

## B. F. Skinner and T. N. Whitehead: A Brief Encounter, Research Similarities, Hawthorne Revisited, What Next?

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B. F. Skinner and T. N. Whitehead recalled a personal interaction in 1934, with differing memories of the event. No evidence of other subsequent interactions or mutual citations has been found. Although they went their separate ways, three similarities in their research strategies have been found and are discussed. Elements of Whitehead's Hawthorne study and Skinner's concurrent, parallel work reveal that they both (a) introduced the cumulative curve to report data, (b) used a small number of subjects studied over time, and (c) used highly accurate recording devices. A few "afterwords" are offered on their lives and writings, and again, on the Hawthorne effect. A suggestion is made that a Skinner–Whitehead research approach might be useful in studying gambling behavior.

*Key words:* B. F. Skinner, T. N. Whitehead, Hawthorne effect, measurement

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### THE ENCOUNTER

The year: 1934 (Skinner, 1957). The time, place, and occasion: the regular Monday evening dinner in Cambridge, Massachusetts, of the Society of Harvard Fellows. Among the people present, at least those important to our exposition: Thomas North Whitehead and his father, Alfred North Whitehead, plus B. F. Skinner (Skinner, 1957; Whitehead, 1963). At the time, T. N. Whitehead was 43 years old; Skinner was 30.

The date of 1934 is also central to other relevant events. According to the Web site of the Society of Fellows ([www.socfell.fas.harvard.edu](http://www.socfell.fas.harvard.edu)), the Society had been founded in 1933. Senior Fellow Alfred North Whitehead was one of its originating founders. Skinner had also been accepted that year as one of the five original Junior Fellows. T. N. Whitehead (1933) had just completed the

first preliminary report on his part of the soon-to-be-famous Hawthorne study. He did this as a member of the Harvard Business School faculty. Not being of the Harvard Faculty of Arts and Sciences, he was ineligible for membership in the Society.

Although not an official member of the Society, Whitehead was a guest at some of the dinners. Here is his description of that one evening in 1934:

I used occasionally to dine with the Society of Harvard Fellows as a guest of one of the faculty members. ... It was in the days when an extreme form of behaviorism was the fashion, and I remember endless discussion on that subject. On one of those occasions my father ... challenged a vigorous young behaviorist to describe in behavioral terms a green dragon on the dining-room table ... that wasn't there. (1963, p. 99–100)

So, there you have it, Whitehead's version of that event. Note that Skinner was not named. However, given the restricted membership in this group, Whitehead was undoubtedly referring to Skinner. Now, for Skinner's (1957) account. In his telling of the incident, there is a slight variation:

In 1934, while dining at the Harvard Society of Fellows, I found myself seated next to Pro-

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fessor Alfred North Whitehead. We dropped into a discussion of behaviorism, which was then still very much an “ism,” and of which I was a zealous devotee. Here was an opportunity which I could not overlook to strike a blow for the cause, and I began to set forth the principal arguments of behaviorism with enthusiasm. Professor Whitehead was equally in earnest. ... He agreed that science might be successful in accounting for human behavior provided one made an exception of *verbal* behavior. Here, he insisted, something else must be at work. He brought the discussion to a close with a friendly challenge: “Let me see you,” he said, “account for my behavior as I sit here saying ‘No black scorpion is falling upon this table.’” (pp. 456–457)

In this section of his book, Skinner went on for an additional three pages analyzing the challenge made by the elder Whitehead. Clearly, this was a significant incident from Skinner’s point of view. The younger Whitehead likewise must have also considered it a worthy event for inclusion in his autobiography.

About the same time of this encounter, Whitehead was publishing reports on research that would later be shown to have connections with work inspired by Skinner. The early phase of this research, beginning in 1927, was discussed by Roethlisberger and Dickson (1939). Harvard University and the Western Electric Company’s Hawthorne Works cooperated “in a study of the various factors which contributed to employee effectiveness” (p. 19). There were five criteria for selecting the type of job that would be most suited to measuring the impact of those factors: (a) Choose a repetitive task, (b) have each worker engage in the same operation, (c) select a task that “could be performed in a relatively short time, preferably in not more than one minute,” (d) involve a situation in which “employment would continue for a considerable length of time,” and (e) incorporate a task in which it is “best to have the speed of the operation wholly controlled by the operator” (p. 20).

The assembly of about 35 parts into a telephone relay was that task.

Thus, the relay assembly productivity of a small sample of women was systematically recorded over a period of 5 years. No matter what environmental variables were manipulated (pay schedules, rest periods, length of work day or work week) the steady trend in Whitehead’s data showed ever increasing productivity (1938a, 1938b). Forty years later, accounting for this was still a perplexing problem. Parsons (1978) put it well: “But since there were indeed progressive increases in output which could not be attributed to manipulated variables, it was reasoned, quite properly, that some influence must have been at work which the investigators had not controlled. What was it?” (pp. 260–261). Something called the Hawthorne effect was suspected. In 1988 a National Research Council report included a set of key terms that defined this concept quite concisely: “*Hawthorne effect*: Effects on behavior that result from merely being selected to participate in an experiment. Identified by investigators conducting studies on the effects of setting ... on performance at the Hawthorne plant of General Electric [sic]” (Druckman & Swets, p. 25).

There is no evidence that Whitehead discussed the subject of his Hawthorne research in any conversations where Skinner was present. Whether or not Whitehead and Skinner had other occasions to interact, we do not know. What can be said with a fair degree of certainty is that one will not find a Skinner citation in any of Whitehead’s works. Nor will one find a Whitehead writing listed as a source by Skinner. This is the more remarkable when looking at the timelines of their research and the similarities in their strategies for studying behavior.

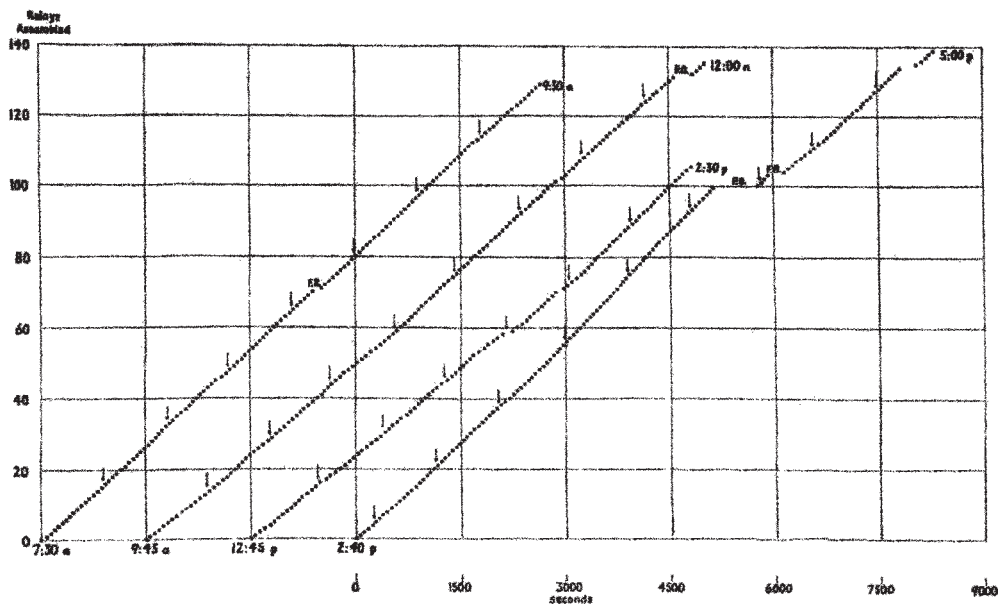
### USING CUMULATIVE CURVES

The first case in point is the use of the cumulative frequency curve as a way of portraying behavioral

Figure II.

## RELAY ASSEMBLY TEST ROOM — Hawthorne Works

CUMULATIVE OUTPUT CURVE FOR OPERATOR NO. 2 FOR MON JULY 6 - FRIDAY



events. An extensive study by Morris and Smith (2004) revealed that Skinner did not use the terms *cumulative* or *cumulative record* until 1937. However, he had referred to frequency-per-unit-time data collected on kymographs as early as 1930. Whitehead, in contrast, used the term *cumulative* as early as 1934 in the caption of a figure in one of his monographs. Whitehead's narrative about this figure reads with a startling contemporary ring:

Figure 2 shows a typical output diagram for Operator 2 for one day. The working day [it seems that industrial workers put in a 9.5 hour day in 1928] is divided into four nearly equal parts by a rest period, the lunch interval, and another rest pause in the afternoon. Each quarter of the day has been plotted from a common base to save paper. Every dot corresponds to one relay assembled, and it is plotted a standard distance above the dot below it. The horizontal distances between successive dots are variable and depend on the times taken to make the various relays. The horizontal time scale, in seconds, is given at

the bottom of the figure. Thus, if all the relays take about the same average time to assemble throughout a quarter day, then the line will be substantially straight; and the line will be more nearly vertical the faster is the average rate of work. The outstanding feature of this graph is the astonishing regularity of the working rate throughout the day. Occasionally a slight warming up period is noticeable at the beginning of the day; it is not present in this instance. There is typically nothing corresponding to an end spurt. Perhaps the most obvious departure from a complete uniformity of rate, is the comparatively slow work in the first half of the afternoon; this is typical but not invariable. Apart from absolute speed, which varies somewhat from one operator to another, this diagram might stand for any of the five assemblers in the test room. (Whitehead, 1934b, pp. 8–9)

With hindsight and a what-if approach, we could speculate as to what might have been if Whitehead had shown Skinner this cumulative record. Skinner was known as “a tinkerer” (Lattal, 2004, p. 330). He might have been able to suggest an electromechanical way for graphing,

cumulatively, the enormous amount of frequency-per-unit-time data Whitehead had been given to analyze. As it turned out, Whitehead's captioned figure was the only cumulative curve to appear in any of Whitehead's publications. Throughout his two subsequent volumes (1936 and 1938b) and in Roethlisberger and Dickson (1939), simple frequency charts and some smoothed frequency curves are shown. A Miss Helen M. Mitchell is credited by Whitehead as having drawn them (1938a, p. xii). She is likely the person who created that one hand-drawn cumulative curve by laboriously plotting each output datum.

The lack of interaction between Whitehead and Skinner can be attributed to at least three circumstances. There was an academic divide between the Harvard Faculty of Arts and Sciences and the Harvard Business School faculty. Furthermore, Skinner's work was highly laboratory oriented, with animal behavior as his subject matter. Whitehead focused on research with humans. Whitehead's status as a British citizen also entered the picture. As World War II started in Europe, Whitehead returned to England as an adviser to the British government on United States affairs. He did not return to the Harvard Business School until 1944 (*New York Times*, 1969).

#### **SMALL NUMBER OF SUBJECTS STUDIED OVER TIME**

Another research strategy Whitehead and Skinner shared was their reliance on careful, long-term observations of single subjects or very small samples. Whitehead cited the work of Jean Piaget as an example of how observations on only a few human subjects can lead to valid conclusions and generalizations (1938a, pp. 6–7). Whitehead saw that this model was a legitimate strategy for his task of analyzing the data from the Hawthorne relay assembly

test room. Both of his volumes about this project (1938a, 1938b) provide an analysis of the assembly line performance of 2 women over a period of 5 years. Six other workers were followed for varying amounts of time over the same years. Their total output amounted to several million accumulated responses. These were recorded for all subjects under highly specified conditions.

Skinner's preference for small-sample longitudinal research is well known. Skinner's debt to Pavlov for providing a single-subject research model is well documented by Catania and Laties (1999). They also cite Skinner's belated recognition of the influence of Thorndike's puzzle-box experiments using cats (p. 460). Skinner could also have made mention of Kohler's (1925) work with chimps as support for his single-subject strategy. In *Schedules of Reinforcement*, Ferster and Skinner (1957) state the case very simply under the heading "Number of subjects." In most instances, 2 subjects were sufficient, "but in some cases as many as four or five are used" (p. 38). They further noted, "More than a million responses per month are often recorded from a single subject, with daily experimental sessions ranging up to 15 hours" (p. 19). In the Skinner–Whitehead contrasts, the pigeon–people differences are obvious; the similarities in research strategy are equally obvious.

#### **EMPHASIS ON PRECISION IN MEASURING BEHAVIOR**

The year 1934 again appears in the record. It is the date Whitehead's *Design and Use of Instruments and Accurate Measurement* (1934a) was published. That was the year of publication, although the text of the book had been nearly complete in 1930. Then he was still a scientific officer in the British Admiralty, a post he held for 10 years (*New York Times*, 1969). Upon coming to the Harvard Business School in 1931, he

was immediately drawn into Elton Mayo's group of researchers. Whitehead describes the contact this way: "Mayo soon collected round him a group of junior colleagues, of whom I was one" (1963, p. 108). Whitehead's writing on accuracy undoubtedly placed him in a position to play a key role in the relay assembly test room part of the Hawthorne study. His "golden rule" probably impressed Mayo: "Never measure more than is absolutely necessary" (1934a, p. 57).

Indeed, he was presented with literally millions of bits of output data that required his expert analysis. Along with the quantitative data, he reported in detail the circumstances of how these bits of data were collected. Witness: "As each girl finished a relay, she dropped it through a hole in the work bench close to her right hand. The relay fell into a chute and from there traveled by gravity into a box. In falling through the chute, the relay hit a light flap and, in doing so, closed an electric circuit which caused a hole to be punched in a traveling tape" (1938a, p. 27). Another detail of accuracy was supplied by Roethlisberger and Dickson (1939, p. 24): "This tape moved through the mechanism at a constant rate of one-quarter inch per minute." Whitehead added that this permitted calculation of the rate of performance "with a probable error not exceeding 0.2 seconds" (1938a, p. 27).

Skinner, too, demanded high accuracy in the measuring of response rates of his animal subjects. The recording devices he used could "handle rates as high as 15 responses per second" (Ferster & Skinner, 1957, p. 22). Furthermore, the total amount of data accurately gathered was enormous. "The research as a whole covers approximately 70,000 recorded hours, during which the experimental subjects emitted approximately one-quarter of a billion responses" (p. 38).

## AFTERWORDS

The brief incident connecting Whitehead and Skinner is but a footnote in their lives. They both labored for many years under the broad umbrella called Harvard University. However, interactions beyond their first encounter appear to have been nonexistent. After his involvement with the Hawthorne study, Whitehead's major focus was teaching in the Harvard Business School and at Radcliffe College (*New York Times*, 1969). Of his seven publications listed in the references to this paper, five were related to the relay assembly test room research. With the exception of his autobiography (1963), the other six spanned a period of only 5 years. No other published work of his could be found.

In contrast, Skinner's research and writing continued on until shortly before his death in 1990. In an interview done during the last year of his life, at the age of 86, one response was startling. When asked which things he had done that gave him the most satisfaction, he put *The Behavior of Organisms* (1938) first, then *Verbal Behavior* (1957):

It may turn out in the long run that my book *Verbal Behavior* is more important than the experimental work. I started working on [it] when I was in the Society of Fellows at Harvard. I had an argument with Alfred North Whitehead, the great philosopher. He said, "Well your behaviorism works except with verbal behavior. How can you explain my sitting here saying something like, 'No black scorpion is falling on this table?'" The next morning I got up and started to write *Verbal Behavior*. That was about 1934 and it was published in 1957, so it took me a good quarter of a century. (Snyder, 1990, p. 4)

So, there you have it. In our little essay we have come full circle, starting with an encounter in 1934 and a recollection of that same event 56 years later. There's a bit of irony here. This last interview with Skinner was conducted by someone from the business world who is applying behavior-analytic principles to manage-



ment. Oh, that Skinner and Whitehead might have interacted more fully and earlier those many years ago! In a collaboration with Skinner, Whitehead might have been able to account for the enigmatic, progressive increase in worker productivity. The steady rise in output could not be accounted for by the manipulation of environmental variables. A hypothetical construct called the Hawthorne effect was invoked as an explanation. Parsons (1978), in dramatic phrasing, called the Hawthorne studies “the biggest Rorschach blot in the history of behavioral and social science. Every theorist read his own interpretation into them. It has even reached the point that whenever an unexpected result occurs in an experiment with human subjects, someone is likely to attribute it to the Hawthorne effect” (p. 261).

Almost 50 years after the Hawthorne relay assembly experiment, Parsons (1978) finally compiled the evidence to support what some behavior analysts had suspected. Elements of “information feedback and reinforcement” (p. 280) were present to account for the increased productivity. Whitehead himself had noted the feedback component, but not in behavior-analytic terms. In Whitehead’s (1934b, p. 15) monograph he said each worker was able to obtain a count of her own output at the end of every day. In addition, there were daily races. “For part of the time, each operator was daily asked to make a few relays as fast as they could. These ‘racing’ times are recorded and are of high interest, although they are not relevant to the subject matter of this book” (1938a, p. 28).

Although Whitehead denied relevancy, each worker could and did compete against her own prior record as well as against her companion workers. Furthermore, aside from the printed record itself, Whitehead said, “a fairly continuous running knowledge through the day ... could only

be gained by personal observation (largely aural)” (1934b, p. 15). As each relay was completed, the recording device emitted an audible click. That click represented an item tallied to be part of a group piecework payment system. In short, a careful behavior-analytic approach to those bits and pieces of data and circumstances could have had a special consequence. The need for the development of the hypothetical concept, the Hawthorne effect, might have been questioned earlier.

### **A SUGGESTION REGARDING IMPLICATIONS: WHAT NEXT?**

Let us put aside speculation about what might have been. What is a possible present-day application of what could be called the Whitehead–Skinner strategy of behavioral research? It could involve a small sample of human subjects, say 5. They could be doing a relatively simple, repetitive act such as pressing a button. Their frequency-per-unit-time behavior could be precisely monitored over a long period, maybe 5 years. The data could be plotted in “lovely” cumulative curves (Skinner, 1976).

What fits this prescription better than gambling? Knapp (1997) has said it quite succinctly: “No other contemporary public policy provides such an isometric fit with the principles of behavior analysis as gambling: an easily counted repetitious behavior which is maintained by its consequences” (p. 130). In this same context, reference could also be made to the five criteria mentioned earlier in this paper. They dealt with the selection of subjects and settings for the original Hawthorne study. Each of those criteria is a perfect fit with the behavior associated with an electronic gambling device (EGD).

The potential for collecting billions, if not trillions, of bits of data currently exists in modern EGD applications. Records are now being

kept regarding which EGD a person chooses, its location, the amount of each wager, and the starting and stopping time for each session at an EGD. It is possible for the frequency per unit time of every such event to be recorded in seconds, minutes, hours, days, weeks, months, and over extended periods of time. There is evidence that as many 600 to 1,000 wagers per hour can be made by an individual pressing the button of an EGD (Claus, 2002, p. 199; Rivlin, 2004, p. 74).

Of course, the manufacturers and casino owners of every EGD consider that they have proprietary rights over this wealth of data on human behavior. At issue is how to make such data available to behavior-analytic research. A difficulty would be in accommodating those proprietary rights as well as the privacy rights of the gambler. As in the days of Whitehead and Skinner, maybe someone associated in some way with the Harvard University Business School could again be a part of an investigation that challenges our conventional wisdom about human behavior. Gary W. Loveman could well be such a person. In 1990 he was on the faculty of the Harvard University Graduate School of Business Administration (Whitehead's academic locale). Loveman (1990) was writing on subjects such as "An assessment of the productivity impact of information technologies." He currently is Chairman of the Board, Chief Executive Officer, and President of Harrah's Entertainment, Inc. (2006), an extremely large gambling enterprise.

Loveman's firm claims to have "more than 25 million gamblers in its database" (Shook, 2003, p. 233). The information on each gambler in this database includes name, address, phone number, e-mail address, age, birth date, which casinos are visited, duration of play at a gambling table or device, frequency of play, how many coins were played, denomina-

tion of the coins played, rate of speed coins are inserted into an EGD, actual wins, actual losses, and size of bank accounts if the gambler applies for credit with the gambling house (Shook, pp. 228–229).

In addition to the research contributions someone like Loveman could make, several organizations claim to support careful, scientific study of gambling behavior. Among these are the Harvard Medical School Division of Addictions and its Institute for Research on Pathological Gambling and Related Disorders ([www.divisiononaddictions.org/institute/index.htm](http://www.divisiononaddictions.org/institute/index.htm)), the American Gaming Association ([www.americangaming.org](http://www.americangaming.org)), and the National Center for Responsible Gaming ([www.ncrg.org](http://www.ncrg.org)). Their resolve to support the scientific study of gambling behavior should be tested using behavior-analytic tools.

Almost 80 years have passed since the Hawthorne relay assembly study was begun. Its research strategy has never been tried again. Its findings challenged our understanding of human behavior in the last century. Using the gambling behavior data that exist, we await a latter-day Whitehead and Skinner to sort it all out for this century.

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