Forecasting trends of development of psychology from a bibliometric perspective

Günter Krampen · Alexander von Eye · Gabriel Schui

Abstract Bibliometric data on psychology publications from 1977 through 2008 are modeled and forecasted for the 10 years following 2008. Data refer to the raw frequencies of the PsycINFO (94% English-language, mainly Anglo-American publications) and the English-language documents of PSYNDEX (publications from the German-speaking countries). The series were modelled by way of exponential smoothing. In contrast to Single Moving Average methods which do not weigh observations, exponential smoothing assigns differential weights to observations. Weights reflect the distance from the most recent data point. Results suggest strongly expanding publication activities which can be represented by exponential functions. In addition, forecasted publication activities, estimated based on psychology publication frequencies in the past, show positive bibliometric trends in the Anglo-American research community. These trends go in parallel the bibliometric trends for the English-language publications of German-speaking authors. However, while positive trends were forecasted for all psychological subdisciplines of the Anglo-American publication database PsycINFO, negative bibliometric trends were estimated for English-language publications from German-speaking authors in 6 out of 20 subdisciplines.

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Introduction

Bibliometric analyses are a significant tool in the historiography of the sciences. Modern online databases make such analyses easier, which, decades ago, had to be performed by hand-counting articles, books, etc. in libraries (e.g., Albert 1985; Bättig 1976; Cattell 1903). By definition, historiography is restricted to retrospective trend analyses, and describes developments in research and publication activities in the long and in the recent past. This contributes to the understanding of the development of a science or of scientific subdisciplines, because the main foci and main streams as well as under-emphasized research activities can be highlighted (e.g., Krampen and Montada 1998; Krampen and Schui 2009; Larsen and von Ins 2010; Schoepflin and Müller-Brettel 1990; Schui and Krampen 2010). However, bibliometric data can be used prospectively too. The objective of such applications refers not only to the description of the past, but to the forecasting of future research and publication trends as well (for mathematics see, e. g., Behrens and Luksch 2011). These future trends are estimated mathematically from trends in past publication activities.

For the following bibliometric forecasted trend analyses, we used the raw frequencies of (1) the PsycINFO and (2) the PSYNDEX databases. Both data sources are available online. Such domain-specific literature databases cover the scientific literature of a discipline better than citation databases (e.g. Science Citation Index and Social Science Citation Index), for which Larsen and von Ins (2010) report a decline in coverage of scientific publications. The PsycINFO database covers mainly (recently 94%) psychological publications in the Anglo-American, English-language literature. While in the twentieth century in total 10% of the PsycINFO documents were non-English, there was a drop in their relative number at time of the last decades of the twentieth century leading to only 6% non-English documents in PsycINFO in the first decade of the twenty-first century (for more details, see, e.g., Krampen 2009). The PSYNDEX database covers psychological publications from the German-speaking countries (i.e., Austria, Germany, and Switzerland) in German as well as in English. We focus on the English-language publications from the German-speaking countries documented in PSYNDEX and compare forecasted bibliometric trends in the Anglo-American with the internationally visible (i.e., English) publications from the German psychological research community. The time series from 1977 through 2008 are used, because PSYNDEX started literature documentation in 1977, and because it can be assumed that literature documentation of the publication year 2008 is completed at the time of data gathering in June 2010.

The following analyses were performed with two goals in mind. First, it was attempted to model the series of scores (smoothing). Second, it was attempted to forecast scores for the 10 years following 2008.

Method

Bibliometric data refer to the raw frequencies of the PsycINFO and the English-language documents of PSYNDEX from 1977 through 2008. To model the series, the method of exponential smoothing was used. In contrast to Single Moving Average methods which do not weigh observations, exponential smoothing assigns differential weights to observations. The benefit of this method lies in the fact that more recent observations carry more weight than earlier observations. Therefore, if the process that determines a trajectory changes over time, the observations from the period before the change will have less effect

on the forecasted trend. By implication, the trend forecasted by exponential smoothing has the potential of being more up-to-date and reflecting current more than past processes. Specifically, exponential smoothing uses weights that exponentially decrease as the distance from the most recent observation, that is, the last score in the series, increases.

To illustrate, consider the estimated (smoothed) value, S_t, for time period t,

$$S_t = \alpha \sum_{i=1}^{t-2} (1-\alpha)^{t-1} y_{t-i} + (1-\alpha)^{t-2} S_{t-2}$$

for $t \geq 2$. The weights, $\alpha(1-\alpha)^t$, decrease exponentially. For example, if the weight is chosen or estimated to be $\alpha = 0.3$, then the value of the last observation is 0.21, the weight of the second last observation is 0.147, the weight of the third-last observation is 0.072, and so forth. The weight of the earlier observations decreases more rapidly as α approaches 1, and it decreases more slowly as α approaches zero. The selection of α can be part of the equation in the sense that the value of α is chosen that comes with the smallest mean square error. For the following analyses, the exponential smoothing module available in SYSTAT 12.0 was used, with the default value of $\alpha = 0.1$, and the linear trend parameter was set to 0.5. The models were re-estimated using different weights. Results changed only when extreme values of α were used.

Results

In the following paragraphs, we present the results of the smoothing and forecasting analyses in two parts. First, we display the results for the PsycINFO data on the Anglo-American psychology publications, second the results for the number of articles published in English, by German-speaking authors, of the PSYNDEX data. In each paragraph, we first present overview results and then detailed results for a selection of subdisciplines of Psychology (classification codes of the thesaurus of psychological index terms; see Gallagher Tuleya 2007). The selection focuses on those subdisciplines that show particularly strong trends in the forecasted period of years.

Results from the PsycINFO data

The smoothed curve of the aggregated number of publications that is documented by PsycINFO from 1977 through 2008 is given in Fig. 1. The abscissa of Fig. 1 (and all following figures) counts the years. The 1st year is 1977, and '31' is year 2008. The ordinate represents the number of documented publications. The graph shows a clear upwards trend. In addition, this trend is positively accelerated. The increase becomes stronger in the years shortly before 2008. Accordingly, the forecasted trajectory, that is, the extrapolated continuation of this trend calls for a further increase.

This overall result for PsycINFO is valid in the sense that it applies to each of the 9 basic and the 11 applied subdisciplines that the domain of Psychology was subdivided into for this study. The forecasted trajectory is positive for each of the subdisciplines (see Table 1). However, the individual subdisciplines differ from each other and the aggregate, in particular in such curve characteristics as elevation, variability and the point in time from which on the acceleration is visible. They differ also in the slope of the forecasted trajectory. This last characteristic is illustrated in the following two examples.
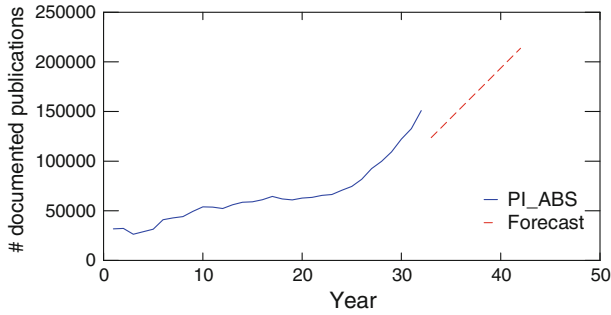
Fig. 1 Smoothed trajectory of the aggregated numbers of PsycINFO-documented publications from 1977 (1st year) through 2008 (31st year)

Table 1 Sign of the forecasted slopes for the total number of publications and of the subdisciplines of psychology based on the PsycINFO and based on the English-language publications of the PSYNDEX	(Sub-) discipline	Forecasted trend[a]	
		PsycINFO	English in PSYNDEX
	Psychology (total)	+1	+1
	Basic subdisciplines of psychology		
	General Psychology: Cognitive Processes	+1	+1
	General Psychology: Motivation and Emotion	+1	+1
	Bio- and Neuropsychology	+1	+1
	Social Psychology	+1	+1
	Personality Psychology	+1	+1
	Developmental Psychology: Childhood	+1	−1
	Developmental Psychology: Adulthood	+1	+1
	Diagnostics and Tests	+1	+1
	Methodology and Statistics	+1	−1
	Applied subdisciplines of psychology		
	Educational Psychology: Teaching	+1	+1
	Educational Psychology: Learning and Achievement	+1	+1
	Organizational Psychology: Personnel Selection and Personnel Training	+1	+1
	Organizational Psychology: Management	+1	−1
	Clinical Psychology: Psychotherapy	+1	−1
	Health Psychology	+1	+1
	Family Psychology	+1	−1
	Sport Psychology	+1	+1
	Political Psychology	+1	+1
[a] +1 = positive forecasted trend, −1 = negative forecasted trend	Environmental Psychology	+1	−1
	Cross-cultural Psychology	+1	+1

Fig. 2 Smoothed trajectory of the aggregated numbers of PsycINFO-documented publications from Bio- and Neuropsychology from 1977 (1st year) through 2008 (31st year)
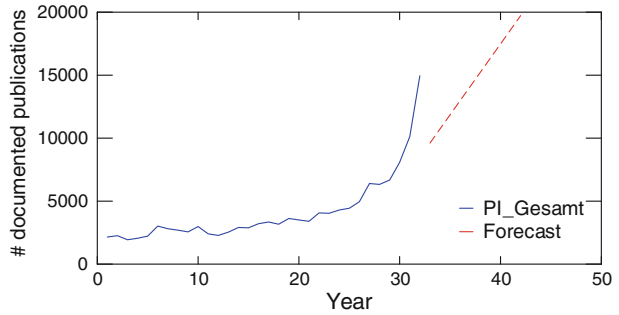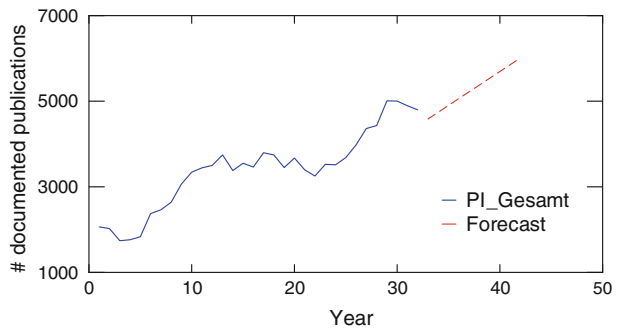

Fig. 3 Smoothed trajectory of the aggregated numbers of PsycINFO-documented publications from Clinical Psychology: Psychotherapy from 1977 (1st year) through 2008 (31st year)

The first example describes the trajectory for Bio- and Neuropsychology. It is characterized by a particularly steep trend. This is depicted in Fig. 2, which shows that the forecasted trajectory for Bio- and Neuropsychology is particularly steep. The figure also shows that the acceleration of this trend started relatively recently, at around the turn of the millennium. Figure 3 shows that the forecasted trend for Clinical Psychology: Psychotherapy is also positive. However, it is clearly less steep than the trend for Bio- and Neuropsychology. The slope parameters for the remaining 18 subdisciplines are between those for Bio- and Neuropsychology and Clinical Psychology.

Results from the PSYNDEX data: English-language publications
from the German-speaking countries

In this section, we analyze the trends in the number of English-language publications that were published by German-speaking authors from 1977 through 2008. Aggregated over all subdisciplines, again a clear upwards trend can be observed (see Fig. 4). Reflecting that the observed number of articles published in English has increased strongly over the 10 years before 2008, the forecasted trend has a positive slope also. This forecasted bibliometric trend goes in parallel with the overall forecasted trend for the Anglo-American psychology literature documented in PsycINFO (see Fig. 1 in comparison to Fig. 4).

In contrast to the forecasted bibliometric trends for the Anglo-American psychology publications, the aggregated trend does not describe each sub-discipline equally well for the English-language publications of German-speaking authors. Both the observed and the forecasted trends vary widely over the subdisciplines (see Table 1). Once again and in

Fig. 4 Smoothed trajectory of the numbers of PSYNDEX-documented English-language publications by German-speaking authors from 1977 (1st year) through 2008 (31st year)
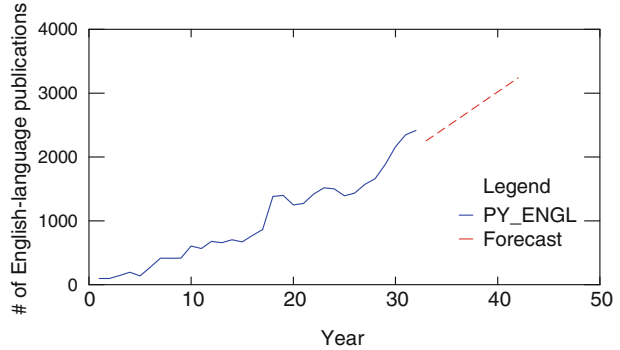

Fig. 5 Smoothed trajectory of the numbers of PSYNDEX-documented English-language publications by German-speaking authors from Bio- and Neuropsychology from 1977 (1st year) through 2008 (31st year)
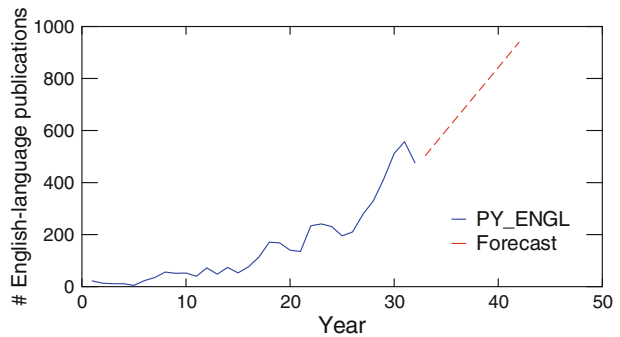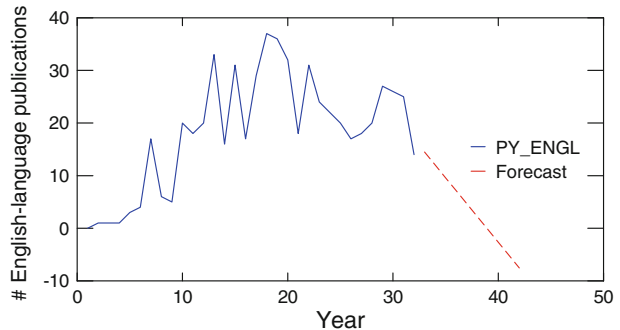

Fig. 6 Smoothed trajectory of the numbers of PSYNDEX-documented English-language publications by German-speaking authors from Family Psychology from 1977 (1st year) through 2008 (31st year)

parallel with PsycINFO, the strongest positive trend and forecast was observed for Bio- and Neuropsychology. The graph for this subdiscipline is given in Fig. 5.

Contrasting with this trend is, for example, the one found for Family Psychology. After a relatively steady increase in the number of English-language publications during the first 20 years of the observation period, the forecasted trend calls for a decrease in the number of English-language publications from German-speaking countries. This is depicted in Fig. 6. Similar negative forecasted bibliometric trends are estimated in addition for the subdisciplines Developmental Psychology: Childhood, Methodology and Statistics, Organizational

Psychology: Management, Clinical Psychology: Psychotherapy, and Environmental Psychology. All of these negative forecasted bibliometric trends for English-language publications of German-speaking authors contrast markedly to these for the Anglo-American publications (see Table 1).

Discussion and conclusions

Overall, the bibliometric results presented here show that psychology was in the last four decades a science with strongly expanding publication activities. The time series of bibliometric raw frequencies can be represented mathematically by exponential functions. These results go in parallel the bibliometric results for mathematics (presented by Behrens and Luksch 2011), a scientific discipline, however, which has a very long history going back to classical antique. With its inception in the second half of the nineteenth century, psychology has a rather short history in the canon of sciences. Therefore, our results are compatible with the hypothesis of consolidation and establishment of psychology in the canon of sciences in its comparatively short history (see, e.g., Wertheimer 1970).

In addition, forecasted scores on publication activities estimated based on past psychology publication frequencies suggest positive bibliometric trends in the Anglo-American research community. These trends develop in parallel with positive forecasted bibliometric trends for the English-language publications of German-speaking authors. This confirms recent developments in anglicizing psychology publications in the German-speaking research community (see, e.g., Krampen et al. 2005, 2011). In addition, it supports the more general bibliometric results that "international cooperation in psychology is on the rise" (Kliegl and Bates 2010, p. 1). However, number of published articles on psychiatry and psychology in the European Union (EU) and their citation frequencies are significantly lower than these in the United States (see Albarrán et al. 2010).

Overall, the picture that was described and bibliometrically forecasted for the Anglo-American and the English-language psychology literature from the German speaking countries is rather homogeneous. However, differences do emerge when the various subdisciplines of psychology are compared. While all psychological subdisciplines show positive forecasted trajectories for the Anglo-American publication database PsycINFO, there are negative forecasted bibliometric trends estimated for English-language publications from German-speaking authors in 6 out of 20 subdisciplines: Developmental Psychology: Childhood; Methodology and Statistics; Organizational Psychology: Management; Clinical Psychology: Psychotherapy; Family Psychology; and Environmental Psychology. These differences in the anglicizing quota of publications from the German-speaking countries between the subdisciplines of psychology can be only in part attributed only to language and culture specifics. Such language and culture specifics may have an impact primarily on German-language publication (instead of English-language publication) from the German-speaking countries in applied subdisciplines (like Family Psychology, Clinical Psychology, and Organizational Psychology), but not in subdisciplines focussing basic research (e.g., Developmental Psychology) as well as Methodology and Statistics. However, for most of the subdisciplines of psychology the positive forecasted bibliometric trends for the number of English-language publication of German-speaking authors develop in parallel with the trends for the number of Anglo-American publications. This can be interpreted as a sign of an increasing international visibility of psychological research from the German-speaking countries in the recent past and with a positive trend, at least for the next 10 publication years.

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