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A CASE STUDY IN GANTT CHARTS AS HISTORIOPHOTY: A Century of Psychology at the University of Alberta

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History is typically presented as historiography, where historians communicate via the written word. However, some historians have suggested alternative formats for communicating and thinking about historical information. One such format is known as historiophoty, which involves using a variety of visual images to represent history. The current article proposes that a particular type of graph, known as a Gantt chart, is well suited for conducting historiophoty. When used to represent history, Gantt charts provide a tremendous amount of information. Furthermore, the spatial nature of Gantt charts permits other kinds of spatial operations to be performed on them. This is illustrated with a case study of the history of a particular psychology department. The academic year 2009–2010 marked the centennial of psychology at the University of Alberta. This centennial was marked by compiling a list of its full-time faculty members for each year of its history. This historiography was converted into historiophoty by using it as the source for the creation of a Gantt chart. The current article shows how the history of psychology at the University of Alberta is revealed by examining this Gantt chart in a variety of different ways. This includes computing simple descriptive statistics from the chart, creating smaller versions of the Gantt to explore departmental demographics, and using image processing methods to provide measures of departmental stability throughout its history.

Keywords: historiography, historiophoty, Gantt chart, image processing, psychology in Alberta

History is almost always presented as historiography (Cronon, 1992; Staley, 2003; Stone, 1979; White, 1988). That is, when historians communicate they do so using the written word, producing narrative structures that are linear and one-dimensional. Historians "configure the events of the past into causal sequences—stories—that order and simplify those events to give them new meanings. We do so because narrative is the chief literary form that tries to find meaning in an overwhelmingly crowded and disordered chronological reality" (Cronon, 1992, p. 1349).

The nature of historiography has been a cause of concern for some scholars. For instance, its narrative organization is similar to the structure of fiction, leading to questions about whether historiographical explanations are possible (Roth, 1988). Similarly, researchers studying the history of psychology have debated whether the linear structure of historiography can appropriately capture the nature of this particular subject matter (Leary, 1995; Weimer, 1974a, 1974b; Wettersten, 1975). Furthermore, some researchers believe that using verbal structures to communicate history imposes constraints on the way that history is thought about (White, 1973, 1987), which in turn limits the manner in which historical information can be understood (Rigney, 2010; Staley, 2003). As a result, it has been proposed that alternative modes of representing history should be seriously considered (Schwartz, 2001; Staley, 2003).

One interesting alternative to historiography is called *historiophoty* (White, 1988). White defines historiophoty as "the representation of history and our thought about it in visual images and filmic discourse" (p. 1193). Much of the interest in historiophoty focuses upon the medium of the motion picture (Friedman, 2010; Jarvie, 1978; Landman & Ballard, 2010; Rosen-

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stone, 1988). Nevertheless, historiophoty encompasses other forms of imagery as well, including photographs, diagrams, simulations, and virtual reality (Hankins, 1999; Miller & Hochberg, 2007; Staley, 2003).

Some examples of this broader sense of historiophoty are provided by the literature about the history of psychology. For example, the *Psychological Atlas* (Katz & Gaynor, 1948) is almost exclusively a collection of pictures of researchers and of their experimental stimuli or equipment, most depicted without captions (a short body of material describing the importance of the pictures is provided separately from the images themselves). *Psychologists in Word and Image* (Wade, 1995) provides over 100 portraits of psychological features that have been artistically "combined with motifs which reflected their contribution to psychology" (Wade, 1995, p. xi). For instance, Wade renders a portrait of vision scientist David Marr in the form of a 2 ½ dimensional sketch, a processed image central to computational theories of vision (Marr, 1982). Some modern books, such as *A Pictorial History of Psychology*, (Bringmann, Lück, Miller, & Early, 1997) illustrate traditional essays with an exceptionally large number of historical images and illustrations. However, these examples are more the exception than the rule. In many influential books about the history of psychology (Boring, 1950; Brett, 1912/1965; Warren, 1921) images are rarely encountered.

Proponents of historiophoty hypothesize that the multidimensional nature of spatial representations might provide a better match to the multidimensionality of historical information (Staley, 2003), and might also engage visuospatial thought processes (Arnheim, 1969; Enns, 2004; Humphreys & Bruce, 1989; Jacob & Jeannerod, 2003; Kosslyn & Osherson, 1995) that are not engaged by the written word. "Thinking about the past in visual form will not be the same as thinking about the past in written form" (Staley, 2003, p. 53).

The purpose of the current article is to illustrate how a particular type of graph, called a Gantt chart, can be used to conduct historiophoty. Invented by Henry Laurence Gantt (1861–1919), who worked with Frederick Taylor at Bethlehem Steel from1887 to 1893 in the application of scientific management principles, a Gantt chart typically plots the temporal progress of the various activities that are required to complete a project (Funkhouser, 1937; Wilson, 2003). It consists of a set of horizontal bars; each bar is associated with a particular activity. The horizontal axis of a Gantt chart represents time; as a result, a bar in the chart represents the start, duration, and end of an activity. Vertical lines can be added to the chart to represent dependencies of one activity on another. The bars of a Gantt chart can also be associated with individual people. For instance, Gantt devised a technique to improve productivity by assigning bonuses to managers and workers in a textile factory. This involved using a Gantt chart to plot whether a particular worker earned or lost a bonus on a particular day (Gantt, 1961).

The case study detailed below uses a Gantt chart of individuals to provide a historiophoty of a psychology department. The chart plots the career of each faculty member in the department, with each bar beginning with a particular individual's arrival and ending with their departure. The current article describes how this image of a department's history can be used to explore a number of interesting historical questions. Simple analyses of this chart provide insight into departmental trends and transitions. Subsets of the main Gantt chart allow exploration of the dynamics in departmental demographics and areas. The spatial nature of the Gantt chart permits the techniques of image processing to be applied, providing a new tool for historical investigation.

A Gantt Chart of a Department's History

The academic year 2009–2010 marked the centennial of psychology at the University of Alberta; in the fall of 2012 this psychology department is also celebrating the first 50 years of its Ph.D. program. The University of Alberta's first class in psychology was taught by John M. MacEachran in 1909, using James' *Psychology: The Briefer Course* (James, 1892/1962) as the textbook, and was the only psychology course in the University Calendar that year. MacEachran, who was trained in Wilhelm Wundt's laboratory, taught nine students in this first psychology offering (Arvidson & Nelson, 1968). One hundred years later, Sandra Wiebe became the most recent addition to a psychology department consisting of 32 academic staff, nine emeritus professors, seven adjunct profes-

sors, 15 sessional lecturers, 15 support staff, and 56 graduate students. Wiebe's first class in the department was an introduction to developmental psychology, and was offered to 292 students who used the 6th edition of a survey text (Lightfoot, Cole, & Cole, 2009). It was one of about 50 different psychology courses offered by a department serving 1,500 psychology undergraduate majors and over 650 psychology undergraduate minors.

Not surprisingly, the arrival of psychology's centennial at the University of Alberta led to renewed interest in the department's history. A basic question raised was what faculty members had belonged to the department during its existence? To answer this question, a list of its full-time members was compiled for each year of its history. This list was created by examining all available university calendars from 1908 to the present, as well as published departmental historiographies (Arvidson & Nelson, 1968; Smith, 1975). This procedure identified 131 different individuals as being department members. Once this year-by-year list of individuals was compiled, I realized that an effective way of communicating it was to convert this list (an example of historiography) into an image (an example of historiophoty).

This was accomplished by using the compiled list of department members as the source of data for a Gantt chart of individuals. The (temporal) horizontal axis of the chart represented over a century of departmental history, illustrating the years from 1909 to 2012 (i.e., from the beginning of the department until the present day). Each row in the (individual) vertical axis of the chart corresponded to a department member. The bar drawn for each department member traced their career from their hiring to their departure from the department. (In two instances, two bars were drawn for individuals, because faculty members left the department, and then returned to it a few years later. In these two cases, the two bars for the same individual were drawn at the same vertical location in the chart, producing a line with a break in the middle of the individual's representation.) Although there were no explicit dependencies drawn from one bar to another, the bars were sorted in ascending order with respect to the year that each individual was hired into the department. As a result, bars in the departmental Gantt chart that are vertically adjacent illustrate cohorts of faculty members. The complete Gantt chart for the Department of Psychology at the University of Alberta is provided in Figure 1. The top bar of the Gantt chart in Figure 1 represents the career of MacEachran, which spanned from 1909 to 1945, and the bottom bar represents Wiebe's University of Alberta career since her arrival in 2009. The remaining bars illustrate the careers of 129 other faculty members.

The Gantt chart presented in Figure 1 is a descendant of a graph called a timeline first presented by Jacques Barbeu-Dubourg in his 1753 *Chronologie Universelle* using a timeline on a 54 foot long scroll that was encased in specialized apparatus that permitted it to be viewed a section at a time (Rosenberg & Grafton, 2010). Timelines were popularized by British theologian and scientist J. B. Priestley in his 1765 *Chart of Biography* (Funkhouser, 1937; Rosenberg & Grafton, 2010). Timelines nearly identical in form to those created by Priestley are found in modern textbooks on the history of psychology; for instance Hergenhahn's *An Introduction to the History of Psychology* presents two striking examples inside the front cover (Hergenhahn, 2009). Priestley later extended his graphical technique to graphically represent chronologies of events instead of just biographies, and later chronologists advanced Priestley's methods to provide more accurate representations of time (Rosenberg & Grafton, 2010).

Priestley's timelines were presented on a chart in vertical layers, where each layer corresponded to a different category of individual, such as artists and poets or mathematicians and physicians (Rosenberg & Grafton, 2010, pp. 118–119). The vertical position of each timeline within a vertical layer was not systematic; lines were as evenly spaced as possible to make them easily seen. Chronologists that followed in Priestley's tradition also paid more attention to the horizontal aspect of their timelines than to the vertical positioning of neighboring lines.

The Gantt chart of Figure 1, though obviously indebted to Priestley's 18th century invention, extends it by making the *vertical* arrangement of timelines meaningful as well. By vertically arranging the bars in order of the year that faculty members arrived, the vertical dimension of Figure 1 provides temporal information as well: adjacent bars reflect cohorts of

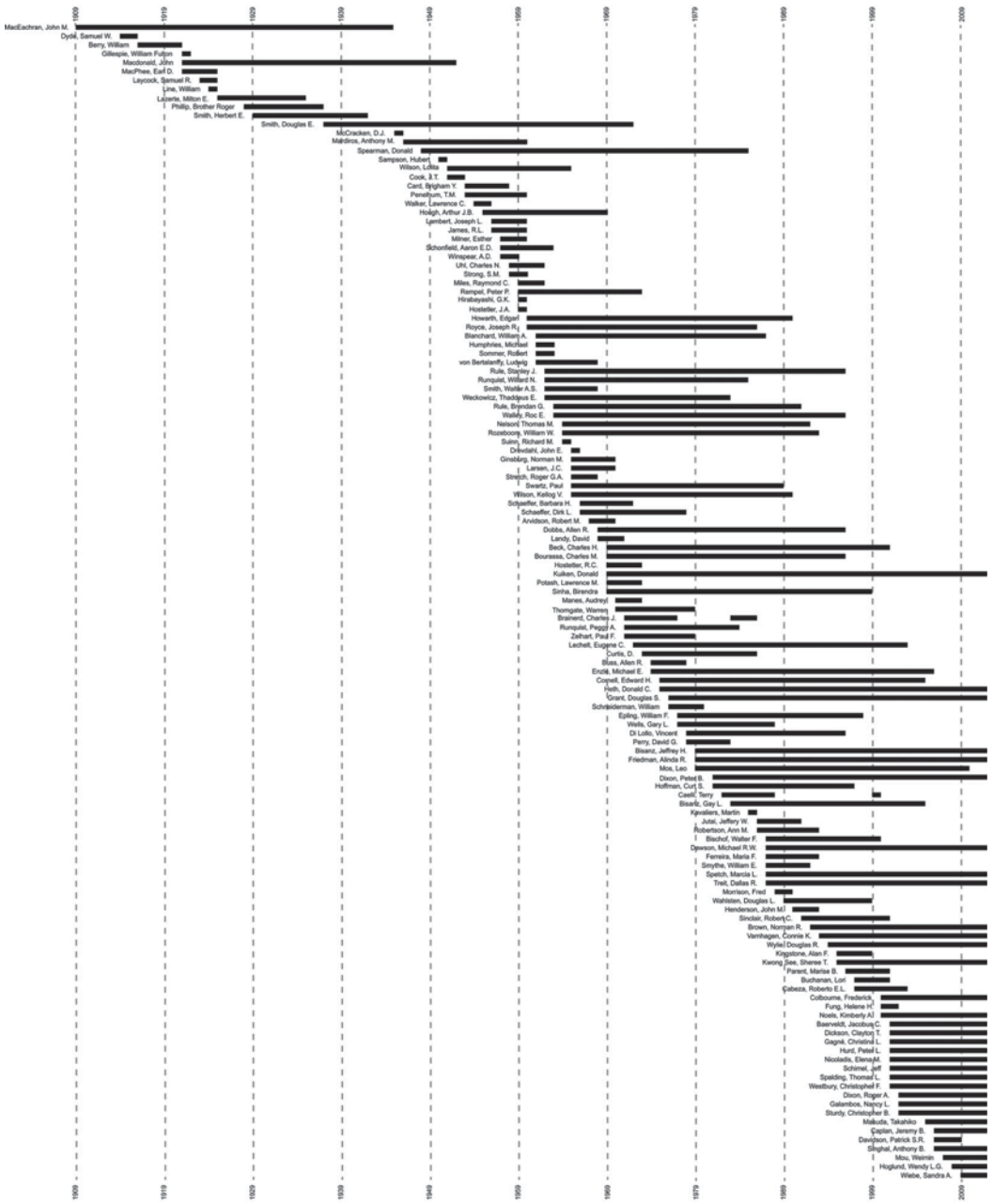

Figure 1. A Gantt chart that illustrates faculty career length in the Department of Psychology at the University of Alberta. Each horizontal line represents the career of an individual in the department; the individual's name is given to the left of each line. The horizontal axis represents time in years. See text for details.

faculty, and reading the faculty member names in order vertically down the graph provides a century-long roll call of individuals in the order in which they were hired. As is detailed later in the article, this vertical regularity in Figure 1 also permits this Gantt chart to be treated as a

visual object to which additional processing can be applied in order to explore a variety of historical questions. This kind of analysis is not possible with Priestley's original representation of timelines.

Staley (2003) argues that for historians to accept historiophoty, they must recognize that visualizations of historical information do not merely serve the purpose of illustrating or decorating text to make it more attention-grabbing. Instead, the purpose of historical visualizations is to organize historical information into a meaningful, spatial form that supports further systematic inquiry. Staley (2003, p. 44) notes that "we can identify a graphic display as a visualization if it invites the viewer to think about the information it organizes and if it generates new ideas or insights into that information." The Gantt chart provided in Figure 1 is clearly such a visualization.

To begin, the general shape of the chart provides a great deal of information about dynamics or changes in the makeup of the department over the past century. Departmental growth is indicated by vertical expansions of the chart. Therefore, the overall shape of Figure 1 reveals two distinct phases of departmental history. The first phase ranges from 1909 to 1950, a period when the department had a small number of faculty members. The second phase, from 1950 to the present, reflects dramatic growth in department size, which is shown as Figure 1 begins to rapidly descend toward the bottom right corner. This raises obvious questions about what factors might be responsible for periods of growth. Later in this article more detailed analyses of Figure 1 are related to funding trends for postsecondary education in Alberta.

Figure 1 also reveals a distinct "feathering" or "fringing" to the right as it descends downward. This ragged appearance is because throughout the entire history of the department some faculty members who arrive around the same period have markedly long careers in it, although others stay for a much briefer time. This characteristic appears to be true of the Gantt chart throughout all of the years plotted, and would not be as evident with nonspatial representations of the same data, such as the list from which the Gantt chart was constructed. Is this characteristic true only of this department, or is it also found in other universities or disciplines? The answer to this question is beyond the scope of the current article, but would be most directly found by applying this type of historiophoty to other departments or units with the aim of comparing the shapes of the resulting Gantt charts.

Informal evidence also suggests that Figure 1 is a visualization in the sense of Staley (2003). A poster of Figure 1 was placed on display near the main departmental office in the fall of 2011, and engaged the attention of existing faculty members. Feedback provided to the author from many of these individuals suggested that the Gantt chart invited them to find their own position in the graph, and to then identify the names of individuals who arrived around the same time. Frequently the names on the chart were scanned, bringing forgotten colleagues to mind. The Gantt chart was also a stimulus that induced these individuals to examine the bars, looking in particular for the longest one. Professor Donald Kuiken, who arrived at the department in 1969, and who in the summer of 2012 will begin the 44th year of his career here, has remarked that several of his colleagues have pointed out to him that his bar is the longest on the chart.

The Gantt chart of Figure 1 can be shown more formally to be a visualization of the type championed by Staley (2003). Staley notes that one can distinguish between primary source visualizations (those created during the historical era being studied, such as photographs) and secondary source visualizations. The latter are visualizations that serve as abstract representations of primary source data. The Gantt chart of Figure 1 is a secondary source visualization because it is a spatial representation of information gleaned from University calendars. Staley also discusses tertiary sources of information, which he defines as arrangements or derivations of secondary sources. In the sections below, I show that tertiary visualizations of Figure 1—that is, new graphs produced by performing different kinds of analyses of Figure 1, analyses made possible by its spatial nature—permit additional historical investigations of the Gantt chart to be performed.

Simple Analyses of the Gantt Chart

The Gantt chart represents historical information about the department that can be further analyzed and summarized through the applica-

tion of very simple techniques. For instance, as one moves from left to right across the chart the sum of the number of bars present for each year is a measure of department size in terms of its number of faculty members. Figure 2 provides the results of this analysis.

Figure 2 reveals four different phases of departmental size. The first occurs from 1909 until 1945 (the first vertical line in Figure 2), which is the span of MacEachran's term as department head. This phase represents a long period of slow growth in a small department. The second phase occurs from 1945 until 1988 (the second vertical line in Figure 2), and indicates a long period of steady and uninterrupted growth during a time in which there was a great deal of growth in Canadian postsecondary institutions (Hauserman & Stick, 2005). When multiple regression is used to predict department size from year over this period, the resulting equation has a slope that is nearly equal to 1. In other words, during this second phase the department grew at a steady rate of nearly one faculty member per year for over 40 years, culminating in a peak department size of 37. The third phase occurs from 1988 until 2001 (the third vertical line in Figure 2). During this period, per capita funding for Albertan postsecondary institutions dropped by 36% to 41% (Hauserman & Stick, 2005); this era of decreased funding is reflected in a marked decrease in department size. The final phase occurs from 2001 until the present, where there is some recovery in department size, but economic uncertainty has worked against the reestablishment of the long period of linear growth that began in 1945.

Demographic Examinations of the Gantt Chart

Another tertiary representation of the Gantt chart can be used to explore the history of departmental demographics or research areas; it is created by selecting just those bars in Figure 1 that correspond to a subset of faculty members of interest. For example, Figure 3A provides the Gantt chart of all the female members of the department. This chart indicates that there have only been 23 female members of the department in its first 100 years. The first was Lolita "Letty" Wilson, who was hired in 1951, and who later became the first female dean at Simon Fraser University when she left the University of Alberta in 1965. The chart also reveals that having six or more female members of the department is a very recent development, first occurring in 1997. Note that the general shape of Figure 3A mirrors that of Figure 1, indicating a similar two-phase history (i.e., an early period in which there were a small number of female faculty members, followed by a later period in which the number of female faculty members grew steadily). An important difference between the two charts, obviously, is the fact that the first

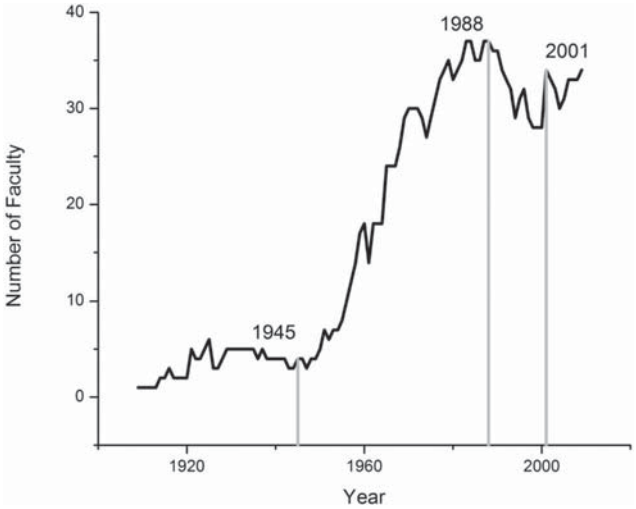

Figure 2. The number of faculty members in the department for each year of its history.

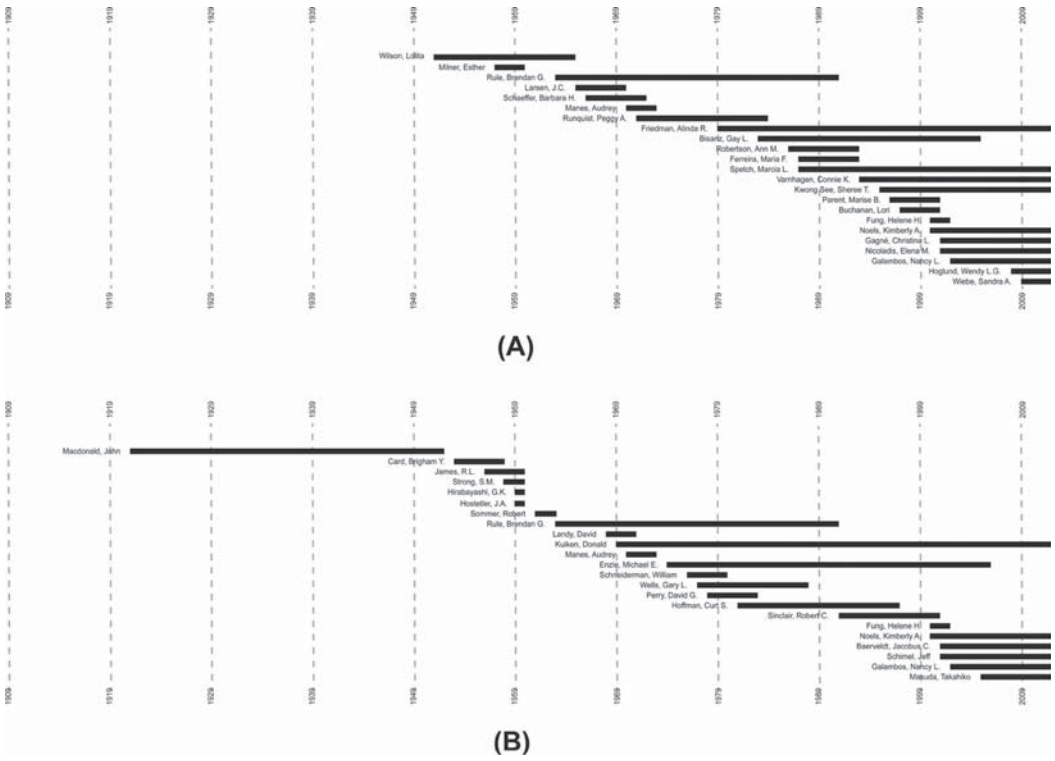

Figure 3. (A) A Gantt chart of the careers of female members of the department. (B) A Gantt chart of the careers of department members whose research was related to social psychology.

bar in Figure 3A begins over 40 years after the first bar in Figure 1.

Another kind of demographic analysis involves plotting a subset of the Figure 1 Gantt chart according to research area. To illustrate this approach, Figure 3B is a Gantt chart of those department members whose research reflected a substantial interest in aspects of social psychology. These researchers included those whose research focused on sociology, group processes, social psychology, social cognition, and social development. Researchers in this group were identified by examining published departmental historiographies (Arvidson & Nelson, 1968; Smith, 1975), and by consulting Professor Donald Kuiken, a current member of the department.

Figure 3B indicates that there has been a long history of social psychology at the University of Alberta, beginning with the hiring of John Macdonald in 1921. However, one interesting feature of Figure 3B is that it reveals a short but striking discontinuity in social psychology. In 1960, all of the four researchers identified as social psychologists (James, Strong, Hirabayashi, and Hostetler) left the department at the same time. Social psychology began anew in the department a year later with the arrival of Robert Sommer and continued with the hiring of Brendan Rule in 1963. This discontinuity coincides with a period of departmental specialization at the University of Alberta. In 1960, what was then known as the Department of Psychology and Philosophy split into the Department of Psychology and the new Department of Philosophy and Sociology. The social researchers who departed from psychology in 1960 all moved into this new department, which in turn split into the Department of Philosophy and the Department of Sociology in 1961. Social psychology was recreated in the department by hiring individuals whose interests were more aligned with psychology than with sociology.

Using Image Processing to Explore the Gantt Chart

In addition to championing historiophoty, Staley (2003) argues that computers will transform the study of history once historians view them not as manipulators of text, but instead as creators of images. However, his discussion of computer technology emphasizes its use in the creation of secondary source visualizations. That is, Staley is inspired by the use of computers to create useful abstract visualizations in such fields as mathematics. In these fields, "computers were helpful not only in crunching the numbers but in graphically organizing those numbers into a useful and meaningful form" (p. 117). He then proceeds to consider a number of ways in which historians could use computers to follow suit. However, the tacit assumption in this view of computer technology is that after the secondary source image is created, it will be interpreted by a human observer, taking advantage of their ability to think visually. "All people can draw upon a form of 'pictoriacy' that allows them to think about abstract concepts in visual form" (p. 121). Staley's view of how computers can be used may be correct, but it is also incomplete. Computers can be used to perform more complicated spatial analyses of visual images, permitting them to create a variety of tertiary visualizations. In short, some important "visual thinking" can be implemented by computer technology.

For example, one can use image processing to filter the Gantt chart in such a way that meaningful historical questions can be explored. In many cases, image processing amounts to performing visual filtering, which is a fundamental method for the computer analysis of visual images, and which also plays a central role in computational theories of human vision (Ballard & Brown, 1982; Gonzalez & Wintz, 1987; Marr, 1982; Winston, 1975). Algebraically, filtering is accomplished by using a mathematical operation called convolution to combine an original image with a second image, the filter, which is typically much smaller in size than the first. The result is a new filtered image that is a distorted version of the original. The kind of distortion that is produced depends on the choice of filter. For example, Marr (1982) described how images could be convolved with a filter that was defined as the difference between two Gaussian functions. This filter averaged away a certain degree of noise from the original image, and also revealed the locations of sudden changes in intensity (i.e., the edges) in the original image.

Algorithmically, convolving an image with a filter can be described as the repeated process of combining a filter and an image at all of the possible locations of the filter on the image. Consider the top part of Figure 4, which illustrates a 15×15 binary image (i.e., each pixel or image cell is either black or white) as well as a smaller 5×5 filter. Each cell of the filter contains a numerical value. (For reasons described later, all of the numerical values used in the filters applied to the Gantt chart were identical; each gray cell in the Figure 4 filter is equal to the value 0.04. However, variations in the numerical values of filter cells are also possible.) To filter the original image, the filter is placed over top of the image at a particular location. Then a simple sum of products is computed. That is, the value of each cell of the filter is multiplied by the value of the image cell that it coincides with. Then all of these products are added together, and this sum is placed in the single cell in the filtered image that corresponds to the location of the center of the filter. The filter is then shifted to a new location, and the process is repeated to fill in a new value in the filtered image. The bottom part of Figure 4 illustrates this process for just two of the many possible locations of the filter.

The layout of the Gantt chart of Figure 1—in which vertically adjacent bars represent faculty members who belong to the same cohort—permit simple filters to be defined to explore such issues as departmental dynamics in a fashion that simple descriptive statistics are unable to provide. For instance, although Figure 2 provides the number of faculty members in the department in any given year of its history, it does not deliver any information about stable cohorts of individuals—groups of faculty members who stay together for a number of years within the department. However, image filtering can deliver *visual* information about the stability of the department by identifying the presence of such cohorts throughout the Gantt chart of Figure 1.

For instance, imagine operationalizing a cohort by defining it as a group of five faculty members who stay together in the department

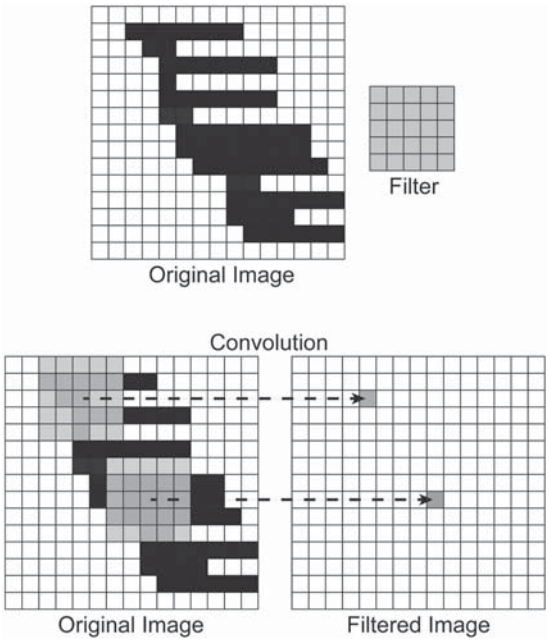

Figure 4. An illustration of convolution. A raw image is to be processed by combining it with a smaller filter, both illustrated in the upper part of the figure. The combination involves centering the filter at a particular location on the raw image, and computing the sum of the products of the filter values with the corresponding image values. This sum of products is then entered as the value at the same location of the filtered image that is being computed. The figure illustrates this operation for only two of the possible locations of the filter. In this figure, the gray squares of the filter represent a particular numerical value (0.04 in this example); the black squares of the image represent a value of 1, and the empty squares of the image represent a value of 0.

for a period of 5 years. This definition of a cohort can be used to construct a 5 × 5 filter (such as the one illustrated in Figure 4) that can be used to detect the presence of this particular type of cohort in the Gantt chart. Each column of this filter corresponds to a year in the department's history, and each row of this filter represents members of the department at the same time (taking advantage of the vertical layout of Figure 1 which sorts individuals in terms of their year of arrival). Let each cell in the filter be equal to the numerical value 1/N, where N is the number of cells in the filter; for the 5 × 5 filter N is 25 and, therefore, each filter cell would be assigned a value of 0.04. When this filter is convolved with the Gantt chart, it will return a maximum value of 1 when it is placed on a location of that corresponds to a period in which there were five department members in adjacent rows of the chart, and all five department members were in the department together for a period of 5 years. If some cells of the Gantt chart are empty, then convolving it with the filter at this location will return a value that is less than 1, indicating that at this location of the chart there is less evidence of this type of cohort. If all of the cells are empty beneath the filter, then the filter will return a minimum value of 0. In short, when this simple filter is convolved with the original Gantt chart, the filtered image will show the degree to which this particular definition of stable cohort is satisfied at each location. The result of convolving the entire Gantt chart of Figure 1 with this 5 × 5 filter is presented in Figure 5. Note that this filtering produces a blurred version of Figure 1; the darker regions of Figure 5 reflect higher values being returned by the 5 × 5 filter.

Of course, other definitions of "stable cohort" are possible, and it is not clear which of these is

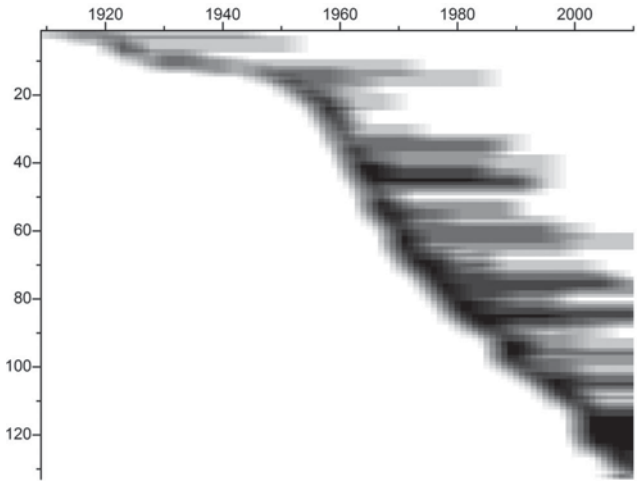

Figure 5. The result of filtering the Figure 1 Gantt chart with a 5 × 5 filter is a blurred version of the original chart. The darker the blurring, the closer the filtered value is to 1.

most apt. To deal with this situation, one can define several different filters, each corresponding to a different notion of "stable cohort." The original image can be convolved with each of these filters separately, and then the results of these different convolutions can be combined in some way to produce a robust measure of departmental stability. This is the approach that we adopted. We considered three different sizes of cohorts: 5, 11, or 17 faculty members. We also considered two different career durations for each cohort: 5 or 11 years. This resulted in the creation of six different filters; the cells of each were filled with the value of 1/N. The filters that we used were 5 × 5, 5 × 11, 11 × 5, 11 × 11, 17 × 5, and 17 × 11. We convolved Figure 1 with each of these filters. We then summarized these convolutions by identifying the maximum value generated for each filter for each year in the Gantt chart (i.e., we identified the best evidence for each cohort at each year in the chart). Finally, we averaged the maximum values of each of the six filters for each year of the chart. The averaged maxima are plotted in Figure 6, which summarizes departmental stability over time by combining these six different notions of "stable cohort."

The general shape of Figure 6 is similar to that of Figure 2, which is not surprising given that the number of faculty members in the department in each year contributes to the shape of both graphs. However, Figure 6 has a smoother shape than Figure 2 which is also expected because each filtering of the Gantt chart produces a blurred image (see Figure 5). As well, Figure 6 makes periods of change in departmental dynamics more explicit than does Figure 2. For instance, there is a substantial decrease in departmental stability (indicated by a downturn in the Figure 6 graph) at the time of the Second World War. There is a second sharp downturn beginning in 1960, which was the period in which psychology, philosophy, and sociology fragmented into separate departments. There is an extended but shallower decrease in stability beginning around 1990, a time of fiscal restraint in Alberta. The temporal axis of the graph ends before the temporal axis of the filtered Gantt chart because filters placed at the far right of the Gantt chart are missing data because they are processing future years for which Gantt chart data does not yet exist.

The image processing described above is just one example of how the spatial nature of a Gantt chart permits further (computer-aided) visual investigation. Different filters could be constructed to explore other issues. For instance, the "feathered" appearance of Figure 1 could be assessed by building a filter sensitive to this visual characteristic, and different degrees of feathering exhibited by different Gantt charts could be assessed by quantifying the results of using such a filter. This sort of inquiry illustrates new realms of investigation made acces-

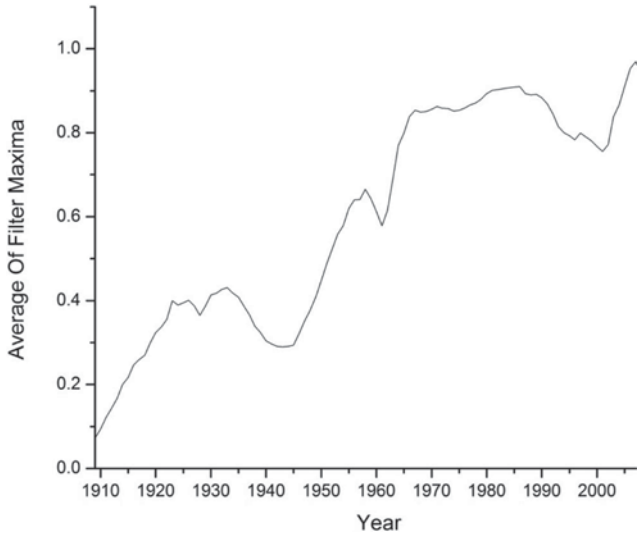

Figure 6. A plot of departmental stability computed by averaging the maximum values of six different filters for each year of department history. See text for details.

sible by exploring historiophoty that are impossible in traditional historiography.

Conclusion

The current article has shown how a century of the history of a particular psychology department can be represented and explored using historiophoty. In particular, this history can be easily rendered as a Gantt chart. The shape of this chart is itself an interesting historical visualization (Staley, 2003), and can be used as the source of other visualizations. For instance, the Gantt chart provides the source of data for other graphs—tertiary representations—that illustrate such content as a tally of the number of department members in each year, a sense of arrivals and departures of faculty members in each year, and the time course of demographic subsets of faculty members. Furthermore, image processing techniques such as convolution can be applied to investigate departmental dynamics, such as the presence of stable cohorts of faculty members through its history.

The Gantt chart discussed in the current article has been presented as an example of historiophoty. Interestingly, the extant literature on historiophoty tends to emphasize the use of motion pictures to represent and explore historical information (Friedman, 2010; Jarvie, 1978; Landman & Ballard, 2010; Rosenstone, 1988). One reason for this emphasis is that we "live in a world deluged with images, one in which people increasingly receive their ideas about the past from motion pictures and TV, from feature films, docudramas, miniseries, and network documentaries" (Rosenstone, 1988, p. 1174). Another reason is that the motion picture preserves the narrative structure of historiography, but adds to this structure additional dimensions of information (Staley, 2003). "As a medium that displays many idioms, film is capable of depicting vision, sound, diction, gesture, and movement at the same time. Film provides a compelling way to depict much more of the Arnheimian 'four-dimensionality of reality' than written words alone" (Staley, 2003, p. 71).

Gantt charts might provide an interesting alternative for historians to conduct historiophoty. A Gantt chart is itself fairly straightforward to construct. Furthermore, it has been argued that Gantt charts themselves preserve a sense of narrative (Yakura, 2002): "Because timelines portray a series of events in time with a clear beginning, middle, and end, they satisfy the minimal conditions for narrative, conveying the relationship of events over

time" (Yakura, 2002, p. 958). The narrative structure of a Gantt chart might, therefore, be attractive to historians accustomed to the narrative nature of historiography which is extended when films are used as historiophoty. It is hoped that the example analyses presented above convince the reader that Gantt charts can be used as a rich medium of historical investigation.

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