International Journal of Humanities and Social Sciences
p-ISSN: 1694-2620
e-ISSN: 1694-2639
Vol. 8 No. 3, pp. 44-66, ©IJHSS

Some unobtrusive indicators of psychology's shift from the humanities and social sciences to the natural sciences

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Abstract
Unobtrusive indicators of the status of psychology within the humanities, social sciences, and natural sciences were outlined and examined from a historical perspective. Specifically, the unobtrusive indicators considered to differentiate between the three branches included the (1) dominant scientific publication type (e.g., books vs. journal articles), (2) number of coauthors of journal publications, (3) number of references in journal publications, (4) length of journal contributions, and (5) linguistic features of scientific papers (e.g., Genera Verbi, length of sentences). These indicators were measured in two psychological databases (PsycINFO: 1900-2014; PSYNDEX: 1980-2014), random samples of psychological publications from the Web of Science, and in content analyses of publication guidelines of psychology journals. Scientometric results clearly show that psychology started at the beginning of the 20th century as a book science and shifted rapidly in the 1920s in a rather unidirectional way to a journal science in the domain of the natural sciences.

Keywords: psychology, branches of science, state of sciences, humanities, social sciences, natural sciences, methodology, scientometrics, unobtrusive measures, history of psychology.

Introduction

In the late 19th century, the distinct discipline of psychology appeared within the branches of sciences. Scientists on both sides of the Atlantic served as catalysts for the birth of this new discipline. From the German-speaking and European countries, Wilhelm Wundt (1832-1920) was the first person worldwide to receive a psychology professorship in 1875 at the University of Leipzig, Germany, and from the Anglo-American arena, William James (1842-1910) received the first professorship of psychology and philosophy in the U.S. in 1876 at Harvard University and James McKeen Cattell (1860-1944), who was initially a graduate student in Germany before becoming Wundt's first assistant at Leipzig University, received the first professorship of psychology in the U.S. in 1888 at Penn State University (Krampen, 2016). Today, these "great men" embody the historical roots of psychology in the times before it was established as a concrete discipline. These roots lie in several branches of the sciences including philosophy and the humanities (William James' scientific origins are found in philosophy and Wilhelm Wundt added this in later years) and the natural sciences (as a psychologist, William James propagated

empirical methods whereas Wilhelm Wundt, with his background in physiology and medicine and later psychology, propagated experimental methods in research, expounded on theories of structuralism and hermeneutics, and laid the foundation for ethnic or cultural psychology, i.e., Völkerpsychologie) (Krampen, 2016). J. M. Cattell started with the study of philosophy, added psychology at Leipzig University and—significant for the development and history of psychometrics and statistics—visited Sir Francis Galton's (1822-1911) psychometric and experimental laboratory in London from 1886-1887.

Thus, in the brief span of time since its beginnings (about 150 years), psychology has been firmly established in the contemporary sciences, embedded not only in the humanities and the natural sciences but in the social sciences as well (Krampen, 2016). Likewise, the first "students of psychology" of these three great men actually came from very different (i.e., multidisciplinary) scientific backgrounds including, for example, educators and teaching students and students of philosophy and philology (representing the humanities) and physicians and medical students and mathematicians and mathematics students (representing the natural sciences). Consequently, the applied science of psychology began in a multidisciplinary way that was based upon and included a variety of scientific backgrounds and methodologies right from the very start.

A controversial methodological divide has existed in psychology practically from its inception and is based on the quantitative experimental versus qualitative hermeneutic methodology proposed by these early psychologists which has led to extensive tension and debate (Krampen, 2016). However, (and often ignored is the fact that) these two methodologies refer to empirical data, which can, in differing ways, be more nomothetic or idiographic, respectively (see, e.g., Danziger, 1995). Nonetheless, the differences between these two methodologies (which are differentially preferred in the diverse subdisciplines of psychology) led to increasing tensions and even to crises within the field of psychology with dangers of splitting the field and *vice versa* to stereotyping of the opponents.

Such tensions and their inherent danger for the rather young, discrete discipline of psychology were identified early on and reported in monographs by eminent psychologists such as Hermann Ebbinghaus (1908, p. 7) on the brief history of psychology and Karl Bühler (1927) on the crisis of psychology (Krampen, 2016). According to Bühler (1927), the methodological crisis that psychology was experiencing was a transitional period of a young science, and to solve it, he suggested that psychology demand several (i.e., experimental, hermeneutic, and behavioral) methodologies and methods (Krampen, 2016). His innovative line of argumentation thus rendered the "crisis obsolete by the insight and knowledge that all 'three psychological aspects' are *a priori* necessarily and adequate for the characterization of the subject matter of psychology" (Krampen, 2016, p. 1218).

More recently in the field psychology, the "complex pattern of continuity and discontinuity in psychology" (Herrmann, 2009, p. 95) has been described and reflected upon, the "trends in the prominence of four widely recognized schools in scientific psychology: psychoanalysis, behaviorism, cognitive psychology, and neurosciences" (Robins, Gosling, & Craik, 1999, p. 117) have been described and scientometrically analyzed, the "100 most eminent psychologists of the 20th century" (Haggbloom et al., 2002, p. 139) have been identified by means of citation analyses and surveys, to name a few. All these analyses not only reveal the ups and downs of trends in psychological concepts, theories, and "great names," but also a strong continuity and discontinuity of methodological preferences based on the tension between qualitative and quantitative methodologies, which are characteristic of the humanities versus the natural sciences (with the social sciences falling somewhere in the middle). Van Rappard (1993,

p. 187) aggregated this in his central argument: "In psychology the past is part and parcel of the present. In other words, there is a good deal of history in psychology."

At the same time, there are frequent descriptions of and complaints about a decreasing interest in the history of psychology within psychology and by psychologists (e.g., Allesch et al., 2015; Danziger, 1994; Herrmann, 2009). Reflecting on his research area of the history, current presence, and future of psychology, Herrmann (2009, p. 96), for example, speculated "that about 95% of all currently active psychologists in Germany do not find my present topic too interesting." In the German-speaking countries, most of the researchers focusing on the history of psychology are located in the section "History of Psychology" of the *Deutsche Gesellschaft für Psychologie* (DGPs). With 59 members at present, this is the smallest group of the 15 DGPs sections while other sections have up to 640 members, with an average membership of 344 (*SD* = 193.6) (Margraf, 2015).

In Danziger's (1994) essay "Does the history of psychology have a future," he links this disinterest in history to the above-discussed multidisciplinary foundation of psychology in the humanities and natural sciences. Criticizing, he establishes that "the history of psychology tends to be accorded a purely pedagogical role within the discipline rather than being seen as a possible source of substantive contributions" which he feels is indicative of "a type of mobilization that is characteristic of the natural rather than the human sciences" (Danziger, 1994, p. 467). Up to this point, these statements are in agreement with Bühler (1927). Next, Danziger (1994, p. 467) distinguishes between "a shallow history of the scientific review" and the dominant educational objective to "help to organize consensus" (thus, "conformity in educational and research settings," Krampen, 2016, p. 1219; see also, e.g., attempts to set "standards for research in psychology," Appelbaum, Cooper, Maxwell, Stone, & Sher, 2008; and publication guidelines, APA, 2010) as opposed to the "critical history" representing "a threat to the moral community of researchers" (Danziger, 1994, p. 467; see also Krampen, 2016). Krampen (2016, p. 1219) summarizes this as follows:

> While "shallow history" refers to regular, normal epochs of science of science that revolve around main stream research programs and paradigms including immunization strategies against falsifications, "critical history" has—at the very least—the potential for essential changes of research paradigms, i.e., that is, the potential for "scientific revolutions" (Kuhn, 1970). Undoubtedly, scientific revolutions and significant changes in research paradigms are rather infrequent, but they are predicated on a critical, self-regulated learning and research that includes a critical history of the science under study.

However, we are missing more systematic evidence for the development as well as recent and current status of psychology in the branches of science, that is, in the context of the humanities and natural sciences. Are there—at best unobtrusive—indicators of a shift of psychology from the humanities and social sciences to the natural sciences? In the history of the sciences such shifts have taken place, are seldom reflected upon, and rather tend to be forgotten. Mathematics is a good example: Dating back to Ancient Greece in the humanities because of its theoretical subject matter, abstractness, and universality, it shifted to the natural sciences because of mathematics' broad and fruitful applications in many "true" natural sciences. The distinction between "applied mathematics" (both in and as natural sciences) and "pure mathematics" (theoretical math in the humanities) may be of significance for psychology as well.

Differences between the natural sciences and the humanities in the preferred and instructed ways of research and scientific communication patterns are frequently described (e.g., Puuska, 2014) and called discipline-specific cultures in different research communities. Such rules, norms, and standards of scientific communication can be—frequently international—

formalized (e.g., in publication manuals, submission guidelines of journals, etc.) or informal within a research community, the latter with differences between nations and ethnicities, too (see, e.g., Liu & Fang, 2014). Such differences in professional communications and publications between the humanities (and—at least in part—the social sciences) and the natural sciences refer, for example, to (1) the preferred publication types (e.g., so-called book sciences vs. journal sciences), (2) the frequency of single versus multiple authorships and the number of coauthors, (3) the number of references, (4) the length of publications, and (5) linguistic style (e.g., passive vs. active voice, longer vs. shorter sentences, etc.). These indicators of professional communication culture in the sciences are unobtrusive measures, which were introduced 50 years ago as "novel methods" by Webb, Campbell, Schwartz, and Sechrest (1966, p. V; for an overview see, e.g., Lee, 2000) to the social sciences. Unobtrusive measures avoid perfectly reactive measurement effects (measurement errors from the respondent, i.e., the subject under study), because they refer to, for example, physical traces, archives, simple and contrived (hidden) observations, etc. In short, the data (or artifacts in historical research) are already there and must (only?) be analyzed. Scientific publications and databases—"Werke von Menschen" (human works) in terms of Bühler (1927)—belong to such data, and unobtrusive measurements of the above-mentioned indicators are possible.

Based on the considerations summarized above, the main *research question* focuses on the five unobtrusive indicators of differences in scientific communication in the humanities (and social sciences) versus the natural sciences and their applicability for the analysis of psychological publications since 1900. Are there discernible hints for a shift of psychology from the humanities and social sciences to the natural sciences in one, some, or all of these indicators? Specifically, developmental trends are briefly analyzed for psychology publications over a period of 11 decades (1900-2009) and in more detail for the 35 publication years between 1980 and 2014, which is the last year for which complete database documentation in PsycINFO und PSYNDEX can be expected (at the time of analyses in November 2015). In addition, supplemental research questions are formulated (1) to explore the trends in the frequencies of different publication types (i.e., books, chapters, dissertations, and journal articles) and (2) to make comparisons between the two psychology databases. *Ex ante*, a remark on the possible objection that publication output of the natural sciences is much higher than that of the humanities and social sciences combined: Who publishes more or less is the wrong question; rather, the correct question for scientific publications refers to scientific quality and innovative strength. It may be that many (as the case may be, short) publications are necessary for high research quality (e.g., because of the necessity of independent replications) and innovations as well as it may be that only a few publications or even one can result in the same quality and innovativeness.

Unobtrusive Indicator I: Publication Type

Seldom official, but rather informal is the differentiation between "book sciences" and "journal sciences," a distinction that can—however—lead to major differences in the university library budgets for acquiring publications. Typical book sciences are the arts and humanities, typical journal sciences are the natural sciences, and the social sciences are located in the middle with a tendency toward the book sciences. This is quite independent of digitalization, because—at least—in the last two decades, scientific journals and an increasing number of books as well are available digitally or in both digital and print versions in all branches of the sciences.

Thus, providing a wealth of information on the status of psychology in its branch of science is the first unobtrusive indicator, publication type. Important is the historical examination of this indicator to reveals its development over time. Psychological databases are the sources that contain information on various publication types. Due to their high publication frequency in the sciences, the focus here is on journal articles, books (including both authored

and edited books), dissertations/dissertation abstracts, and book chapters (which—however—can only be differentiated from edited books in one of the two usable psychological databases). Publication types such as psychological tests, audiovisual media, digital resources, Internet resources, etc. are grouped together to form a category that is not the topic of the present investigation.

Method

Databases. Unobtrusive data analyzed in the following derive from PsycINFO and PSYNDEX. The publication samples were selected via identical search strategies from the basic populations of both databases (date of searches: November, 2015). The total samples from PsycINFO and PSYNDEX include all publications documented in the following classification code[1] (CC; *Thesaurus of Psychological Index Terms*; Gallagher Tuleya, 2007) categories:

- CC = 2* (assigned to publications on general psychology, psychometrics & statistics & methodology, human experimental psychology, animal experimental & comparative psychology, physiological psychology & neuroscience, psychology & the humanities, communication systems, developmental psychology, social processes & social issues),
- CC = 3* (assigned to publications on social psychology, personality psychology, psychological & physical disorders, health & mental health & treatment & prevention, professional psychological & health personnel issues, educational psychology, industrial & organizational psychology, sport psychology & leisure, military psychology, consumer psychology), and
- CC = 4* (assigned to publications on engineering & environmental psychology, intelligent systems, forensic psychology & legal issues).

PsycINFO®. The *American Psychological Association* (APA, Washington, DC) produces PsycINFO and features it as an international database of publications in psychology and the behavioral and social sciences which dates back to 1806. The majority of publications recorded in PsycINFO are English-language publications deriving from Anglo-American countries (>90 percent whereas <2% are English- and German-language publications from the German-speaking countries; Krampen, 2009, 2016), and its coverage of psychology publications greatly improves but only after the appearance of digitalization in the late 1970s (Krampen, 2016). As of late 2015, there are about 4 million documents recorded in PsycINFO (which can be retrieved, e.g., from http://www.apa.org/pubs/databases/psycinfo/index.aspx). The search routine described above resulted in 3,941,090 PsycINFO documentations of psychological publications.

PSYNDEX®. This database, developed and hosted by the *Leibniz Institute for Psychology Information* (ZPID; Trier, Germany), is the complementary, comprehensive database containing German- and English-language publications in psychology and related disciplines in the German-speaking countries (described by the acronym DACHLL: D = Germany, A = Austria, CH = Switzerland, first L = Liechtenstein, second L = Luxembourg; *note*: for two countries, Switzerland and Luxembourg, German is one of three widely used official languages). Documentation in PSYNDEX began in 1977 (for German psychological tests: 1945). As of late 2015, approximately 300,000 documents are recorded in PSYNDEX and can be retrieved, for example, from www.zpid.de, www.MEDPILOT.de, or www.pubpsych.eu. The search routine outlined above resulted in 305,051 PSYNDEX documentations of psychological publications. Thus, in absolute numbers, PsycINFO contains almost 13 times more documents than its European counterpart, PSYNDEX.

Search strategy. Besides the documentation field "Publication Year" (Gallagher Tuleya, 2007), the field "Publication Type" was used to determine the number of documented journal

articles, books (i.e., authored book or edited book), book chapters, and dissertation abstracts or dissertations, respectively, per publication year.

Results

To present a clear description of results, publication years are aggregated to decades (10 years). For the more detailed analyses of the last 35 publication years, these are aggregated to quintades (five years).

Publication types in PsycINFO between 1900 and 2009. Publication type results for journal articles, books, and dissertations documented in PsycINFO during the 110 publication years from 1900 to 2009 are presented in Table 1. Solid confirmation is provided for the well-documented vast increase in the overall number of psychological publications in the 20th century (which can be modeled by way of exponential smoothing; Krampen, von Eye, & Schui, 2011). This is similar to findings in the other sciences: Behrens and Luksch (2011), for example, showed a similar increase in literature published in the field of mathematics between 1868 and 2010, which can be modeled by exponential or linear functions. These increased rates reflect the growth of the research communities and resources and have been—in addition—strongly intensified in the last decades by digitalization technologies that enable more efficient submission, communication, and publication systems via the Internet, shorter production times, and perhaps shorter peer review times, too.

Table 1. *Absolute Numbers (f) of Publications Documented in PsycINFO*[a] *as well as Absolute Numbers (f) and Relative Frequencies (%) of Different Publication Types in the Publication Years 1900-2009*

Publication year	all documents in PsycINFO [a]	Publication type					
		journal articles		books		dissertations	
		f	%	*f*	%	*f*	%
1900-1909	5,744	1,006	17.5	3,745	65.2	0	0.0
1910-1919	8,853	2,732	30.9	4,759	53.8	0	0.0
1920-1929	27,032	17,336	64.1	5,659	20.9	0	0.0
1930-1939	63,996	49,132	76.8	5,178	8.1	1	0.0
1940-1949	56,732	42,946	75.7	4,560	8.0	225	0.4
1950-1959	92,721	69,859	75.3	5,658	6.1	4,616	5.0
1960-1969	141,948	110,754	78.0	4,022	2.8	14,291	10.0
1970-1979	280,769	200,610	71.5	4,156	1.5	53,411	19.0
1980-1989	454,178	324,108	71.4	30,692	6.8	74,039	16.3
1990-1999	629,390	426,183	67.7	91,703	14.6	75,200	11.9
2000-2009	1,112,116	800,188	72.0	116,662	10.5	87,793	7.9

Note. [a] Documentations of publications with the PsycINFO classification codes (CC) = 2* or 3* or 4* in the *Thesaurus of Psychological Index Terms* (Gallagher Tuleya, 2007; Retrieval, e.g., from http://www.apa.org/pubs/databases/psycinfo/index.aspx).

With the exception of dissertations (or dissertation abstracts), which are documented in PsycINFO since the 1950s with a very high growth rate, journal articles and books show very strong absolute increases throughout the entire time frame between 1900 and 2009. However, the proportions of journal articles and books are statistically significant with a numerically high *negative* correlation (r = -.99; p < .01). This demonstrates the compensatory relation between published books and journal articles (see Figure 1): At the start of the 20th century the majority of psychology publications documented in PsycINFO were books. This changed rather abruptly in the 1920s in favor of journal articles, which then provided approximately 75% of the

psychology literature published between the 1930s and 1960s. From the 1970s to the decade after the millennium, the proportion of journal articles is around 70%, while the proportion of books recovered from its deep and long-lasting fall to peak at about 20% at the turn of the century to about 10% after the first decade, and since their inclusion in the mid-1940s, dissertations abstracts have been situated between 10% and 20%.

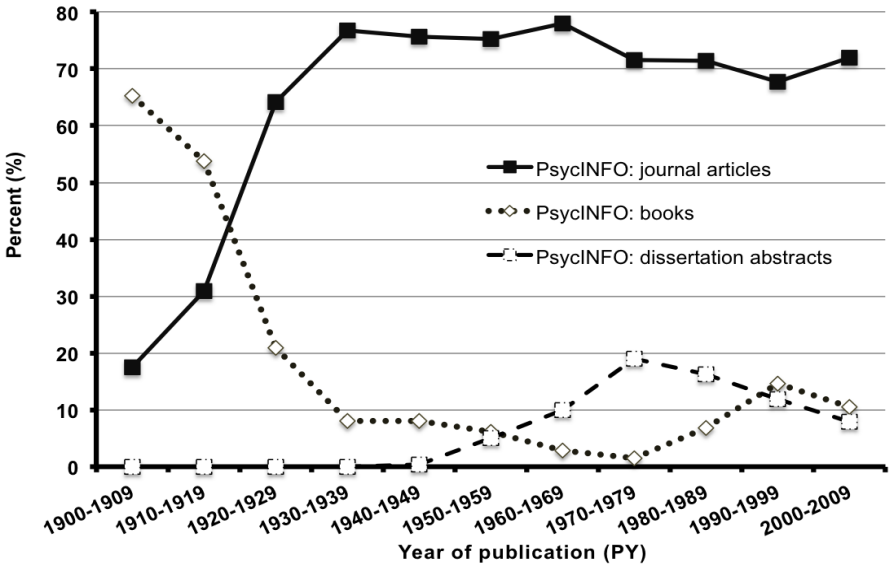

Figure 1. Percentage (%) of journal articles, books, and dissertation abstracts documented in PsycINFO, 1900-2009.

Special case of dissertation abstracts in PsycINFO. The hypothesis that the number of dissertation abstracts could have biased these results due to double documentation as (later) published authored books or journal articles in the database, was checked for a random sample of N = 200 U.S. dissertations from the publication years 1966-2000. Only 30 of these dissertations led to a somewhat later published journal article (15%; mostly in coauthorship), and none led to an authored book. Only 28 dissertation authors (14%) published more psychology literature (1-6 publications; M = 1.7) after their dissertation. Therefore, the bias hypothesis can be rejected. Furthermore, it is worth noting that the results of only a small number of dissertations are even published for a broader scientific readership and that only very few of these authors are involved in further publication activities after the completion of their dissertation.

Publication types in PsycINFO between 1980 and 2014 in more detail. Results on frequencies of publication types in PsycINFO in the publication years 1980-2014 are presented in Table 2 and Figure 2 in more detail. Besides the huge increase in psychology publications during these 35 years for the total (primarily Anglo-American) psychology literature, there are clear absolute increases in all four publication types considered here. Highest growth rate is found for the journal articles (which quadruple from the 1980s to the early 2010s), and the other three publication types triple or double their numbers. Note, however, that PsycINFO subclassified 92% of the articles as "peer-reviewed journals" and 0.00003% as "non-peer-reviewed journals" (mainly U.S. edited public law journals), with 8% subclassified as "peer-review status unknown." Beyond the large differences between peer-review procedures (e.g.,

open vs. blind vs. double blind reviewing, number of reviewers, etc.), these percentages certainly lead to some doubt about this subclassification of journals as an evaluation criteria because it is an extremely one-sided distribution.

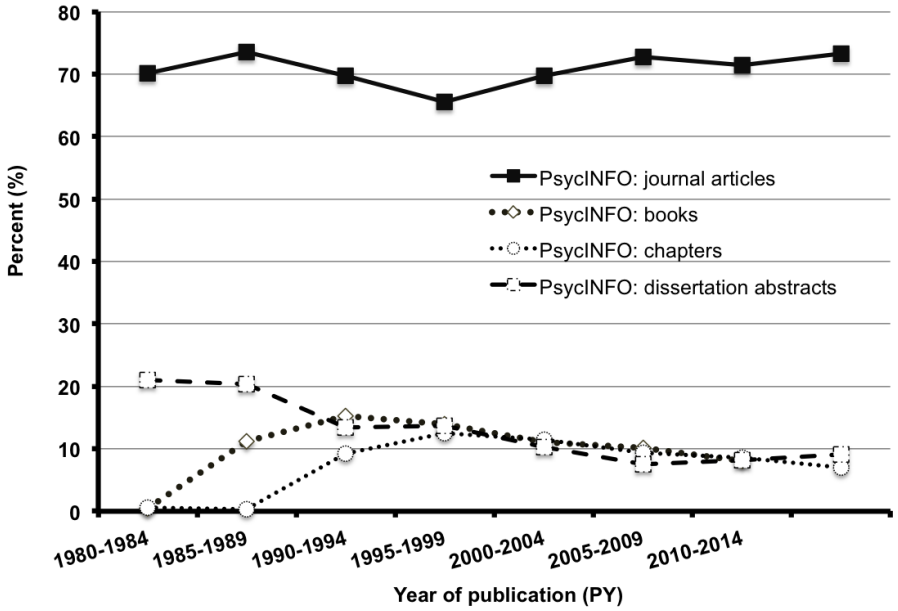

Figure 2. Percentage (%) of journal articles, books, chapters, and dissertation abstracts documented in PsycINFO, 1980-2014.

Table 2. *Absolute Numbers (f) of Publications Documented in PsycINFO[a] as well as Absolute Numbers (f) and Relative Frequencies (%) of Different Publication Types in the Publication Years 1980-2014*

Publication year	all documents in PsycINFO [a]	Publication type							
		journal articles		books		chapters		dissertations	
		f	%	*f*	%	*f*	%	*f*	%
1980-1984	188,944	138,957	73.5	835	0.4	646	0.3	38,298	20.3
1985-1989	265,620	185,509	69.8	29,857	11.2	24,524	9.2	35,741	13.4
1990-1994	306,393	200,605	65.5	46,525	15.2	38,415	12.5	41,934	13.7
1995-1999	323,110	225,680	69.8	45,178	14.0	37,093	11.5	33,266	10.3
2000-2004	422,951	307,809	72.8	47,132	11.1	39,952	9.4	31,596	7.5
2005-2009	689,289	492,489	71.4	69,530	10.1	59,364	8.6	56,197	8.2
2010-2014	894,910	655,755	73.3	71,575	8.0	62,708	7.0	81,271	9.1

Note. [a] Documentations of publications with the classification codes (CC) = 2* or 3* or 4* of the *Thesaurus of Psychological Index Terms* (Gallagher Tuleya, 2007; retrieval from http://www.apa.org/pubs/databases/psycinfo/index.aspx).

Publication types in PSYNDEX between 1980 and 2014 in more detail. The frequencies of publication types in the German- and English-language literature output from psychology in the German-speaking countries (DACHLL) in the last 35 years are presented in Table 3 and Figure 3. For all publications the numbers double between the early 1980s and 2010s, the numbers of journal articles and books chapters triple, the number of dissertations explodes after the millennium, and—very different from the PsycINFO results—the number of books is (with few exceptions) relatively stable over time. It is worth noting that PSYNDEX differentiates clearly between book chapters and edited books, that is, their frequencies can be counted independently.

The proportions of publication types depicted in Figure 3 illustrate the clear dominance of journal articles with a slight decrease in the 1980s and early 1990s (minimum: 53%) and a rather continuous increase after the millennium (maximum: 65%) with an upward trend. Proportional development of books and chapters shows strong oscillation, a finding which is typical for smaller databases. The percentage of dissertations documented in PSYNDEX increases continuously after the millennium to a maximum of 5% in the early 2010s.

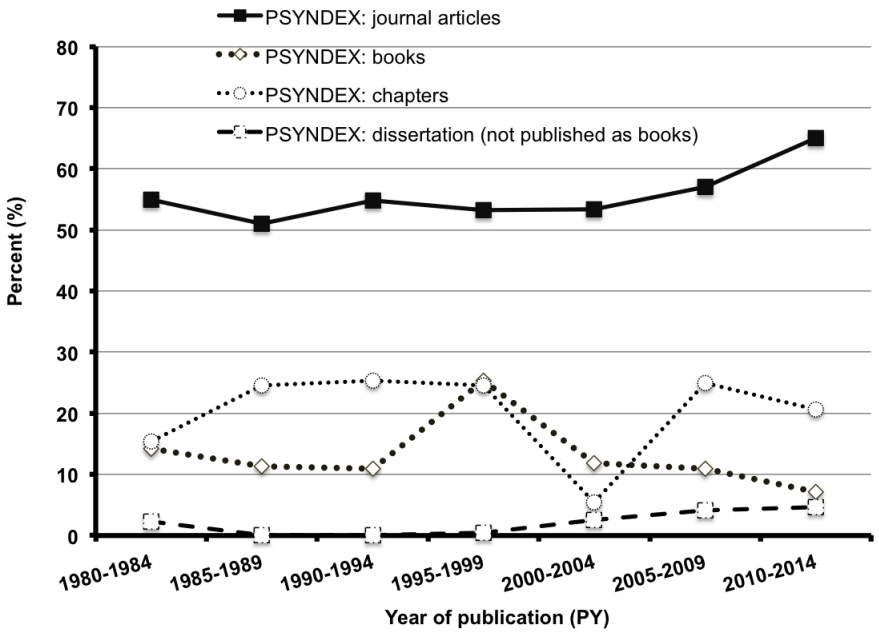

Figure 3. Percentage (%) of journal articles, books, and dissertations (not published as books) in PSYNDEX 1980-2014.

Table 3.*Absolute Numbers (f) of Publications Documented in PSYNDEX[a] as well as Absolute Numbers (f) and Relative Frequencies (%) of Different Publication Types in the Publication Years 1980-2014*

Publication year	all documents in PSYNDEX[a]	Publication type							
		journal articles		books		chapters		dissertations	
		f	%	*f*	%	*f*	%	*f*	%
1980-1984	22,952	12,619	55.0	3,254	14.2	3,536	15.4	611	2.3
1985-1989	37,707	19,213	51.0	4,261	11.3	9,282	24.6	37	0.0
1990-1994	44,152	23,879	54.8	4,865	11.0	11,178	25.3	73	0.0
1995-1999	44,262	23,528	53.2	5,213	11.8	10,863	24.5	223	0.0
2000-2004	43,154	23,034	53.4	4,688	10.9	10,977	25.4	1,111	2.6
2005-2009	47,432	27,028	57.0	4,212	9.0	11,858	25.0	1,951	4.1
2010-2014	52,020	33,834	65.0	3,673	7.1	10,723	20.6	2,404	5.0

Note. [a] Documentations of publications with the classification codes (CC) = 2* or 3* or 4* of the *Thesaurus of Psychological Index Terms* (Gallagher Tuleya, 2007; retrieval from http://www.apa.org/pubs/databases/psycinfo/index.aspx).

Special case of dissertations documented in PSYNDEX. Noteworthy is the fact that the absolute number of dissertations in the German-speaking countries increased sharply after the millennium. Nevertheless, dissertations constitute only 5% of all psychology publications in the DACHLL countries. Remarkably, of this number, 44% of all dissertations are published either as an authored book by a publishing company or as a journal article, both increasing the possibility to be recognized by the broader scientific public. The other 56% are "pure" dissertations, which are only available online at university dissertation repositories or printed in limited numbers by small or independent presses and—therefore—although formally published, remain less "public" and less visible to the research community.

Summary of Results on the Unobtrusive Indicator I: Publication Type

Results from PsycINFO data show clearly that at the start of the 20th century psychology was a "book science", which—however—rapidly and with great intensity developed into a "journal science." Since the 1930s, around 70% (and up to nearly 80% in the 1930s to 1960s) of the literature output documented in PsycINFO is published in scientific journals. PSYNDEX data confirm this result for the last 35 publication years with a somewhat lower percentage of around 55%, but with an increasing trend (up to 65% in the early 2010s). Thus, the overall proportion of authored books, edited books, and book chapters is about 30% in PSYNDEX (without any clearly distinct trends) and only 10% in PsycINFO with a decreasing trend over the last 35 years. A striking finding is the high percentage of book chapters (about 18%) documented in PSYNDEX in comparison to PsycINFO (about 7%), because the peer-review status and scientific quality control of many editions remain unclear.

Conspicuous is also the result that the majority of the (mainly Anglo-American) dissertations documented in PsycINFO tend to remain "pure" dissertations without later publication as a journal article or authored book. Thereby, potentially valuable psychological knowledge and results are lost because of their diminished visibility. Furthermore, only few authors of dissertations are involved in further publication activities after completion of their dissertation. This leads to the hypothesis that they vanish from the psychological research arena in spite of their academic qualifications and research experience. However, the situation is somewhat better in the German-speaking countries where results from almost half of the completed dissertations are later published in the form of a journal article or an authored book.

Besides these differences between data and results derived from PsycINFO and PSYNDEX, the results on the status of psychology as a book versus journal science are in accordance. PsycINFO data show that psychology was a book science at the beginning of the 20th century, but rapidly changed in the early 1920s to a journal science and has remained as such up to the publication year 2014. In the last 35 years this trend is more pronounced in PsycINFO, but is clearly existent in PSYNDEX as well. Taken together, the scientometric results on the first unobtrusive indicator "publication type" confirm an early shift of psychology from the humanities and social sciences (as classic book sciences) to the natural sciences (journal sciences) in the first quarter of the 20th century, which has lasted almost 100 years to the present date.

Unobtrusive Indicator II: Single versus Multiple Authorship

Journal articles with multiple coauthorships are more typical in the natural sciences, because research is frequently implemented in larger teams—for example, in multicenter studies, large lab studies, large equipment research—and all participants are named as authors. This avoids extensive acknowledgments in footnotes with thanks to some who contributed to the research at some point, but were not intensely involved in the research conception, analyses, interpretation, and dissemination. However, persons mentioned in such acknowledgments are frequently

dissatisfied, and at least in some branches of science, to dispel any cases of doubt, ethical standards instruct authors to indicate all participating scientists with their individual contribution, a demand that is being made by more and more journals for paper submissions (e.g., *Nature*: "Authors are required to include a statement to specify the contributions of each co-author") or before paper acceptance (e.g., *Science*: "Before acceptance, each author will be required to indicate their role in the research…"), respectively. Thus, number of authors is rising and continues to climb, partly due to extreme coauthorships of more than 100 or even 150 authors per paper. Such publications present, for example, results of intercultural comparisons, large equipment research, or international studies sampling very specific human genome material from all over the world under the leadership of one scientist (whose fellow coauthors contribute typically one dataset each). Journal articles with single authorship or only few coauthors are more typical for the humanities and the social sciences.

There is some empirical evidence that coauthorship is increasing because research collaboration is necessary to integrate different experts' knowledge, to improve the access to research funds as well as to advance both professionally and scientifically (Beaver, 2001; Behrens & Luksch, 2011; Huang, 2015). More concretely, regarding (co)authorship in the field of mathematics, Behrens and Luksch (2011) concluded:

> The average number of authors per publication in mathematics has been increasing steadily; while it was close to 1 up to the first quarter of the last century it has now reached a value of 2 in the last few years. This means that the percentage of single-authored papers has fallen from over 95% in the years before 1930 to about 30% today. (p. 179)

Up to now there are some hints that multiple authorships of psychology journal articles have increased in a likewise manner—at least as a result of the anglicization of former German-language psychology journals (Krampen, Huckert, & Schui, 2012) and for journal publications with very high citation rates (Krampen, Schui, Ferring, & Bauer, 2014). The latter result is in line with others which have shown that coauthored journal articles have higher citation rates in and impact on different scientific disciplines. For Finnish scientists of various disciplines, for instance, Puuska, Muhonen, and Leino (2014) reported that "international co-publications by ten authors or more gather significant more citations than other publications. In humanities, the difference in citation impacts between co-authored publications in relation to single-authored publications is significant" (p. 823). Levitt's (2014) scientometric results "suggest that whilst having at least two authors gives a substantial citation impact advantage in all social science disciplines, additional authors are beneficial in some disciplines but not in others." Moreover, Blagus, Leskosek, and Stare's (2015) results confirm that researchers with a "large number of co-authors are systematically ranked higher" in impact measures like the "*h*-index or total citations" (p. 1743).

The results on citation advantages of publications with multiple authorships in comparison to these with single authorship has led to the suspicion that multiple authorships may be less or even not motivated—at least sometimes—scientifically and with reference to the actual contributions to research of all coauthors, but rather is a strategy to achieve more citation impact for all (Beaver, 2001; Persson & Glänzel, 2014). Persson, Glänzel, and Danell (2004) measured inflationary bibliometric tendencies for multiple coauthorships, which refer to strategic coauthorships like "honorific authorship" (Persson & Glänzel, 2014) and/or "hyperauthorship" as "a postmodern perversion or evidence of a structural shift in scholarly communication practice" (Cronin, 2001, p. 558). Therefore, multiple authorships are sometimes rather nontransparent, perhaps obscure, and journals try to control this by the demand for personal statements of each coauthor about his/her individual contribution to the research.

In any case, these considerations and results cast some light on the problems that can arise when the sciences slide down in the direction of "mercantilization" (Herrmann, 1996). Science is not a like the marketplace where the vendor with the most beautiful yet relatively inexpensive fruits and vegetables has the highest income. Surely, science is also a competition, albeit one that is less motivated by economics, but rather by scientific enhancement and insight. Nonetheless, results of a functional neuroimaging study of 18 neuroscientists working in research labs (neurologists, psychiatrists, and psychologists) for M = 5.2 years show that "the incentive structure of a scientist's life is increasingly mimicking economic principles" (Paulus, Rademacher, Schäfer, Müller-Pinzler, & Krach, 2015, p. 1). These results provide experimental evidence on the identification with the journal impact factor, which shapes scientists' reward signals in the *nucleus accumbens* during the anticipation of a publication.

Because empirical evidence is missing, a bibliometric analysis on the unobtrusive indicator "number of single versus multiple authorships" of psychological journal articles in comparison to these in other disciplines and its development was implemented using the *Web of Sciences* (WoS). This analysis was conducted despite the doubts about the motivation for and justification of—at least some—multiple coauthorships.

Method

Unobtrusive data analyzed in the following derive from the Web of Science (WoS), which is produced and hosted by Thomson Reuters (http://apps.webofknowledge.com/) and contains over one billion searchable, cited references from journal articles. Implemented was "basic search" in the research area "psychology" and—excluding the research area psychology—in the research domains "arts humanities," "social sciences," and "science technology" (including natural sciences as biology, biochemistry, oncology, etc.) fixed for searches of "article" and selected publication years. Number of authors was counted for random samples of each 100 journal articles published in the years 1984, 1994, 2004, and 2014, respectively.

Results

Results in Table 4 show that the percentage of single authorship of psychology journal articles decreases rather continuously from 66% in 1984 to 31% in 2014, while a statistically significant rise in the number of authors per articles from M = 1.3 (1984) to M = 2.2 (2014) is verified. In the arts and humanities as well as in the social sciences, single authorships compose the majority of publications at any given time (between 60% and 81%); number of coauthors shows only a small—with one exception—change between publication years. Comparable with authorship trends in psychology publications are those from the natural sciences: Single authorships, starting at a low level in 1984, clearly decrease and the number of coauthors increases significantly.

Summary of Results on Unobtrusive Indicator II: Single versus Multiple Authorship

In agreement with other results (see above) are the findings that single authorships decreased in the last four decades in the natural sciences and in psychology, while they have remained dominant in the arts and humanities and the social sciences. Concurrently, the number of coauthors increases significantly in psychology and the natural sciences, but not in the two other domains of the sciences. Thus, the results on the second unobtrusive indicator "number of authors" confirm the closeness of psychology to the natural sciences and its distance to the humanities and social sciences, at least during the last four decades. To what extent strategic coauthorships play a role in psychology and in the domains of the sciences remains an open question.

Table 4. *Percentage (%) of Single Authorships of 400 Articles (published 1984, 1994, 2004, and 2014) in the Research Area "Psychology" and the Three Research Domains [a] Documented in the Web of Science (WoS) and Mean Numbers of Authors*

Publication year	Research area psychology		Research domain [a]					
			arts humanities		social sciences		science technology	
	Single author	Number of authors	Single author	Number of authors	Single author	Number of authors	Single author	Number of authors
	%	*M*	%	*M*	%	*M*	%	*M*
1984	66	1.3	78	1.2	70	1.1	41	2.3
1994	52	1.5	77	1.1	69	1.2	50	2.7
2004	34	1.7	81	1.1	71	1.1	43	3.0
2014	31	2.2	76	1.1	60	1.5	22	3.8

Note. [a] Excluding the research area of psychology.

Unobtrusive Indicator III: Number of References

Paper submission standards for the number of references are very different: Most science journals demand only that reference lists are complete (e.g., to avoid plagiarism) and therefore exclude reference lists from word counts defining paper length. Comparatively few journals have restricted reference lists to small numbers of references to regulate and restrict paper length, by demanding, for example, that only the last two or three significant publications on the topic to be cited (e.g., in some journals of theoretical physics). However, demands such as these were discarded in times of digitalization. Despite this, a more systematic historical research orientation may lead to the expectation that reference lists are longer in the arts and humanities than in the natural sciences, which may refer primarily to the most recent publications on a topic while omitting older ones.

Method

Number of references was counted for the same random samples of 100 journal articles published in the years 1984, 1994, 2004, and 2014, respectively, which were studied with respect to the unobtrusive indicator II (see above).

Results

Results in Table 5 show that the mean number of references is lowest in natural sciences journal articles and is decreasing from 1984 to 2014. This is followed by psychology papers with no significant differences between the publication years examined here. Journal articles from the humanities and social sciences have significantly longer reference lists, however, this with a somewhat larger variability (see the standard deviations in Table 5).

Table 5. *Means (M) and Standard Deviations (SD) of the Number of References in 400 Articles (Published in 1984, 1994, 2004, and 2014) in the Research Area "Psychology" and the Three Research Domains* [a] *Documented in the Web of Science (WoS)*

	Number of references							
			Research domain [a]					
Publication year	Research area psychology		arts humanities		social sciences		science technology	
	M	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
1984	32	6.4	40	8.4	51	6.9	27	4.1
1994	35	5.2	38	7.9	47	7.3	18	3.7
2004	29	4.8	35	8.1	42	7.0	21	3.5
2014	30	5.1	41	7.7	43	6.8	19	3.8

Note. [a] Excluding the research area of psychology.

Summary of Results on Unobtrusive Indicator III: Number of References

The results on the third unobtrusive indicator "number of references in journal articles" confirm the closeness of psychology to the natural sciences and its distance to the humanities and social sciences, at least during the last four decades. In the context of digitalization, this indicator may soon become obsolete.

Unobtrusive Indicator IV: Length of Journal Articles

Paper submission standards for the length of submissions are very different among journals. Most science journals generally restricted the length of submissions in the past, but have been dropping this policy recently in part due to digitalization. Nonetheless, most journals adhere to limits, for example, to enhance readability and/or to minimize narrative, digressive writing. Typically, journals of the humanities and social sciences provided and continue to provide more generous restrictions of paper length than journals in the natural sciences. Today, some of the latter journal types set limits of "no more than 5 pages" (e.g., *Nature*) with a maximum of 1,300 words per page. "There is not any restriction on the number of pages" represents the other extreme and is most typically found in guidelines for authors in some of the journals of the humanities and social sciences.

Because the unobtrusive indicator "length of journal articles" has been recently and is currently undergoing various changes, historically oriented trend analyses are not meaningful. Instead, systematic comparisons of submission limits for papers in eminent journals in psychology with those in the arts and humanities, social sciences, and natural sciences (all excluding psychology journals) were performed.

Method

Random samples of each 10 eminent journals (impact factor > 3.0) from psychology as well as the humanities, social sciences, and natural sciences (excluding psychology journals) were selected from the journal lists of social science, natural sciences, the arts and humanities, and psychology in WIKIPEDIA. Submission guidelines were checked for limitations of paper length (e.g., pages and words per page, words count, text including vs. excluding references, tables, figures, etc.) and standardized to the number of maximal allowed pages x 1,300 words per page.

Results

No limits of text length are given in the submission guidelines of three journals from the arts and humanities and in one from the social sciences, while all 10 journals examined here from both psychology and the natural sciences set limits (see Table 6). The limits of the number of standard pages (1,300 words) are lowest for the journals of the natural sciences, followed by the psychology journals. The majority of the journals from the arts and humanities and social sciences set either no limits or more than 21 standard pages as a limit. On average, maximum number of words allowed is lowest for the natural science journals, highest for journals from the arts and humanities and social sciences with psychology journals in between.

Summary of Results on the Unobtrusive Indicator IV: Length of Journal Articles

Limitations of manuscript length in the submission guidelines of psychology journals are more similar to natural science journals than to those of journals from the arts and humanities and social sciences. However, it should be kept in mind that submission guidelines on paper length are currently changing. Editors and publishing companies are balancing reasons with reference to economic digitalization allowing longer papers versus an economic and efficient readability of shorter publications.

Table 6. *Text Length Limits for Manuscript Submissions to Journals of Randomly Selected Journals from Psychology, Arts and Humanities, Social Sciences, and Natural Sciences (10 Journals Each)*

Science domain/area	Maximal text length for journal submissions							
	No limits (*f*)	Maximal number of words		Maximal number of standard pages (*f*)				
		M	*SD*	≤ 5	6-10	11-15	16-20	≥ 21
Psychology	0	24,073	12.5	0	1	2	6	1
Arts and humanities	3	35,110	21.9	0	0	0	4	3
Social sciences	1	31,788	19.3	0	0	0	5	4
Natural sciences	0	17,375	10.8	1	3	4	2	0

Note. [a] Standard page: 1,300 words.

Unobtrusive Indicator V: Linguistic Style

Besides others, the voice (Genus Verbi, in this case, i.e., active vs. passive voice) is a significant linguistic feature of scientific texts. Passive voice serves the emphasis of neutrality and objectivity, thus, personal distancing to avoid or—at least—to reduce idiosyncrasies in descriptions and explications of results in favor of more general presentations of scientific results and insights. This may be linked to an "I taboo" and avoidance of personal pronouns in writing. Passive voice places the author in the back seat and promotes—critically considered—anonymization: Emphasis is not on the question "Who did it?" but rather on "What was done?" Furthermore, passive sentence structures support control of sentence structure in reading, because the change of subject and object place the correct information to refer back to at the beginning of sentences. However, passive voice is criticized frequently because (1) it can be copious and sluggish, making texts longer, (2) promotes nominalizations, (3) it can be more "indirect" and therefore more ambiguous, (4) scientific accuracy may decline because of hanging attributes, (5) it can be misleading due to pompous, artificial formulations, and (6) it can be more difficult to formulate in and may not be mastered by anyone correctly (what—principally—cannot be an argument against it). Active voice—so the argument—eliminates or, at least, minimizes all these problems. Furthermore, writing in the active voice would (7) eliminate prepositions, (8) describe science more appropriately, because it is done actively by individuals or teams, and (9) recognize individual contributions more adequately.

Despite the ongoing debate on the usage of passive versus active voice in the sciences at least since 1957 in high-ranking science journals (e.g., *Science*, *Nature*, *Physics in Technology*; for an overview, see Sheffield, 2013), it seems today that reality has made this debate obsolete, at least in journals of the natural sciences: "Journals prefer active voice" (Sheffield, 2013, p. 4). This discussion has reached the social sciences and humanities although without a clear decision today. Proponents of the active voice use the above-mentioned arguments; proponents of the passive voice emphasize its contribution to neutrality, objectivity, and personal distancing in scientific texts in favor of more general presentations of scientific results and insights. More than that, proponents of passive voice interpret this linguistic shift in the sciences as an indicator of a changing understanding of science and the self-concept of scientists, which conforms to the active, self-regulated, internally attributing image of mankind. At the same time, there are movements leading away from the ideal of science as a time- and culture-related total of systematic experience and insights, which are related in a theoretical rationale as well as an ideal

of scientists, who are unselfishly committed and intrinsically motivated to the gain of knowledge and humanity for the sake of the research object in particular.

Since 2010 the submission guidelines of most psychology journals include recommendations or even instructions for authors to avoid the passive voice, to avoid the third person by using personal pronouns, to write short sentences, etc. This is a change in writing style with a long history, although these changes have been supported by the APA early on as evidenced in the second edition of the *Publication Manual of the Psychological Association* published in 1974: "An experienced writer can use the first person and the active voice without dominating the communication and without sacrificing the objectivity of the research. If any discipline should appreciate the value of personal communication, it should be psychology" (p. 28). Each new edition has elaborated on the preferred voice use in scientific writing, and even though the active voice is clearly becoming the norm, the sixth edition reminds us that "the passive voice is acceptable in expository writing and when you want to focus on the object or recipient of the action rather than on the actor" (APA, 2010, p. 77).

Discussion and Conclusions

In summary, the results on the five unobtrusive indicators of the status of psychology within the branches of sciences or research domains show that psychology has experienced a rather unidirectional shift toward the domain of the natural sciences. Scientometric findings from PsycINFO data reveal that at the start of the 20th century, psychology was a "book science," which—however—changed rapidly and effectively to a "journal science." Since the 1930s, around 70% (up to nearly 80% during the 1930s to 1960s) of the literature output documented in PsycINFO is published in scientific journals. PSYNDEX data confirm this result for the most recent 35 publication years with a somewhat lower percentage of around 55%, but with an increasing trend (65% in the early 2010s). Thus, without any clearly visible trend, authored books, edited books, and book chapters together comprise about 30% of the literature documented in PSYNDEX (cf. Krampen, Weiland, & Wiesenhütter, 2015), and this is only 10% in PsycINFO with a perceptible decreasing trend during the last 35 years. The results for the other four unobtrusive indicators are in agreement with this, thus empirically confirming the natural science orientation of the clear majority of modern psychology not only once but five times. Data argue for an early shift in the 1920s, which is still present today and has even slightly increased during the past 100 years.

However, there are some serious limitations of the results presented on the publication types in psychology. It may be argued that publication documentation in PsycINFO has been selective, and the described shift from a book science to a journal science may actually be caused by the changing strategies in PsycINFO documentation and coverage. This argument cannot be rejected because there is no documentation of the changes that have been implemented in the history of PsycINFO and *Psychological Abstracts* (the printed precursor of PsycINFO). We can only be reasonably assured that, since the late 1970s, both PsycINFO and PSYNDEX are fulfilling the objective of exhaustive documentation of the psychological publications from the Anglo-American and the German-speaking countries, respectively. Anyone who might be systematically searching for psychology literature before this time is dependent on PsycINFO and—therefore—only the literature documented in PsycINFO can be taken into consideration. Another possible objection is that the publication output of the natural sciences is much higher than that of the humanities and social sciences together. However, as mentioned earlier, to publish more or less is the wrong question here; the correct question rather refers to the scientific quality and innovative strength of scientific publications. It may be that many (as the case may be, short) publications are necessary for advancement and high research quality (e.g.,

because of the necessity of independent replications) or it may be that only a few or even one publication can result in the same quality and innovativeness.

Results of the examination of developmental trends of the number of books and book chapters during the latest 35 publication years show that there are rather strong increases in their absolute numbers with some differences between psychology publications from the Anglo-American and the German-speaking countries: While the number of books published between 1980 and 2014 remains quite stable in the German-speaking countries, this number more than doubles in the Anglo-American world. Book chapters—in contrast—triple in the German-speaking countries. However, after the millennium, the (relative) percentage of books and chapters are at levels of less than 10% in PsycINFO (books and chapters, respectively) and in PSYNDEX (books only), but at about 20% for chapters in PSYNDEX. Thus, we have an ambiguous picture: Even though the absolute numbers of authored and edited books are on the rise, they are increasingly eclipsed by the vast increase in journal articles in both databases.

The majority of these journal articles present results of empirical studies, meta-analyses, and overviews of empirical studies, fewer focus on theoretical and methodological issues (approximately 25%; Schui, Müller, & Krampen, 2015). These issues tend to be the main topics of authored books and some of the edited books as well. Theory formulation and integration, conceptual analyses, and methodological (not or less methodical or technical) advances require the publication of books in the tradition of the humanities and the social sciences. In addition, the psychological tradition in the humanities and the social sciences refer, for example, to these traditions and subject matters of psychology, which recently can be exemplarily listed as theoretical psychology, including *a priori* elements in psychological theories and "psycho-logic" (Smedslund, 1988), formalization of psychological theories, idiographic, "idiothetic," and meta-idiographic research methodologies, logical learning theory of personality, and teleological psychology (Rychlak, 1981). In addition, hermeneutics from the humanities and the social sciences cannot be forgotten because this is necessary in psychological interventions and, for example, for the interpretation of the majority of statistical results as well (e.g., factor and cluster interpretations of factor and cluster analyses), which is—however—frequently hidden and handled as something like a secret.

In the history of sciences, such shifts of research areas and disciplines between the domains of sciences have transpired. The example of mathematics was mentioned in the introduction: Started in Ancient Greece in the humanities because of its theoretical subject matter, abstractness, and universality, it shifted to the natural sciences because of mathematics' broad and fruitful applications in many "true" natural sciences. The distinction between "applied mathematics" (in and as natural sciences) and "pure mathematics" (theoretical math in the humanities) may be of significance for psychology as well. It may be reasonable to classify (empirical) research in the basic disciplines of psychology and some sort of basic research in applied (e.g., clinical) psychology with little reference and significance to real (clinical) psychological practice to the natural sciences. Applied, theoretical, and methodological psychology are the areas that belong more to the humanities and social sciences, because of—both—the significance of hermeneutics and qualitative methodologies as well as the necessity to consider social and societal determinants of psychological routine practice. This is just the opposite of mathematics, but may be fruitful for the future of psychology as one science with strong foci in the natural sciences and in the humanities and social sciences, too.

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Footnote

[1] To serve the purpose of describing the content of the PsycINFO and PSYNDEX databases (Gallagher Tuleya, 2007), one or more four-digit classification codes, beginning with the numerals 2, 3, or 4, are assigned to all documents.