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The Psychic Life of Micro-Organisms: A Study in Experimental Psychology, A review of the book by Alfred Binet

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This article introduces the little-known contributions of Alfred Binet to comparative psychology. While Binet's contributions to intelligence testing are well known and widely discussed in introductory psychology and history of psychology texts, his contributions to comparative psychology are largely forgotten. To acquaint textbook writers and students with Binet's contributions, we review his 1889 book, *The Psychic Life of Micro-Organisms: A Study in Experimental Psychology*. This book details his observations of the behavior of microscopic organisms. We discuss each of the nine chapters and close with speculation of how his book may have helped develop his problem-solving tests.

Keywords: Binet, comparative psychology, history, micro-organisms, psychology

Most readers will recognize Alfred Binet and his collaborator Théodore Simon from their development of tests used to help the French government identify students who needed special assistance in school (Walsh et al., 2014). These tests laid the foundation for what became known as "Intelligence Tests." With the help of Simon, Binet developed a set of tasks that required abstract reasoning and problem-solving skills. However, what is not widely known is that before the development of these tests, Binet focused his attention on comparative psychology, especially the "psychic life of micro-organisms."

Recently, there has been renewed interest in the comparative psychological study of micro-organisms (Abramson & Levin, 2021). The purpose of this article is two-fold. First, we hope to acquaint students and researchers with the book, "*The Psychic Life of Micro-Organisms: A Study in Experimental Psychology*" (Binet, 1889). Here, Binet suggests that micro-organisms perceive and discriminate among objects and even display purposive behavior. He also provides a review of early literature. Second, we hope to stimulate textbook writers in the areas of Introductory Psychology, History of Psychology, and Comparative Psychology, to mention Binet's contributions to comparative psychology. Moreover, we hope that such writers stress how the skills associated with comparative psychology have wide applicability.

Comparative psychology has been defined as "The application of the comparative method to problems in psychology" (Abramson, 2018, page 3). It is the oldest organized psychology. The term "comparative psychology" appeared as early as 1858 (Abramson, 2018). This predates both the founding of psychology as independent from philosophy in 1879 and the founding of the American Psychological Association in 1892. As reflected in the number of comparative psychology textbooks and review articles, comparative psychology was perhaps the most popular type of psychology in the United States and perhaps worldwide. It is now in decline and has practically disappeared from the psychological landscape with few textbooks, an insufficient number of graduate programs, and limited undergraduate course offerings (Abramson, 2015, 2018).

To estimate the contemporary popularity of the book, a literature review of the twenty years after it was published (1890 – 1920) was performed. The search was constrained since this material is old and the primary source is in French. Nevertheless, two references included mentions of *The Psychic Life* (Bruyere, 1899; Mills, 1904). However, these citations were not reviews of the work, but rather simple mentions that the book is available and interesting. Additionally, one result (included in its entirety below) contains an original notice for the book:

This is a study in Experimental Psychology from the pen of Alfred Binet. We defer to a future number a notice of this interesting little book, recommending our readers in the meantime to obtain a copy of it for themselves in the original French edition or the American translation (*The Psychic Life*, 1890, page 425).

Regarding *The Psychic Life* being cited in textbooks, Herbert Jennings (1906), Margaret Washburn (1908), and Samuel Holmes (1911) cited *The Psychic Life* in some early comparative texts. Surprisingly, Binet's work was not cited in the three-volume set on comparative psychology authored by Warden, Jenkins, and Warner. This is especially odd given that Volume 2 is devoted entirely to invertebrates and plants (Warden et al., 1940). Equally odd, is that Binet's book was not cited in the three-volume set on invertebrate learning (Corning et al., 1973). The second volume of that series was entirely devoted to protozoans through segmented worms (Corning et al., 1973). It was also not cited in the *Handbook of Comparative Psychology* (Greenberg & Haraway, 1989) nor in the comparative texts authored by Morgan (1894), Thorndike (1911), Watson (1914), Moss (1942), Dewsbury (1984), Lester (1973), Lieberman (1993), or Papini (2008, 2021). Munn's (1950) book on the psychology of the rat contains some comparative information on invertebrates (see Appendix II, p. 479) but does not mention the contributions of Binet.

Introductory psychology texts discuss the research of Binet, but they leave out his research in comparative psychology (Coon et al., 2022; Gazzanga & Heatherton, 2003; Gleitman, 1991; Goldstein, 1994; Kassin, 1995; Lahey, 2009; Lefton, 1991; Passer & Smith, 2009). The same is true with history of psychology texts. All mention Binet in the context of intelligence testing and fail to credit the contributions of Binet to comparative psychology (Alexander & Shelton, 2014; Baker, 2012; Fancher & Rutherford, 2012; Goodwin, 2012; Hothersall, 2004; Hunt, 1993; Leahey, 2000; Munger, 2003; O'Boyle, 2006; Pickren & Dewsbury, 2002; Pickren & Rutherford, 2010; Viney & King, 2003). Of the history of psychology texts reviewed, only Schultz and Schultz (2008) describe Binet's previous research in comparative psychology.

Biography

Alfred Binet (née Binetti, 8 July 1857 – 18 October 1911) was born in Nice, France to an artist mother and a physician father. According to biographies, he was always fascinated with behavior and with animals (Fancher & Rutherford, 2012; Wolf, 1973). Although at a young age, his father once forced him to touch a cadaver, this traumatizing experience did not stop Binet from pursuing research in behavior, physiology, dissection, and anatomy. Before his research in comparative psychology, Binet originally pursued a law degree.

Binet spent his days reading philosophy at the Bibliothèque Nationale de France. He found himself enamored with articles about experimental psychology (Wolf, 1973). As an admirer of John Stuart Mill (1806 – 1873, English philosopher), Binet agreed that one's own experiences shaped their character. Like Mill, he argued that intelligence could be explained in part by associationism (Wolf, 1973). In 1883, he began an unpaid assistantship at the Salpêtrière Hospital in Paris, where he remained until 1889.

While at Salpêtrière, Binet was fascinated with “comparative psychology.” He entered a zoology laboratory and practiced dissection for many hours each week (Wolf, 1973). For his doctorate thesis, he put forth a series of original histological and anatomical drawings, entitled “*A Contribution to the Study of the Subintestinal Nervous Systems of Insects*” (Binet, 1894). After the Salpêtrière, the independently wealthy Binet began a second unpaid assistantship, this time at the Sorbonne in Paris (Wolf, 1973). At the Sorbonne, Binet collaborated with Théodore Simon (1873 – 1961, French psychologist) to identify schoolchildren who were mentally challenged. Binet was especially interested in the problem of intellectual disabilities.

Review of *The Psychic Life*

Binet published *The Psychic Life* in 1889 while he was working at the Salpêtrière Hospital in Paris. It is interesting to note that the Wikipedia entry devoted to Binet (https://en.wikipedia.org/wiki/Alfred_Binet) only mentions the book title in the section on Publications. *The Psychic Life* predates his work with Théodore Simon on the development of the Binet-Simon tests.

The edition of the book on which our review is based is the 1889 edition published by Longmans, Green, and Company. The translation from French was provided by Thomas McCormack and contained a preface by Binet especially written for the American edition. Open Court Publishing Company of Chicago Illinois published the American edition and Binet approved the translation.

The book is 121 pages. It contains a preface, introduction, and nine chapters including a conclusion. An appendix is provided as well as addenda. The book contains twelve figures. It offers an early account of the debate on whether micro-organisms are sentient or mere machines. This debate is reminiscent of the account of honey bee learning by the early African American pioneer Charles H. Turner (Abramson, 2009; Abramson et al., 2003). One of the more fascinating aspects of the book is that it contains discussions of the early literature that is now difficult to obtain. Moreover, like so many books from the early history of comparative psychology, it provides the thoughtful reader with many ideas for experiments. An open-access copy of *The Psychic Life* is available at: https://archive.org/details/psychiclifeofmic00bine_0/mode/2up.

The Preface

The purpose of the book is best described by Binet and outlined in five pages. “I have endeavored in the following essay upon Micro-organisms to show that psychological phenomena begin among the very lowest classes of beings; they are met with in every form of life from the simplest cellule to the most complicated organism” (p. i). He sets the foundation for which the study of micro-organisms from a psychological perspective is important and necessary. Later, he contrasts his view with that of George Romanes (1848 – 1894, Canadian–Scots, evolutionary biologist, physiologist) who denies the existence of anything remotely psychological in micro-organisms (p. v).

According to Romanes and other naturalists of the time, only motor movements are present in organisms of the lowest classes. Romanes proposes that the faculty of memory does not enter evolutionary history until the echinoderms, the most familiar of which are star-like marine creatures such as starfish, sea urchins, and sea cucumbers. Binet concisely describes how memory is a simple psychological faculty: an animal possesses memory when they repeat the same action after the same excitation (p. vi). Moreover, Binet reasons that if micro-organisms do not possess psychological faculties, then these abilities must have been added later in evolution (p. vii). Memory, “surprise”, and fear are not psychical abilities only possessed by animals higher on the phylogenetic scale, as Romanes suggests.

The Introduction

The introduction is five pages long. Binet highlights the need to study micro-organisms from the perspective of comparative psychology. The introduction represents a fine illustration of the popularity and importance of comparative psychology at this early date. After the introduction, the book is organized into the following chapters:

Chapter 1: The Motory Organs and the Organs of Sense

Chapter 1 is 27 pages long. Binet includes subsections on motility, the nervous system, and the organs of sense. He also describes the morphology of the motor and sensory organs of micro-organisms. Following the logic of Max von Gruber (1853 – 1927, Austrian bacteriologist), Binet argues in favor of a diffused nervous system among micro-organisms. He reasons that the protoplasm must function as their psychological substrate. This inference is founded on the premises that (a) there is no evidence of central nervous systems within micro-organisms and (b) some unicellular organisms, such as stentors, behave together by moving in unison during replication. To explain the ability of these micro-organisms to move in unison without possessing a central nervous system, Binet and Gruber infer that the functions of the central nervous system must be diffused within the protoplasm of the organisms. The protoplasm of micro-organisms embodies the same functions as the central nervous system of larger species. In this chapter, Binet also considers the organs of touch, sight, and hearing. It is most interesting to note that his descriptions of vegetable micro-organisms include reference to visual organs that resemble those that eukaryotes possess.

Chapter 2: Nutrition

Chapter 2 is four pages long. Binet identifies psychological phenomena connected with respiration. He describes some observations about the “Bacteria Method” of Theodor Engelmann (1843 – 1909, German botanist, physiologist, microbiologist). Engelmann suggests that the production of oxygen by plants depends upon the presence of bacteria. For instance, in green algae, the point where the most oxygen is being released is the same as where the greatest amount of light is being absorbed. Englemann deduces that the behavior of bacteria serves as a guide as to where oxygen is present. Micro-organisms in a space lacking oxygen seemingly sense where oxygen can be found: some cells even extend long filaments to the oxygen source. Binet agrees with the “Bacteria Method” and concludes that the protoplasm of micro-organisms must be capable of supporting the “oxygen sense.”

Chapter 3: The Psychology of Nutrition

Chapter 3 contains 20 pages. Binet discusses the various types of nutrition. He focuses on how various micro-organisms seek nutrition. Some species hunt and even appear to make choices. The bacteria that Binet considers in this chapter move voluntarily. These behaviors lead Binet to consider all psychological life within a greater hierarchy, from protozoa to higher animals.

Chapter 4: Colonies of Unicellular Organisms

Chapter 4 consists of six pages. Binet discusses how temporary colonies are formed. He suggests that some micro-organisms form colonies voluntarily. In the case of some larger colonies of micro-organisms, such as the algae, *volvox*, Binet observes and appreciates the unity of their motion. He argues that if 12,000 micro-organisms can move together in harmony, then their coordinated behavior must be controlled by a diffused nervous system.

Chapter 5: The Psychology of Proto-Organisms

Chapter 5 contains five pages. Binet sets the stage for the remaining chapters by presenting the case that some micro-organisms show volition and choice. It is precisely their responses to environmental stimuli and the ability to choose that suggest a “psychic life.” This psychic life can be compared with other organisms higher on the psychological scale. Binet admits the difficulties in describing their hunting behavior without anthropomorphizing. In their hunt for food, the choices of micro-organisms resemble the choices made by larger organisms. Like humans, micro-organisms also distinguish between and among objects. For instance, they avoid grains of sand, which cannot be eaten. Micro-organisms reject these particles, instead choosing to consume organic matter.

Chapter 6: Fecundation

Chapter 6 is 10 pages long. Fecundation is the process of reproduction. Binet discusses observations by Édouard-Gérard Balbiani (1823 – 1899, French embryologist) and Engelmann on copulation in micro-organisms. From the simplest to the most complex instance of fecundation, a common thread emerges: the old nucleus is transformed into the new. An appendix (four pages long) contains depictions mentioned in this chapter.

Chapter 7: Fecundation in Higher Animals and Plants

Chapter 7 contains 16 pages. Binet compares fecundation in higher animals, such as domestic fowls and amphibians, to fecundation in plants, such as ferns, to fecundation of micro-organisms. Topics in this chapter include sexual selection and the effects of chemicals on fecundation. Of special interest are the observations of Hermann Fol (1845 – 1892, Swiss zoologist) on starfish, Gottfried Berthold (1854 – 1937, German botanist) on zoospores (asexual spores that use flag for movement), and Wilhelm Pfeffer (1845 – 1920, German botanist and plant physiologist) on the movements of spermatozoids. Particularly exciting is the application of Weber’s Law (Pickren & Rutherford, 2010) to describe the threshold necessary to elicit an excitatory response in spermatozoids. This application of Weber’s Law to the behavior of a spermatozoid may very well be the first time the law has been used to describe a micro-organism’s “psychological” behavior.

Chapter 8: The Physiological Function of the Nucleus

Chapter 8 contains 13 pages. Binet describes some experiments on the behavior of micro-organisms with and without a nucleus. He focuses on the experiments of Balbiani and Gruber. To understand the function of the nucleus, Balbiani and Gruber split apart micro-organisms so that only some of the resulting fragments contain a nucleus. Gruber observes that the only fragments able to reconstruct themselves were those which contained a nucleus. Balbiani notices that the fragments without nuclei eventually expire. Based on these experiments, Binet concludes that the nucleus not only has the power to reconstruct an organism but even in the organization of the protoplasm.

Chapter 9: Conclusion

Chapter 9 consists of 11 pages. It contains a challenge to his views by Charles Richet (1850 – 1935, French physiologist). Richet criticizes the “psychology” of micro-organisms. Binet reaffirms his position: his principal arguments include the ideas that micro-organisms select their own food and choose their own conjugal partners. When looking at “psychology under a microscope,” Binet believes that no single-celled organism is too “low” to study on the psychological scale. In doing so, Binet affirms the roots of comparative psychology. The field is neither abstract in concepts, nor practice. Comparative psychology grounds itself on the direct observation of behavior.

Interpretation and Discussion

This book contains a wealth of early information of interest to scholars and students interested in the comparative analysis of behavior. These descriptions of the behavior of micro-organisms force the reader to confront their preexisting notions of psychological phenomena. Binet traces the evolution of psychological life from microscopic organisms. He suggested that psychological processes occur at the cellular level. In this, he was prescient.

One may hypothesize how his early work in comparative psychology, *A Contribution to the Study of the Subintestinal Nervous Systems of Insects* in 1894, and *The Psychic Life of Micro-Organisms: A Study in Experimental Psychology* in 1889 helped him develop the Binet-Simon tests. When developing the Binet-Simon tests, Binet relied on his observational skills to identify and describe the intellectual deficits of French school children. His previous research in comparative psychology and his experiences investigating micro-organisms undoubtedly honed his powers of observation. Moreover, Binet developed an appreciation for the individual psychological differences between organisms. This appreciation likely grew from his experiences as a father and as a comparative psychological researcher.

In addition to the development of observational skills and an appreciation of individual differences, Binet learned that behavior could be quantified, as exemplified by the application of Weber's Law to micro-organisms. It would be churlish to deny that these experiences did not influence the development of his tests. His early experience with micro-organisms is similar to the experience of Sigmund Freud (1856 – 1939, Austrian, neurobiologist, psychoanalyst). Before Freud developed psychoanalysis, he was considered a pioneer in crustacean neurobiology (Florey, 1990; Frixione, 2003). We believe that there is little doubt that the observational skills Freud mastered in his research on the crustacean nervous system were applied to his views of psychoanalysis. It is important to note that the theories of Freud were based on his observations of clients rather than direct experimentation. In conclusion, *The Psychic Life* offers the young scientist many starting points for new experiments. We encourage textbook writers and future scholars to acknowledge the role that comparative psychology played in the “psychic life” of Binet and its possible role in the development of the Binet-Simon tests.

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