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Duane M. Rumbaugh: Some Biography and Early Research

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Information about Duane M. Rumbaugh's family, education, and career is presented in the first section. In the second section, information about Rumbaugh's publications from 1962 to 2017 is presented, and details about his early research publications are provided. Although a few of his early publications involved applied research with humans, most of his early programmatic research involved various nonhuman primates, modifications of research equipment, and development of new measures of learning sets. Implications of the early research for later research are also discussed.

Keywords: comparative psychology, history of psychology, biography

Duane M. Rumbaugh: Some Biography and Early Research

Duane Marwin Rumbaugh was born on July 4, 1929 (American Psychological Association, 1963; Rumbaugh, n.d.), in Iowa. There is some inconsistency across sources (e.g., United State Census, 1930, 1940) as to the town, but he himself (Rumbaugh, n.d.) reported his birthplace as Maynard, Iowa. His parents were Arthur F. Rumbaugh, a Presbyterian minister, later superintendent of the Bethany Home, a Presbyterian retirement home in Dubuque (Bethany Home, 2016), at which his mother, Ida Rumbaugh (née Ida Edith Traudt), also worked (as a matron). Duane had two older sisters (Doris Mae, born 1919, and Vida Fae, born 1927).

Both Arthur and Ida were born in Nebraska. Although there is some inconsistency across different sources (e.g., United States Census, 1920, 1930) about the birthplaces of his grandparents, the family appears to have been primarily Midwestern in the United States. Rumbaugh himself grew up mostly in Iowa, with a few years spent in Nebraska.

The years of his childhood and adolescence were the years of the Depression and the Second World War. He graduated from Ackley High School, where he had been president of his class, in 1946, just after the end of the war. During the war, in addition to attending school, Rumbaugh was a farm hand, working, like other boys of his time and place, to make up for the absence of those serving in the military. In an autobiographical manuscript (Rumbaugh, n.d.), he described the experience as one which "steered them from the farm at the earliest possible time."

Rumbaugh attended the University of Dubuque, graduating with a Bachelor of Arts degree in 1950. He also attended the University of Iowa for part of his senior year in college. The following year (1951), he received a Master of Arts degree from Kent State University, where his major professor was Charles C. Perkins. He received his doctoral degree in General Experimental Psychology from the University of Colorado in 1955;

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his major professor at Colorado was Maurice P. Smith. His major professors at both the master's and the doctoral levels had been students of Kenneth Spence. Not surprisingly then, this preparatory stage of his career gave Rumbaugh a "strong orientation in learning theory, research methods, and statistics" (Rumbaugh, n.d.).

In 1952, while a doctoral student at Colorado, Rumbaugh married Phyllis Forsman, also a student, with whom he had a daughter, Joan. He married a second time in 1976; his second wife, Sue Savage, was a fellow psychologist and a long-time collaborator in the work on language processes in nonhuman primates. Rumbaugh adopted Savage's son, Shane. This second marriage ended in divorce in 2000.

Rumbaugh began his first academic position as an instructor at San Diego State College (SDSC) in 1954, the year before he earned his Ph.D. (Rumbaugh, n.d.). By his account, he became a comparative psychologist more or less by happenstance because no one else on the faculty had a claim on that subdiscipline. Despite his learning-theoretic orientation at the time, he was delighted to move into comparative psychology.

Because there was not an animal laboratory in the psychology department, Rumbaugh approached the San Diego Zoo to obtain subjects for his research—not their primate populations, as one might expect given the primary focus of his career, but rather their rats, which they bred as food for the reptiles. His interest in rat research and his commitment to Hullian learning theory soon waned, however, and he decided to find "something more interesting than rats" (Rumbaugh, n.d.). "Something more interesting" included a variety of other organisms: "homing pigeons, assorted monkeys from the zoo, kittens, chickens"—although also "even rats" (Rumbaugh, n.d.). Somewhat surprisingly, when Rumbaugh was working primarily with rats, his research space was in the animal hospital at the zoo. However, once he expanded his range of subject species, he conducted his research on the San Diego State campus, even though some of the subjects were monkeys from the zoo.

Also, during this early period at San Diego State, Rumbaugh conducted his first research with another population that would become important in his later comparative-psychological research, human primates, although this early study was not comparative. In another instance of relative happenstance, this development in Rumbaugh's career occurred because his department chair "volunteered…[him] as the department's representative and psychologist to the San Diego County Heart Association's Cardiac in Industry Program" (Rumbaugh, n.d.). This research is described in more detail below.

In 1957, in response to the Suez Canal Crisis in the Middle East, Rumbaugh temporarily left SDSC to serve as a medical service corps officer in the United States Navy Reserve. During the summer of 1958, while at the U.S. Naval Medical Research Institute, he worked on a project on the prospect of sending squirrel monkeys into space. He described himself as having returned to SDSC to work with "the beautiful array of great apes at the San Diego Zoo from a more informed perspective." He retired from the Naval Reserves as a lieutenant commander in 1972. Rumbaugh rose through the ranks at SDSC, being promoted to assistant professor in 1955, associate professor in 1959, and professor in 1963.

In 1969, Rumbaugh moved to the Yerkes Regional Primate Center at Emory University in Atlanta, Georgia, as Associate Director and Chief of Primate Behavior**.** At Yerkes, Rumbaugh began his groundbreaking studies of language acquisition by Lana and other apes using a lexigram board. In 1971, he moved to Georgia State University (GSU). He had applied for an adjunct faculty position at GSU. As it happened, the department was searching for a new chair, and the chair of the Chair Search Committee (the first author of this paper) encouraged him to apply for that position instead. Thus, Rumbaugh moved to GSU as

chair of the psychology department. For the first decade of his tenure at GSU, Rumbaugh continued to conduct his research with apes at Yerkes, but, in 1981, he founded the Language Research Center (LRC) at GSU and moved his research to the new facility.

Although Rumbaugh had had an administrative position at Yerkes (Associate Director and Chief of Primate Behavior), becoming chair of the GSU psychology department and, subsequently, adding the position of Director of the LRC represented a substantial increase in administrative commitments. Rumbaugh's skill as an administrator was illustrated by two features of his tenure as department chair. First, he managed to meld experimental psychology into a program that had been focused on psychotherapy as a private practice enterprise. He found ways of having psychologists with very different concepts of psychology work together to develop a large, well-respected doctoral program.

Second, during his relatively long tenure as department chair, he continued and expanded his research program, in part by using his support staff effectively. It is common for administrative responsibilities, such as chairing a department, to interfere with scholarly achievement, but this was not true in Rumbaugh's case. Although one's publication record is only one indicator of scholarly productivity, it can be a convenient index. In the five years (1966-1970) prior to Rumbaugh's becoming chair of the GSU department, he had an average of two publications per year. Over the years of his chairmanship, he averaged over five publications per year. In addition, he was an effective mentor during that time and aided in the development of outstanding psychologists.

In 1988, Rumbaugh retired as chair of the department, but he remained on the faculty of GSU, holding the title of Regents Professor of Psychology and Biology, until December 31, 1999. He continued his research at the LRC even after retiring from the faculty. In 2004, Rumbaugh became involved with an organization, the Great Ape Trust of Iowa (GATI), in Des Moines, Iowa, returning to his Midwestern roots. According to a local newspaper article about the founding of the GATI (Mcgee, 2006), the GATI was founded by an Iowa businessman, Ted Townsend, who had become intrigued by great apes on business trips to Africa. On discovering that a prominent researcher studying apes (i.e., Rumbaugh) was a native Iowan, Townsend, as quoted in the article, "just picked up the telephone and called him cold." After Townsend visited him in Atlanta, Rumbaugh moved to GATI, meanwhile retaining positions as Director Emeritus of the LRC and Professor Emeritus in the Departments of Psychology and Biology at GSU. Rumbaugh spent the end of his life in New Jersey, where his daughter was living. He died on June 24, 2017, having had a stroke.

Over the years, Rumbaugh received many honors and awards. Among them were the presidencies of Division 6 (now the Society for Behavioral Neuroscience and Comparative Psychology) of the American Psychological Association (in 1988) and the Southern Society for Philosophy and Psychology (1996). The accolades have continued since his death, marking his ongoing importance to the field of comparative psychology, generally, and to the study of ape language and cognition, more specifically.

Early Research

Rumbaugh's research for both his thesis for a Master of Arts degree and his dissertation for a Doctor of Philosophy degree concerned basic aspects of learning, as did many projects in the 1950s. He earned a Master of Arts degree in psychology from Kent State University in 1951, and his thesis (Rumbaugh, 1951) involved place learning in rats. After earning the Master of Arts degree, he enrolled at the University of

Colorado and earned his Ph.D. in 1955. His dissertation (Rumbaugh, 1955) involved the investigation of the relation between habit strength, drive level, and amount of training, a study that was clearly Hullian, as were many investigations in the 1950s. Subsequently, Rumbaugh investigated more complex learning situations.

Rumbaugh published his first article in 1962 and his last article in 2015, a remarkable span of 53 years, with grant support for a large majority of that research. Quantitative analyses of either research or publications cannot capture all the elements of the publication record, but such an analysis provides some useful information. The numbers of articles, chapters, reviews, and other publication forms by publication decade, beginning with 1962, are shown in Table 1. The substantial increase in publications from the first to second decade of his publication history most likely is a result of his maturing as a researcher and author and, perhaps more importantly, of his having begun language-type research. Rumbaugh had many co-authors during his career, and often those co-authors were his students or former students, some of whom have become comparative psychologists. A more extensive quantitative analysis of his research and publications is a topic for further investigation but beyond the scope of this paper.

Table 1
Rumbaugh Publications by Type and Decade

	Decade					
Publication Type	1962-1971	1972-1981	1982-1991	1992-2001	2002-2011	2012-2017
Article	28	33	30	42	12	5
Chapter	4	29	17	29	2	0
Review	0	2	6	8	6	0
Other	5	1	0	7	0	0
Total	37	65	53	86	20	5

In the remainder of this article, we discuss only Rumbaugh's earliest research for three reasons. First, some of that research is not as well known as his nonhuman primate language research and his transfer index research. Second, some of the early research is clearly a precursor to his later research projects, and third, his extensive research cannot be described completely in such a brief article.

Rumbaugh published 37 articles and chapters including one test in his first decade of publishing (1962-1971). In that decade, he had 30 co-authors, some of whom were his students, and some of whom published more than one article with him. He published some one- or two-page articles, lengthy chapters, and more typical journal articles. He included humans, great apes, other primates, and, most often, squirrel monkeys (13 articles) in his research projects. The topics that he investigated were varied. With humans, he investigated various behaviors in patients with senile psychosis and those with heart disease. In various primates, he studied discrimination learning, discrimination reversal, learning sets, and observational learning.

Applied Research

Although his graduate school research involved traditional topics, his first publication was atypical in that it was an investigation of factors involved in the assessment of the return-to-work potential of patients with heart disease. Rumbaugh and Kuzman (1962), a physician colleague, investigated the relations among

various factors that might influence a health care group's assessment of a patient's potential to return to work. That research was followed by the development of the Cardiac Adjustment Scale (CAS), which contained 160 items that were used to assess the potential to return to work (Rumbaugh, 1964). In a study with 94 patients, the correlation of the CAS score with status (employed or unemployed/deceased) 3 years later was significant (Rumbaugh, Knapp, & McCarty, 1965). Rumbaugh also participated in the development of the Psychological Abilities Scale for Seniles (Kaplan, Rumbaugh, Mitchell, & Thomas, 1963). Some of Rumbaugh's later research concerned applied topics, but these early studies were relatively isolated and not a part of his general program of research.

Equipment Modification, Comparative Research, and Measurement

At the same time that Rumbaugh was investigating an applied problem in a human medical situation, he began an extensive program of complex learning research with nonhuman primates. In the remainder of this article, we will discuss Rumbaugh's early comparative research, beginning with his modifications to the Wisconsin General Test Apparatus (WGTA). With the modified WGTA and various animals, he investigated discrimination learning, discrimination reversal, various training procedures, and measures of discrimination learning and learning sets, leading to his development of the transfer index.

Rumbaugh made a series of modifications to the WGTA to accommodate various species that he used in his research. Some of the animals that he observed were more dexterous than others, and he modified the apparatus so that differences in dexterity would not affect the assessment of learning. Rumbaugh and Rice (1962) placed discrimination objects in plexiglass boxes affixed to panels that covered the food wells so that the animals could see but not touch or manipulate the objects. Peterson and Rumbaugh (1963) modified the WGTA differently by using a plexiglass shield rather than a box that prevented the subject from touching the discrimination objects. In a still later modification, Pournelle and Rumbaugh (1965) affixed metal plates to the bottom of the discrimination objects, and magnets were placed where food wells had been. The subjects could not pick up or manipulate the discrimination objects; rather, the subjects touched or pointed to the objects. This modification of the stimulus tray eliminated differences in responding that might have resulted from differences in strength or dexterity across species. Long after the first decade of his publication history, Rumbaugh continued to make modifications to the WGTA and other devices.

In his first nonhuman primate study (Rumbaugh & Rice, 1962), Rumbaugh began comparative research. In that first study, a gorilla, chimpanzee, and orangutan were observed in a simple discrimination situation and in a learning-set situation by using a modified WGTA. For discrimination learning and the development of learning sets, the gorilla's performance was highest, the chimpanzee's performance was next, and the orangutan's performance was the lowest. The modified WGTA was effective in the study of discrimination learning and learning sets in great apes. In this study, discrimination learning and the development of learning sets were compared directly across species, but, in other studies, Rumbaugh compared the behavior of a single species in his study with the behavior of other species in other laboratories.

Rumbaugh used many different species in his early studies, but for 13 studies during his first publication decade, the subjects were spider monkeys. In many of those studies, he investigated discrimination learning, learning sets, or both. In his first study of squirrel monkeys, Peterson and Rumbaugh (1963) demonstrated that touching or manipulating the discrimination objects is unimportant in discrimination learning and the development of learning sets. The WGTA with a plexiglass shield that prevented the subjects from touching the discrimination objects was used for some discrimination problems and not used for other

discrimination problems. In the latter condition, the subjects touched the objects. The learning exhibited by the subjects was comparable in the two conditions, and it was concluded that touching or manipulating the discrimination objects was not critical for discrimination learning or the development of learning sets.

Rumbaugh, Sammons, Prim, and Phillips (1965) used a modified WGTA to investigate the importance of detection of dimensions of stimulus objects. Some subjects were trained initially with a sequence of single objects to which a response was always reinforced. A second group was trained with a sequence of the same objects, but only 50% of the responses were reinforced. A third group received the same number of trials, but the same object was presented on all trials, and each response was reinforced. A final group received learning-set trials. It had been suggested that exposure to multiple objects might enhance the subject's attention to differences in the objects, which might in turn influence discrimination learning. However, it was concluded that the presentation of single stimulus objects with rewards did not affect subsequent development of learning sets.

Initially, Rumbaugh used the standard learning-set procedure, in which animals were trained to a criterion before learning-set trials began. On learning-set trials, a pair of objects was presented for a standard number of trials (e.g., 6 trials), after which a new pair was presented. In the transfer trials, Trial 2 responses and Trials 2 to 6 responses were analyzed for a large number of pairs of discrimination objects. Rumbaugh and Ternes (1964) demonstrated that the assessment of learning sets using only 2 trials is comparable to the measurement using Trial 2 or Trials 2 to 11 of 11-trial sequences. Thus, it is more efficient and equally accurate to use only 2 trials rather than 11 trials.

In typical learning-set research, the number of transfer trials was constant across problems. For example, each learning-set problem was presented for only 6 trials before the problem was changed. In other research, more learning-set trials were given, but the number of trials was set for all problems. In some research, Rumbaugh used criterial discrimination for each learning-set problem. Specifically, trials were continued until the subject had reached a specific criterion, such as 20 correct responses in 25 trials. Rumbaugh and McQueeney (1963) found that squirrel monkeys acquired learning sets with fewer trials than required in the standard fixed-trial procedure. The level of correct responding was at least as good in fewer trials as in the fixed-trial procedure.

In summary, Rumbaugh moved from relatively simple learning situations in his graduate school research to more complex learning situations in his first publication decade. He and his colleagues demonstrated that various factors, such as touching and manipulating discrimination objects, did not influence the acquisition of learning sets or performance in discrimination reversal situations. Perhaps more importantly, Rumbaugh's early research was a precursor to his development of the transfer index (Rumbaugh, 1969).

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