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The History of Teamwork's Societal Diffusion: A Multi-Method Review

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Abstract

In the literature, the notion of the ever-growing prevalence of teamwork is dominating. First, has there indeed been a steadily increasing trajectory of the societal diffusion of and academic research on teamwork? If so, what have the main drivers of this trajectory been? In this review, we apply a multi-method approach to examine these questions. Specifically, we combine the established bibliometric method of scholarly article counts with the innovative approach of culturomics that allows the content analysis of a literature corpus spanning millions of books, both popular and scholarly. The results show that although academic research on teamwork has grown constantly and has shown a sharp increase over the past 40 years, the societal diffusion of teamwork, as indicated through the culturomics approach, actually followed a volatile trend in the past century. Certain large-scale events and developments, such as war, may serve as an explanation for these changing trends.

Keywords

teamwork, societal diffusion, history, culturomics

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An abundance of academic literature has been published about the organization of work in teams, and the number of new scholarly publications seems to have steadily, if not rapidly, increased each year. A considerable number of scholarly books and articles have been written about such diverse applications of teamwork as top management teams (e.g., Carpenter, Geletkanycz, & Sanders, 2004; Raes, Glunk, Heijltjes, & Roe, 2007), innovation teams (e.g., Caldwell & O'Reilly, 2003; Hoegl & Gemuenden, 2001), virtual teams (e.g., Jarvenpaa & Leidner, 1999; Johnson, Bettenhausen, & Gibbons, 2009), health care teams (e.g., Tschan et al., 2009; Weiss et al., 2014), and many more, covering the antecedents, processes, and outcomes of teamwork in organizations. To recapitulate the fast-paced advances of the body of knowledge on teams and teamwork, periodically published reviews on this topic, such as in this issue, serve the important role of accumulating the state of the art to keep track of the various advancements in this research field (e.g., Bettenhausen, 1991; Cohen & Bailey, 1997; Mathieu, Maynard, Rapp, & Gilson, 2008; Steiner, 1964). A common thread throughout these reviews, with only a few exceptions (e.g., Steiner, 1986), is the report of the steady growth of teamwork's importance as a concept in organizational research and literature. This growth was assumed having occurred as a response to the steadily increasing diffusion of teamwork in society, particularly in organizations, emphasized by the applied and scholarly literature as a trend of teamwork's ever-growing importance for organizational success in modern business, and supposedly indicated by an increased application of this organizational form (Cohen & Bailey, 1997).

However, is this assumption actually true, and has there indeed been a steadily increasing trajectory of the diffusion of teamwork? There is little objective evidence on whether the diffusion of teamwork has continued to expand. Although practitioners and scholars tout the ever-growing importance of teamwork, the conclusion at which Devine, Clayton, Philips, Dunford, and Melner (1999) arrive seems still current:

> Groups and teams are ubiquitous in organizations—at least that is the impression one gets from reading the introduction to almost any article on the topic published in the last decade. Studies pertaining to work groups or teams typically begin by noting how widespread teams are and citing others who have arrived at the same conclusions, but there is little data to support this assertion. The increase in published research on task-oriented groups and teams is real enough (Bettenhausen, 1991; Cohen & Bailey, 1997; Guzzo & Dickson, 1996; Guzzo & Shea, 1992; Ilgen, 1999; Levine & Moreland, 1990; Sundstrom, de Meuse, & Futrell, 1990), but it would be fallacious to assume that greater visibility coincides with a general increase in the use of teams. (pp. 678-679)

Although there are studies suggesting an increasing diffusion of the teamwork concept, most represent cross-sectional studies that are not able to show trends over time (Cappelli & Rogovsky, 1994; Devine et al., 1999; Gordon, 1992). Albeit offering valuable hints on such trends, the rare studies using longitudinal designs, like that of Lawler, Mohrman, and Ledford (1995) who reported a clear step-up of firms' use of self-managing work teams, usually do not span a sufficiently long period (in this case, a 6-year interval) to provide insights about long-term trends. Furthermore, most of these studies focused on samples of large and successful companies (e.g., the Fortune 500), which casts into doubt the representativeness of the organizations analyzed, given that the backbone of most economies is formed by small- and medium-sized companies (Devine et al., 1999) and teamwork is not only carried out in business organizations.

Article count analyses of published work in academic journals offer a valuable bibliometric tool to examine changing trends in research methods and topics (Robins, Gosling, & Craik, 1999). Applying this type of analysis, Wuchty, Jones, and Uzzi (2007), for example, were able to show a steady trend of the increasing diffusion and application of teams in the scientific context throughout the past five decades, using their prevalence in the production of scientific publications as a key indicator. However, an appropriate instrument for analyzing such trends outside the realm of scientific knowledge production has been lacking and, as a consequence, evidence generalizable beyond the scientific domain for assumptions such as that "the use of teams has expanded dramatically in response to competitive challenges" (Cohen & Bailey, 1997. p. 239) as well. Fortunately, the recent development of the technique of culturomics allows such trends of the societal diffusion of concepts to be quantitatively investigated in a more convenient way (Michel et al., 2011), thus meaningfully complementing bibliometric approaches building on analyzing article count data in academic journals. Culturomics, as this technique was named by its inventors (Michel et al., 2011), means the quantitative analysis of cultural trends by measuring changes in relative word frequency in a corpus of several million digitized books (but not journals), which resulted from Google's effort to digitize books and includes both fiction and non-fiction literature. Applying word count statistics on this huge corpus of digitized books may thus serve as a robust indicator of the broader societal diffusion of certain concepts, for example, teamwork, throughout periods as long as the entire 20th century (Michel et al., 2011). The basic idea of culturomics is that the higher the relative frequency of certain terms such as teamwork, the more diffused this concept is assumed to be in the cultural repertoire. To put it in the words of Michel et al. (2011), "cultural change guides the concepts we discuss" (p. 176) and more widely diffused concepts

are discussed to a greater extent in the literature, which, in turn, is indicated by the relative word frequency.

By systematically scanning and evaluating this corpus and combining this analysis with the bibliometric examination of article count data, we aim to make three main contributions in this study. First, the long-term development of the societal diffusion of teamwork reveals a more nuanced picture of changing trends in this regard, updating the widespread view of the steady growth of the societal diffusion of teamwork. By linking turning points between trends incorporating increasing and decreasing societal diffusion of teamwork to certain parallel societal, technological, and organizational trends and developments, we are also able to offer possible explanations as to why during some periods, teamwork enjoyed increasing popularity, but seemingly went out of fashion during others. Second, we analyze whether the changing diffusion of teamwork in the academic literature materializing through article count statistics preceded or followed societal trends and whether these two domains of literature are related to each other (Mazza & Alvarez, 2000). In this regard, we also probe the dynamics in academic research on teamwork regarding the trends of specific teamwork-related topics and the disciplines in which such research has been carried out. Finally, by utilizing the large database of digitized books created by Michel and colleagues (2011), which is available freely online, we introduce the method of culturomics to organizational and team research, which appears worthwhile not only for gaining a new perspective on work and organization-related trends but also for linking these trends with specific circumstances or occurrences. In the present case, it enables us to examine the root of research on teamwork and of important turning points in the history of this domain.

Teamwork and Societal Diffusion

The term *team* stems from Middle English and originally referred to a set of draft animals, for example, a *team of oxen*. Thus, the term literally referred to a relatively small number of entities that pull together to reach a common goal. In the academic literature, a team is more specifically defined as a social system of multiple individuals who are interdependent in collaborating on a common task, have a shared responsibility to reach a common goal, who see themselves and who are seen by others as a team, and who are embedded in one or more larger social systems (Cohen & Bailey, 1997; Hackman, 1987). Thus, teams represent a subcategory of groups; a group is defined as multiple individuals sharing some attribute and also includes entities such as families, occupational groups, or demographic groups. Accordingly, teamwork refers

to the common actions carried out by teams as defined above to reach their goals. Basically, teamwork is as old as humankind itself, and organizing people in teams to reach a common goal has been practiced since ancient times for purposes such as hunting, defending against and attacking enemies, or farming (Cannon-Bowers & Bowers, 2011). Nonetheless, the literature assumes a steep and steady increase in the popularity and societal diffusion of teamwork throughout the past decades (e.g., Coultas, Driskell, Burke, & Salas, 2014; Hackman, 1987; Jordan, Feild, & Armenakis, 2002).

Societal diffusion refers to the degree to which a concept is prevalent within a society (Lima, Barnett, & Vala, 2005). Along with cultural, societal, and technological changes, concepts gain and lose popularity and relevance, resulting in changes in their societal diffusion. For example, although the concept of telegraphing was widely popular at the beginning of the past century, this concept has now become largely obsolete, resulting in marginal societal diffusion. The Internet concept has moved in the opposite direction. Unknown to the broader public roughly two decades ago, now it represents one of the most broadly societally diffused concepts.

However, it remains unclear which trajectory the societal diffusion of teamwork took throughout the past century. Therefore, we conducted a study based on the methodology of culturomics for the quantitative historical analysis of concepts to examine trends in the societal diffusion of teamwork, along with potential drivers of this societal diffusion.

Method

The analyses in the article are based on two main data sets and corresponding statistical methods. First, we build on the newly introduced method of culturomics that provides information on the relative frequency with which words have been mentioned in a large corpus of books (Michel et al., 2011). Second, we apply bibliometric analyses quantifying the number of articles on the topic of teamwork in academic journals. Thus, for the analyses to be performed in this article, we combine the widely used method of reviewing the development of the importance and intellectual structure of concepts and literatures by article count analyses (Robins et al., 1999; Stojanowski & Buikstra, 2005) with the innovative method of culturomics (Michel et al., 2011), which provides count data on a much larger scale and outside the academic literature. By synchronizing these data for a period of time spanning more than a century (1900-2008), we are able to reap the benefits of both methods and to leverage synergies between these approaches, enabling us to perform analyses that would not be possible otherwise.

Culturomics

Culturomics describes "the application of high-throughput data collection and analysis to the study of human culture" (Michel et al., 2011, p. 181). It represents an approach to content analysis based on a corpus of scanned books that evolved out of Google's efforts to digitize several millions of books they received from publishers, university libraries, and public libraries around the world (Michel et al., 2011). Content analysis is an approach used to examine the construction of implicit meaning in communication processes (Krippendorff, 2004). In this sense, the idea behind culturomics is to count every single word and word combination in the millions of books scanned by Google to interpret the frequency of concepts, indicated by corresponding words and combinations of words, as the degree of their societal diffusion (Michel et al., 2011). This means that the more frequently a concept is mentioned in books within a certain period, the more salient this concept can be assumed to have been in this time period in the respective society. This approach thus allows for a large-scale longitudinal quantitative analysis of the societal diffusion of concepts (such as teamwork) over a period of time spanning more than a century. This has not been possible before and offers the examination of a completely new set of research questions.

The culturomics database was created by extracting and sorting all words and combinations of words in the digitized books for different languages for each year covered. Specifically, the database consists of *n*-grams, which represent n strings of characters uninterrupted by a space, that is, word groups (Michel et al., 2011). For example, a 1-gram represents a certain word such as *teamwork*, a 2-gram represents a group of 2 words, such as *team work*, and so forth. In the database, each *n*-grams is listed separately for each year it has been mentioned, accompanied by information on the frequency of its occurrence in each of these years. Moreover, information is provided about the total number of *n*-grams for each year to enable the calculation of relative frequencies. Thus, technically, culturomics provides information about how frequently each word and word combination (the *n*-grams) has been mentioned in all books in the corpus of a given year. This number is set in relation to the total number of *n*-grams in the same year, yielding a number that quantifies the share of the total number of *n*-grams a specific *n*-gram takes in a given year. This share can then be seen as an indicator of the salience of the concept behind the *n*-gram in the society where the books have been published.

In total, the culturomics database used for the analyses in this article comprises 5,195,769 books in several languages (i.e., Chinese, English, French, German, Hebrew, Italian, Russian, Spanish) published in the period from 1800 to 2008, and comprising both specialist and popular works (Michel

et al., 2011). This number corresponds to roughly 4% of all books ever published in this period (Michel et al., 2011). The developers of culturomics selected books from the even larger number of books digitized by Google (which amounted to roughly 15 million books at the time of database creation, that is, about 12% of all books ever published) based on the quality of scans that could be obtained and depending on the ability to identify the books' publication dates and locations (Michel et al., 2011).

Connected to the culturomics database, Google offers the service of an *n*-gram viewer (http://books.google.com/ngrams), an easily usable online application that enables data on the relative frequency of specific *n*-grams to be retrieved quickly (Michel et al., 2011). Although previous researchers applied this more convenient option of working with the culturomics data (e.g., Greenfield, 2013; Oishi, Graham, Kesebir, & Galinha, 2013; Roivainen, 2013), we could not capitalize on this application because it only allows the relative frequencies of specific, single *n*-grams to be retrieved. For example, entering *teamwork* in the *n*-gram viewer would result in the output of relative frequencies pertaining to this exact 1-gram. However, to be more precise in our analysis, we also had to look for the commonly written alternative *team work* or the verbalization *teamworking*. Thus, we had to create a data set tailored to this study, which is possible as the culturomics raw data are freely available on the Internet (provided at http://storage.googleapis.com/books/ngrams/books/datasetsv2.html).

Sampling and database generation. We extracted data from the culturomics database for the period from 1900 to 2008 from the corpus of English books published in the United States. This corpus is by far the most extensive one and was used for similar research questions in previous studies (e.g., Greenfield, 2013; Oishi et al., 2013). For our sampling period, it comprises 1,185,000 books and 134,687,393,911 words (Michel et al., 2011, Supplementary Online Material). We chose the start cutoff date of 1900 because it is in line with recommendations by Michel et al. (2011) who describe this period as the one with the highest data quality due to the extensive number of scanned books. To illustrate, while the complete corpus for the year 1800 consists of 98 million words, it comprises 1.8 billion words in 1900. Moreover, the early 20th century coincides with the beginning of systematic research on psychological and sociological phenomena such as teamwork. For example, the *Psychological Bulletin* was first issued in 1904, and the *American Journal of Sociology* was established in 1895. Choosing this start date of our culturomics analyses thus parallels the relevant period for the article counts. The end cutoff date is determined by culturomics data availability, which is the case until 2008 (Michel et al., 2011).

For the culturomics analyses in this article, we created a data set comprising all terms representing the theme of teamwork. In the first step, we condensed the more than 100-gigabyte database of American English 1-grams and 2-grams (downloaded on November 16, 2011; the culturomics data set used in this article is Version 20090715) to those *n*-grams that clearly and directly represent the concept of teamwork, that is, *teamwork*, *team work*, *teamworking*, and *team working*. Following previous research (e.g., Greenfield, 2013), we applied such restrictive criteria for *n*-gram selection to ensure a narrow range of the *n*-grams' semantic interpretations. An *n*-gram that does not directly and clearly refer to the target concept (in this case, teamwork) is likely to be mentioned in another context than the intended one. Thus, when using *n*-grams with a broader range of possible semantic interpretations, there is an increased likelihood of including *n*-grams that are irrelevant to the target concept that is intended to index (Greenfield, 2013; Michel et al., 2011). Thus, a narrower range of *n*-grams included in the data set to be studied helps to gather frequency counts that are, in fact, clearly related to the concept under study, that is, teamwork. This is also why we did not include the term *group* as a potential synonym in our sampling frame, as this term has a much broader range of possible semantic interpretations than the term *team* that are unconnected to the teamwork concept (e.g., social groups such as specific worker groups, age groups, and large groups), which would introduce a considerable amount of noise in our data. An example to illustrate the rationale behind the decision to rely only on the term *team* and not on the term *group* for our analysis comes from the classic Ohio State Leadership Studies (Stogdill & Coons, 1957). Although dealing with *work groups* and how they perceive the behavior of their leaders, the researchers explicitly advised the respondents of the Leader Behavior Description Questionnaire that "The term, 'group' as employed in the following items, refers to a department, division, or other unit of organization which is supervised by the person being described" (Fisher College of Business, 1957, p. 1). This explanation reveals a much broader concept behind the term *group* than the concept that we understand to describe a team and that forms the subject of analysis in this article. The frequency of all relevant *n*-grams identified this way was then accumulated for each year, forming the basis for our frequency analyses.

Analytic approach. The culturomics analyses are based on timeline plots that are created by dividing the number of times the relevant *n*-grams appear in a given year in the specified corpus by the total number of words in the corpus in that year, thus showing the *n*-grams' relative frequency (in % of total words). Thus, the analyses are performed on the relative share of words per year, which gives a much better estimate of concept importance than absolute

numbers. Because the percentages indicating the relative frequencies are based on a denominator of the total number of words mentioned in roughly 1.16 million books in the American English sample, the absolute percentage of any *n*-gram is necessarily small. However, we do not focus on the interpretation of the frequency values per se, but on the relative trends over time, which are particularly meaningful to interpret for our purposes (Greenfield, 2013; Michel et al., 2011). Following established procedures (Michel et al., 2011; Oishi et al., 2013; Robins et al., 1999), we smooth the values over 3-year periods in the diagrams.

In the specific analyses, we will first look for turning points in the societal diffusion of teamwork and then for research to identify important events that coincided with these turning points that might serve as an explanation for them. Thus, our procedures essentially represent an event study method (MacKinlay, 1997; McWilliams & Siegel, 1997), in this case, however, relying on a much larger text base for content analysis. Moreover, we will compare the culturomics timelines with the timelines of the number of academic journal articles that deal with the topic of teamwork.

Article Count Analysis

To analyze the article count in academic journals, we followed previous research based on this kind of article count analysis (e.g., Robins et al., 1999; Shane & Ulrich, 2004; Stojanowski & Buikstra, 2005) and performed a key word search in the titles, key words, and abstracts of articles in comprehensive academic databases to identify articles related to the theme of teamwork. Key words have been the same words or combinations of words related to teamwork used in the culturomics analysis described above: *teamwork*, *team work*, *teamworking*, and *team working*. In line with the key word selection for our culturomics analysis, we deliberately chose a narrower range of key words for our article search to gather frequency counts that are clearly related to the concept under study, that is, teamwork. Based on article count data and after the removal of duplicates, we obtained metrics of the absolute number of total articles published in academic journals as an indicator of the volume of teamwork-related academic research.

To obtain the absolute number of articles, we used these key words to search through academic databases. Specifically, to capture the breadth of disciplines engaged in research on teamwork (Beck, 2013; Salas, 2013), we scanned SCOPUS, Web of Science (i.e., the Science Citation Index and the Social Science Citation Index), Academic Search Complete, PsycArticles, SocIndex, ERIC, EconLit, and Business Source Complete to identify and count relevant articles. This resulted in a comprehensive search of the body of academic

journals, given that Scopus and Web of Science alone represent databases that cover all scientific fields and more than 16,000 (Scopus) and 11,500 (Web of Science) peer-reviewed academic journals. Only publications in academic journals were used for this search. As some of the searched databases also cover material from other sources than academic journals, we used filters to exclude all other sources, such as trade publications or conference proceedings. Moreover, we only included research articles (including empirical studies, theoretical papers, and reviews) and excluded publications primarily serving administrative and political issues such as editorials, errata, or announcements. After removing duplicates, we found a total of 11,493 journal articles dealing with teamwork from 1900 to 2008. To determine the specific discipline of each article for the discipline-based statistics, we used the journal an article was published in as an indicator to specify the disciplines. The specific disciplines examined (i.e., education, health care/medicine, management, psychology, engineering/technology) reflect the five disciplines with the largest share of articles within the sample. Consistent with our approach for societal diffusion, we calculated 3-year floating averages for the diagrams illustrating the results.

Finally, we had a detailed look at the specific topics published in *SGR*. Assuming that *SGR*'s intellectual structure reflects an interdisciplinary picture of research on teams and teamwork, the identification of specific topic-related trends over five decades (1970-2008) provides additional insight into the qualitative nature of academic teamwork research. In these analyses, we followed the approach of similar previous efforts (Quiñones-Vidal, Loźpez-García, Peñarañda-Ortega, & Tortosa-Gil, 2004; Shane & Ulrich, 2004) to identify and quantify such trends based on the content analysis of article titles. We performed a quantitative content analysis of the titles of all academic articles in SGR in the four decades from 1970 to 2009 to identify the 10 most frequently mentioned substantive terms in these titles. To do so, we downloaded citation data of all articles published in *SGR* in the relevant period, removing non-academic articles (e.g., call for papers, book reviews), which yielded a total of 1,258 academic articles. For each decade, we counted all the words mentioned in the titles, sort ordered them by frequency (including singular and plural forms), and removed non-substantive words and generic terms that did not relate to the specific content domain of the article (e.g., *study*, *analysis*, *effect*).

Results and Discussion

The Societal Diffusion of Teamwork

The trend line depicting the societal diffusion of teamwork is shown in Figure 1. At this point, we would like to emphasize again that this societal diffusion does

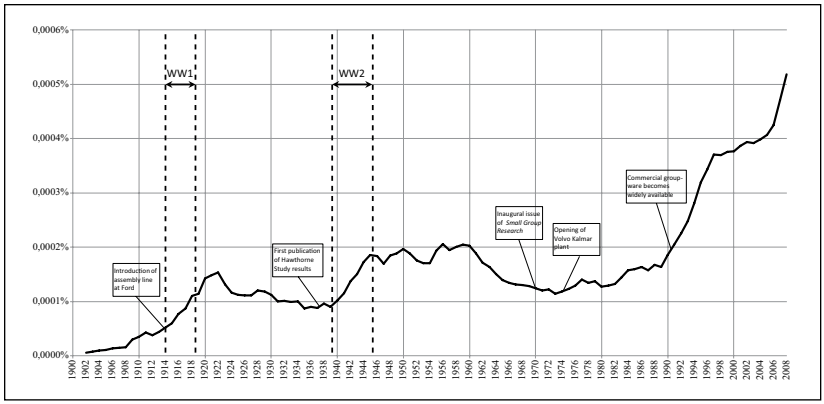

Figure 1. Results of culturomics analysis for teamwork.
Note. Relative frequencies in percent.

not relate to any specific subdomain of society, such as business organizations or the military, but spans all societal domains. Moreover, we would like to stress that our explanatory approaches represent our offerings for interpreting the various turning points in the trajectory of the societal diffusion of teamwork. We do not intend to promote them as conclusive solutions; rather, we would like to relay them as plausible starting points for a reflection about events and developments that affected the societal diffusion of teamwork.

Generally, there does not appear to be a steady increase in the societal diffusion of teamwork throughout the past century. Instead, the trend line is quite ragged, showing several turning points and pronounced phases of growth and decline. Many of these turning points coincided with large-scale events and developments. Specifically, we see a moderately rising trend curve at the beginning of the past century, with an increasing inclination from about 1915 until 1920. After the rise slightly leveled off, we see a turning point around 1922, which is followed by a declining trend curve throughout the 1920s and 1930s, only to sharply ascend again in the first half of the 1940s. This pronounced increase is displaced by a plateau phase that lasted until the beginning of the 1960s, in which the trend line remained roughly on the level of this temporary maximum. Then, in the first half of the 1960s, the trend line shows a steep decrease that lessens but continues until around 1974. Here, we see the (so far) final turning point with the societal diffusion of teamwork rising again, at first slightly, and then more rapidly from the end of the 1980s on. This rapid rise was somewhat interrupted from 1997 to 2005, but then, it gained momentum again, with a sharp increase continuing until the end of available data in 2008.

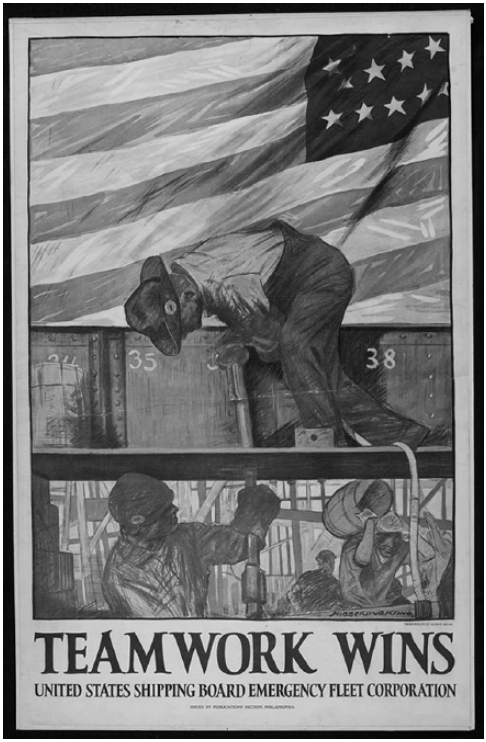

Figure 2. World War I poster from the U.S. Emergency Fleet Corporation (1917).

Teamwork and war. The unique trajectory of the trend line suggests that the teamwork concept became increasingly important in times of major war. Specifically, during World Wars I and II, the trend line reflects a sharply increasing societal diffusion of teamwork. This increasing importance of teamwork in wartime might stem from the perceived need and desire for social cohesion in such times, just as intergroup conflict is likely to foster intragroup cohesion (Benard & Doan, 2011). To illustrate this importance of teamwork in times of large-scale armed conflict, Figure 2 depicts a poster from World War I. Such social cohesion and a sense of collective identity are expected to raise morale and to boost efforts, both of the troops and the civilians burdened by the direct and indirect consequences of war. Soldiers involved in combat operations have to heavily rely on their comrades, as, for example, expressed by Steiner (1974):

> Military experience had convinced me that no human is an island unto himself, that each of us is shaped to fit existing social niches, and that our behaviors simultaneously reflect what is happening within us and what is happening outside of us. (p. 94)

Another aspect driving the diffusion of teamwork in times of war is the experience of personnel constraints during such times. In times of a major war, most professionals are pulled out of their regular careers to become directly or indirectly involved in war-related activities, such as combat operations, medical services, or the production and transport of weapons and other war supplies (Dechter & Elder, 2004). In many areas, this results in an undersupply of skilled personnel, both for regular professional activities to maintain life in areas not being theater of war *and* for war-related activities that afford massive human input (Dechter & Elder, 2004). One way to get along with this shortage is to rely on teams that may compensate for the lack of individual expertise, which was practiced in many areas, especially during World War II. For example, in these times, medical and surgical care teams have been widely and effectively used by the United States (Baldwin, 2007), and success stories of teamwork, such as the extensive interdisciplinary team efforts that enabled the Manhattan Project or the development of penicillin (Bud, 2008; Fiore, 2008), added to the popularity of teamwork at that time.

Plateaus and downturns. Importantly, the trend line showed several periods of stagnation, or even decline, of the societal diffusion of teamwork, contradicting those sources in the literature that assumed a steady increase in the prevalence of teamwork. The first of these periods occurred between World Wars I and II. After reaching a temporary maximum in 1922, the trend showed a decline until 1939. One reason for this trajectory after the end of World War I could be that the application of and the emphasis on teamwork in society, and thus, its societal diffusion, simply were throttled once teamwork lost its war-induced prominent position. Another driving force of the observed pattern might relate to technical developments that changed the organization of work, most importantly, the introduction and diffusion of assembly line production (Adler, 2003). This form of work organization, particularly, the early versions of assembly lines used during the first few decades after its introduction, can be seen as the opposite of teamwork (an exemplary illustration of an assembly line in that time is provided in Figure 3). It consists of highly individualized, simple, and clearly specified shop operations carried out by workers, being almost completely deprived of any interpersonal collaboration (Peterson, 1987; Tannenbaum, 2013). Even if the configuration of assembly lines (or the noise surrounding them) would

Figure 3. A typical assembly line in the 1920s.

have allowed for interpersonal interaction, workers were usually not allowed to do so; in many cases, assembly line workers were even prohibited from talking to each other (Peterson, 1987).

After World War II, the societal diffusion of teamwork roughly maintained the high level of diffusion reached in wartime in a plateau phase spanning roughly 15 years until 1960. In contrast to the period after World War I, the trend curve only flattens out, but does not decline. In this respect, new developments in the organization of work might have counteracted the tendency of shifting attention away from teamwork after the end of the war, in this case, the human relations movement that peaked in terms of its influence on the organization of work in the period from the mid-1940s to the mid-1950s (Kaufman, 1993). This movement had its roots in the impactful Hawthorne Studies carried out in the 1920s and 1930s (Roethlisberger & Dickson, 1939), which guided the focus of attention to recognizing the potential value of teamwork as an organizational form within organizations (Sundstrom, McIntyre, Halfhill, & Richards, 2000). During this peak period, organizations increasingly reorganized workplaces, which had been organized in a Tayloristic way before, in line with the ideas of the human relations movement. Peaking union memberships and power in this period further contributed to this trend (Kaufman, 1993). Consequentially, the huge influence of the movement also led to a discussion of these ideas, such as teamwork, among the public at large. Together, these aspects are likely to

have compensated for the decline in societal diffusion of teamwork after World War II that otherwise would have been expected, thereby yielding the overall flat trend line in this period.

In the 1960s, the trend line showed a pronounced decline of the teamwork concept's societal diffusion and remained on a relatively low level throughout the 1970s. Given the revolutionary transformation of social values in this period (Inglehart & Baker, 2000), the observed trajectory is hardly surprising. After all, the generation coming of age in this period was labeled the *me generation* to express the marked shift toward individualism during that time (Greenfield, 2013; Inglehart & Baker, 2000; Yankelovich, 1998). It is therefore straightforward to assume that a more collectivistic idea involving interdependency and shared responsibility such as teamwork suffered from declining popularity in this period, which materialized in an apparent reduction of societal diffusion.

Revitalization and explosion. In the early 1980s, the teamwork concept experienced a real comeback, entailing an enduring period of growth. A main driver of this development can be found in management innovations (Birkinshaw, Hamel, & Mol, 2008). Specifically, teamwork was implemented in areas traditionally characterized by individualized and more hierarchical work processes, such as in gastronomy (Ganter, 2004) or production plants (Adler, 2003). To mention a highly referenced example, the groundbreaking implementation of team-based organizations in Volvo's Kalmar plant (Aguren, Hansson, & Karlsson, 1976; see Figure 4) is an exemplar of introducing teamwork in a previous stronghold of individualistic, in this case assembly line, workplaces. The initial success of the early adopters of this innovation spread, and many organizations aimed to adopt it. Although car manufacturing today is done using assembly line technology, these initial forays with production teams in the automotive industry have led to more team elements in modern automobile plants, such as quality circles, for instance (Abrahamson & Fairchild, 1999; Osterman, 1994; Sundstrom et al., 1990). In addition, technological innovations also paved the way for a larger share of tasks to be carried out in teams. In this respect, in many sectors such as manufacturing or banks and insurances, the rising degree of automation superseded a major portion of previously common stand-alone manual tasks (Adler, 2003). Moreover, and at least in part connected to increasing automation and computerization, but also due to changing market conditions, job tasks tended to become more complex and critical. Thus, it became more convenient that teams, rather than individuals, carry out these tasks, as the latter were barely able to entirely capture the multitude of parallel processes (Salas, Cooke, & Rosen, 2008; Vallas, 2003).

Figure 4. Early team-based configuration of car assembly in Volvo's Kalmar Plant 1973-1994.
Note. Courtesy of Volvo Car Corporation.

These tendencies were even reinforced in the following years (until today) with ever more jobs being organized based on teamwork and surmounted to what can be seen as a dramatically rising societal diffusion of teamwork throughout most of the 1990s. This observation is compatible with the profound shift toward team-based forms of organizing work, which has been reported in the management and business literature (Cappelli & Rogovsky, 1994). This has been the case in general with regard to the application of teamwork in organizations (e.g., Ancona & Caldwell, 1992; Gladstein, 1984; Jordan et al., 2002), as well as concerning specific domains, in which an increase in teamwork has been reported (Adler, 2003), such as for innovative tasks (e.g., Hoegl & Gemuenden, 2001; Lovelace, Shapiro, & Weingart, 2001). The emergence of groupware to support teamwork, even over geographical distances in virtual teams (Johnson et al., 2009), also contributed to the breathtaking speed of developing team-based organization processes (Graetz, Boyle, Kimble, Thompson, & Garloch, 1998; Grudin, 1994).

To solidify evidence on these reports, a number of research efforts point to the diffusion of teamwork in organizations during that time. For example, in a longitudinal design spanning 6 years, Lawler et al. (1995) reported a clear increase in firms' use of self-managing work teams. In their research on management fashion or fads, Gibson and Tesone (2001) presented consistent

findings on the use of self-managing teams. Specifically, basing on life-cycle theory of management fads by Ettorre (1997), they describe self-managing teams as a management concept that was discovered in the 1980s, followed by a *wild acceptance* from 1991 to 1996, and a stage of *digestion* that upheld at the time when their study took place (which seems to reflect the period of slower growth of the trend line between 1997 and 2005). Specific examples for the new application of teams in organizations put forth in the literature that gained prominence in all kinds of organizations since the 1980s are production groups, quality circles, and (cross-functional) project teams (Druskat & Kayes, 2000; Hackman & Wageman, 1995; Sundstrom et al., 2000; Yong, Sauer, & Mannix, 2014).

However, the use of teams did not only sharply increase in business organizations. In scientific research, teamwork turned into the prevalent organizational form (Falk-Krzesinski et al., 2011; Fiore, 2008). In this regard, building on bibliometric analyses and article count analyses of 19.9 million articles published in academic journals and 2.1 million patents over five decades, Wuchty et al. (2007) provided convincing evidence that teamwork gained steadily increasing importance as an organizational form of scientific work in the second half of the 20th century. Similarly, team-based approaches have also proliferated in education in this period (e.g., Hall, 2002; Tonso, 2006). Given that considerably more people became involved in this organizational form in the 1990s, it is only consequential that the societal diffusion of teamwork rose dramatically in these years. After all, being a *team player* is now considered a virtue in itself in society, and most job advertisements emphasize the importance of the potential applicants' capacity for teamwork, no matter whether teamwork is actually necessary and applied (to a greater extent) at the workplaces. Consistent with this, in their study on job advertisement content, Kennan, Cole, Willard, Wilson, and Marion (2006) found that interpersonal skills are the most frequently mentioned content category in job advertisements, and that their mentioning has increased from 22.6% of job advertisements in 1974 to 68.4% in 2004 (Kennan et al., 2006).

Academic Research on Teamwork

General trend in academic research. In contrast to the trend line pertaining to the societal diffusion of teamwork, the trend line representing the number of academic research articles dealing with teamwork paints a completely different picture (see Figure 5). Although the concept of teamwork found noticeable entrance in the academic literature relatively late, the curve is less ragged than the one depicting the societal diffusion of teamwork. The trend line shows the relatively low level of academic effort devoted to teamwork until the early

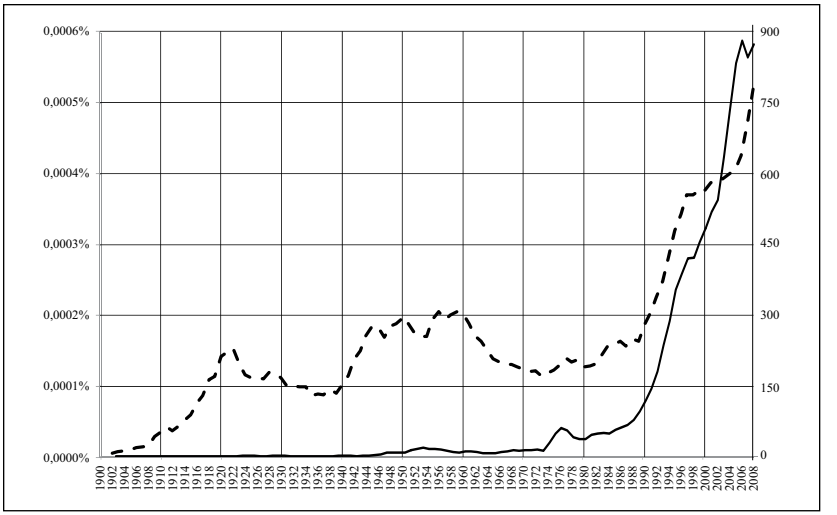

Figure 5. Results of article count analysis for teamwork in academic journals (number of articles published).
Note. Solid line represents article counts in academic journals; dashed line represents the societal diffusion trend line for comparison.

1970s, only interrupted by a slight increase in publications in the 1950s, peaking around 1953. Throughout the 1970s and 1980s, we see a moderate increase in publications on teamwork (with a small peak in the middle of the 1970s), which is then followed by a dramatic increase in academic publication activity starting in the late 1980s and lasting until the end of data availability (with only one minor interruption around 2006). Thus, with regard to academic research, the accounts of the steady and rapidly increasing prevalence of teamwork in the past three decades are certainly correct.

As the extant literature dealt with the history of teamwork, particularly for the fields of psychology and health care, several reviews reflected this development, and a number of articles and book chapters were specifically devoted to this purpose as well (Baldwin, 2007; Brown, 1982; Cannon-Bowers & Bowers, 2011; Moreland, Hogg, & Hains, 1994; Ryan, 1996; Sanna & Parks, 1997; Simpson & Wood, 1992; Sundstrom et al., 2000). Consistent with each other, these previous accounts of the history of teamwork research report that the study of teamwork had a slow start, some ups and downs in between (Brown, 1982; Cannon-Bowers & Bowers, 2011; Ryan, 1996; Simpson & Wood, 1992), and finally "literally exploded in recent years," now resulting in a "voluminous literature on the subject" (Cannon-Bowers & Bowers, 2011,

p. 597). In fact, the pattern of teamwork research in psychology and health care presented in narrative reviews followed strikingly similar patterns, replicating a curvilinear trend line with peaks and lows in parallel order.

Our analysis of the number of academic articles on teamwork is only partly consistent with these reports. First, the peak in research on teams and teamwork in the 1950s (Ryan, 1996; Simpson & Wood, 1992) appears less pronounced in our analyses, as could have been expected, given the impression created in reviews of team research during that time (e.g., Brown, 1982; Cannon-Bowers & Bowers, 2011; Ryan, 1996; Simpson & Wood, 1992). As explained above, we deliberately focused our analyses on the terms relating to teamwork, and thus cannot rule out that such early team research might have also referred to groups, rather than teams. Despite this possible limitation, one reason for this discrepancy surely lies in the overall smaller number of publications in these days, which might cause different perceptions of what a high level of academic attention actually means in terms of publications. Moreover, streams of literature that subsequently became powerhouses of team research, such as management (Stewart, 2010), had just begun to emerge in the 1950s and 1960s, and interdisciplinary research on teamwork has set off even later (as an indicator of the emergence of broader interdisciplinary research on teamwork, SGR was established in 1970), which makes the case for an even smaller publication base back then. Thus, the increase of academic efforts devoted to research on teamwork must have appeared to expand notably in the 1950s in relation to the previous situation, but compared with later developments, this increase might appear minuscule. In fact, even the quantitative reviews of the development of teamwork research are based on relative metrics and/or focused on a small number of journals or even single journals (e.g., Moreland et al., 1994; Ryan, 1996; Sanna & Parks, 1997). However, our analyses are at least partially consistent with these reports in psychology and health care concerning the slump in interest in team research in the 1960s and 1970s (Moreland et al., 1994; Sanna & Parks, 1997; Steiner, 1974), and the following increase starting in the mid-1970s and the tremendous rise of teamwork research from the second half of the 1980s on (Cannon-Bowers & Bowers, 2011; Moreland et al., 1994; Sanna & Parks, 1997).

Discipline-specific trends in academic research. The results of the analysis of trends in five academic disciplines heavily engaged in teamwork research (i.e., education, health care and medicine, management, psychology, engineering/technology) are shown in Figure 6. Due to the negligible number of total publications before 1950, we constrain our analysis to the period starting in that year. A comparison of the number of academic publications in these fields shows that most are published within the domain of health care/

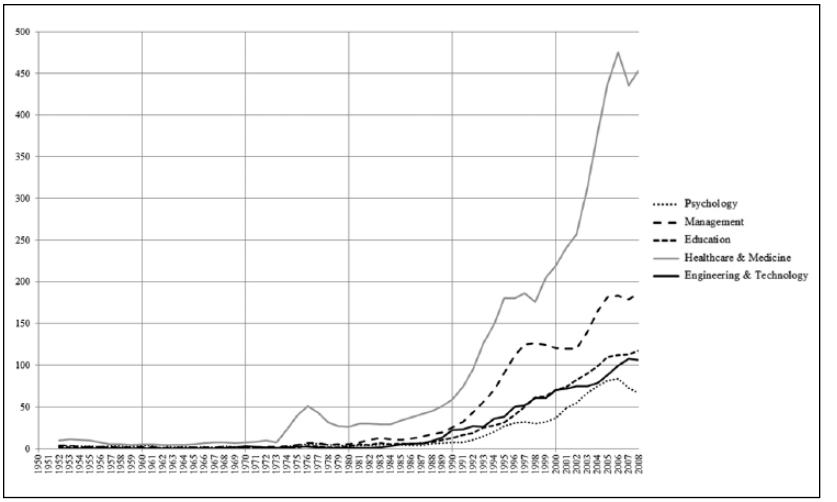

Figure 6. Discipline-specific count analysis for teamwork in academic journals (number of articles published).

medicine, followed by management, and the other three disciplines (among which, there are less pronounced differences). However, interpreting differences in the absolute numbers of academic articles between the individual disciplines is problematic, due to the notable differences in their total output volume in some cases. It appears more informative to compare the trajectories of the different disciplines. Here, it becomes clear that health care/medicine is the discipline that first started to produce a sizable number of academic articles, substantially earlier than the other disciplines did. Specifically, there is also a first pronounced peak in the mid-1970s in health care/medicine, which the other disciplines do not show. We also see that the increase in publications on teamwork accelerated in the beginning of the 1990s in all disciplines, particularly in health care/medicine and management. Finally, although the trajectories of psychology, education, and engineering/technology show a quite continuous increase throughout the 1990s and 2000s (except a downturn in psychology in the second half of the 2000s), the trajectories of health care/medicine and management show a brief but pronounced interruption of growth or even a brief decline in the mid-1990s (health care/medicine) and in the late 1990s and early 2000s (management), respectively, and a reduction in publication output in 2007.

One key stimulus for the discipline of health care/medicine's early start in team research is likely the initiative of the federal government in the 1970s to

promote interdisciplinary health care teams and to provide federal funding to train students in this interdisciplinary team approach (Heinemann, 2002). The reason the federal government was motivated to push interdisciplinary teamwork in health care was similar to the suspected driver of the teamwork approach in wartimes—that is, personnel shortages in skilled health professionals (Heinemann, 2002). Why this peak was then followed by a decline in teamwork research in the late 1970s before the trajectory started to rise again, however, is less easily detectable. It would make sense that, once the foundations for training and applying interdisciplinary teams were laid, the immediate urgency for academic research on interdisciplinary teamwork in health care declined again.

The driver underlying the striking interruption of the rise in published articles in the discipline-specific trajectories of health care/medicine and management in the mid to late 1990s might be that these disciplines reached a state of consolidation of teamwork research after the tremendous acceleration they experienced in the preceding decade. This would be consistent with literature on management fads and fashions that postulates that a period of pronounced attention to a specific management concept is usually followed by a stage of decline or stagnation (Abrahamson & Fairchild, 1999; Ettorre, 1997; Nijholt & Benders, 2007), as shown for the specific teamwork applications of self-managing work teams or quality circles (Abrahamson & Fairchild, 1999; Gibson & Tesone, 2001; Nijholt & Benders, 2007). When contrasting our results with these specific life-cycle modes of management fads and fashion, our results tend to support the model by Nijholt and Benders (2007); although there is a visible decline or stagnation after periods of rapid growth, concepts that are subjects of an intense temporary discourse are not necessarily transient, but may persist in discourse after such pronounced periods of rising and stagnating/declining popularity.

Trends in SGR. Looking at the content of academic articles published in *SGR*, some clear thematic trends become visible, as shown in Table 1. Although in the first two decades of *SGR* in the 1970s and 1980s the topics of psychotherapy and training headed the research agenda, these topics experienced substantially reduced attention in *SGR* in the following decades, in which they did not even appear in the top 10 topics any more. Instead, the largest share of attention in the 1990s and the 2000s was directed toward more management-related topics; *SGR* literally became more performance-oriented and task-focused.

Moreover, only a few topics remained constantly (in at least three decades) among the most focused topics in *SGR*: *interaction*, *processes*, *communication*, *tasks*, and *leadership*, with changing prominence in the top 10 though,

Table 1. Trends in Topics Published in SGR (Based on Article Title Mentions).

Rank	1970s	1980s	1990s	2000s
1	(Psycho-)therapy	(Psycho-)therapy	Decision	Performance
2	Training	Training	Task	Task
3	Interaction	Process	Performance	Communication
4	Change	Development	Leadership	Conflict
5	Encounter	Learning	Process	Development
6	Process	Interaction	Interaction	Cohesion
7	Experience	Leadership	Information	Process
8	Communication	Behavior	Communication	Computer
9	Sensitivity	Task	Conflict	Efficacy
10	Marathon	Decision	Gender	Leadership

and only with *processes* present in all decades of *SGR*'s publications. In contrast, some topics apparently represent specialties of specific time periods. For example, in *SGR* in the 1970s, an intense academic debate on *marathon groups*, *sensitivity training*, and *encounter groups* took place (e.g., Smith, 1979; Stava & Bednar, 1979; Uhlemann & Weigel, 1977) that faded in the following decades. Similarly, the 2000s saw an unprecedented focus in *SGR* on the aspects *cohesion*, *efficacy*, and *computers* (e.g., Chiocchio & Essiembre, 2009; Edmonds, Tenenbaum, Kamata, & Johnson, 2009; Johnson et al., 2009). Whereas the latter (computers) are mainly discussed in the context of virtual teams and thus reflect a general trend toward an increasing digitization of the (business) world, the former can be seen as the harbingers of an upcoming trend in teamwork research to focus on emergent states to explain the mechanisms underlying well-researched input–team performance relationships (Coultas et al., 2014).

Societal Diffusion Versus Academic Research

Given these results, the question arises as to whether the trends in academic research on teamwork were stimulated by the societal diffusion of teamwork that mirrors societal attitudes and developments of organizing work in practice (i.e., demand pull), or whether academic research, in turn, provided an impetus for the organization of work in practice (i.e., knowledge push) and thus drove the societal diffusion. Comparing the two trend lines of societal diffusion (Figure 1) and academic publications (Figure 5), we observe that until the 1970s, the two lines are apparently independent of each other, as the pronounced ups and downs in societal diffusion are not

mirrored in academic publications. Until the mid-1970s, the only somewhat parallel movement of the two trend lines is the peak in the 1950s, which, however, occurred later and lasted shorter in academic research than in societal diffusion. Beginning with the upward trend in the mid-1970s, however, the two lines become apparently interconnected and show almost the same moderate rise until the late 1980s, which turns into a rapid increase from the 1990s on (the only marked difference is the intermitting phase from ~1997 to 2005, where the pace of the increase of societal diffusion slowed down to a moderate one).

Thus, there does not seem to be a connection between academic research on the concept of teamwork and its societal diffusion in the first half of the past century. From the 1970s on, the two curves nearly perfectly align; even the small and short peak around 1976 is visible in both curves, and both curves show a temporary slowing of growth in the late 1990s (although differently pronounced). In sum, we interpret this parallel pattern in favor of a demand pull explanation of academic research in that, parallel with growing societal diffusion, the teamwork concept also diffused into the domain of academic research and became an even more important topic here. If the reverse were the case, we would have expected the societal diffusion trajectory to lag behind the academic curve, indicating its diffusion from academics into the broader societal context. Our analyses therefore tend to support the idea that the attention of academic research is consistent with broader societal trends, but it does not set such trends through new insights. Our results also show, however, that this has been the case only from the 1970s on, and that there was previously a long-lasting disconnect between societal trends and academic research on teamwork.

As a consequence, our results only partly align with extant research on this issue. Reviews of teamwork history (Brown, 1982; Cannon-Bowers & Bowers, 2011) suggested a demand pull in this regard. For example, Brown (1982) attributed the pronounced increase in teamwork research in health care in the 1950s to newly emerging medical specialties in health care during this period. Similarly, with regard to the unprecedented upswing of team research in psychology in the late 1980s and into the 1990s, Cannon-Bowers and Bowers (2011) located the trigger for this growth of teamwork research in developments in the sectors of commercial aviation and the military (Cannon-Bowers & Bowers, 2011; Salas, Bowers, & Cannon-Bowers, 1995). They report that problems associated with teamwork contributed to several severe aviation accidents and urged commercial aviation to rethink and improve teamwork in aircrafts, which was accompanied by increasing investments in research on this topic (Cannon-Bowers & Bowers, 2011; Wiener, Kanki, & Helmreich, 1993).

Moreover, our results also resemble findings by Abrahamson and Fairchild (1999), who showed that the rising and falling popularity of management models in academic research followed (rather than led) public interest. They based their analyses on juxtaposing academic articles and articles in the popular press; we arrived at consistent results building on the analysis of books in the culturomics corpus, thus fortifying evidence for the prevalence of a demand pull in the topic choice of academic research in the social sciences. Moreover, the findings support reports of popular media gaining increasing influence on the topics investigated by academic research (Mazza & Alvarez, 2000). Thus, our observations are in line with the observation that not only "science is transforming modern society," but that "society, in speaking back, is transforming science" (Gibbons, 1999, p. C82). On one hand, noticing that academic research in social sciences tends to follow societal trends and demands can be interpreted in a pessimistic way, as it shows the failure of academic research in the social sciences to set evidence- and theory-based trends. On the other hand, one can see this in a more positive light as well, in that it shows academic research in the social sciences to fulfill its obligations to deal with the most pressing problems and topics in society, according to a social contract between science and society (Gibbons, 1999; Lubchenco, 1998). This contract, whose bonds apparently tightened from the 1970s on, might reflect the fact that the societal relevance of topics gained in importance for academic researchers' focus of attention as a means to maintain the societal legitimacy of the scientific enterprise (e.g., Hessels, van Lente, & Smits, 2009).

General Implications for Teamwork Research

Making use of a new methodological approach allowed us to examine how the cultural diffusion of teamwork developed over the past century, depicting long-term trends that have been out of reach for scientific inquiry before. In so doing, our analysis served to introduce this innovative method to the study of teams and displayed the value of culturomics (Michel et al., 2011) as a means to detect societal trends and to connect them to large-scale events and cultural developments. For team researchers, this presents at least two worthwhile opportunities. First, applying this method enables further studies on the drivers of teamwork's societal diffusion that take a more fine-grained view in this respect. A further step in this direction, for example, would be the comparison between different societies and cultures to compare trajectories and potential drivers of societal diffusion. Second, the method allows a deeper analysis of changing trends within the domain of teams over time. In this regard, changing applications for teams (e.g., project teams, product

development teams, top management teams) and the changing contexts of teamwork (e.g., virtual teams, intercultural teams, cross-functional teams) can be examined and linked to each other or other societal and technological developments. Moreover, further aspects of recorded history such as newspaper articles, radio programs, and more recently, television programs and movies might be operationalized and used for this kind of research to substantiate and expand our results. Similarly, when shorter time spans are the focus of analysis, new social media such as Facebook or Twitter might offer valuable data to examine trends related to the diffusion and usage of teamwork in society, as has already been done in other research domains (Bakshy, Messing, & Adamic, 2015; Boyd & Crawford, 2012; Doré, Ort, Braverman, & Ochsner, 2015). Generally, we hope that through our study, team research will better leverage the largely untapped potential of content analyses of media and historical materials that nicely supplement more established methodological approaches in our field.

The multi-method analyses applied in this review provide valuable insights into the origins of teamwork research and which events and developments shaped the field to become what it is today. We have learned a great deal from reviewing this domain over the past century and think that it has given us insights into what might be expected from the future development in the domain of teamwork research. Extrapolating from past developments, we can expect the societal diffusion of teamwork to further expand (while bearing in mind that some drivers have the potential to bring this growth to a halt). This is important, given that questions about the prominence and societal relevance of research domains will be asked by those decision makers who have to configure resource allocations among competing domains through instruments such as hiring and funding. In this respect, the science of teams and teamwork appears to be growing rapidly, becoming a larger enterprise that involves more and more institutions and scholars. Therefore, analyses such as ours provide evidence that this growing enterprise corresponds to a growing societal relevance and thus justifies spending related to the study of teams and teamwork.

Limitations

This research has several limitations. The first set of limitations concerns our analysis of the culturomics data. In this regard, Google's sampling approach of books to be digitized has changed in 2001 (Michel et al., 2011). Although the volume of scanned books can be assumed to be of such enormous size that no specific biases should be introduced by these changes and our trend line of teamwork's societal diffusion does not show an apparent change from 2000 to

2001. This should be kept in mind when interpreting the results. Second, although our analyses are based on the most recent culturomics database at the time we performed our analysis, Google, as well as the group providing the culturomics data around Michel, is constantly scanning further books and adding them to the culturomics corpus and updating the corresponding data for download (Lin et al., 2012). Thus, the analyses in this article were based on an older version, as currently available online. To test for potential changes resulting from these changes in data, we compared the curves for the 1-gram *teamwork* (which is the *n*-gram with by far the highest frequency in our data set) based on our data set with the most recent version of the data. No noteworthy changes could be observed in the pattern of the trend line; the trends identified in this article even appeared to be slightly more pronounced when analyzing the updated data. Furthermore, the percentages of the frequency of the *n*-grams related to teamwork might appear extremely small, suggesting only marginal differences on the trend line. However, when considering the tremendous size of the underlying corpus, even small differences in percentages reflect large magnitudes in absolute terms. Moreover, we focused on the relative differences throughout the observed century, and these showed marked differences. For example, the societal diffusion of teamwork at least doubled between each pair of temporary maxima and minima, in 2008 even growing to 5 times the relative frequency than it was in the 1970s. Finally, as of now, there is no bibliography of the corpora included in the culturomics database available. Knowing precisely which books form the sample of our analysis might help to better evaluate the variety of material included and would therefore allow a better interpretation of our results.

Another potential shortcoming of our approach concerns the focus on the books scanned by Google itself. Focusing only on books does not represent the complete range of relevant media, as there are many other forms of societal publications. Thus, books represent only one aspect of the societal diffusion of concepts, and focusing on books might be too restrictive. Although these issues should be kept in mind when reading the article and interpreting our findings, there are also arguments that mitigate these concerns, at least to some extent. In this regard, books can be seen as mirrors of a society and were used for other research efforts from other fields on topics similar to ours (e.g., Greenfield, 2013; Oishi et al., 2013; Roivainen, 2013). Even if the content transported in books might not completely overlap with that published in other mass media, it is unlikely that there are systematic and substantial differences, especially given the sheer number of books scanned in Google's efforts that makes a representative sample quite likely. The enormous number of books the analyzed corpus comprises also tends to lessen concerns regarding an academic bias in this corpus. Nonetheless, to check for such a bias, we

ran our analyses on an English subcorpus that comprises only fictional literature (we did not choose to use this subcorpus for our analyses in the article due to problems connected with this subcorpus mentioned by Michel et al., 2011], in their Supplementary Online Materials). The results closely resembled the patterns and trends observed in our analyses, most of them being even more pronounced. This makes academic bias in our data quite unlikely, although our results appear to be more conservative through the presence of academic literature in the focal corpus.

Finally, we are aware that our analyses and interpretations build on correlational relationships and cannot establish causality between the proposed events and developments and the trajectory of the various trend lines shown in this article. Furthermore, we want to emphasize that we did not directly measure the societal or academic diffusion of the teamwork concept, that is, the actual spreading of teamwork in society. Rather, we operationalized it through the prevalence of terms in published books, based on the assumption underlying the culturomics approach that the relative frequency of word usage is representative of societal usage. But it is important to remember that this is an operationalization.

Conclusion

Our findings on the changing societal diffusion of teamwork show that large-scale events, such as war, and technological, institutional, or other changes may influence the role specific concepts play in society, in this case, the concept of teamwork. Using books as an imprint of the times in which they have been created allows for tracking such changes over long time spans in a quantitative way. Thus, "cultural features can be indexed by word-use frequencies, which, in turn, reflect what is prioritized by a population" (Greenfield, 2013, p. 1729), and the methodology of culturomics provides the means to do so (Michel et al., 2011). Our study built on this tool to specify which trends might have caused the promotion or decline of the teamwork concept in society and to illustrate the interrelationship between societal diffusion and academic research. That being said, we would like to emphasize again that our interpretations of the curve and the potential drivers of trends in the societal diffusion of teamwork we identified are by no means to be understood as claims of final solutions, nor as exclusive explanations for the observed patterns of societal diffusion. We outlined those drivers we perceived to have played a significant role in shaping teamwork's societal diffusion, knowing that there may well be a number of other drivers that had their share in this regard as well, or altogether different and better explanations, and which shall be illuminated by future research. With this initial study, we hope to

spark the interest of other scholars in this kind of research and to provide a stimulus to take into consideration the influence of society-level developments on the role of teams and teamwork. In sum, we are confident that this new perspective, enabled through the emergence of new technology and data, nicely complements existing research approaches to enrich our understanding of teams and teamwork.

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