SOME NEGLLECTED CONTRIBUTIONS OF WILHELM WUNDT TO THE PSYCHOLOGY OF MEMORY

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Summary.—Wilhelm Wundt, whose name is rarely associated with the scientific study of memory, conducted a number of memory experiments that appear to have escaped the awareness of modern cognitive psychologists. Aspects of Wundt's system are reviewed, particularly with respect to his experimental work on memory. Wundt investigated phenomena that would fall under the modern headings of iconic memory, short-term memory, and the enactment and generation effects, but this research has been neglected. Revisiting the Wundtian perspective may provide insight into some of the reasons behind the historical course of memory research and in general into the progress of science in psychology.

Current cognitive psychologists rarely associate the name Wilhelm Wundt with the scientific study of memory. Indeed, modern cognitive psychology textbooks do not contain information about Wundt's interest in memory (the only known exception is Blumenthal, 1977), and even some of Wundt's own writings appear at first glance to place little importance on the topic (e.g., see 1897/1969a, p. 11). According to some historians, Wundt considered memory to be useful only for an analysis of individual differences in conscious processes and did not believe that memory should be represented as a category in psychology (Danziger, 2001a). Wundt was reluctant to conceptualize memory as a measure of retention, a view more consistent with Ebbinghaus who would later be so influential in memory research (see Wertheimer, 1986). It seems that Wundt altogether dismissed the concept of memory, a topic studied from antiquity and one which seems to fit so well within a science wherein mental processes are investigated.

Wundt did not actually exclude the concept of memory from psychology. He merely refused to conceptualize memory as a psychological category, reflecting his disdain for the earlier faculty psychology (Danziger, 2001a). Wundt's terminology also differed from that of contemporary cognitive psychology, so his memory research is not immediately apparent to a modern reader. For example, Wundt's experimental work on memory is not found

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under the heading memory. Rather, it is described under the headings scope of attention, scope of consciousness, or temporal ideas (see Wundt, 1897/1969a, 1912/1973). A careful examination of these sections of Wundt's work, however, shows he conducted a number of studies that clearly fall within what is called memory research today. Wundt and his students were conducting memory experiments at Leipzig during the same years that Ebbinghaus was conducting his now classic study at Berlin (Ebbinghaus, 1885/1913). However, Wundt's work on memory was never as influential as that of Ebbinghaus and is largely neglected in both historical and contemporary accounts.

The purpose of the current paper is to highlight the less familiar components of Wundt's psychology that deal with memory, specifically: (1) a brief description of Wundt's model of memory processes, (2) key memory experiments Wundt conducted, and (3) reasons for Wundt's failure to influence subsequent research. Wundt did not influence the course of memory research outside of his own laboratory. However, some of the findings produced by his studies closely resemble those of later research, most of which do not refer to Wundt's earlier work. The goal of this paper is not to provide a theoretical treatment of Wundt's memory research (for this, see Wundt, 1911) but, rather to emphasize the apparent similarities in findings between Wundtian and post-Wundtian memory studies. These findings and their implications are discussed later. First, consider a brief overview of Wundt's approach to memory.

Wundt's Psychology of Memory

Background

Wundt did not invest psychology in the fall of 1879 in Leipzig, Germany. In fact, the term psychology had already been introduced long before that, and research that would later be considered physiological psychology was being conducted by well-known figures such as Helmholtz, Hering, and Mach (Diamond, 2001). The new psychology was not based exclusively on Wundt's systematic viewpoint, but Wundt is properly regarded as the first to operate a functional research laboratory (Blumenthal, 1997).

Wundt defined psychology as the science that investigates "the facts of consciousness, its combinations and relations, so that it may ultimately discover the laws which govern these relations and combinations" (1912/1973, p. 1). Unconscious processes, on the other hand, were "entirely unproductive for psychology" (1897/1969a, p. 208). Wundt did not reject the idea

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1Definitions of memory phenomena described in this paper are derived from Wundt's translated introductory texts. For a more detailed analysis of the development of Wundt's theoretical treatment and definitions of memory, interested readers are referred to the sixth edition of the untranslated Grundzüge der physiologischen Psychologie (Wundt, 1911).
that there are unconscious processes, nor did he deny that they may influence conscious experience. Rather, Wundt's conviction about the uselessness of unconscious experience was derived from his belief that the nature of the unconscious is unknowable. The scope of psychological science, therefore, must be restricted to conscious processes.

Wundt attempted to explain the nature of consciousness through a synthetic approach, in which simple sensations and feelings combine to form more complex ideas. He defined *psychical elements* as "absolutely simple and irreducible components of psychical phenomena" (1897/1969a, p. 28). Elements include sensations such as light and heat, along with the feelings that accompany them. Multiple combinations of elements result in the formation of *psychical compounds*, which are more complex phenomena such as ideas and emotions. Compounds can also be interconnected through the elements shared between them, and this interconnection among compounds is what Wundt referred to as *consciousness* itself (p. 203).

Wundt distinguished between simultaneous and successive types of associations to explain how the interconnection among compounds takes place. When many of the same elements are shared between compounds, the interconnection is simultaneous and somewhat automatic, a process Wundt referred to as *assimilation* (1897/1969a, p. 228). For example, the ability to comprehend spoken speech results from assimilating the sounds of the spoken words with previous encounters of the same words. If the spoken words and previously encountered words share many of the same elements, e.g., phonological characteristics, then comprehension seems to take place rather automatically, without a clear separation in time between hearing the word and understanding its meaning.

Successive associations, on the other hand, take place when fewer of the same elements are shared among compounds. In this case, the interconnection is not automatic, but instead there is a clear separation in time between the first idea and subsequent ideas. For example, identifying an acquaintance after an extended absence does not occur automatically, given the presence of dissimilar elements, e.g., changed physical characteristics, between the past and present encounters. Instead, there is a clear act of perception followed by an act of recognition, and these are experienced as two successive events. The second event, recognition, was an important feature of Wundt's conceptualization of *memory* (see Wundt, 1912/1973, p. 104).

**Wundt's Associative Model of Memory**

*Recognition*, according to Wundt, occurs when an object is identified as one that has been previously encountered, based on the presence of similar elements in both past and present ideas about it. Unlike assimilation, however, recognition involves a number of dissimilar elements between past and
present ideas. These dissimilar elements are not assimilated, but instead remain in the more obscure regions of consciousness, having their influence in the awareness that the idea is somehow familiar. Wundt referred to this awareness as the "feeling of familiarity" (1897/1969a, p. 237). Recognition could be immediate—in which familiarity is quickly apparent and perception and recognition are less distinguishable from one another—or mediate, in which a time interval elapses before familiarity is produced, leading to a more pronounced inhibition between perception and recognition such that an object cannot be recognized without the help of some accompanying attribute(s). To illustrate, Wundt gives the example of a man who is recognized because he is with a particular companion, rather than through his own characteristics (p. 239).

The memory process, according to Wundt, occurs when all of the dissimilar elements between a past and a present idea combine among themselves to form a special compound, called a memory image, that directly refers to the past idea (1897/1969a, p. 241). Unlike a successive association in which the two events of perception and recognition refer to the same object, e.g., the acquaintance above, the memory image does not refer to the object being perceived but rather to the circumstances present during the past experience with that object. For example, one may perceive and recognize a specific type of flower (successive association), which brings to mind the experience of a past vacation (memory image) in which the flower was first encountered.

Wundt's entire definition of memory consisted of successive associations among ideas currently in consciousness. In this way, Wundt's definition bears some resemblance to modern concepts of short-term or working memory. This conceptualization is quite different from that of Ebbinghaus, who viewed memory as a measure of retention. Clearly, it was Ebbinghaus, not Wundt, whose views most strongly influenced subsequent memory research during the 20th century. Although Wundt's approach was very different from that of Ebbinghaus, he still found the study of memory useful in ways that were more suited to his conceptual framework. Instead of measuring retention, Wundt was measuring the nature of associations between ideas in consciousness. Memory, according to Wundt, made up only a small part of these associations.

**Wundt's Memory Research**

Wundt's definition of memory helps in understanding key features of his methodology that may seem unusual to modern researchers. Wundt's memory experiments were carried out in a single trial, using nonverbal materials (such as pictures, colors and tones), and usually relied upon measures of recognition rather than recall (see Scheerer, 1980). Although these design
features contrast with those of the more popular multitrial list learning experiments, they were well-suited to Wundt's purpose of identifying the associative processes responsible for the interconnection among ideas. For example, yes/no recognition measures made it possible to control the number of shared elements between the standard and the comparison stimulus, single-trial experiments helped maintain the number of associations at a controllable level, and nonverbal stimuli reduced the familiarity of the materials to obtain a more pure association that would not be possible with verbal items. Some of Wundt's memory experiments are reviewed here, specifically with regard to the similarity in results obtained by Wundt and later researchers. The discussion of these studies is based on effects as described by contemporary terminology and not by Wundt.

**Iconic Memory**

Wundt was interested in exploring the boundaries of consciousness. Specifically, he was interested in the number of elements that could be held in consciousness following brief exposure, a concept he referred to as the **scope of attention** (1897/1969a, p. 210). To investigate this, Wundt arranged 95 single letters in circular fashion around a central fixation point (1912/1973, p. 19). The participant was required to focus on the central fixation point while the letter array was presented very briefly via a tachistoscope and then hidden again. Following the presentation, the participant reported which letters were remembered. Wundt carefully replicated these experiments using different letter arrays and different observers and consistently found that the number of letters successfully remembered was sometimes as few as three but never more than six (1912/1973, p. 24).

Wundt’s experiments on the scope of attention are cited in Sperling’s well-known study (1960) of iconic memory. Sperling relied upon the same method used by Wundt, but he used an array of letters varying between three and twelve (three rows of four) instead of 95, and instructed participants to recall the letters in different ways. Under **whole report instructions**, participants were required to recall any of the letters in the array, whereas under **partial report instructions**, they were required to recall only one row of letters. Participants in the partial report condition were informed prior to stimulus presentation that they would be asked to recall only one row but were not informed about which row to recall until after stimulus presentation. Sperling found that participants recalled about three letters per row in the partial report condition, and between three and five letters in the whole report.

Although Wundt usually relied upon nonverbal items, the use of letters is necessary in this experiment because, by virtue of their familiarity, letters are perceived as more distinct than nonverbal items, e.g., dots, which renders them better contained in consciousness and easier to report (see Wundt, 1912/1973, p. 24).
report condition. Although Sperling credits Wundt's earlier work, few people today know that Wundt conducted some of the first experiments in this area and found results similar to those of Sperling's more recent, well-known research.

**Span of Immediate Memory**

Another one of Wundt's techniques for investigating the boundaries of consciousness was the metronome experiment (1912/1973, p. 2). A same/different recognition judgment was required for two sequences of metronome beats, e.g., sequences were varied according to time interval between beats, and the number of beats was increased until the participant could no longer determine whether the two sequences were the same or different. The maximum number of beats at which the participant could still successfully distinguish the two sequences represented the number of elements that could be contained in consciousness at one time, which Wundt referred to as the scope of consciousness (1897/1969a, p. 211). The scope of consciousness consisted of about 18 beats when no rhythm was apparent in the sequences. However, when rhythm was introduced to the sequences (by manipulating accents on some of the beats), the scope of consciousness increased to about 40 beats (1912/1973, p. 11).

The results of Wundt's metronome experiments are consistent with the more recent research on the capacity of short-term memory. Miller's (1956) well-known article illustrates how information in short-term memory is consistently limited to about seven items, plus or minus two. Through the process of chunking, individual items can be combined to form meaningful units, and the short-term memory capacity for these meaningful units is the same as that for individual items. In this way, a large number of individual items can be recollected if they are chunked into meaningful units. Miller describes a study involving memory for binary sequences of digits, in which the number of these digits that could be retained without chunking was about nine, whereas the number that could be retained with chunking increased to about 40. Not only are these values similar to the results of Wundt's metronome experiments, but Wundt also gives a detailed description of how the scope of consciousness is increased when items are grouped together into meaningful wholes (1912/1973, pp. 2-11). Miller does not refer to Wundt's work in this area, however, and may not have been aware of Wundt's contributions.

**Forgetting From Short-term Memory**

In exploring the scope of consciousness, one of the factors Wundt manipulated was the presentation rate of metronome beats. When the presentation rate for the sequence was slowed down, recognition accuracy declined. Wundt explains, "When the rate of succession is slower...it becomes im-
possible to combine successive impressions to a temporal idea; by the time a new impression arrives, the preceding one has already disappeared from consciousness” (1897/1969a, p. 215). Thus, forgetting occurs when some elements of a sequence are no longer present in consciousness, so that the entire sequence cannot be perceived as a meaningful whole. Wundt’s experiments demonstrated that not only does the scope or span of consciousness depend on the number of elements present, but it also depends on the passage of time.

Wundt’s results are consistent with later experiments on forgetting from short-term memory, which also observed the inverse relationship between time interval and accuracy of memory. For example, in Peterson and Peterson’s well-known study (1959; see also Brown, 1958), participants were required to remember a three-letter stimulus after counting backwards for a time interval that lasted between 3 and 18 sec. Accurate recall of the three-letter stimulus declined rapidly with increasing time intervals, which was interpreted as support for a decay theory of forgetting. Wundt’s notion of impressions “disappearing” from consciousness seems to be similar to the more recent conceptualization of decay. However, references to Wundt’s work have not been found in any of the more recent research on forgetting from short-term memory.

Enactment and Generation Effects

Another Wundtian memory experiment was conducted by one of Wundt’s graduate students. Berlage (cited by Scheerer, 1980) studied recognition for sung vowels as a function of a varied retention interval, to find that accuracy was higher when the vowel was sung by the research participant rather than by another person. In modern memory research, this finding might be referred to as the enactment effect—the advantage in memory for material associated with actions carried out, i.e., “enacted,” by the participant as opposed to another person (Engelkamp, 1998)—or, the generation effect, the advantage in memory for information that is produced, i.e., “generated,” by the participant as opposed to another person (Slamecka & Graf, 1978). The results of Berlage’s study are quite similar to those from these much more recent studies.

Modern researchers of the enactment and generation effects do not seem to be familiar with Wundt’s earlier work, perhaps in part because Berlage’s study is available only in the original German. Furthermore, Wundt did not incorporate the advantage in memory for self-enacted or self-generated material into his model of memory. He attributed this finding to the simple act of subvocal articulatory rehearsal (Scheerer, 1980). Nonetheless, it is noteworthy that Wundt’s memory studies were producing results consistent with some that would not be generated for many decades.
Wundt’s Lack of Influence on Memory Research

Wundt and his students carried out a number of memory experiments at Leipzig. However, these studies have not received the large number of citations that have been made of Ebbinghaus’s classic study (1885/1913). By the end of the 19th century, the Ebbinghaus approach was clearly favored over the Wundtian approach (Danziger, 2001a), which helps to explain why memory research over the 20th century took the course it did.

Wundt’s associative model of memory, with its emphasis on the interconnections between elements in consciousness, was not very useful for understanding the complexities of everyday memory outside of the laboratory. The approach of Ebbinghaus was more relevant to daily life and thus appealed to the public’s curiosity about memory (for more on this point, see Danziger, 2001a). Offering something useful to the nonscientific community turned out to be an important step in psychology’s early struggle for recognition and an approach that could satisfy applied interests helped support recognition of the usefulness of psychological research on memory (Shore, 2001). Even some of Wundt’s own students abandoned the Leipzig memory paradigm to pursue what they considered to be more fruitful avenues consistent with the Ebbinghaus approach. For example, Ernst Meumann became convinced of the value of memory research in learning and education (e.g., see Meumann, 1912). By the 1890s the psychological laboratory at Göttingen, headed by George Elias Müller (an opponent of Wundt’s method), surpassed the laboratory at Leipzig in technological apparatus for studying memory (Haupt, 2001). The combination of more sophisticated methodological techniques and theoretical agnosticism allowed the later researchers to produce large amounts of data without strict theoretical limitations, a trend Blumenthal (1985) referred to as experimentalism.

Applied research on memory was especially popular in America, where the tendency was to expand, rather than restrict, the definition of memory and the methods used to study it (Shore, 2001). Wundt refused to carry out research in the interests of application (Danziger, 2001a), so his approach was never popular in America, where research in applied psychology was promoted during the first and second World Wars but not in Germany (Blumenthal, 1997). Following Germany’s economic decline after World War I (corresponding closely to the time of Wundt’s death in 1920), Wundt’s complete library was sold to Tohoku University of Sendai, Japan, because the Wundt family would not allow the collection to belong to an American university (Takasuna, 2001). Wundt’s approach could have been made accessible via his American students who were willing to carry on the Wundtian legacy of experimental psychology, but these students were not interested in doing so (Rieber, 2001). Wundt’s entire approach to psychology was abandoned by the new generation of psychologists because the range of pheno-
mena that could be studied was limited. As Danziger (1990) put it, "Virtu-
ally everything that happened in modern psychology was a repudiation of
Wundt" (p. 34).

CONCLUSION

Wundt conducted a good deal of memory research that seems to have
escaped the attention of cognitive psychologists today. Furthermore, several
of Wundt's experiments yielded findings that were later rediscovered by
well-known researchers who seemed unaware of Wundt's work, specifically
in regard to the span of immediate memory, forgetting from short-term mem-

Wundt's unwillingness to carry out applied research (which may have
contributed to the demise of his approach) reflects his strict adherence to a
method firmly grounded in a theoretical framework. However, the image of
Wundt presented in most cognitive psychology textbooks today does not
seem to reflect adequately his belief in the importance of methodology in
the context of theory-driven research. The method commonly associated with
Wundt is introspection, a sort of free association about feelings, sensations,
etc. that presumably yields information concerning the structure of mental
contents. However, historical treatments of the topic are making it increas-
ingly clear that Wundt was neither an introspectionist of this sort nor a
"structuralist" (e.g., Blumenthal, 1975, 1979, 2001). Consider an example
from Wundt's own writings on the methods of psychology:

The contents of this science are exclusively processes, not permanent objects. In order to invest-
igate with exactness the rise and progress of these processes, their composition out of various
components, and the interrelations of these components, we must be able first of all to bring
about their beginning at will, and purposely to vary conditions of the same. This is possible
here, as in all cases, only through experiment not through mere introspection (Wundt, 1897/
1969a, p. 20).

Wundt believed that humans take an active role in these mental processes,
and as such, his thinking is better characterized as voluntarism than struc-}

tralism (Danziger, 2001b). Furthermore, he clearly stated in the above quota-
tion that these processes must be investigated by experimentation and not
by introspection." Developing a more accurate picture of Wundt may indi-
cate that modern cognitive psychologists have more in common with him
than was once believed.

It is not altogether surprising that modern researchers do not refer to

7Wundt used the term introspection in two ways: first, to describe the mere act of self-observa-
tion and, second, to describe the experimental method for varying conscious processes in a way
that is more objective and accurate, the latter being the only type of introspection amenable to
scientific study (Wundt, 1873/1969b, p. 7; see also Danziger, 1990, p. 35).
Wundt’s work on memory. Data are usually given meaningful interpretation only within the theoretical framework from which they were derived, and it is clear that the theoretical frameworks of today bear little resemblance to those offered by Wundt. The phenomena which Wundt and his students were investigating within the framework of “scope of consciousness” were conceptualized differently from similar empirical phenomena that are investigated today within the framework of “information processing.” The similar findings produced by these two perspectives have been treated as independent contributions, a bit of evidence that scientific research often does not progress in a linear fashion. Apparently, several empirical phenomena needed to be rediscovered because there was lack of awareness of prior work combined with different approaches to similar problems.

Progress in any discipline depends upon an awareness of the history of past approaches—why they succeeded and why they failed. Scientific perspectives are certain to change in the course of time, and knowledge of these perspectives helps explain present ones and can guide how future ones should be improved. This review of Wundt’s approach to memory, based on work translated into English, is intended to shed some light on one very interesting perspective that seems to have been neglected for some time.

REFERENCES


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