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1 AUTHOR:

Sachi Sri Kantha
Gifu University
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Scientific Productivity of Einstein, Freud and Landsteiner

S. SRI KANTHA

5-16-305 Tsukimicho, Fukuroi City, Shizuoka 437-01, Japan. Tel & Fax: +81-538-49-2274

Abstract — The scientific productivity of Albert Einstein was compared to that of designated controls Karl Landsteiner (an experimental scientist) and Sigmund Freud (an eminent theorist). Three assumptions made for this comparison were (1) that Einstein and his designated controls had equal scientific stature; (2) that their publications were produced in a similar, if not identical, sociocultural milieu; and (3) the number of publications is directly proportional to scientific productivity. At the end of their illustrious careers, Einstein, Freud and Landsteiner accumulated 315, 320 and 345 scientific publications respectively. Einstein was the sole author in 88% of his publications, which validates the third assumption. Thus, one can conclude that quantitative comparison of Einstein's total scientific publications with that of appropriate controls such as Landsteiner and Freud shows that Einstein's chronic ill health did not influence his scientific productivity.

Introduction

During the past three decades, scientific productivity of eminent scientists and its link to quality of research have been studied by sociologists of science (1–5). Two studies also exist on the age and productivity among scientists (6,7). Previously, I have reported on the scientific productivity of prominent scientists who have authored over 1000 publications (8,9). I had also wondered whether Albert Einstein's chronic illness influenced his scientific productivity (10). While analyzing the productivity of Einstein, I was faced with the dilemma of choosing a contemporary of him with equal stature as a control. I finally settled on Karl Landsteiner (11), who also made his landmark discovery of blood groups at the turn of this century, as an appropriate control.

Since Landsteiner was predominantly an experimental scientist compared to Einstein (a prominent theorist), I also chose Sigmund Freud as another control. Though Freud was a senior contemporary of Einstein (almost a generation older than the latter), I felt that, for multiple reasons, he served as another appropriate control to evaluate Einstein's productivity. First, like Einstein, Freud also distinguished himself as a pre-eminent theorist in his area of speciality. Second, both Freud and Einstein suffered from overt Nazi harassment in Europe. Third, in 1905 (Einstein's annus mirabilis), Freud also published his pioneering work, *Drei Abhandlungen zür Sexual Theorie* [*Three Essays on the Theory of Sexuality*], in which he described his theory of infantile sexuality and libidinal development. Fourth, in 1915, when Einstein presented his 'masterpiece', the general theory of relativity, Freud

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also completed five essays (*Instincts and their Vicissitudes, Repression, The Unconscious, The Metapsychological Supplement to the Theory of Dreams* and *Mourning and Melancholia*). According to Freud's biographer, Ernest Jones (12), these '. . . are among the most profound and important of all Freud's works'. Fifth, like Landsteiner, Freud also lived in Vienna and distinguished himself in muliple disciplines such as neurobiology, psychiatry, psychoanalysis and sex research (13). Last but not the least, the health profile of Freud differed noticeably from that of Einstein. While Einstein suffered his first serious setback in health when he reached 38 years (10), Freud was in robust health until he reached his late 60s (14).

In this communication, I compare the scientific productivity of Einstein, Landsteiner and Freud and conclude that Einstein's chronic illness did not influence his productivity.

Method

Though publication counts are an imperfect indicator of productivity among scientists, they serve the function of a rough but serviceable gauge of research performance (7,15). When other important parameters such as age, place of work and caliber of research are equal, the publication count provides the easiest scale on which to compare the research productivity among scientists.

The bibliographies of Einstein (16,17), Landsteiner (18) and Freud (19) were compared to check for any significant difference in the quantity. The following assumptions were made for this comparison:

1. Einstein and his designated controls had equal scientific stature.
2. Their publications were produced in a similar, if not identical, sociocultural milieu.
3. The number of publications is directly proportional to scientific productivity. A high percentage of single-author papers in a scientist's bibliography validates this assumption.

Results and discussion

Table 1, which shows the biographical synopses of Einstein, Landsteiner and Freud, is presented to validate the first two assumptions. At the end of their illustrious careers, Einstein, Freud and Landsteiner had published 279, 320 and 345 papers respectively. If 19 patents co-authored by Einstein (17,20) are included, the total number of Einstein's publications increases to 298. An additional 17 short annotations written by Einstein between 1905 and 1907, on papers and book chapters published by his contemporaries (21), brings the grand total of Einstein's publications in science to 315. Among these, the percentages for single-author, two-author and three-author publica-

Table 1 Biographical synopses of Einstein, Landsteiner and Freud

Parameters	Einstein	Landsteiner	Freud
1. Life span (years of birth–death)	1879–1955	1868–1943	1856–1939
2. Place of birth	Ulm, Germany	Vienna, Austria	Freiberg, Moravia (then Austria–Hungary)
3. Period of childhood	Munich	Vienna	Vienna
4. Native tongue	German	German	German
5. Cultural milieu	Jewish	Jewish	Jewish
6. Academic degree	PhD	MD	MD
7. Specialty area	Physics	Bio-medicine	Psychology
Early research	Physical chemistry	Chemistry	Anatomy and physiology
8. Age at the appearance of first paper	22 yr	24 yr	21 yr
9. Places of work	Switzerland Germany USA	Austria Netherlands USA	Austria
10. Lasting recognition in research	Relativity Quantum theory	Blood groups Immunochemistry	Sexuality Dreams Consciousness
11. Nobel prize	Physics (1921)	Medicine (1930)	No award*

*His peers had recognized Freud as belonging to the Nobel class and, according to Gay (22), he was nominated for the prize more than once. Heinrich Meng, the editor of *Zeitschrift für Psychoanalytische Padagogik*, made a valiant attempt to enlist the support of prominent personalities to nominate Freud for a Nobel prize. Gay (22) has also stated that, '. . . the psychiatrist whom the Swedish Academy consulted as its authority dismissed Freud as a fraud and a menace'.

tions amount to 88, 11 and one respectively. This publication count of Einstein was primarily based on the compilation of Shields (16) up to the year 1950 and six bibliographical items which appeared between 1952 and 1955 with Einstein's name. The only year in which Einstein failed to publish a scientific item, since beginning his publishing career in 1901, was 1951.

The scientific productivity of Einstein, Landsteiner and Freud are grouped at ten-year intervals and shown in Table 2. Einstein's peak productivity (averaging nearly 85 papers per decade) occurred in the two decades following his 30th birthday. Like Einstein, Landsteiner also had two peaks of productivity, but these were spaced by a decade. Landsteiner's first peak of productivity was in his third decade (over 100 papers). His second peak of productivity was in his mid fifties (over 88 papers). Somewhat varying from the pattern demonstrated by Einstein and Landsteiner, the peak productivity of Freud was between 1911 and 1920, when he was in his mid fifties. These profiles agree well with the existing notion among the sociologists of science that, compared to the scientists in biomedical discipline, scientists from the physical sciences and mathematics disciplines peak early in their productivity.

Table 2 Comparison of the research publication count of Einstein, Landsteiner and Freud

Years	Number of Research Publications		
	Einstein[1]	Landsteiner[2]	Freud[3]
1877–1880	–	–	5
1881–1890	–	–	33
1891–1900	–	13	37
1901–1910	39	104	49
1911–1920	89	57	77
1921–1930	86	88	63
1931–1940	52	69	41 (5*)
1941–1950	26	14	15*
1951–1955	6	–	–
Total	298#	345	320

*Posthumous publications.
#Including the 19 co-authored patents, but excluding the short annotations of Einstein discovered by Klein and Needell in 1977.
[1]Ref. 16, 17 (1901 was the first year of publication for Einstein.)
[2]Ref. 18 (1892 was the first year of publication for Landsteiner.)
[3]Ref. 19.

Since Freud is a senior contemporary of Einstein, and published his early papers even before the birth of Einstein, in the Figure, I have compared the annual research productivity of Einstein with that of Landsteiner, who published his first paper only nine years ahead of Einstein. The trends observed in the cumulation of publications at ten-year intervals (Table 2) are also reproduced in Figure. Of the two prominent peaks noticeable in Landsteiner's career, the first occurred during the 1900–1910 decade while he was in Austria. The second productivity peak of Landsteiner appeared between 1923 and 1932, when he moved to New York. Similarly Einstein's scientific productivity also shows two prominent peaks. The first peak, an acute one, reached its zenith around the years 1914–1915, when he put forward his 'masterpiece' – the general theory of relativity. It was followed by a trough, probably due to the first attack of ill health suffered by Einstein in 1917. The second peak of Einstein's productivity was spread over the 1920s.

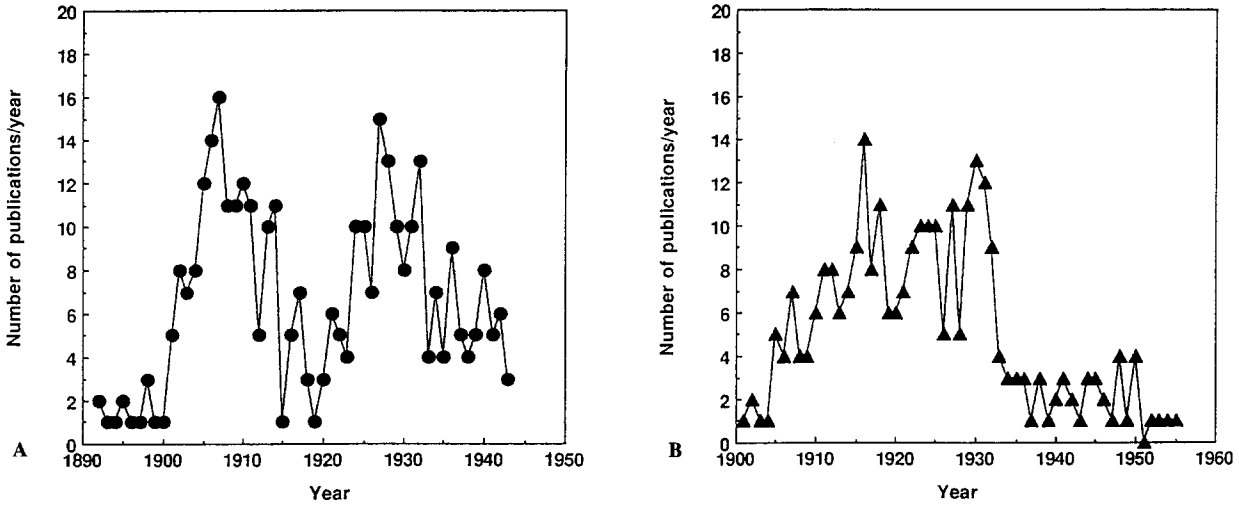

Figure Research productivity of (**A**) Karl Landsteiner and (**B**) Albert Einstein.

Both productivity peaks of Einstein occurred during his Berlin period, which spanned nearly two decades.

Compared to the total productivity (315 publications) of Einstein, his controls Freud and Landsteiner authored 2 and 10% more scientific papers respectively. However, if one considers additional evaluationary criteria such as the fact that Einstein, (1) had 88% of single-author publications compared to 31.5% authored by Landsteiner; (2) also contributed nearly 140 non-technical publications in science and social themes for four decades beginning from 1914; and (3) also had active extracurricular interests related to Zionism and peace activism, one can infer that the 2–10% difference in the total number of scientific publications of Einstein to that of his controls is negligible.

In conclusion, quantitative comparison of Einstein's total scientific papers with that of appropriate controls such as Landsteiner and Freud shows that Einstein's chronic ill health did not influence his scientific productivity.

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