

THE RISE OF NULL HYPOTHESIS SIGNIFICANCE TESTING AS THE GOLD STANDARD IN  
PSYCHOLOGY, 1940-55

SPENCER ARSHINOFF

A THESIS SUBMITTED TO THE FACULTY OF GRADUATE STUDIES IN PARTIAL  
FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF MASTER OF ARTS  
GRADUATE PROGRAM IN PSYCHOLOGY

YORK UNIVERSITY

TORONTO, ONTARIO

SEPTEMBER 2024

© SPENCER ARSHINOFF, 2024

### **Abstract**

In the midst of the ongoing replication crisis, it is more important than ever for psychologists to look critically at methodology. Nearly every psychologist uses null hypothesis significance testing (NHST) to analyze and draw conclusions from quantitative data, despite its imperfections and the heavy criticisms it has received, particularly in recent years. Though NHST is usually taught as a strictly formalized, “objective” procedure inherent to the field, it was only introduced to psychology in the 1930s. The method reached its current status of ubiquity during the so-called “inference revolution” of 1940-55 (Gigerenzer & Murray, 1987). However, the means through which this revolution occurred remain unclear. By reviewing course catalogues from six major Canadian universities from 1940-55 and situating my findings in the broader historical context, I aim to disentangle how, and why, NHST became the gold standard of psychological statistics during this time.

## Table of Contents

Abstract .....	ii
Table of Contents .....	iii
List of Tables .....	iv
List of Figures .....	v
Chapter 1: Introduction .....	1
The History of Null Hypothesis Significance Testing .....	3
Canadian Postsecondary Education .....	5
Academic Psychology in Canada .....	8
Chapter 2: Review Background .....	13
Dalhousie University .....	14
McGill University .....	15
Queen’s University .....	16
University of Toronto .....	17
University of Alberta .....	18
University of British Columbia .....	19
Review Methods .....	20
Chapter 3: Findings .....	22
Dalhousie University .....	22
McGill University .....	23
Queen’s University .....	26
University of Toronto .....	28
University of Alberta .....	31
University of British Columbia .....	32
Chapter 4: Discussion .....	37
Summary .....	37
Historical Context .....	38
Conclusion .....	43
Bibliography .....	45

**List of Tables**

Table 1: Psychology Departments and Heads, 1940-55 .....	20
Table 2: Statistics Textbooks Used in Psychology Instruction, 1940-55 .....	34

## List of Figures

Figure 1: The Usage Rate of $p$ -Values in Psychology Journals, 1911-98 .....	2
---	---

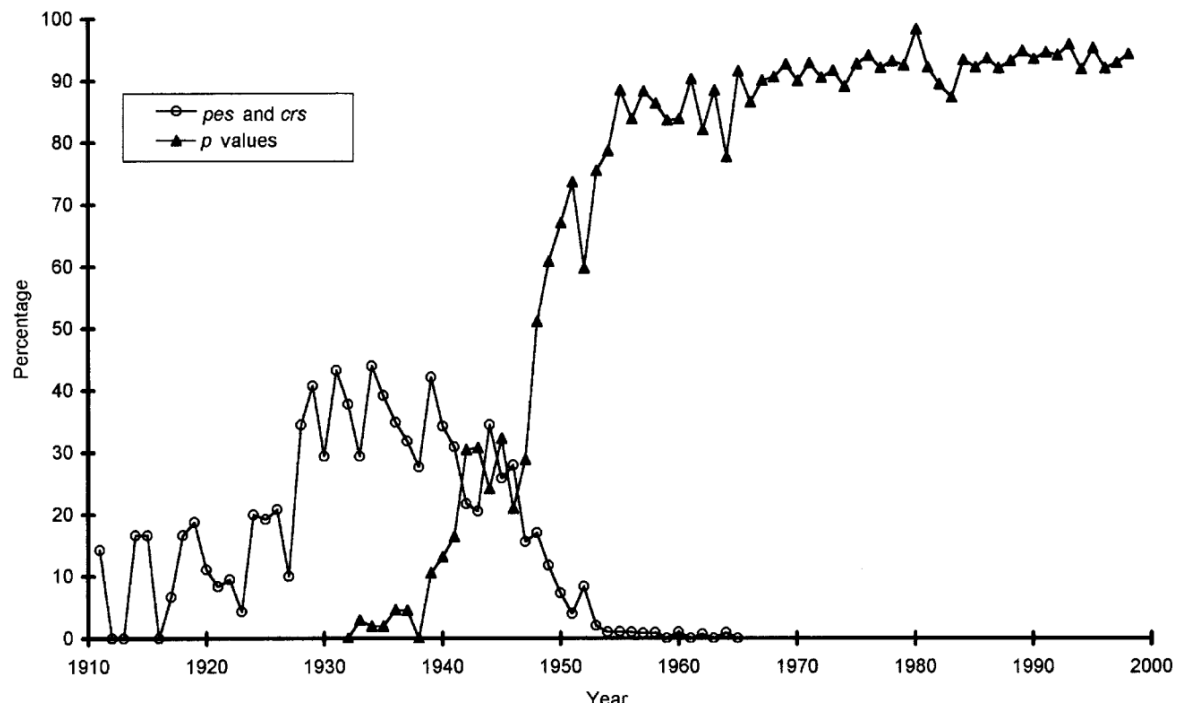
## Chapter 1: Introduction

Null hypothesis significance testing (NHST) is the statistical method most commonly used in psychology today. Even with a fair share of criticisms levelled at it (e.g., Albers, 2019; Bakan, 1966; Berkson, 1942; Gigerenzer & Marewski, 2015; Green, 2021; Lakens et al., 2018; Lykken, 1991; Meehl, 1978; Nelder, 1999; Rosnow & Rosenthal, 1989; Rozeboom, 1960; Tukey, 1991; for review, see Hubbard, 2016), NHST remains the method which psychologists default to using in their own work, which journals encourage if not outright require, and which most classes and textbooks teach with little scrutiny. So enshrined is this procedure in the psychological discipline that some have compared it to a ritualistic behaviour or a form of “sorcery” (Gigerenzer, 2004; Lambdin, 2012).

This was not always the case. Hubbard & Ryan (2000) looked at a selection of articles from 12 American Psychology Association journals every year from 1894-1998, and found that a majority of published empirical quantitative research did not test for statistical significance until 1940. Even then, the method that was used to test for statistical significance varied, with probable error and critical ratio reaching similar levels of frequency to NHST. It wasn't until the 1950s that *p*-values, a hallmark of modern NHST methods, reached 50% usage. In later decades, the rate was above 90% (Fig. 1; Hubbard & Ryan, 2000).

**Figure 1**

*The Usage Rate of p-Values in Psychology Journals, 1911-98*



Note: The papers are taken from a sample of 12 *American Psychology Association* journals yearly from 1911-98. Probable error and critical ratio usage is also measured on the graph. Nonempirical papers are not included (Hubbard & Ryan, 2000).

Students of psychology are routinely taught NHST as a “given truth”, rather than just one of a multitude of ways to make statistical inferences, with arbitrary components of the method such as the use of 0.05 as *alpha* (the cutoff point at which a *p*-value indicates statistical significance) treated as if they were set in stone (Little, 2003). These myths are perpetuated by textbooks and instructors, and thus are allowed to continue circulating, unchallenged (Gigerenzer, 2004). How and why this cycle of learning and teaching came to be is not entirely clear, requiring a multifaceted analysis of psychology as a discipline and of postsecondary institutions.

## The History of Null Hypothesis Significance Testing

In the late 19th century, psychologists were eager for their field to be treated like a useful contributor to science, rather than as a branch of philosophy. Additionally, they wished to distance themselves from the “pseudo-scientific” spiritualist practices popular at the time (Hornstein, 1988). Even though statistical methods had not fully taken hold in the “physical sciences”, such as biology, chemistry, and physics, some felt that their incorporation into psychology was the best way to ensure that the scientific nature of their area of study not be questioned. The pioneering psychologist James McKeen Cattell wrote in 1890 that “[p]sychology cannot attain the certainty and exactness of the physical sciences unless it rests on a foundation of experiment and measurement” (quoted in Camic & Xie, 1994, p. 786).

However, NHST had not been developed at the time, and as statistical practices began to take hold in psychology, no one method reigned supreme. Aggregated data were often presented in full, accompanied by descriptive statistics. There was no one way to analyze or draw conclusions from data. In cases where it was thought necessary to determine a difference from standard sampling error, probable errors or critical ratios could be used. Crucially, there was no formalized definition of statistical significance as there is today (Gigerenzer & Murray, 1987). When reviewing other psychologists’ work, statistics was rarely a key component of evaluation. Rather, work was judged using more abstract and subjective criteria such as “plausibility” (Hornstein, 1988).

Null hypothesis significance testing is primarily the work of Sir Ronald Aylmer Fisher, the preeminent statistician of the 20th century. Fisher’s techniques, sometimes collectively

referred to as the “new” statistics at the time,<sup>1</sup> centred around the assessment of statistical significance. NHST, which can be taken as a collective name for a variety of related methods including analysis of variance, became the most popular method of testing significance (Acree, 2021).

Beginning in the 1940s, psychologists began to recognize the applicability of Fisher’s statistical tools and started using them for themselves. Later, the work of statisticians Jerzy Neyman and Egon Pearson became known to psychologists, particularly the type I and II error. Though the two conceptions of statistical inference were fundamentally at odds with one another, as were the statisticians themselves, a form of NHST was devised that combined the two into a “hybrid” of which neither Fisher nor Neyman and Pearson would have likely approved.<sup>2</sup> Gigerenzer & Murray (1987) refer to the period from 1940-55, when this hybrid method reached its dominance, as the “inference revolution” in psychology. In modern teaching of NHST, the existence of Fisher, Neyman, and Pearson are rarely mentioned, let alone that there was any dispute among them (Gigerenzer, 2004).

Textbooks are a source of confusion for students regarding the nature of NHST (Gigerenzer, 1993). From the beginning of the inference revolution, some of the most used statistics textbooks by psychology instructors (Rucci & Tweney, 1980) such as E.F. Lindquist’s *Statistical analysis in educational research* (1940), Helen M. Walker’s *Elementary statistical methods* (1943), and Quinn McNemar’s *Psychological statistics* (1949), presented a hybrid model of significance testing similar or identical to the one used today, receiving little pushback

---

<sup>1</sup> Fisher published in a variety of fields and topics, and some of his ideas such as fiducial probability did not have nearly the same impact as statistical significance (Acree, 2021). When statistical methods are described as “Fisherian” or as being part of the “new” statistics, chances are that statistical significance is being invoked.

<sup>2</sup> This hybrid form has also been referred to as the “Intro Stats’ method” (Dixon & O’Reilly, 1999).

in the process (for a rare example, see Festinger, 1950). More recent textbooks used for the same purpose often contain misconceptions related to NHST, such as a misinterpretation of the meaning of  $p$ -values (Cassidy et al., 2019) that Fisher himself saw fit to call out over a half century ago (Hubbard, 2016).

Some textbook authors may have a more nuanced, in depth understanding of NHST, and only include an oversimplified explanation at the request of their publishers (Gigerenzer, 2004). However, it may be the case that the authors' own confusion is the source of these errors. Survey results indicate that many instructors themselves hold misconceptions regarding NHST (Gigerenzer, 2018), suggesting that when textbooks containing errors are used in instruction, these errors are typically left unchallenged by instructors.

Faulty textbooks and instructor misconceptions can help explain how the hybrid model of NHST was spread and continues to be spread. Yet, this leaves unanswered the question of how and why this model originated in Canadian psychology. For a more in depth understanding, a clear picture of Canadian psychological education, and Canadian postsecondary education in general, is needed.

### **Canadian Postsecondary Education**

Canadian postsecondary education can be traced back to 1635, over two centuries before the establishment of Canada as an independent nation. Postsecondary education slowly but steadily grew until the early 20th century, by which point a university had been established in each of Canada's newly added Western provinces, and the right to university education had been extended to women. However, universities were poorly attended and received little funding, causing them to grow at a much slower rate than their United States counterparts. It was not

always clear whether post-secondary education in Canada had a future (Axelrod, 2006; Eastman et al., 2022; Harris, 1976).

World War I led to changes in the perception of Canadian universities. This was largely due to the role played by Canadian scientists in the war effort, particularly as weapons researchers and developers (Avery, 2012). Universities also contributed both space and student volunteers for the armed forces (Axelrod & Levi, 2012). Prior to the war, it was common for Canadian students with scientific inclinations to move to the United States for graduate school, but this became less frequent afterwards (Axelrod, 2006). The interwar years were relatively stagnant for these institutions, even with increases in enrolment and a greater proportion of woman students (Harris, 1976). However, all this was about to change, as World War II would prove a crucial turning point for Canada's universities.

World War II was sometimes referred to in Canada as the "scientist's war" (Damer & Rosengarten, 2009), and for good reason. Compared to World War I, the armed forces were more reliant on research during WWII. The National Research Council (NRC), an organization created in the wake of WWI to ensure that scientific resources were allocated properly in the event of future conflicts, gave out several research grants, including those for military deferments for graduate students whose work directly contributed to the war (Avery, 2012). As most work was conducted in government laboratories,<sup>3</sup> universities were left understaffed (Friedland, 2013).

The previously understaffed Canadian universities rapidly grew in the wake of WWII. Their contribution to the war effort had reaffirmed their importance, and the federal government

---

<sup>3</sup> One notable exception was Canada's contribution to nuclear weapons research, which was completed at Université de Montréal (Friedland, 2013).

began issuing unprecedented grants to postsecondary institutions as part of the “postwar Keynesian consensus” (Weaver, 2007, p. 6). Scientists were given greater freedom, due to both increased government spending and their profession being held in higher esteem. For scientists who returned to the academy from the military, greater travel opportunities existed, both nationally and internationally. The Defence Research Board (DRB) was created by the federal government for those who wished to remain involved with the military, though many accepted research positions with the United States Armed Forces (Axelrod & Levi, 2012).

The Veteran Rehabilitation Act (VRA), signed into law in 1944, provided resources for honourably discharged veterans to reintegrate back into society, including grants for postsecondary education. As 38% of Canadian men aged 18-45 served in WWII, the VRA led to massive increases in enrolment. A “spillover effect” occurred, with non-veterans enrolling in larger numbers as well. During the war, enrolment rates stayed steady at 40 to 50 thousand per year, whereas in 1948, this increased to more than 80 thousand (Lemieux & Card, 2001). Faculty members were in high demand, and some schools relied upon less qualified faculty members in these unprecedented circumstances. For instance, at Queen’s University, one year teaching contracts were given to students whose highest degrees were Master’s, or, in some cases, Bachelor’s degrees (Gibson, 1983).

In the late 1940s, as veterans began to graduate, Canadian universities were in financial need. Enrolment numbers were not decreasing, and without money from the VRA this would not be sustainable. Upon the recommendation of the Royal Commission on National Development in the Arts, Letters and Science, the Canadian government handed out grants intended for universities to do with them as they pleased. A motivation for these grants, as detailed in the

report, was the value of research for national security, as well as the potential for schools as recruiters for both the civil and military service (Lupien, 1992).

The composition and character of student bodies changed considerably in the years following WWII. Even with the influx of male veterans, the proportion of women enrolments continued to increase. Unlike the previous two decades, this change was noticeable in traditionally male-dominated areas, such as medicine and chemistry (Axelrod & Levi, 2012). It was also during this time that the Canadian government began providing grants for students from so-called “underdeveloped” nations, such as the recently independent nations of South Asia, to study at Canadian universities.<sup>4</sup> These grants received bipartisan support, but many became suspicious as student bodies became more diverse in their ethnic and national origins, even if these groups only represented a miniscule segment of student bodies (McCartney, 2016).

Canadian universities were not immune to the cultural and political changes which occurred in the aftermath of WWII. Student bodies became increasingly radical, antiauthority, and involved in the counterculture of their day (Damer & Rosengarten, 2009). It wasn't just students that were of concern, though. The worry that professors might be instilling left wing ideas in students was so strong that the Research Council of Alberta expanded significantly so that more of the province's research was done by civil servants unaffiliated with universities; if these researchers espoused unwanted political views, they could be fired without concerns that academic freedom was being violated (Macleod, 2008).

### **Academic Psychology in Canada**

---

<sup>4</sup> As the stated goal of this initiative was to have the foreign students return to their homelands and impart “Canadian” ways of knowledge, these grants have been criticized as being part of a neocolonial project (McCartney, 2016).

In the 19th century, many philosophers claimed that what they taught was psychology (Slater, 2005). As far back as 1866, a year prior to Confederation and thus the official beginning of Canada as a nation, William Lyall was given the title of Chair of Psychology and Metaphysics at Dalhousie College (Page, 1980). However, recognizably modern psychology didn't truly begin in Canada until the arrival of James Mark Baldwin at the University of Toronto Department of Philosophy in 1889. He developed a psychology course to be taught in the 1890-91 schoolyear, and established a psychology laboratory, the first of its kind in Canada.<sup>5</sup> Baldwin left for Princeton University in 1893, at which point psychology at the University of Toronto hit somewhat of a roadblock (Green, 2002, 2004).

Prior to the 1940s, Canadian psychology was largely of the applied variety, with little money allocated for so-called "basic" (i.e., experimental) research. Not only was there a need for psychologists to prove their usefulness, but social changes created supposed problems for them to solve, particularly following WWI. The growing "mental hygiene" movement created an area of study with which numerous psychologists found themselves involved. The Great Depression created even more of a need for applied work, such as the study of the effects of unemployment (M. J. Wright & Myers, 1982). To reflect the increasing prominence of the field, many departments of philosophy changed their name to include psychology as well, and a select few schools created separate departments of psychology (Harris, 1976).<sup>6</sup>

The Canadian Psychological Association (CPA) was formed in 1938 at a meeting of the American Association for the Advancement of Science. Almost immediately after, with the

---

<sup>5</sup> Baldwin claimed that this was the first psychology laboratory in the entire British Empire (Rodgers, 2013). However, James McKeen Cattell had set up an "unofficial" temporary laboratory at Cambridge University in 1887 (Sokal, 1972). Baldwin's Toronto laboratory was nonetheless the first permanent psychology laboratory in the British Empire (Green, 2002).

<sup>6</sup> In addition to McGill University and the University of Toronto, the much smaller Acadia University, located in Wolfville, Nova Scotia, had a department of psychology beginning in 1926 (M. J. Wright & Myers, 1982).

outbreak of WWII, association members were required to contribute to the war effort, particularly as part of the Test Construction Committee. A number of tests were made, most notably the Revised *M Test*, which was administered to over one million people (Conway, 2010).<sup>7</sup> Psychologists contributed their expertise in other capacities, such as influencing public opinion, improving morale among servicepeople, and training nursery school teachers in England (Conway, 2010).

As a consequence of the ongoing war, psychologists at Canadian universities were in short supply, not unlike their colleagues in the natural sciences. In 1943, Queen's University principal Robert Charles Wallace noted that "[a]t the beginning of the war, the contribution which [psychologists] could make was not appreciated by any of the services. Today no university in Canada can maintain its staff of psychologists. They are all on war work" (quoted in Gibson, 1983, p. 456). University of Toronto president Henry John Cody put it more bluntly: "our department of psychology is being shot to pieces" (quoted in Axelrod & Levi, 2012, p. 261).

A proposal to suspend social science and humanities programs due to their irrelevance to the war effort was put forth in 1942 by Wallace and McGill University president F. Cyril James, but was roundly rejected by other university administrators and the government (Waite, 1997). Even still, enrolment in arts programs such as psychology decreased during WWII, likely as a result of the government discouraging studies in fields with little to no perceived practical military value (Axelrod & Levi, 2012). Accordingly, nonmilitary psychology research of any type was near nonexistent (Ketchum, 1947). A few psychologists remained government

---

<sup>7</sup> According to McGill University's George Ferguson, the test was primarily the work of his colleague Nelson W. Morton (1992).

employees well after the war, such as Nelson W. Morton who worked for the DRB (Conway, 2010).

Post-WWII, Canadian departments of psychology faced a new problem in the form of increasing enrolment numbers. Over half of the veterans whose postsecondary educations were funded by the VRA were in arts and sciences (Axelrod & Levi, 2012). Even with most personnel returning, faculties needed to grow and expand drastically. Teaching became a major part of instructors' schedules, leaving them with less time for research. Eventually, university psychology did expand enough to accommodate these higher numbers. By 1960, there were over 100 psychology faculty in the nation's universities, compared to 22 in 1940. It was during this two decade period that many schools established separate departments of psychology (Harris, 1976).

A 1943 report estimated that following the war, 450 applied psychologists would be needed to assist WWII veterans. Some believed that this role could be fulfilled by graduates of basic psychology programs, who could gain applied experience postgraduation. Nonetheless, there was a push for expansion of applied research, as there was only one graduate psychology program that was specifically applied.<sup>8</sup> With many federal government departments requesting contributions from applied psychologists, the Associate Committee on Applied Psychology was founded in 1948 by the National Research Council. Great strides were also made in the matter of certification of professional psychologists, in addition to the development of a code of ethics for the profession (Conway, 2010).

---

<sup>8</sup> The program was the graduate-level Diploma in Child Studies, offered at the University of Toronto (Conway, 2010).

A 1948 report, by the CPA's Standing Committee on the Teaching of Psychology, on 15 psychology programs across Canada<sup>9</sup> indicated that, while general attitudes towards psychology and education were largely uniform, course content varied widely. Notably, seven of the reviewed programs offered some sort of statistics courses, though it was not made clear which schools did so (Liddy, 1948). While still representing a minority of schools, this indicated that the subject was becoming of interest to more Canadian psychologists. In his CPA presidential address the same year, Sperrin N.F. Chant (Chant, 1948) noted that the "statistical method of validation" was "extensively applied" (p. 101).

Canadian psychology remained applied for some time after the war, but by the 1950s the tide would begin to turn away from the applied and towards the experimental. Robert B. MacLeod, in his 1955 report to the Canadian Social Science Research Council, wrote disparagingly that Canadian psychology was "becoming a profession before we had become a science" (quoted in Williams, 1992, p. 708). This report caused some worry and led to the holding of a 1960 conference of academic psychologists by the CPA. The Opinicon Conference, as it came to be known due to its location near its namesake Ontario lake, concerned the state of psychological research and research training in Canada (Myers, 1982). Eventually, applied psychology would be largely pushed to the wayside, with even the Associate Committee on Applied Psychology rebranding itself the Associate Committee on Experimental Psychology (Conway, 2010).

---

<sup>9</sup> The schools were: (from west to east) University of British Columbia, University of Alberta, University of Saskatchewan, University of Manitoba, University of Western Ontario, McMaster University, University of Toronto, Queen's University, McGill University, Sir George Williams College, Bishop's University, University of New Brunswick, Mount Allison University, Acadia University, and Dalhousie University.

## Chapter 2: Review Background

University of Alberta, University of British Columbia, Dalhousie University, McGill University, Queen's University, and University of Toronto (See Table 1) were selected as the six schools for review. McGill and Toronto are top schools in Canada in all areas, including psychology (see below). The remaining four schools were chosen as representative of psychology outside of the "big two" in their respective regions: Dalhousie and Queen's in Eastern Canada, and Alberta and British Columbia in Western Canada. All four schools played an important role in academic psychology, though not to the same extent as McGill and Toronto. They were also ahead of most other Canadian schools in graduate studies: in the 1950s, there existed a "clear hierarchy" of graduate programs in Canada with McGill and Toronto at the top followed by British Columbia, Dalhousie, and Queen's (Levi, 2009, p. 6).

French language universities have played a major role in Canadian academic history, including in psychology (M. J. Wright & Myers, 1982). However, these schools have not been included in this review, for several reasons. Not only do Anglophone Canadians outnumber Francophones, but traditionally they have received education at higher rates (Wanner, 1999). Following WWII, there was less of an enrolment increase under the VRA at Francophone schools, because Francophones served in WWII at lower rates than Anglophones (Lemieux & Card, 2001). Attitudes towards education in Francophone Canada at the time were much more conservative and religiously oriented. Some of the largest Francophone schools were still religiously affiliated until the 1960s (Eastman et al., 2022). Because of their Roman Catholic orientation, psychology at these schools was taught as a component of philosophy and religious studies well into the 20th century (M. J. Wright & Myers, 1982). The nature of statistics

instruction in Canadian French language departments of psychology should be studied as a separate phenomenon elsewhere, but unfortunately is not within the scope of the present study.

The structure of degree programs in the 1940s and 1950s should be noted, as there are some differences from today. Nearly every school in Canada had a single faculty for Arts & Sciences, and the specific department to which a student belonged would determine whether a Bachelor of Arts or Bachelor of Sciences degree was received. Psychology was at the time considered an art rather than a science, and psychology students would usually receive a B.A., even in schools where psychology was in a separate department from philosophy. English language schools tended to have a rigidly structured B.A. course regardless of major, with an array of subjects including English, philosophy, mathematics, and foreign languages. Many schools, particularly the larger ones, offered honours courses for more ambitious students. Master of Arts programs favoured students with honours degrees, sometimes outright excluding applicants with only a general degree. A non-honours B.A. typically took three years, whereas an honours B.A. required either three or four, depending on the school. M.A. programs often lasted only one year (Harris, 1976).

### **Dalhousie University**

Located in Halifax, Nova Scotia, Dalhousie University can lay claim to being the oldest degree-granting institution in what is today Canada (Eastman et al., 2022). It was formed by the joining of University of King's College and Dalhousie College, the latter of which was founded with the name College of Halifax. However, this combination did not occur until 1923. Though College of Halifax was founded as Methodist, Dalhousie University was a nonsectarian institution (M. J. Wright & Myers, 1982).

Compared to other universities of its size and stature, the state of psychology at Dalhousie was often smaller and less organized (Page & Clark, 1982). No doubt standing in the way of this was Carleton Stanley, who served as president from 1931-45. He was a firm believer in the value of more classical subjects, such as Greek, Hebrew, and mathematics, writing in 1931 that “[f]illing up our schools and colleges with alleged economics, alleged psychology, [and] alleged sociology in place of these fundamental studies” would lead to “barbarism” (quoted in Waite, 1997, p. 59). Unsurprisingly, it was 1948, three years after Stanley’s departure, that the Department of Psychology gained its independence from philosophy, at which point a Master of Arts program was also introduced (Page & Clark, 1982).

Dalhousie University was strongly affected by WWII even compared to other universities, given Halifax’s importance as an Atlantic port. Not only were there great financial losses, but, according to Stanley, the university lost more students than any other in the nation (Waite, 1997). Interestingly, Dalhousie continued to suffer disproportionately following the war. Federal grants for universities were given to provincial governments, with the amount proportional to the province’s overall population rather than student population, thus creating provincial inequalities favouring provinces with fewer students per capita (Weaver, 2007). In the 1950s, Nova Scotia had the most students per capita of any province, thus limiting the growth of its universities (Waite, 1997).

### **McGill University**

McGill University was founded in 1821, in Montréal, Québec, albeit initially only for medical students (M. J. Wright & Myers, 1982).<sup>10</sup> Despite being secular since inception, Anglicanism and Presbyterianism had strong presences until 1852, when a new charter was

---

<sup>10</sup> For more on the influence of medicine on McGill psychology, see Oosenbrug (2020).

written (Eastman et al., 2022). It has since grown into one of North America's largest and most prestigious postsecondary schools. In 1922, a faculty of graduate studies was formed, making it one of Canada's premier schools for postgraduate work along with the University of Toronto (Frost, 1980).

In 1910, McGill's first psychology laboratory was founded by William Dunlop Tait, who had arrived a year prior. In 1924, McGill University became the first Canadian university with a department of psychology, at the insistence of Tait (Bazar & Green, 2022). Tait was an applied psychologist with "little concern for psychology as a scientific discipline" and wanted to run an applied department (Ferguson, 1982, p. 46). Despite its head start, the department made little progress initially, due in part to Tait's repeated arguments with university administrators and colleagues (Bazar & Green, 2022).

Tait passed away in 1944 and the department of psychology was able to grow and adapt (Bazar & Green, 2022). Experimental psychology became more of a priority, and in 1953 the "semi-autonomous" Applied Psychology Centre was created to allow the remainder of the department to focus only on their experimental work (Oosenbrug, 2020). Though McGill did not receive as much federal aid as Anglophone schools in other provinces due to discouragement by the provincial government, it compensated for this with private funding (Frost, 1980), as well as grants from specific government institutions. In 1954-55 alone, it received over \$1 million CAD<sup>11</sup> from the NRC and DRB (Lupien, 1992).

### **Queen's University**

Founded by Presbyterians and modeled after Scottish universities, Queen's University opened its doors in 1841 in Kingston, Ontario, under the name Queen's College. Initially marred

---

<sup>11</sup> Equivalent to \$11.4 million CAD in 2024, adjusting for inflation (*Inflation Calculator*, 2024)

by financial troubles, the school eventually grew into one of the country's largest and most prestigious institutions, attracting students from across the nation. In 1912, it shed its religious affiliation and changed its name to Queen's University (Gibson, 1983; Neatby, 1976).

George Humphrey, whose tenure as a Queen's University professor lasted from 1924-47, greatly advanced and modernized the school's psychology instruction. A "psychologist in philosopher's clothing", Humphrey introduced a number of new psychology courses to the Department of Philosophy, helping psychology become a scientific rather than applied field (Inglis, 1982, p. 104). Queen's may have produced more psychologists in the 1920s and 1930s if not for its enrolment numbers; unlike other schools during this time, enrolment did not increase significantly (Harris, 1976). This was due to both a financial crisis that occurred at the school and the attitude of Robert Charles Wallace, Queen's principal from 1936-51, who wished to keep the student population small (Gibson, 1983). In 1948-49, the Department of Philosophy: Mental and Moral was renamed the Department of Philosophy and Psychology, and the following year saw philosophy and psychology split into their own separate departments (Inglis, 1982).

### **University of Toronto**

The University of Toronto was founded under the name King's College at York in 1827 as an Anglican institution. In 1850, it was renamed the University of Toronto, and became a nondenominational institution, suitable for its intended purpose of Ontario's flagship provincial university (M. J. Wright & Myers, 1982).

Arguably, modern Canadian psychology began at the University of Toronto, with the arrival of James Mark Baldwin in 1889 and his creation of Canada's first psychology laboratory (see Academic Psychology in Canada). However, Baldwin's departure in 1893 left psychology with few advocates at the school (Green, 2002, 2004). It was not until 1927 that a department of

psychology would be formed, with the applied psychologist Edward Alexander Bott as the head, a position he would hold until his retirement in 1956, save for a stint in Britain during the Second World War. Under Bott, the type of psychology practiced at the University of Toronto had an applied character, though not everyone in the department agreed with Bott's orientation. By the 1950s, some attempts were made to bring experimental psychology to Toronto (Myers, 1982; Slater, 2005).

Historically, McGill University and the University of Toronto have played an outsized role in Canadian research, including but not limited to psychology. In his 1952 presidential address to the CPA, Nelson W. Morton (1952) stated "I suspect that on the whole there was very little [psychological research in Canada prior to WWII], and that it was concentrated mostly in two or three universities" (p. 104). It is reasonable to assume that McGill and Toronto were the universities being referred to. They were also internationally the best known, if not the only known, Canadian schools for research around this time (Eastman et al., 2022).

### **University of Alberta**

In 1906, only three years after its official inception as a province of Canada, Alberta enacted legislation for the creation of a provincial university. The eponymous school was created in 1908 in the province's capital of Edmonton. It was secular from its inception and committed to ensuring that women were given equal opportunities to men; its first ever graduate was a woman. Unlike other schools, the University of Alberta's financial troubles began in the early 1920s and lasted throughout the Great Depression, likely preventing even further growth (Macleod, 2008).

Psychology at the University of Alberta began very shortly after the school's inception, with the arrival of John M. MacEachran<sup>12</sup> in 1909, who taught psychology courses in every year he was there. When the Department of Philosophy, Psychology, and Education was founded in 1933, making University of Alberta was the first Western Canadian university to have a department with "psychology" in its name, MacEachran was made its inaugural head. He retained that position until 1945, by which point the department had been renamed the Department of Philosophy and Psychology. Psychology continued to thrive in the department, as MacEachran's successor John Macdonald, who held the position from 1945-52, also had some background in psychology. It was probably because of this that the University of Alberta did not gain its own separate department of psychology until 1960, later than the other three "provincial" universities in Western Canada (M. J. Wright & Myers, 1982).

### **University of British Columbia**

The University of British Columbia was founded in the province's largest city of Vancouver in 1915, seven years after university legislation was enacted. Prior to this, McGill University operated a degree-granting college in British Columbia, but the province had no such institutions of its own. The early years of the school were tumultuous, due to the ongoing First World War and an unsympathetic provincial government, though it remains British Columbia's premier university (Damer & Rosengarten, 2009).

The Department of Philosophy and Psychology was established at the University of British Columbia in 1936, though a psychology course was offered as early as 1915. The first psychologist to head the Department of Philosophy and Psychology was Sperrin N.F. Chant, who

---

<sup>12</sup> MacEachran is perhaps best remembered for his involvement in the eugenics movement. According to Thomas M. Nelson, this was not true of the rest of the department (1982).

aimed to strengthen the psychology aspect of the department by hiring more psychologists during his tenure from 1945-58. When the Department of Psychology was founded, Chant was made the inaugural head, and held this position for eight years, until 1964. Under Chant, psychology at British Columbia had no specific psychological orientation and instructors were free to instruct in their own preferred style. However, one pattern among instructors did emerge: many completed their graduate work at the University of Toronto, a school that was not as lenient in terms of its orientation towards psychology (MacKay, 1982; M. J. Wright & Myers, 1982).

**Table 1**

*Psychology Departments and Heads, 1940-55*

University	Department	Department Head(s)
Alberta	Department of Philosophy and Psychology	John M. MacEachran, 1933-45; John Macdonald, 1945-52; Douglas E. Smith, 1952-57 (Nelson, 1982)
British Columbia	Department of Philosophy and Psychology	J.A. Irving, 1940-45; Sperrin N.F. Chant, 1945-58
Dalhousie	Department of Philosophy (prior to 1948) Department of Psychology (1948 onwards)	H.L. Stewart, 1913-48; F. Hilton Page, 1948-62
McGill	Department of Psychology	William Dunlop Tait, 1924-44; Chester E. Kellogg, 1944-46 (acting); Robert B. MacLeod, 1946-48; Donald Olding Hebb, 1948-58
Queen's	Department of Philosophy (prior to 1948) Department of Philosophy & Psychology (1948-49) Department of Psychology (1949 onwards)	George Humphrey, 1925-47, Br. Roger Philip, 1947-49, Julian M. Blackburn, 1949-64
Toronto	Department of Psychology	E.A. Bott, 1927-56 (Karl Bernhardt served as acting head during WWII)

**Review Methods**

With the aforementioned context in mind, I reviewed course catalogues from the six Canadian universities in question during the “inference revolution” of 1940-55, with a focus on statistics instruction, or lack thereof, for psychology students. In total, 91 catalogues were reviewed: 11 from Dalhousie University, ranging from the 1940-41 to 1951-52 schoolyears, as later years were not accessible; and 16 from the other five schools, ranging from the 1940-41 to 1955-56 schoolyears. The catalogues were reviewed for references to what statistics courses were offered to, or required by, psychology students at the time, to paint a picture of the state of statistics instruction at those specific institutions. Specific attention was paid to the instructor(s), textbook(s) used (See Table 2), and course description(s), when provided. More information was sought out regarding listed instructors and textbooks, so as to further elucidate what sort of material was being taught in these classes.

## Chapter 3: Findings

### Dalhousie University

Only 11 Dalhousie course catalogues were reviewed, ranging from the 1940-41 to 1951-52 schoolyears, as those from 1952-53 to 1955-56 were not accessible. For most of the time period reviewed, there were only six psychology courses offered, and none of them related to statistics. Students who wished to educate themselves on statistics lacked good opportunities outside of the department, as in many years the only explicitly statistics focused course was in the Department of Commerce, outside of the Faculty of Arts & Sciences. Interestingly, a course in the Department of Education that was offered most years, “Experimental Education”, contained a reference to statistics in its description long before any psychology courses did. Because no further details were provided and no textbooks were listed, however, the nature of the statistics included in the course is unknown and may have varied from year to year.

In 1949-50, the first full year with a separate Department of Psychology, two new psychology courses were offered, one of whose descriptions (“Psychometrics”) mentioned statistics. Expansion of the department continued the following year, with three new faculty members listed. One such member, Frances Marshall (née Botkin), taught “Psychometrics”, which again was the only course in the department with any statistical content. It is unknown what, if any, interest Marshall had in statistics; her doctoral thesis contained little statistical analysis, using primarily arithmetic means and medians (Botkin, 1927), and her only known published work after receiving a Ph.D. pertains to educational testing of children with no statistical analysis (Curti et al., 1935).

Of the three textbooks used in “Psychometrics” in 1950-51, the only one with any statistical relevance was *Theory and practice of psychological testing* by Frank S. Freeman

(1950). Freeman (1898-1986) had a background in education and spent most of his career in the Department of Psychology at Cornell University, with an interest in individual testing and assessment (Ryan, 1988). Not uncommon for textbooks written by those with no statistical background, Freeman's (1950) presents a semi-hybridized model of NHST. The null hypothesis is defined as that which "assumes no difference" (p. 61), i.e., the *nil hypothesis*, something not present in Fisher's original conception of hypothesis testing (Gigerenzer, 2004). Freeman (1950) also alleges that one can "prove the existence of a difference by disproving the null hypothesis" (p. 62), even though it is not possible to disprove a null hypothesis (Gigerenzer, 2004).<sup>13</sup> This, unfortunately, is typical of the textbooks of this era, as evidenced by the other textbooks included in this review. It is unknown if this textbook or a similar one was used in later years, as catalogues for the schoolyears from 1951-52 to 1955-56 were unavailable.

### **McGill University**

At the start of the 1940s, undergraduate psychology students at McGill University had the option to learn about statistics but were not required to. Initially, this was through the course "Experimental Psychology", taught by Nelson W. Morton and William D. Tait. Another course, "Psychometrics", which contained some statistical content, was added in 1941-42. Taught by Chester E. Kellogg, it was not a requirement for honours students but was a prerequisite for a Ph.D. The textbook used in "Psychometrics" for its first two years of existence was *Statistical procedures and their mathematical bases* by C.C. Peters & Walter R. Van Voorhis (1940). Unusual for textbooks of its time, it contained some reference to NHST but was quite critical of it, arguing that it was inappropriate for "constructive research" (p. 179).

---

<sup>13</sup> This fallacious belief has been called the "illusion of certainty" (Gigerenzer, 2004).

The schoolyear 1943-44 was likely the first where NHST was taught to psychology students at McGill, making it the first school reviewed and perhaps the first in all of Canada to do so. That schoolyear, the course “Elementary Statistical Methods” was introduced, taught by Kellogg, with “Experimental Psychology” ceasing to teach statistics. The two textbooks used in “Elementary Statistical Methods”, J.P. Guilford’s *Fundamental statistics in psychology and education* (1942) and Helen M. Walker’s *Elementary statistical methods* (1943), were both early examples of textbooks outlining NHST.

Both Guilford and Walker were preeminent and influential figures in psychology whose textbooks were widely cited (Gigerenzer, 2004; Rucci & Tweney, 1980). Guilford was an educational researcher who served as president of the American Psychological Association, leading to his textbooks being used in psychology departments frequently (Comrey, 1993). Walker had interests both in education and statistics, serving as both president of the American Statistical Association and the American Educational Research Association (Stinnett, 1990), but her textbook was meant for students of education and psychology (Blommers, 1944). Both textbooks presented a hybridized version of NHST similar, if not outright identical, to the version used today, no doubt contributing to its frequent usage (Guilford, 1942; Walker, 1943).

It was also 1943-44 during which the textbook used in “Psychometrics”, still taught by Kellogg, was replaced with *Applied General Statistics* by F.E. Croxton and D.J. Cowden. Despite both authors being professors of statistics and not of psychology, the book has some resemblance to the textbooks written by psychologists of the period in its portrayal of NHST. The null hypothesis is presented as something to be accepted or rejected, even if a fixed level of significance is discouraged (Croxton & Cowden, 1939).

From 1944-45 to 1946-47, courses shuffled around, though there was always at least one course using either the Walker or Guilford textbook. 1947-48 marked a new era for statistics at the McGill Department of Psychology, likely due to the arrival of George A. Ferguson (Ferguson, 1982). Ferguson had made significant contributions to testing during WWII, and continued this work after his arrival at McGill (Conway, 2010). However, statistics was clearly an interest of his, as he went on to author the widely cited textbook *Statistical analysis in psychology and education* (Ferguson, 1959).

Ferguson's arrival coincided with the introduction of the course "Psychological Statistics", which was required for honours psychology students in both the B.A. and B.Sc. streams. The following year, the description of the course was updated to reference "tests of significance". This course would remain in all years reviewed, though it is unclear what, if any, textbooks were used by students of *Psychological Statistics*. However, it is clear that NHST was included as part of the course: from 1948-49 onwards, "tests of significance" was one of the techniques mentioned in the course description.

At least three faculty were enlisted as "Psychological Statistics" instructors: Ferguson, Charles F. Wrigley, and William N. McBain. Ferguson was an appropriate instructor for the course, as was Wrigley, who was published repeatedly in the *British Journal of Statistical Psychology* (Wrigley, 1952, 1957, 1959). He was only present at McGill from 1949-52 and only held the position of Assistant Professor, suggesting that his impact on the department was minimal. McBain, conversely, who taught the course in 1954-55 and 1955-56, was a member of the Applied Psychology Centre from its founding in 1953 (Oosenbrug, 2020). If "Psychological Statistics" was indeed the flagship statistics course for undergraduate students, then the decision to give the course to McBain suggests that statistics was not a major priority for the department.

The graduate psychology program at McGill put a heavy emphasis on statistics throughout the reviewed period. In nearly every year, an advanced statistics course was offered to master's students and would sometimes be mandatory. In 1943-44, the description of the advanced course referenced "analysis of variance", a technique associated with NHST, meaning that graduate students may have first been exposed to NHST the same year as undergraduate students.

Students wishing to enter the Ph.D. program were expected to have some degree of statistical knowledge in every year reviewed. Initially, there was no standardized way of assessing this, only a disclaimer that "[a]ll students are required to have a knowledge of Advanced Statistical methods". Later, this changed to a preliminary examination with a statistics component, though in some years the component was elective and statistical knowledge was primarily assessed with certain prerequisite courses.

### **Queen's University**

Statistics education was rather scant at the Queen's University Mental & Moral Philosophy program (as it was known at the time) during WWII. The course "Experimental Psychology" seemingly had some statistical content based on its course descriptions. According to Inglis (1982), the course was added due to the 1939 arrival of Donald Olding Hebb, who served as its instructor every year until his departure in 1943. In 1943-44, a replacement was found in J.H. Houck, who had only just attained his M.A. (Inglis, 1982). Considering there were no other courses with any references to statistics or any external statistics requirements, it is fair to assume that "Experimental Psychology" continued to provide statistics education for psychology students up until 1944-45.

It was that year which saw the arrival of Bruce M. Springbett, who began teaching “Experimental Psychology”, at which point its description radically changed. Not only were there no longer any references to statistics, but a note was added stating that “[t]he principles of military personnel selection will be discussed”, indicating the priorities of the time. While this note was removed in later years, the course nonetheless remained mostly the same, with statistics having been thoroughly erased from its curriculum. To make up for this change in “Experimental Psychology”, it was recommended starting in 1944-45 that undergraduate honours psychology students take a statistics course from another department, with the note some years that students who plan to go on to graduate school may wait until then to fulfill this requirement.

Outsourcing the role of statistics instruction to other departments appears to have been responsible for introducing Queen’s students to NHST. While it is theoretically possible that the statistics component of “Experimental Psychology” included NHST, there is no evidence that it did, and this would appear unlikely based on what was taught at other schools around this time. Starting in 1944-45, students of psychology had the option of taking one of two courses to fulfill their statistics requirement: “Introduction to Statistics” or “Mathematical Statistics”.<sup>14</sup> Both lacked descriptions but used the same textbooks throughout the 1940s. In the case of the former, it was Croxton & Cowden’s *Applied general statistics* (see McGill University section; 1939), whereas the latter used *An introduction to statistical analysis* by mathematician C.H. Richardson (1944). The text by Richardson, unlike Croxton & Cowden’s, does not discuss acceptance or rejection of the null hypothesis, meaning that the form of hypothesis testing presented is more in line with Fisher’s original conception rather than the hybridized form. However, Richardson not

---

<sup>14</sup> The two courses were offered by the Department of Political & Economic Science, and the Department of Mathematics, respectively.

only fallaciously equated the nil and null hypotheses but attributed this definition to Fisher himself (1944).

In 1951-52, the Department of Mathematics introduced “Applied Statistics”, a course which honours psychology students were now required to take, in lieu of “Introduction to Statistics” and “Mathematical Statistics”. The textbooks used in “Applied Statistics”, *Elements of statistics* by mathematician Elmer Mode (1951) and *Psychological statistics* by Quinn McNemar (1949, 1955),<sup>15</sup> both presented a much more recognizably modern and hybridized form of NHST, the latter even using the term *type I and II error*. The course was not explicitly a psychology course, and in fact was recommended to or required by students in other departments such as economics and geology. Thus, it is peculiar that it would use the McNemar textbook, as it was written for psychology students by a psychologist (Hastorf et al., 1988). Nonetheless, it indicates that psychologists had become somewhat of a reputable source on matters of statistics, for better or worse.

### **University of Toronto**

From the beginning of the reviewed period, the University of Toronto Department of Psychology offered a great deal of statistics instruction to honours undergraduate students. As department head E.A. Bott was primarily an applied psychologist for most of his tenure (Myers, 1982), the great variety of courses was likely a simple reflection of the size and stature of the

---

<sup>15</sup> One indication of the influence of McNemar’s texts on psychological statistics comes from one of many humorous songs written by University of Toronto psychologist John Davidson Ketchum, “The Uses of Statistics” (Myers, 1982). The song begins:  
*Statistics are a wonderful thing*  
*If you know how to use them*  
*No matter how weak your findings are*  
*The staff will think them up to par*  
*If you borrow enough from McNemar—*  
*They’ll never dare refuse them!* (Ketchum, 1965, p. 64)

department, and the fact that there was a separate psychology department at all. It should also be noted that typically, around half of the students in the University of Toronto Faculty of Arts and Science were honours students, compared to 5-20% at other schools (Harris, 1976).

In 1940-41 and 1941-42, there were no less than three statistics-related courses that were mandatory for honours psychology students, as well as an advanced graduate course. Starting in 1942-43, two of the three undergraduate courses and the graduate course were no longer offered. This coincides with the absence of Sperrin N.F. Chant from the university, who went on leave to contribute to the war effort, never to return to Toronto. Chant was known as the “statistician of the Department” (Myers, 1982, p. 86) in the 1930s, and taught at least one statistics course in 1940-41. It is quite likely that Chant was the instructor for the other two statistics courses which were no longer offered starting 1942-43.

From 1942-43 to 1945-46, the only statistics course offered by the Department of Psychology was “Statistical Exercises”. The course continued to be mandatory for honours students, though seeing as it was only an hour a week, it is unlikely to have been particularly in depth. No graduate courses in statistics were offered during this time either. 1946-47 was the only schoolyear throughout the entire decade during which no statistics courses were offered to psychologists at any level.

In the latter half of the 1940s, Bott’s orientation began to shift away from applied to experimental psychology, and he attempted to bring the entire department with him (Myers, 1982). This can be seen in the introduction of two new courses in the 1947-48 year: “Experimental and Applied Psychology” and “Experimental Psychology”, both of which had some statistical content. While the latter was a mandatory honours course, the former was a pass

course, i.e., not designed specifically for honours students. This marked the first time that the department provided non-honours students with any sort of statistics instruction.

Bott hired several new faculty with the goal of making the department more experimental, including Alfred Henry Shephard, who arrived in 1950 (Myers, 1982). Shephard, an experimentalist (M. W. Wright, 1982), wrote that upon his arrival in Toronto the department's approach to statistics was "medieval" (1972, quoted in Myers, 1982, p. 89). It seems that Shephard may have been the catalyst for an increase in statistics courses offered by the department. In 1950-51, the year of his arrival, and every subsequent year reviewed, there was a pass (i.e., non-honours) course with some statistical content, and at least one honours course specifically devoted to statistics, often more than one. Though instructors were not listed for these courses, it is possible that Shephard served as an instructor at some point, seeing as he was an instructor for a graduate statistics course (see below).

The first schoolyear where there was evidence of the teaching of NHST was 1952-53, specifically the level two honours course "Experimental Statistics". Though its course description made no specific references to NHST, the textbook used was *A first course in statistics* by E.F. Lindquist, one of the earliest books to reference testing a null hypothesis (1942; see also Huberty, 1993). In his outline of NHST, Lindquist suggests that a null is to be either accepted or rejected, though he encourages readers to go beyond the statistics and think critically about what may actually be causing a statistically significant difference (1942).

Following the departure of Chant in the 1942-43 schoolyear, the department offered no graduate courses in statistics until 1949-50 with the introduction of "Advanced Statistics". Though Shephard would go on to teach this course multiple times, he was not yet at University of Toronto in the first year it was offered. That year, the listed instructor was "Professor

Jackson”. As there were no department faculty listed with the surname Jackson, it is possible that Professor Jackson was a student who had not yet completed their doctoral work, or a member of a different faculty. In either case, it suggests that statistics was not a priority of the department.

### **University of Alberta**

Throughout the 1940s, statistics appeared to be an afterthought for psychology at the University of Alberta. Not only were there no psychology courses with any statistics listed, but there was no requirement or expectation that students would be taught the subject. Even in the latter part of the decade, where several new courses were added, statistics was not explicitly mentioned in any course descriptions. Like at Dalhousie University, the Department of Education was ahead of Philosophy & Psychology in this regard: statistics was a component of the Department of Education course “Educational Psychology”, which was offered every year that decade. However, as no further description was provided and no textbooks were listed, the nature of the statistics being taught in “Educational Psychology” remains unclear.

Several new psychology courses were introduced in the 1949-50 schoolyear. One new course that may have provided students with statistics education is “Elementary Psychometrics”, taught by Donald Spearman. Though no textbook was listed, and statistics was not mentioned in the course description, “Psychometrics” at Dalhousie University, introduced the same year, had a statistics component. Thus, it is within the realm of possibility that its University of Alberta counterpart had one as well, though it may be unlikely given that Spearman was a clinician (Nelson, 1982).

In 1952, experimental psychologist Douglas Elstow Smith was made the head of the department, and made several organizational changes (Nelson, 1982). In his first full schoolyear in this position, undergraduate psychology was split into two separate streams: Philosophy-

Psychology and Experimental Psychology, which were a B.A. and B.Sc. program respectively. The former stream, which changed its name to simply “Psychology” two years later, had no statistics requirements; whereas the latter encouraged students to take “Statistics”, a course in the Department of Mathematics.

In taking “Statistics”, Experimental Psychology students from 1952-53 onwards would have received exposure to NHST. The textbooks used in the course were Samuel S. Wilks’ *Elementary Statistical Analysis* (1948), and *Mathematics of statistics: Part one* by J.F. Kenney and E.S. Keeping (1954), both of which present a version of NHST. Wilks’ version is quite similar to the modern day hybrid model, positing that alpha is equal to the probability that the null hypothesis was rejected incorrectly (what would today be called a *type I error*; 1948). While the version laid out by Kenney and Keeping does not have quite as many features of the hybrid model, it still presents a version of NHST where the null is to be accepted or rejected (1954).

### **University of British Columbia**

A specialized statistics course, usually named “Statistics”, was offered to honours psychology students by the University of British Columbia every reviewed year except for 1951-52, during which it was “[p]robably not offered”. However, these courses were not mandatory until 1954-55. From 1940-41 to 1944-45, the course was taught by Frederick Thomas Tyler, a specialist in educational testing and measurement but with a particular focus on the use of statistics (e.g., Tyler, 1951, 1952, 1954). It is possible that his arrival at British Columbia in 1939 (MacKay, 1982) is what spurred the introduction of the statistics course, helping the school stay ahead of the curve in the area.

The first year in which NHST was taught in the statistics course may have been 1944-45, as the description that year was appended to include “the analysis of variance and covariance”, a

procedure associated with NHST. Prior to that, there were no such mentions in course descriptions, many of which were detailed in listing the statistical methods they were teaching. The course textbook that was listed before this time was Henry E. Garrett's<sup>16</sup> *Statistics in psychology and education* (1937), the most recent version of which lacked any reference to the new procedure.<sup>17</sup>

Sperrin N.F. Chant arrived at the University of British Columbia in 1945, and was immediately made head of the Department of Philosophy & Psychology (MacKay, 1982). Possessing an interest in statistics (see University of Toronto section), he taught "Statistics" beginning in 1947-48, though he may have been the instructor during the two previous schoolyears as well, as an instructor was not listed. Coincidentally, this was the year that the third edition of Garrett's *Statistics in psychology*, the textbook that was still used in the course, was published. This version was updated to include a fairly straightforward outline of NHST along the lines of Fisher (1947).

In 1947-48, the course "Experimental Psychology" updated its description to contain references to statistics. During this change, it was taught by Edwin W.S. Belyea, who had arrived in 1946 (MacKay, 1982). Though it did not specify what methods were being taught, the textbook that was used most years, *A simplified guide to statistics for psychology and education* by physician and marine biologist (Merriman, 1952) G. Milton Smith, contained an outline of

---

<sup>16</sup> Garrett is today best remembered for his support for the eugenics movement and his arguments in favour of racial segregation in the United States (Winston, 1998). It is unclear how much, if at all, his racial views were a factor in the selection of his textbook at the University of British Columbia.

<sup>17</sup> One reviewer criticized Garrett's neglect of these new methods: "Fisher's extremely useful concepts of 'randomization,' 'the null hypothesis,' and 'efficient statistics' find no mention, nor is the logical development of his methods for the analysis of variance attempted" (Melton, 1938, p. 102).

NHST that was along the lines of the hybridized approach (Smith, 1946).<sup>18</sup> “Experimental Psychology” was sometimes listed as mandatory for an honours degree.

Two figures may have been responsible for this advancement of statistics in the British Columbia curriculum. The first of these was Chant, as during his time at the University of Toronto in the 1930s, Chant was known as the “statistician of the Department” (Myers, 1982, p. 86). The second such figure was Belyea, who was primarily an industrial psychologist (MacKay, 1982). It is possible that Belyea was brought to British Columbia by Chant to help incorporate statistics into the “Experimental Psychology” course.

**Table 2**

*Statistics Textbooks Used in Psychology Instruction, 1940-55*

Author	Author Affiliation(s)	Title	Year of Publication	Known Uses	Mentions NHST?
Croxton, F.E. & D.J. Cowen	Columbia University & University of North Carolina	<i>Applied general statistics</i>	1939 (1st ed.)	McGill University: 1943-45 Queen’s University: 1944-50	Yes
Freeman, Frank S.	Cornell University	<i>Theory and practice of psychological testing</i>	1950 (1st ed.)	Dalhousie University: 1950-51	Yes
Garrett, Henry E.	Columbia University	<i>Statistics in psychology and education</i>	1937 (2nd ed.) 1947 (3rd ed.)	University of British Columbia: 1940-42, 1946-49, 1949-51 (as reference)	2nd ed.: No 3rd ed.: Yes

<sup>18</sup> Interestingly, Smith lists a “rough rule of thumb” that, when a  $p$ -value is between 0.01 and 0.05, the null hypothesis should not be accepted or rejected. It is unclear where this comes from, as this suggestion seemingly does not appear in any other textbook (1946, p. 60).

Guilford, J.P.	University of Southern California	<i>Fundamental statistics in psychology and education</i>	1942 (1st ed.) 1950 (2nd ed.)	McGill University: 1946-47 University of British Columbia: 1949-51 (as reference)	Yes
Kenney, John F. & E.S. Keeping	University of Wisconsin & University of Alberta	<i>Mathematics of statistics, part one</i>	1954 (3rd ed.)	University of Alberta: 1954-56	Yes
Lindquist, Everett F.	State University of Iowa	<i>A first course in statistics: Their use and interpretation in education and psychology</i>	1942 (Revised ed.)	University of Toronto: 1952-54 University of British Columbia: 1952-54	Yes
McNemar, Quinn	Stanford University	<i>Psychological statistics</i>	1955 (2nd ed.)	Queen's University: 1955-56	Yes
Mode, E.B.	Boston University	<i>Elements of statistics</i>	1951 (2nd ed.)	Queen's University: 1952-53, 1954-55	Yes
Peters, C.C. & W.R. Voorhis	Pennsylvania State College & Fenn College	<i>Statistical procedures and their mathematical bases</i>	1940 (1st ed.)	McGill University: 1941-43	Yes, critically
Richardson, C.H.	Bucknell University	<i>An introduction to statistical analysis</i>	1944 (Revised ed.)	Queen's University: 1944-50	Yes
Smith, G. Milton	College of the City of New York	<i>A simplified guide to statistics for psychology and education</i>	1946 (Revised and enlarged ed.)	University of British Columbia: 1949-52	Yes
Walker, Helen M.	Columbia University	<i>Elementary statistical methods</i>	1943 (1st ed.)	McGill University: 1943-46 University of British Columbia:	Yes

Wilks, S.S.	Princeton University	<i>Elementary statistical analysis</i>	1948 (1st ed.)	1949-51 (as reference) University of Alberta: 1952- 54	Yes
-------------	-------------------------	--	-------------------	--	-----

---

## Chapter 4: Discussion

### Summary

It is interesting to note that prior to the “inference revolution”, not all psychology programs in Canada provided any sort of statistics instruction. Of the six schools reviewed, only British Columbia, McGill, and Toronto did so from the onset on the 1940s, whereas Queen’s, Alberta, and Dalhousie did not. For McGill and Toronto, this is likely a consequence of their size allowing them to offer a greater variety of courses. Additionally, having separate departments of psychology may have allowed them greater freedom in subject matter. British Columbia was a smaller size and did not have a separate department of psychology, so it is not immediately clear why it was quicker to adopt statistics instruction than other schools of similar size. Frederick Thomas Tyler, who arrived in 1939 and taught statistics in the early 1940s, was no doubt involved but given that he was only an assistant professor (MacKay, 1982), it is unlikely that he had much of an influence. It may simply be a case of a university department aiming to distinguish itself somehow.

It is noteworthy that statistics was often initially taught as part of an experimental psychology course, before the introduction of a specialized statistics course. At Queen’s University, for instance, “Experimental Psychology” was the only psychology course with any statistical content from 1940-43; the first school year that psychology students were required to take a separate statistics course, 1943-44, “Experimental Psychology” was changed to no longer have any statistical content. On the other hand, continuing its reputation as a leader in statistics, University of British Columbia had a specialized statistics course from the onset of the 1940s, and continued to do so even after statistics became a component of “Experimental Psychology”. In some other cases, statistics was part of a psychometrics course, which is perhaps unsurprising

given that educational and mental testing was an entry point for statistics into psychology (see Historical Context).

All six schools, even those which did not have any statistics instruction at the beginning of the “inference revolution”, were teaching NHST to psychology students by the end of the so-called revolution. This appeared to happen in two “phases”, the first occurring at the tail end of World War II and the second at the beginning of the 1950s. British Columbia, McGill, and Queen’s fall into the former phase, as they all began to teach NHST between 1943-45; whereas Alberta, Dalhousie, and Toronto did not begin until 1950-52. Given the size, it is plausible that the University of Toronto began teaching NHST well before the 1950s, as they would have been far more likely than British Columbia and Queen’s to have a qualified teaching staff. This is further complicated by the fact that descriptions of courses at University of Toronto were often missing from course catalogues, or lacked detailed information as to what sort of statistics were taught.

This lack of information is indicative of a larger issue with the type of historical research conducted here. While they are the best indication of what specifically was and was not being taught during this time, course catalogues often contain large gaps in information. In addition to the Dalhousie catalogues that were not accessible, it was not uncommon for course listings to fail to provide a course description or to list the instructor and/or textbook(s). Even when descriptions were provided, it was not always possible to ascertain what components of statistics were being taught, as oftentimes there was only a passing mention of statistics at all. While this absence does indicate the low level of priority that may have been given to these courses at the time, it is nonetheless a limitation of this mode of research.

## **Historical Context**

The dates of the “inference revolution” are typically given as 1940-55. However, the effects of this revolution on Canadian classrooms were not felt until the mid to late 1940s. There are several reasons why this may have been the case. First, the new methods would have needed time to extend their reach to instruction. Teaching these methods requires not only that there are instructors both willing and qualified to take on the challenge, but that course materials exist as well. Though textbooks containing the “new” statistics were written as early as 1938 (Huberty, 1993), it would take years before there existed a substantial variety of reliable, positively reviewed textbooks on the subject from which to draw. Psychologists at the outset of the “revolution” may not have been confident that the new methods were relevant or necessary to teach, or at the very least that they would make such a powerful impact on the field. This is reflected in a 1941 review of two textbooks, where it was written that “[t]he fruitfulness or sterility of the applications of the ‘modern’ methods in educational research will, of course, provide the verdict on the opposing points of view set forth by these two books”, with the points of view being the “new” statistics versus “classical” methods (Hagood, 1941, p. 570).<sup>19</sup>

World War II played a role in this “delayed response” as well. Large portions of teaching staff were on military leave, including many qualified senior faculty who may have been among the best equipped to teach the “new” methods, such as Toronto’s Sperrin N.F. Chant. The faculty who remained may not have had the same teaching experience or qualifications, lacking the confidence to teach the new statistics. Even among those who may have been qualified as instructors, the context of the war meant that many aspects of the future were more uncertain

---

<sup>19</sup> The textbooks reviewed were *Statistical analysis in educational research* by E.F. Lindquist (1940), an early example of a textbook that taught Fisher’s “new” statistics; and *Statistical procedures and their mathematical bases* by Charles C. Peters and Walter R. Van Voorhis (1940), which primarily focused on “classical” methods.

than usual, and thus they may have wished for more stable circumstances before introducing something so new to their instruction.

One fact that is particularly of note is that at two of six schools reviewed, University of Alberta and Dalhousie University, statistics instruction was offered to students of education long before students of psychology. This is not entirely surprising, as educational researchers were among the first to embrace the “new” statistics (Martin, 2011). Many textbooks used to teach the new statistics were written by educational researchers. Of the authors whose textbooks were used in the reviewed classes, many had an educational background, including E.F. Lindquist, S.S. Wilks (a student of Lindquist; Martin, 2011), and Helen M. Walker (who served as president of the American Educational Research Association; Stinnett, 1990).

The vast majority of textbooks used by Canadian instructors at the time were from the United States. Additionally, many instructors of the subject were either originally from, or educated in, the US.<sup>20</sup> Very little, if any, direct influence came from the United Kingdom, a somewhat unexpected outcome given that R.A. Fisher, the man whose writings set off the new revolution, was from the UK and did most of his work there. His visits to Iowa State College proved monumental, however, as it was there that he encountered George Waddell Snedecor, who was crucial in introducing the “new” statistics to the US. His work on the subject became far more popular than Fisher’s, due to its greater readability (D. C. Howell, 2005; Lovie, 1979). Though Canada has always had a stronger UK influence than the US has, it appears that in the case of the new methods, the US was the intermediary between Canada and the UK.

---

<sup>20</sup> Examples include Dalhousie’s Frances Marshall, who completed her Ph.D. at the University of Chicago (Page & Clark, 1982); McGill’s Chester E. Kellogg, who completed his Ph.D. at Harvard University (Ferguson, 1982); and Toronto’s Alfred Henry Shephard, who was Canadian but completed his Ph.D. at the University of Iowa (Myers, 1982).

There is a multitude of reasons why the “new” statistics were so pervasive and so readily embraced. Though NHST has proven useful in experimental psychology, its initial popularity was in educational and mental testing: “correlational” psychology, in the parlance of Cronbach (Hornstein, 1988; Martin, 2011). In testing research, the new statistics allowed groups to be compared, such as different schools. As the primary unit of study in psychology shifted from individuals to groups of individuals, NHST found its home in educational testing (Martin, 2011). Having just come off of a war where tests were administered to over one million Canadians, psychologists no doubt had testing on the mind, at which point the new statistics began to make their way to other areas of psychology.

Statistics in psychology began as a way for the fledgling field to prove its connection to the natural sciences and differentiate itself from other “non-scientific” fields (Hornstein, 1988). The introduction of the new statistics may have had a similar motivation. Using a method that originated in agricultural research and was being used in other fields not only helped psychology present itself as a science but would have enabled communication between these fields. A commonly raised concern in metascience is that psychologists have *physics envy*: a desire to resemble more closely, and thus be treated like, the “canonical” sciences such as physics (J. L. Howell et al., 2014). A simultaneous agreement to use one particular method seems as good an example of physics envy as any.

A frequent criticism of more contemporary psychology is its privileging of methodological “purity” at the expense of other considerations (Chamberlain, 2000).<sup>21</sup> This may have very well been a reason why NHST attained its current status. By agreeing on a shared

---

<sup>21</sup> This tendency is sometimes called “methodolatry”, a combination of “method” and “idolatry” (Chamberlain, 2000).

method, psychologists no longer needed to critically evaluate each other's work. Rather, work was judged based on statistical soundness and methodological rigor. In a field that was growing, changing, and diversifying, thanks to psychologists' uptick in funding and newfound freedom of movement, having an efficient means of sorting "good" psychology from "bad" was crucial. Quantitative methods in general, and NHST in particular, take a good deal of conscious thought out of the equation (Hornstein, 1988). In the case of NHST, as practiced now, this is often reduced to a binary decision. In a review of 16 statistics textbooks intended for education students written between 1946-1960, Martin (2011) found that when Fisher's "new" statistical methods were brought up, authors highlighted their "economy and efficiency" (p. 205) rather than the specific problems that Fisher and colleagues were attempting to solve.

Of course, it wasn't just the field of psychology itself that was diversifying. Canadian society in general underwent a lot of changes in the postwar period. In his 1947 CPA presidential address, Karl Bernhardt listed ten "important research problems" for social scientists, including those "arising from the diversity of cultural groupings in Canada", "of immigration and the relocation of groups", and "arising from the changing functions of the family and the changing role of women in society" (Bernhardt, 1947, pp. 57, 58). These changes were reflected in classrooms as well, with numbers of international students increasing (McCartney, 2016) and a growing radical student movement (Damer & Rosengarten, 2009). For psychology to address these rapid and unpredictable changes, a means of faster and more effective knowledge production was required (Hornstein, 1988), and NHST could have provided just that.

Lastly, the Cold War may have been an important factor in the teaching and proliferation of the "new" statistics. A great deal of funding was offered for scientific research, and psychologists were eager to receive their share. Even with their contributions to military efforts,

psychology had experienced a decline in interest and perceived legitimacy during WWII, with some even proposing the suspension of academic psychology altogether. The “relevancy” of certain academic fields was a common concern, leading to the marginalization of some liberal arts (Damer & Rosengarten, 2009). This led to psychology and other social sciences doing their best to resemble the natural science, so as to appear more relevant. The DRB and NRC provided funding for psychological studies, the vast majority of which were experimental (Morton, 1952). An entirely new paradigm of “Cold War social sciences” emerged, with a key feature being empiricism and formal quantitative methods (Dawson et al., 2019). The ability to point to consistent, results-producing statistical procedures was undoubtedly a factor in this.

## **Conclusion**

The analysis of course catalogues from six different Canadian schools appears to provide support for Gigerenzer & Murray’s contention of the 1940-55 “inference revolution” in psychology. While the new statistics of the revolution did not appear to have taken off in Canadian schools from the beginning of the decade, the effects can be observed in Canadian course catalogues from 1943-55. This is likely due to a variety of factors, including the rapid expansion and diversification of the field of psychology, changes in societal trends, and the influence of the Cold War on social science.

There are several considerations that were outside the scope of the present analysis. While representative of Canada’s multiple geographic regions, the six schools chosen nonetheless were all larger, more established institutions. Future analyses should investigate smaller institutions, as well as the contingent of French language schools in Canada. Moreover, it would be useful to compare and contrast the results of this analysis with similar catalogues from

abroad, particularly the United States, as the nation that most strongly influenced the inference revolution in Canada.

## Bibliography

- Acree, M. C. (2021). *The myth of statistical inference*. Springer International Publishing.  
<https://doi.org/10.1007/978-3-030-73257-8>
- Albers, C. (2019). *A note on the alpha-level: Not all alphas can be justified*. PsyArXiv.  
<https://doi.org/10.31234/osf.io/erwvk>
- Avery, D. H. (2012). Canadian university scientists and military technology: The challenge of total war, 1939–1945. In E. L. Panayotidis & P. J. Stortz (Eds.), *Cultures, communities, and conflict: Histories of Canadian universities and war* (pp. 175–201). University of Toronto Press.
- Axelrod, P. (2006). The character of Canadian higher education: An historical perspective. In S. Y. Llomovatte & J. Naidorf (Eds.), *Perspectivas críticas desde el siglo XXI sobre la educación en Argentina y en Canadá: Estudios comparados y lecciones de las experiencias* (pp. 25–38). Centro de Estudios Argentino-Canadienses de Buenos Aires.
- Axelrod, P., & Levi, C. (2012). Universities, students, and the conduct of war in Canada and Britain: A comparative perspective. In E. L. Panayotidis & P. J. Stortz (Eds.), *Cultures, communities, and conflict: Histories of Canadian universities and war* (pp. 253–271). University of Toronto Press.
- Bakan, D. (1966). The test of significance in psychological research. *Psychological Bulletin*, 66(6), 423.
- Bazar, J. L., & Green, C. D. (2022). How Canada's first psychology department arose at McGill University. *Canadian Psychology / Psychologie Canadienne*, 63(1), 149–160.  
<https://doi.org/10.1037/cap0000238>

- Berkson, J. (1942). Tests of significance considered as evidence. *Journal of the American Statistical Association*, 37(219), 325–335.
- Bernhardt, K. S. (1947). Canadian psychology—Past, present and future. *Canadian Journal of Psychology / Revue Canadienne de Psychologie*, 1(2), 49–60.  
<https://doi.org/10.1037/h0084025>
- Blommers, P. (1944). [Review of *Elementary statistical methods*, by H. M. Walker]. *The Accounting Review*, 19(3), 343–344.
- Botkin, F. R. (1927). *The influence of vision on the acquisition of skill* [Ph.D., University of Chicago]. <https://catalog.lib.uchicago.edu/vufind/Record/12697420?sid=63337684#>
- Camic, C., & Xie, Y. (1994). The statistical turn in American social science: Columbia University, 1890 to 1915. *American Sociological Review*, 59(5), 773–805.  
<https://doi.org/10.2307/2096447>
- Cassidy, S. A., Dimova, R., Giguère, B., Spence, J. R., & Stanley, D. J. (2019). Failing grade: 89% of introduction-to-psychology textbooks that define or explain statistical significance do so incorrectly. *Advances in Methods and Practices in Psychological Science*, 2(3), 233–239. <https://doi.org/10.1177/2515245919858072>
- Chamberlain, K. (2000). Methodolatry and qualitative health research. *Journal of Health Psychology*, 5(3), 285–296. <https://doi.org/10.1177/135910530000500306>
- Chant, S. N. F. (1948). Some observations on the validation of psychological knowledge. *Canadian Journal of Psychology/Revue Canadienne de Psychologie*, 2(3), 97–103.  
<https://doi.org/10.1037/h0084056>
- Comrey, A. L. (1993). *Joy Paul Guilford (1897-1987)*. National Academy of Sciences.

- Conway, J. (2010). *A Chronicle of the Activities of the Canadian Psychological Association, 1938-2000*. Canadian Psychological Association.  
[https://cpa.ca/docs/File/A\\_Chronicle\\_of\\_the\\_Activities\\_of\\_CPA\\_1938\\_2000\\_Sept\\_13\\_10.pdf](https://cpa.ca/docs/File/A_Chronicle_of_the_Activities_of_CPA_1938_2000_Sept_13_10.pdf)
- Croxton, F. E., & Cowden, D. J. (1939). *Applied general statistics* (1st ed.). Prentice-Hall Incorporated. <https://archive.org/details/in.ernet.dli.2015.228775>
- Curti, M. W., Marshall, F. B., & Steggerda, M. (1935). The Gesell schedules applied to one-, two-, and three-year-old negro children of Jamaica, BWI. *Journal of Comparative Psychology*, 20(2), 125.
- Damer, E., & Rosengarten, H. (2009). *UBC: The first 100 years*. University of British Columbia.
- Dawson, M. R. W., Baerveldt, C., Shillabeer, E., & Richard, V. (2019). Theoretical psychology at the University of Alberta as social science during the Cold War. *History of Psychology*, 22(1), 87–106. <https://doi.org/10.1037/hop0000104>
- Dixon, P., & O'Reilly, T. (1999). Scientific versus statistical inference. *Canadian Journal of Experimental Psychology*, 53(2), 133–149.
- Eastman, J., Jones, G. A., Trottier, C., & Bégin-Caouette, O. (2022). *University governance in Canada: Navigating complexity*. McGill-Queen's University Press.  
<https://doi.org/10.2307/j.ctv307fhcx>
- Ferguson, G. A. (1959). *Statistical analysis in psychology and education* (pp. vii, 347). McGraw-Hill.
- Ferguson, G. A. (1982). Psychology at McGill. In M. J. Wright & C. R. Myers (Eds.), *History of academic psychology in Canada* (pp. 33–67). C.J. Hogrefe.

- Ferguson, G. A. (1992). Psychology in Canada: 1939-1945. *Canadian Psychology / Psychologie Canadienne*, 33(4), 697–705. <https://doi.org/10.1037/h0078747>
- Festinger, L. (1950). [Review of *Psychological statistics*, by Q. McNemar]. *Psychometrika*, 15(2), 209–214. <https://doi.org/10.1007/BF02289203>
- Freeman, F. S. (1950). *Theory and practice of psychological testing* (1st ed., pp. xxi, 518). Henry Holt and Co. <https://archive.org/details/theorypracticeof0000free>
- Friedland, M. L. (2013). *The University of Toronto: A history* (2nd ed.). University of Toronto Press.
- Frost, S. B. (1980). *McGill University: For the advancement of learning, Volume II, 1895-1971*. McGill-Queen's University Press.
- Garrett, H. E. (1937). *Statistics in psychology and education* (2nd ed.). Longmans, Green and Co.
- Garrett, H. E. (1947). *Statistics in psychology and education* (3rd ed.). Longmans, Green and Co. <https://archive.org/details/statisticsinpsyc0000henr>
- Gibson, F. W. (1983). *Queen's University. 2: 1917-1961: To serve and yet be free*. McGill-Queen's University Press.
- Gigerenzer, G. (1993). The superego, the ego, and the id in statistical reasoning. In G. Keren & C. Lewis (Eds.), *A handbook for data analysis in the behavioral sciences: Methodological issues* (pp. 311–339). Lawrence Erlbaum Associates, Inc.
- Gigerenzer, G. (2004). Mindless statistics. *The Journal of Socio-Economics*, 33(5), 587–606. <https://doi.org/10.1016/j.socec.2004.09.033>

- Gigerenzer, G. (2018). Statistical rituals: The replication delusion and how we got there. *Advances in Methods and Practices in Psychological Science*, 1(2), 198–218.  
<https://doi.org/10.1177/2515245918771329>
- Gigerenzer, G., & Marewski, J. N. (2015). Surrogate science: The idol of a universal method for scientific inference. *Journal of Management*, 41(2), 421–440.  
<https://doi.org/10.1177/0149206314547522>
- Gigerenzer, G., & Murray, D. J. (1987). *Cognition as intuitive statistics*. Psychology Press.  
<https://doi.org/10.4324/9781315668796>
- Green, C. D. (2002). Toronto's "other" original APA member: James Gibson Hume. *Canadian Psychology*, 43(1), 35–45.
- Green, C. D. (2004). The hiring of James Mark Baldwin and James Gibson Hume at the University of Toronto in 1889. *History of Psychology*, 7(2), 130–153.  
<https://doi.org/10.1037/1093-4510.7.2.130>
- Green, C. D. (2021). The tragedy of psychological theory. *Academia Letters*, 142.
- Guilford, J. P. (1942). *Fundamental statistics in psychology and education*. (1st ed.). McGraw-Hill. <https://archive.org/details/in.ernet.dli.2015.228996>
- Hagood, M. J. (1941). [Review of *Statistical analysis in educational research; Statistical procedures and their mathematical bases.*, by E. F. Lindquist, C. C. Peters, & W. R. Van Voorhis]. *Social Forces*, 19(4), 569–571. <https://doi.org/10.2307/2571223>
- Harris, R. S. (1976). *A history of higher education in Canada 1663-1960*. University of Toronto Press.
- Hastorf, A. H., Hilgard, E. R., & Sears, R. R. (1988). Quinn McNemar (1900–1986). *American Psychologist*, 43(3), 196–197. <https://doi.org/10.1037/h0091955>

- Hornstein, G. A. (1988). Quantifying psychological phenomena: Debates, dilemmas, and implications. In *The rise of experimentation in American psychology* (pp. 1–34). Yale University Press.
- Howell, D. C. (2005). Snedecor, George Waddell. In B. S. Everitt & D. C. Howell (Eds.), *Encyclopedia of statistics in behavioral science*. John Wiley & Sons, Ltd.  
<https://doi.org/10.1002/0470013192.bsa628>
- Howell, J. L., Collisson, B., & King, K. M. (2014). Physics envy: Psychologists' perceptions of psychology and agreement about core concepts. *Teaching of Psychology*, *41*(4), 330–334.  
<https://doi.org/10.1177/0098628314549705>
- Hubbard, R. (2016). *Corrupt research: The case for reconceptualizing empirical management and social science*. SAGE Publications, Inc. <https://doi.org/10.4135/9781506305332>
- Hubbard, R., & Ryan, P. (2000). The historical growth of statistical significance testing in psychology—And its future prospects. *Educational and Psychological Measurement*, *60*(5), 661–681. <https://doi.org/10.1177/0013164400605001>
- Huberty, C. J. (1993). Historical origins of statistical testing practices: The treatment of Fisher versus Neyman-Pearson Views in textbooks. *The Journal of Experimental Education*, *61*(4), 317–333.
- Inflation Calculator*. (2024). Bank of Canada.  
<https://www.bankofcanada.ca/rates/related/inflation-calculator/>
- Inglis, J. (1982). Psychology at Queen's. In M. J. Wright & C. R. Myers (Eds.), *History of academic psychology in Canada* (pp. 100–115). C.J. Hogrefe.
- Kenney, J. F., & Keeping, E. S. (1954). *Mathematics of statistics: Part one* (3rd ed.). D. Van Nostrand Company, Inc. <https://archive.org/details/in.ernet.dli.2015.239837>

- Ketchum, J. D. (1947). Psychology and the Canadian social science research council. *Canadian Journal of Psychology / Revue Canadienne de Psychologie*, 1(1), 14–16.  
<https://doi.org/10.1037/h0084019>
- Ketchum, J. D. (1965). The uses of statistics. In J. V. McConnell (Ed.), *The worm re-turns: The best from the Worm Runner's Digest* (pp. 64–65). Prentice-Hall.  
<https://archive.org/details/wormreturnsbe00mcco/mode/2up>
- Lakens, D., Adolphi, F. G., Albers, C. J., Anvari, F., Apps, M. A. J., Argamon, S. E., Baguley, T., Becker, R. B., Benning, S. D., Bradford, D. E., Buchanan, E. M., Caldwell, A. R., Van Calster, B., Carlsson, R., Chen, S.-C., Chung, B., Colling, L. J., Collins, G. S., Crook, Z., ... Zwaan, R. A. (2018). Justify your alpha. *Nature Human Behaviour*, 2(3), 168–171.  
<https://doi.org/10.1038/s41562-018-0311-x>
- Lambdin, C. (2012). Significance tests as sorcery: Science is empirical—significance tests are not. *Theory & Psychology*, 22(1), 67–90. <https://doi.org/10.1177/0959354311429854>
- Lemieux, T., & Card, D. (2001). Education, earnings, and the “Canadian G.I. Bill.” *The Canadian Journal of Economics / Revue Canadienne d’Economique*, 34(2), 313–344.
- Levi, C. (2009). *Canada: The Commonwealth Scholarship and Fellowship Plan*. Van Hùgel Institute for Critical Catholic Inquiry, St. Edmund’s College. <https://www.vhi.st-edmunds.cam.ac.uk/system/files/documents/Canada.pdf>
- Liddy, R. B. (1948). The teaching of psychology in Canadian universities. *Canadian Journal of Psychology / Revue Canadienne de Psychologie*, 2(3), 104–111.  
<https://doi.org/10.1037/h0084062>
- Lindquist, E. F. (1940). *Statistical analysis in educational research* (pp. xii, 266). Houghton Mifflin.

- Lindquist, E. F. (1942). *A first course in statistics: Their use and interpretation in education and psychology* (Revised). Houghton Mifflin.  
<https://archive.org/details/in.ernet.dli.2015.18259>
- Little, J. (2003). The Peter effect in early experimental education research. *Journal of Technical Writing and Communication*, 33(1), 41–63. <https://doi.org/10.2190/J5CB-2QNK-JGKK-YHX0>
- Lovie, A. D. (1979). The analysis of variance in experimental psychology: 1934–1945. *British Journal of Mathematical and Statistical Psychology*, 32(2), 151–178.  
<https://doi.org/10.1111/j.2044-8317.1979.tb00591.x>
- Lupien, Y. (1992). *Post-secondary education in Canada: The role of the Canadian government* [MPA, The University of Manitoba]. <http://hdl.handle.net/1993/18541>
- Lykken, D. T. (1991). What’s wrong with psychology, anyway? In D. Chicchetti & W. M. Grove (Eds.), *Thinking clearly about psychology* (pp. 3–39). University of Minnesota Press.
- MacKay, D. C. G. (1982). Psychology at British Columbia. In M. J. Wright & C. R. Myers (Eds.), *History of academic psychology in Canada* (pp. 220–234). C.J. Hogrefe.
- Macleod, R. C. (2008). *All true things: A history of the University of Alberta, 1908-2008* (1st ed). University of Alberta Press.
- Martin, S. A. (2011). Not as the crow flies: ‘Styles’ of educational measurement in the reception of inferential statistics at Iowa and Minnesota. *History of Science*, 49(2), 187–215.  
<https://doi.org/10.1177/007327531104900203>
- McCartney, D. M. (2016). Inventing international students: Exploring discourses in international student policy talk, 1945–75. *Historical Studies in Education / Revue d’Histoire de l’Éducation*. <https://doi.org/10.32316/hse/rhe.v28i2.4457>

- McNemar, Q. (1949). *Psychological statistics* (1st ed.). John Wiley & Sons.
- McNemar, Q. (1955). *Psychological statistics* (2nd ed.). John Wiley & Sons.  
<https://archive.org/details/in.ernet.dli.2015.223737>
- Meehl, P. E. (1978). Theoretical risks and tabular asterisks: Sir Karl, Sir Ronald, and the slow progress of soft psychology. *Journal of Consulting and Clinical Psychology*, 46, 806–834.
- Melton, A. W. (1938). [Review of *Statistics in psychology and education, 2nd edition*, by H. E. Garrett]. *Psychological Bulletin*, 35(2), 99–102. <https://doi.org/10.1037/h0050380>
- Merriman, D. (1952). George Milton Smith: An appreciation of his library. *The Yale University Library Gazette*, 26(3), 137–146.
- Mode, E. B. (1951). *Elements of statistics* (2nd ed.). Prentice-Hall Incorporated.  
<https://archive.org/details/elementsofstatis0000elme>
- Morton, N. W. (1952). Psychological research in Canada and in Canadian defence. *Canadian Journal of Psychology*, 6, 103–115.
- Myers, C. R. (1982). Psychology at Toronto. In M. J. Wright & C. R. Myers (Eds.), *History of academic psychology in Canada* (pp. 68–99). C.J. Hogrefe.
- Neatby, H. (1976). *Queen's University. 1: 1841-1917: And not to yield* (F. W. Gibson & R. Graham, Eds.). McGill-Queen's University Press.
- Nelder, J. A. (1999). From statistics to statistical science. *Journal of the Royal Statistical Society: Series D (The Statistician)*, 48(2), 257–269. <https://doi.org/10.1111/1467-9884.00187>
- Nelson, T. M. (1982). Psychology at Alberta. In M. J. Wright & C. R. Myers (Eds.), *History of academic psychology in Canada* (pp. 192–219). C.J. Hogrefe.

- Oosenbrug, E. (2020). *Building a “cross-roads discipline” at McGill University: A history of early experimental psychology in postwar Canada* [Ph.D., York University].  
<http://hdl.handle.net/10315/38000>
- Page, F. H. (1980). William Lyall in his setting. *Dalhousie Review*, 60(1), 49–66.
- Page, F. H., & Clark, J. W. (1982). Psychology at Dalhousie. In M. J. Wright & C. R. Myers (Eds.), *History of academic psychology in Canada* (pp. 220–234). C.J. Hogrefe.
- Peters, C. C., & Van Voorhis, W. R. (1940). *Statistical procedures and their mathematical bases* (1st ed., pp. xiii, 516). McGraw-Hill. <https://archive.org/details/dli.ernet.8016>
- Richardson, C. H. (1944). *An introduction to statistical analysis* (Revised). Harcourt, Bruce and Company. <https://archive.org/details/in.ernet.dli.2015.200406/>
- Rodgers, D. M. (2013). Insects, instincts and boundary work in early social psychology. *History of the Human Sciences*, 26(1), 68–89. <https://doi.org/10.1177/0952695112464000>
- Rosnow, R. L., & Rosenthal, R. (1989). Statistical procedures and the justification of knowledge in psychological science. *American Psychologist*, 44(10), 1276–1284.  
<https://doi.org/10.1037/0003-066X.44.10.1276>
- Rozeboom, W. W. (1960). The fallacy of the null-hypothesis significance test. *Psychological Bulletin*, 57(5), 416–428. <https://doi.org/10.1037/h0042040>
- Rucci, A. J., & Tweney, R. D. (1980). Analysis of variance and the “second discipline” of scientific psychology: A historical account. *Psychological Bulletin*, 87(1), 166–184.  
<https://doi.org/10.1037/0033-2909.87.1.166>
- Ryan, T. A. (1988). Frank Samuel Freeman (1898–1986). *American Psychologist*, 43(8), 655–655. <https://doi.org/10.1037/h0092005>

- Slater, J. G. (2005). *Minerva's aviary: Philosophy at Toronto, 1843-2003*. Univ. of Toronto Press.
- Smith, G. M. (1946). *A simplified guide to statistics for psychology and education* (Revised and enlarged). Rinehart & Company, Inc.
- Sokal, M. M. (1972). Psychology at Victorian Cambridge: The unofficial laboratory of 1887-1888. *Proceedings of the American Philosophical Society*, 116(2), 145–147.
- Stinnett, S. (1990). Women in statistics: Sesquicentennial activities. *The American Statistician*, 44(2), 74–80. <https://doi.org/10.2307/2684131>
- Tukey, J. W. (1991). The philosophy of multiple comparisons. *Statistical Science*, 6(1), 100–116.
- Tyler, F. T. (1951). A factorial analysis of fifteen MMPI scales. *Journal of Consulting Psychology*, 15(6), 451–456. <https://doi.org/10.1037/h0054518>
- Tyler, F. T. (1952). Some examples of multivariate analysis in educational and psychological research. *Psychometrika*, 17, 289–296. <https://doi.org/10.1007/BF02288759>
- Tyler, F. T. (1954). Organismic growth: P-Technique in the analysis of longitudinal growth data. *Child Development*, 25(2), 83–90. <https://doi.org/10.2307/1126157>
- Waite, P. B. (1997). *Lives of Dalhousie University, Volume 2: 1925-1980, The old college transformed*. McGill-Queen's University Press. <http://hdl.handle.net/10222/73583>
- Walker, H. M. (1943). *Elementary statistical methods* (1st ed.). H. Holt.  
<https://archive.org/details/elementarystatis0000hele>
- Wanner, R. A. (1999). Expansion and ascription: Trends in educational opportunity in Canada, 1920–1994. *Canadian Review of Sociology/Revue Canadienne de Sociologie*, 36(3), 409–442. <https://doi.org/10.1111/j.1755-618X.1999.tb00582.x>

- Weaver, P. (2007). The demise of universality: Federal financing for post-secondary education in Canada. *Federal Governance*, 4(1), Article 1. <https://doi.org/10.24908/fg.v4i1.4409>
- Wilks, S. S. (1948). *Elementary statistical analysis*. Princeton University Press.  
<https://archive.org/details/in.ernet.dli.2015.5781>
- Williams, D. C. (1992). The frustrating fifties. *Canadian Psychology / Psychologie Canadienne*, 33(4), 705–709. <https://doi.org/10.1037/h0078746>
- Winston, A. S. (1998). Science in the service of the far right: Henry E. Garrett, the IAAEE, and the Liberty Lobby. *Journal of Social Issues*, 54(1), 179–210.  
<https://doi.org/10.1111/j.1540-4560.1998.tb01212.x>
- Wright, M. J., & Myers, C. R. (Eds.). (1982). *History of academic psychology in Canada*. C.J. Hogrefe.
- Wright, M. W. (1982). Psychology at Manitoba. In M. J. Wright & C. R. Myers (Eds.), *History of academic psychology in Canada* (pp. 171–177). C.J. Hogrefe.
- Wrigley, C. (1952). The prediction of a complex aptitude. *British Journal of Statistical Psychology*, 5(2), 93–104. <https://doi.org/10.1111/j.2044-8317.1952.tb00115.x>
- Wrigley, C. (1957). The distinction between common and specific variance in factor theory. *British Journal of Statistical Psychology*, 10(2), 81–98. <https://doi.org/10.1111/j.2044-8317.1957.tb00180.x>
- Wrigley, C. (1959). The effect upon the communalities of changing the estimate of the number of factors. *British Journal of Statistical Psychology*, 12(1), 35–54.  
<https://doi.org/doi.org/10.1111/j.2044-8317.1959.tb00022.x>