	.42	.32	.19	-.75	-.22	.58	.47	-.07	.62
Citation Status*																	
7							.65	.47	.49	.12	.00	-.24	.03	-.10	.17	.05	.74
8								.72	.59	.04	-.02	-.56	-.04	-.22	.38	-.22	.57
9									.41	.14	-.08	-.50	.21	-.31	.29	-.08	.52
Measures of Language and Emotion*																	
10										.12	.29	-.26	-.44	-.48	.37	-.31	.53
11											.02	-.05	-.39	-.23	.33	.56	.54
12												-.06	-.02	-.50	.41	-.02	.17
13													-.06	.67	-.69	.38	-.48
14														.25	-.03	-.01	-.04
15															-.69	.32	-.55
16																-.55	.16
17																	.05

Note.—Correlations in boldface are those with $p < .05$, two-tailed. *1 = Neuropharmacological, 2 = Review/Commentary, 3 = Learning/Perception/Experimental, 4 = Developmental/Educational, 5 = Abnormal/Psychopathology, 6 = Published by APA, 7 = Log(base 10) of citation frequency, 8 = Impact, 9 = Immediacy, 10 = Proportion of punctuation in the title, 11 = Activation or arousingness of words, 12 = Pleasantness of words, 13 = Proportional use of numerals in abstract, 14 = Sentence length, 15 = Proportional use of rare words, 16 = Proportional use of common and functional words, 17 = Imagery of words, 18 = Log (base 10) of circulation.

less Active ($3.86 < 3.97$). They contained an extremely low proportion of common and functional words—35% as opposed to better than 50% for a varied corpus of 350,000 words ($z = 54$, $p < .001$) (Whissell, 1998), and they were also very poorly imaged. Their Imagery mean of 1.03 was 14 *SE* below the population mean of 1.32 ($z = -14$, $p < .001$), and it was the lowest Imagery mean sampled for prose to date. Although journals also differed from each other in their abstracts' Imagery scores and the use of functional and common words, these differences were minuscule in comparison to the difference of abstracts as a whole from other types of prose (Table 1).

The main conclusion of this phase of the study was that abstracts in highly cited psychology journals as a group were complex and intangible rather than being simple and concrete. They included longer sentences, more unfamiliar words, fewer functional and common words, and less concrete imagery than comparative samples. Abstracts as a whole were also relatively Inactive and Unpleasant.

Ammons (1998a, 1998b) noted the lack of clarity and possible confusion inherent in writing which skimps on the use of connectives. Connectives are among the most frequently used words in English. Their presence or absence in an abstract would influence the proportion of functional and common words which was unusually low in the present data, suggesting a relative absence of connectives. There is probably a great temptation to do without connectives in abstracts where space is at a premium. However, if "the chief purpose of publishing scientific research is to communicate one's thoughts and findings" (Ammons, 1998a), space should not be saved at the cost of communication.

Correlations among Measures and Journal Descriptors

Correlations performed with several dummy binary categorizations of the set of all journals indicated that neuropharmacological journals had abstracts of a less Pleasant emotional tone than other journals ($r = -.42$), that developmental and educational journals had abstracts of a more Pleasant emotional tone than other journals ($r = .71$), that journals dealing with psychopathology had abstracts of a less Pleasant ($r = -.44$) and more Active ($r = .49$) tone and that learning, cognition, and perception journals had abstracts of a less Active emotional tone ($r = -.50$). These data suggest that readers of the various abstracts would be exposed to texts which differed not only in linguistic simplicity but also in emotional connotation. For example, abstracts from learning, perception, and cognition journals would make for rather dry reading while abstracts from developmental journals would induce a mild sense of pleasantness. Intercorrelations among variables are reported in Table 2.

CONCLUSIONS

Although there were both emotional and stylistic differences among journals and although these differences were related to the category and citation status of the journals, these data provide no basis for an assessment of causality. Certain journals may be more linguistically complex because they have a higher citation status or the opposite might be the case. The face validity of the relationship between emotion and journal category suggests that these variables may both be driven by a third external variable, the nature of the subfield. Also, words are at a premium in the process of abstracting because the length of abstracts is limited. Some of the linguistic differences observed in the abstracts studied here are probably a result of this factor.

One of the readers reviewing an early draft of this paper suggested that citation might be mediated to some extent by circulation which is an indicator of journals' availability. The correlation between the log of circulation and the log of citation was indeed high (.74) and circulation was also positively correlated with Impact and Immediacy ($r = .57$ and $.52$). These data do not prove that availability produces citations, but they certainly add to the questions surrounding the issue of what citation statistics actually measure. The most available journal (the *American Psychologist*) was a member of several highly cited categories of journal. The availability of this journal is a function, at least in part, of society membership rather than specific subscription. At the moment, there is no way to tease out the variance in citation statistics related to availability from that related to other sources such as quality or language, even if the likelihood of reciprocal causality among these sources were temporarily ignored.

The purpose of journal abstracts is to reach the maximum number of readers while effectively communicating the exact contents of articles. Highly educated professionals have little trouble understanding complex abstracts (Hartley, 1994), but a reader operating at the level of introductory psychology texts would have considerable trouble in reading and interpreting many of the abstracts analyzed. The target population for abstracts is not necessarily one of students in introductory psychology, but neither is it limited to a small and highly select band of expert readers sharing an exclusive language. The group reading abstracts often includes researchers for whom English is a second language. Advances in the electronic dissemination of abstracts suggest that these are becoming available to an increasingly broad sample of interested readers, including introductory psychology students. It was not only the use of rare words but also the use of complex titles, longer sentences, less tangible imagery, and few functional words which pinpointed the greater complexity of abstracts in the most highly cited journals. The claim of a "special technical vocabulary," which applies especially to some groups of

abstracts such as neuropharmacological ones, would explain only one of these differences.

Accuracy and clarity are both functions of linguistic complexity, but one is a direct function and the other an inverse function. Readers of abstracts would benefit from the identification of the balance for linguistic complexity that *simultaneously maximizes* both clarity, i.e., the number of readers who understand the abstract, and accuracy, i.e., the faithful depiction of complex information.

It is not necessary to address all of the linguistic measures described here to promote comprehension of abstracts by relatively inexperienced readers. Lafontaine (1998) marginally increased the number of common and function words (from 36% to 38%) and appreciably decreased sentence length (from 24 words to 19 words) in a study in which first-year students demonstrated a significant increase in their understanding of the content and implications of simplified abstracts. Lafontaine did not manipulate the use of rare words (24%), leaving the specialist vocabulary of each abstract relatively intact. Hartley (1994), on the other hand, *increased* sentence length in an example of a successful manipulation included in his paper (from 28 to 32 words), while decreasing the proportion of rare words (from 16% to 12%) and increasing the proportion of common and function words (from 42% to 45%). The relative starting values of the various variables for different abstracts may influence comprehension, and there is evidence of a trade-off effect wherein longer sentences *which include more common and function words and fewer rare words* lead to better comprehension of abstracts.

A common conclusion of both experimental studies of abstracts was that comprehension for material in unmodified abstracts was extremely low for naive populations (13% for Lafontaine's first-year students and 18% for overseas postgraduate librarianship students from Hartley's study).

Not all readers of abstracts approach them in a similar manner, so it is possible that comprehension is less relevant to the reading of abstracts than one might suppose. If abstracts are treated as a menu rather than a complex text, readers may simply scan for and spot relevant words before deciding to copy or read an article. This approach is similar to that of the search engine provided by PsycLIT which scans for the presence of specific individual words in abstracts. If all abstracts were read in this manner, however, it would not be necessary to write them as text. A simple list or menu of relevant descriptors would be sufficient. Personal experience with data bases that take the menu approach has led to the conclusion that it is considerably less fruitful, at least for an experienced reader, than the approach which provides textual abstracts.

Colleagues of the author have mentioned that some doubt should also be cast on the assumption that all writers of abstracts intend to communi-

cate clearly about their work. An incomprehensible abstract could serve two purposes, that of enticing the reader into reading the article for clarification or that of demonstrating the intellectual power of the writer. No data exist to support the presence of intentional obfuscation in abstracts, either as an appetizer or as a dominance behavior; the issue of abstract-writers' intentions is one that still needs to be examined. In fact, the writing and reading of abstracts are best viewed as a starting point for such research.

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