Fluency Research: An Example From History
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A thorough review of the literature concerning the development of frequency aims and fluency criteria reveals a common thread running throughout. Responding to stimuli at high rates, or frequencies, improves performance in the following areas: Retention, Endurance, Application, and Performance Stability which have been declared the products of fluency. While there are numerous definitions for fluency, Binder (1988, 1990, 1996) described it as “the fluid combination of accuracy plus speed that characterizes competent performance.” (For a more thorough treatment, see the issue of The Behavior Analyst, Fall, 1996). Many of these claims are supported by copious amounts of data (Binder, 1996); unfortunately, space restrictions preclude their inclusion here.

One set of data is conspicuous by its absence from this body of literature. These data were collected by an individual whom we shall refer to only by his initials. The data were collected before the advent of the Standard Celeration Chart, so we have taken the liberty of replotting for this audience.

METHOD

Participant
The male participant, H.E., was approximately 29 years of age at the time of the experiment. Prior to the experiment, his history included extensive training in philosophy that eventually led to the acquisition of a doctoral degree.

Apparatus
The experiment was conducted in the study of the participant’s home. Approximately 2,300 novel letter combinations (consonant-vowel-consonant) were created, mixed together, and randomly selected to create lists of sixteen combinations each (H.E., p.22). These tests were to be later learned via the See/Say learning channel as subsequently described by Haughton (1980). A timing device was used to record response times as well as trial durations.

PROCEDURE

Each test was constructed in the following manner. The lists of 16 different 3 letter (CVC) combinations were compiled into sets of six, with one set serving as both test and retest for a given set of 96 syllables. Overall, the experiment consisted of 10 such test-retest trials for each of seven conditions. A condition was defined by the number (8,16,24,32,42,53, or 64) of times the participant was required to read aloud the set of 96 syllables. The first reading of a particular test was therefore repeated 8,16,24,32,42,53, or 64 times for a total of seven conditions. Twenty four hours later, the same test materials were relearned up to the point of “first possible errorless production” (H.E., p.56).

During each of the first tests, H.E. was required to read and/or recite the
material to an arbitrarily set of frequency aim of 150 per minute. The separate lists were always read/recited from beginning to end; they could not be learned as separate pieces, and based on his verbal report, the harder portions were not repeated more frequently. H.E. then reread the list a required number of times for the experimental condition. This was repeated 10 times within each condition. For each of the ten different repetitions per condition, first test frequencies and durations remained constant.

During each second test, H.E. read and/or recited the same test series presented 24 hours earlier to the set frequency aim of 150 items per minute. Whenever a probe for the first possible errorless production was conducted, upon hesitation the rest of the list was read through to the end before H.E. began again. All probes were initiated by the participant. After reciting each list, a pause of 15 seconds occurred to allow for scoring and was followed immediately by the next list in the test series. First possible errorless production “...was considered attained when, the initial syllable being given, a series could be recited at the first attempt, without hesitation, at a certain rate, and with the consciousness of being correct.” (H.E., p. 23) During each test-retest trial, distractions were kept to a minimum, and an attempt was made to keep the history of the participant constant throughout the course of the experiment.

RESULTS

The original experimenter’s presentation of the data did not allow for easy plotting in the Standard Celeration Chart. It was necessary to recalculate the data to derive actual response times per item and hence response duration for each test. These items appear to be fairly constant across conditions and tests due to the frequency aim, the number of responses per test, as well as the individual overall test and retest durations. The scoring and hesitation times were not included in calculating test durations.

Prior to contemporary presentation and interpretation of these data, one important point had to be accommodated: Due to the constant rate of responding for each of the first tests (ten per condition), the frequencies and durations for each of the first tests were plotted as rotated Aim Stars (Journal of Precision Teaching and Celeration, 1993) at the beginning of each condition to allow for comparison to the subsequent retest conditions. This permitted all of the resultant data to be displayed on one piece of chart paper. This procedure appears to be sufficient to permit accurate analysis of the data.

The data for the first two conditions, 8 and 16 repetitions, clearly show that relearning the six lists of 16 syllables to the point of first errorless reproduction required more time than the initial recitations. These changes in duration measures, 1/d, (Pennypacker, et al. 1972) are approximately +4 frequency multiplier (F.M.) in the 8x condition and a +2 F.M. in the 16x condition. The durations for the 24x test and retest conditions appear to be stable at x1.0. As displayed on the Chart, the frequency data showed very little deviation from the set frequency aim of 150 responses per minute across conditions. The variability was explained by the original author as being a result of slight changes in the “inner conditions” at the time of
“first fluent reproduction”. Beginning with the 32x condition, and continuing in subsequent conditions, the steadily increasing median duration measures to achieve first possible errorless reproductions, ranging from a x1.5 F.M. to a x5 F.M., are clearly revealed. The Chart thus shows the systematic benefit of increased practice on attainment of fluency. These data also offer support for the contemporary procedure of starting acquisition at high frequency, letting accuracy emerge with practice (Lindsay, 1992).

In the 64x condition, first test durations lasted approximately 45 minutes. The participant’s verbal reports during this condition included complaints of headaches, exhaustion, and other symptoms, which may have complicated the conditions of the test if the number of repetitions had been increased. In this condition, the participant was emitting strings of 6,144 responses at the frequency aim of 150 per minute! As originally interpreted, these data suggest that an endurance ceiling for this type of performance had been approximated. These data were drawn from a series of experiments conducted by an individual who has been hailed as “…One of psychology’s foremost pioneers, ranking with (if not ahead of) others from his time who are remembered more favorably today” (Roediger, 1985, p 519). When H.E. began his experiments, the prevailing zeitgeist was that, in principle, an experimental science of higher mental processes was impossible. When Memory: A Contribution to Experimental Psychology was first published in 1885, the direction of psychology was significantly altered – perhaps signaling the beginning of a paradigm shift. H.E. had arguably shown that higher mental processes were no longer exempt from scientific investigation.

Today, the work of Hermann Ebbinghaus continues to serve as a fundamental underpinning of experimental psychology. Herr Ebbinghaus selected the following quotation as the epigram for his volume, “From the most ancient subject we shall produce the newest science,” (as translated by E.G. Boring, according to Hilgard, 1964). We take the liberty to suggest that the reinterpretation of these data can now be used as foundational support for continued fluency research, or as Binder (1996) has claimed, “….The Evolution of a New Paradigm”.

REFERENCES


