

Acceleration of citing behavior after the millennium? Exemplary bibliometric reference analyses for psychology journals

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Abstract With reference to social constructivist approaches on citing behavior in the sciences, the hypothesis of acceleration of citing behavior after the millennium was empirically tested for a stratified random sample of exemplary psychology journal articles. The sample consists of 45 English and 45 German articles published in the years 1985 versus 1995 versus 2005 in high impact journals on developmental psychology, psychological diagnosis and assessment, and social psychology. Content analyses of the reference lists refer to the total number of references cited in the articles and the publication years of all references. In addition, the number of self-references, the number of pages, and the number of authors were determined for each article. Results show that there is no acceleration of citing behavior; rather, on the contrary, a significant trend is revealed for an increase in authors' citing somewhat older references in the newer journal articles. Significant main effects point also at more citations of somewhat older references in the English (vs. German) journal articles as well as in articles on social psychology and psychological diagnosis (vs. on developmental psychology). Complementary analyses show that multiple authorships and the number of pages as well as the total number of references and the number of self-references increase significantly with time. However, percentage of self-references remains quite stable at about 10%. Some methodological and statistical traps in bibliometric testing the starting hypothesis are considered. Thus, the talk that has been circulating among psychology colleagues and students on the potential millennium effects on citing behavior in the sciences (which can, however, become a self-fulfilling prophecy) are not confirmed—at least for psychology journals.

Keywords Citing behavior · Literature references · Citations · Bibliometrics · Content analysis · Millennium · Self-fulfilling prophecy · Scientometry · Psychology

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Introduction

Social constructivist views on citing behavior (e.g., Gilbert 1977) complete the traditional normative theory of citing (e.g., Merton 1957, 1973) by subjective factors referring to a boarder range of authors' motives for their citing behavior as well as their different intentions and meanings of citations (for an overview see, e.g., Bornmann and Daniel 2008; Cozzens 1989; Cronin 1984). In current listings of the factors codetermining citing that have not much or not at all to do with the accepted conventions of scholarly publishing (e.g., factors related to journals, field of research, types of articles, potential readers, etc.), time dependent factors are mentioned as well (see e.g., Bornmann and Daniel 2008; Burrell 2003; Cawkell 1976; Cozzens 1985; Garfield 1972, 1998).

Recently, in the sciences a time dependent factor has become apparent which might codetermine citing behavior in a quite informal, perhaps unintentional, hidden manner: There have been recent discussions with students and among students as well as with research colleagues and among colleagues about not citing the 'old' publications from the 20th century anymore. It seems as if the millennium could be regarded as a self-settled barrier for references: Citing articles and books published "in the last century" may be something like a stigma, they are much too old and—perhaps—outdated, at least not up-to-date, out of the mainstream, and not en vogue. Obviously, this hypothesis refers to rumors, attitudes, and stereotypes, which are subject of empirical analyses in social psychology. The results of such empirical analyses confirm the impact of these social cognitions on human behavior. Therefore, the question for research is if this is true for contemporary citing behavior as well.

In this contribution, the hypothesis of acceleration of citing behavior after the millennium is empirically and bibliometrically tested for a stratified random sample of psychology journal articles: Do reference lists of scientific articles published in 2005 (i.e., five years after the millennium) include more references from the preceding five years (i.e., references published between 2000 and 2004) than the reference lists of articles published in 1995 (i.e., references published between 1990 and 1994) and 1985 (i.e., references published between 1980 and 1984)? Statistically, the hypothesis is tested by means of repeated measurement (first factor: publication year 1985 vs. 1995 vs. 2005) for a stratified random sample of 45 English and 45 German articles (second factor: English vs. German publication language) published in high impact journals on developmental psychology, psychological diagnosis and assessment as well as social psychology (third factor: three subdisciplines of psychology). Language and subdiscipline are considered in addition as independent factors, because the generalizability of the results for at least two publication languages and three subdisciplines of psychology should be tested complementarily. By the way and only for the sake of replication of former bibliometric results (see Krampen et al. 2007), number of self-references, number of authors per article (i.e., multiple authorships), and number of pages are considered as dependent variables as well.

Method

The text materials and reference lists used in the content analyses refers to a stratified random sample of 90 journal articles published in the areas of developmental psychology, psychological diagnosis and assessment, and social psychology. Journals were drawn from the pool of high impact Anglo-American and German psychological journals published under the editorial auspice of the American Psychological Association (APA) or the

German Psychological Association (Deutsche Gesellschaft für Psychologie, DGPs), respectively. Manuscript requirements and guidelines of these APA- and DGPs-journals (e.g., on maximum page number, reference citations style, peer reviewing, publication ethics) are the same. All types of original contributions—i.e., empirical studies (95%) and theoretical studies (5%)—were considered. Random article selection was accomplished by applying the formula “number of articles in the volume of the journal divided by 15”, which leads to the code number by which the 15 original articles per volume were determined randomly. The material studied in the current analysis consisted of

- (1) 45 journal articles published in three Anglo-American APA journals (i.e., *Developmental Psychology*; *Psychological Assessment*; *Journal of Personality and Social Psychology: Section Social Psychology*) in the years 1985, 1995, and 2005 (15 articles from each volume);
- (2) 45 journal articles published in three German DGPs journals (i.e., *Zeitschrift für Entwicklungspsychologie und Pädagogische Psychologie*; *Diagnostica*; *Zeitschrift für Sozialpsychologie*) in the years 1985, 1995, and 2005 (15 articles from each volume).

Content analysis focused on the list of references in each publication. Numbers of total references were recorded. The publication years (PY) of all references cited were documented. In addition and only for the sake of replication, information about the number of authors per articles (multiple authorships), the number of self-references, and the number of pages of the 90 articles (all journals have similar layouts), from which the reference lists were analyzed, was gathered.

Results

Multivariate analyses of variance (MANOVA) with the independent factors “Publication Year” (PY: 1985 vs. 1995 vs. 2005), “Publication Language” (L: English vs. German) and “Subdiscipline of Psychology” (D: developmental psychology vs. psychological diagnosis and assessment vs. social psychology) with repeated measurement on the first factor were computed for all dependent variables. Descriptive statistics of all indices of citing behavior and the MANOVA results are summarized in Table 1.

Analysis of variance results in significant main effects of publication year, publication language, and psychological subdiscipline for the *number of references in total* (see Table 1): Number of references increase with publication year from 1985 to 1995–2005 significantly; there are significantly more references in the English journal articles than in the German ones; articles on psychological diagnosis and assessment have, on average, significantly shorter reference lists than articles on both developmental and social psychology. Two significant interaction terms (of publication year and language as well as language and subdiscipline; see Table 1) modify the interpretations only slightly and are therefore not pursued further here.

In the second row of Table 1 the results of the first analysis of variance for the dependent variable “number of references from the five years before publication” are presented. A statistical artefact suggests wrong conclusions, that is, findings confirming the hypothesis of millennium effects in citing behavior: The significant main effect of publication year suggests an increase in the number of references from the five years before publication, because the average number in the 2005 publications ($M = 12.8$) is significantly greater than this in the 1995 publications ($M = 10.9$), and both are significantly

Table 1 Means (*M*) and standard errors (*SE*) of the indices of citation behavior as well as results of the analyses of variance

Variable	Publication year (PY)				Language (L)		Discipline (D)		Analysis of variance						
	1985	1995	2005	E ^a	G ^a	Dev ^b	Diag ^b	Soc ^b	PYF (2/83)	LF (1/84)	DF (2/84)	PY*LF (2/83)	PY*DF (4/168)	PY*L*DF (4/168)	L*DF (2/84)
Total number of references	<i>M</i>	25.1	40.8	50.3	43.1	34.4	43.9	25.3	47.8						
	<i>SE</i>	2.4	2.5	2.1	1.9	1.9	2.3	2.3	2.3	31.5**	10.7**	26.5**	5.7**	1.1	1.0
Number of references from the five years before PY	<i>M</i>	8.1	10.9	12.8	10.5	9.8	13.0	6.5	12.4						
	<i>SE</i>	1.1	0.9	0.8	0.2	0.2	0.8	0.8	0.8	6.2**	0.3	17.7**	2.3	0.6	1.5
Percentage of references from the five years before PY	%	32.2	26.7	25.4	24.4	28.5	29.6	25.7	25.9						
Average deviation from PY of all references	<i>M</i>	9.3	10.2	10.9	10.5	9.8	9.3	10.4	10.8						
	<i>SE</i>	0.3	0.3	0.2	0.2	0.2	0.3	0.3	0.3	7.4**	4.6*	6.4**	2.7	0.9	1.8
Number of self- references	<i>M</i>	2.7	4.4	4.8	4.7	3.2	4.3	2.9	4.6						
	<i>SE</i>	0.3	0.5	0.4	0.3	0.3	0.4	0.4	0.4	8.4**	12.5**	5.6**	2.3	2.9*	0.5
Percentage of self- references	%	10.7	10.8	9.5	10.9	9.3	9.8	11.5	9.6						
Number of pages	<i>M</i>	10.8	13.7	12.9	12.0	12.9	12.3	12.3	12.8						
	<i>SE</i>	0.6	0.5	0.4	0.4	0.4	0.5	0.5	0.5	7.4**	2.8	0.4	31.3**	3.7**	5.6**
Number of authors	<i>M</i>	1.9	2.2	2.9	2.7	2.1	2.4	2.2	2.4						
	<i>SE</i>	0.1	0.1	0.2	0.1	0.1	0.2	0.2	0.2	9.2**	9.3**	0.4	1.3	1.5	1.8

^a *E* English language journals, *G* German language journals, ***p* < .01; * *p* < .05

^b *Dev* journals on developmental psychology, *Diag* journals on psychological diagnosis, *Soc* journals on social psychology

^c Absolute numbers suggesting wrong conclusions (see text for explanations)

greater than this in the 1985 publications ($M = 8.1$). The additional significant main effect of “subdiscipline” can be neglected, because it suggests incorrect conclusions as well. The next row in Table 1 shows the percentages for the number of references from the five years before article publication relative to the (significantly increasing; see above) number of references in total. This percentage is *decreasing* from the value in the 1985 publications (32%) to the 1995 publications (27%) to the 2005 publications (25%), a finding that points at a reverse effect.

Therefore, a new bibliometric indicator was computed with reference to the *average deviation of the publication years of the references* ($PY_{\text{reference}}$) from the publication year of the journal article (PY_{article}) analyzed. This indicator is mathematically formalized as: Average Deviation = $[\sum \text{number of } PY_{\text{reference}} \times (PY_{\text{article}} - PY_{\text{reference}})] / \sum (\text{number of references})$. The MANOVA results for this new indicator of citing behavior are presented in the fourth row of Table 1. There are significant main effects of publication year, publication language, and subdiscipline as well. The first significant main effect confirms the impression suggested by the percentages documented above, because the average deviation increases significantly from publication year to publication year; in other words, the reference lists in 2005 publications include more older references than the reference lists in 1995 publications and both include more older references than the reported reference lists in the 1985 publications. This is confirmed by a quite stable average number of references to publications dated 1950 and before in the articles of all the analyzed publication years (1985 publications: $M = 0.37$; 1995 publications: $M = 0.46$; 2005 publications: $M = 0.41$). Thus, these results do not provide support for the original hypothesis of millennium effects on citing behavior.

The second main effect (publication language; see Table 1) indicates significantly greater average deviations between the publications years of articles and references cited in the English journal articles than in the German ones, that is, citations of older references are found more frequently in the Anglo-American psychological community than in the German one. Significant differences exist between the three psychological subfields as well (see Table 1): There are fewer citations of older references in articles on developmental psychology than in articles on psychological diagnosis and assessment as well as on social psychology. It must be added that all interaction terms are not statistically significant.

A similar artefact is documented in the MANOVA for the dependent variable of the number of self-references suggesting—besides other significant main effects and some significant interaction terms—an increase of self-references from 1985 to 1995–2005 (see fifth row of Table 1). Again, the significant increase of the reference lists in total must be considered. In the next row the *percentages of the number of self-references* relative to the (significantly increasing; see above) number of total references are presented. These percentages of self-references are rather stable over the publication years, the publication languages, and the psychological subdisciplines under study. Average percentages of self-references are situated around 10%, which is very similar to former results for psychological publications (Krampen et al. 2007) and for other scientific publications as well (Garfield 1979).

Finally, the results of the analyses of variance for the number of pages and the number of authors are reported: The *number of pages* increases significantly with the publication year (see Table 1). Post-hoc tests show that—both 1995 publications ($M = 13.7$ pages) and 2005 publications ($M = 12.9$)—are significantly ($p < .05$) longer than the 1985 publications ($M = 10.8$). This result agrees with the increasing length of reference lists ($r = .55$; $p < .01$), which suggests that the extension of journal article length is—at least, partly and at least in the psychological subfields studied here—caused by an extension of

reference lists. In addition, there are no significant main effects of publication language and subdiscipline, but, however, all interaction terms are statistically significant (see Table 1). These significant findings indicate some complex statistical interactions of publication year, publication language, and subdiscipline on the length of psychological journal articles. A detailed interpretation of these findings is not presented here because even though they are of primary interest within science research in psychology, they are only of minor interest in general (and their determined variances are rather low).

There is a slight, but statistically significant trend to an increase of multiple authorships in psychology (see last row in Table 1): The average *number of authors* increases from $M = 1.9$ (publication year: 1985) to $M = 2.2$ (1995) to $M = 2.9$ (2005). Post-hoc tests show that all of these differences are statistically significant ($p < .05$). This is independent from the publication year significantly more distinctive in English language journals ($M = 2.7$ authors) than in German ones ($M = 2.1$; see Table 1). However, the significant interaction of “publication language” and “psychological subdiscipline” shows that (1) articles on developmental psychology ($M = 2.85$ vs. $M = 2.00$) and articles on social psychology ($M = 3.00$ vs. $M = 1.85$) have, on average, significantly more authors in the English language journals than in the German language, while articles on psychological diagnosis and assessment are written by more authors publishing in the German language journals ($M = 2.36$) than in the English journals ($M = 2.13$) on average. Thus, the increase of multiple authorships is dependent from publication language and scientific field in psychology—this, however, with an independent general significant increase over time, that is, with the publication year.

Discussion and conclusions

First of all, the hypothesis of acceleration of citing behavior after the millennium is exemplarily not supported for a stratified random sample of psychology journal articles published in 1985 versus 1995 versus 2005. In other words, the rumors amongst colleagues and students of psychology about a millennium barrier for not citing articles and books published “in the last century” as well as attitudes and stereotypes influencing this behavior (e.g., because they are outdated, out of the mainstream, and not en vogue) do not stand up empirically—at least until now and at least in the psychological subfields under study (this finding does not exclude the possibility, however, that they can still become a self-fulfilling prophecy).

Instead, the data presented here show a reverse effect: The average deviation between the publication year of a journal article and the publication years of the references cited in the article increases significantly from the 1985 to 1995 to 2005 publications—that is, the reference lists of the 2005 publications include more older references than the reference lists found in the 1995 publications, and both more recent years include more older references than the reference lists of the 1985 publications. This is confirmed by a quite stable average number of references to publications dated 1950 and before.

In addition, the average deviation between the publications years of articles and references cited in the English journals is significantly greater than in the German ones, that is, there are more references to older, “classical” literature in the Anglo-American psychological community than in the German. This is astonishing, because psychology originated in the late nineteenth century as an independent science in the German language area (for an overview see, e.g., Marx and Hillix 1963; Wertheimer 1970), and US American scientists still give more reference to this fact than the Germans do (see e.g.,

Krampen et al. 2002). Furthermore, there are significant differences between the three psychological subfields included in this study as well, which are of minor general, but of special interest in the research of science within psychology.

In the statistical analyses presented here, some methodological traps in bibliometric and scientometric research are emphasized. For instance, it is empirically shown how the selection of absolute bibliometric indicator variables suggests conclusions which are incorrect yet plausible at first glance. A demonstration of this type of error is presented in the initial analysis of a millennium effect on citing behavior for the bibliometric indicator “number of references from the five years prior to publication” as well as for the “number of self-references”. Results for both indicator variables do not stand when these indicator variables are relativized with reference to the number of references in total.

Finally, it should be noted that the replication of former results on about 10% self-references in journal articles (see e.g., Garfield 1979; Krampen et al. 2007) was successful. This proportion of self-references can be evaluated positively, because self-references should not only be viewed as self-marketing strategies of scientists, but as indicators of the continuity of the research they have undertaken (representing central themes of their work) as well. However, the replication of this quotient confirms the quality of the stratified random sample of psychology journal articles included in the present study. The same is true for the increase of multiple authorships in psychology over time, a finding which is somewhat more pronounced in Anglo-American journals than in the German ones (Krampen et al. 2007). Increase of multiple authorships is a general trend in the sciences, which, however, until now has not been so present in the humanities and social sciences.

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