The Würzburg School

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In 1896 the Institute of Psychology was founded in the „Alte Universitaet“ in Wuerzburg.

The foundation of the Würzburg School in 1896

In 1894, Oswald Külpe was appointed professor of philosophy and aesthetics at the University of Würzburg. Two years later, in 1896, together with Karl Marbe, he founded an institute of psychology modelled on the Wilhelm Wundt Institute in Leipzig, where he had worked with Wundt from 1887 to 1894. One of the main subjects of research at the Würzburg institute was the examination of thought processes and their control by volition. Subjects (usually colleagues at the institute) were given simple tasks to make them think: for example, they had to add two numbers or say whether they had understood a sentence such as

> *„One should not look for the rogues among the criminals but among those who do not commit crimes". („Unter den Verbrechern soll man nicht die Schufte suchen, sondern unter denen, die nichts verbrechen").*

In addition, the subjects were asked to describe the processes preceding their answers as precisely as possible. An analysis of these experimentally induced self-observations led the experimenters to conclude that the thought processes observed could not be explained as the result of associative connections between images alone. Rather, they believed that there were *imageless factors* which imparted a direction to the thought processes and determined their course. These considerations were in sharp opposition to the prevailing associationism at that time and were attacked vehemently by its followers, Wilhelm Wundt in particular. It is probably as a result of this at times passionate dispute that the concepts developed at the Würzburg institute evolved into a school of psychology and the methods used to analyse the factors which determine the structure of thought processes were increasingly refined.

Oswald Külpe and Karl Marbe as well as Karl Bühler and Narziß Kaspar Ach were the main figures behind the movement known as the Würzburg School. Otto Selz, who had worked under Oswald Külpe when he taught in Bonn, joined them later. The work of these researchers played an important role in establishing the analysis of „complex" mental processes with direct experimentation as an integral part of psychological research. Thus they have helped to lay the foundation for today's cognitive psychology.

Other co-workers at the Würzburg institute:
Henry Jackson Watt (1879 - 1925), August Messer (1867 - 1937), Johannes Orth (1872 - 1949), August Mayer (1874 - 1951) as well as Ernst Dürr, Adolf Grünbaum, Johannes Lindworsky, Friedrich Schulze and Charles Taylor

Oswald Külpe (1862 - 1915). In Würzburg (1894 - 1909)

Oswald Külpe

Born:	3 September, 1862, in Candau.
1881	Went to the University of Leipzig to study history and philosophy. Became more interested in philosophy and experimental psychology after attending Wilhelm Wundt's lectures.
1882-1883	Studied in Berlin (in particular history under Mommsen und Kirchhoff).
1883-1885	Studied in Göttingen under G.E. Müller, who inspired his work on „sensual feeling".
1886	Returned to Leipzig and worked on his dissertation for Wilhelm Wundt.
1887	PhD „On the theory of sensual feeling".
1887-1894	Assistant at the Institute of Psychology in Leipzig.
1888	Postdoctoral thesis on „The theory of will in modern psychology".
1894-1909	Professor of Philosophy and Aesthetics at the University of Würzburg.
1896	Founded the Institute of Psychology in Würzburg together with Karl Marbe.
1909-1913	Professor in Bonn.
1913-1915	Professor in Munich.
Died:	30 December, 1915, in Munich.

Külpe's most important contribution: The extension of the subject of experimental psychology

For Wilhelm Wundt only the simpler psychical processes of sensation and presentations (*Vorstellungen*) could be analysed by experimental study. In his opinion, access to the higher psychical processes could only be obtained by using the comparative methods of ethnic psychology. In 1909, in „Grundriß der Psychologie" (Outlines of Psychology) he wrote (p. 29):

> *„Thus, psychology, like natural sciences, has two exact methods: the first, the experimental method, serves to analyse the simpler psychical processes; the second, the observation of general mental products, serves the investigation of the higher psychical processes and developments."*

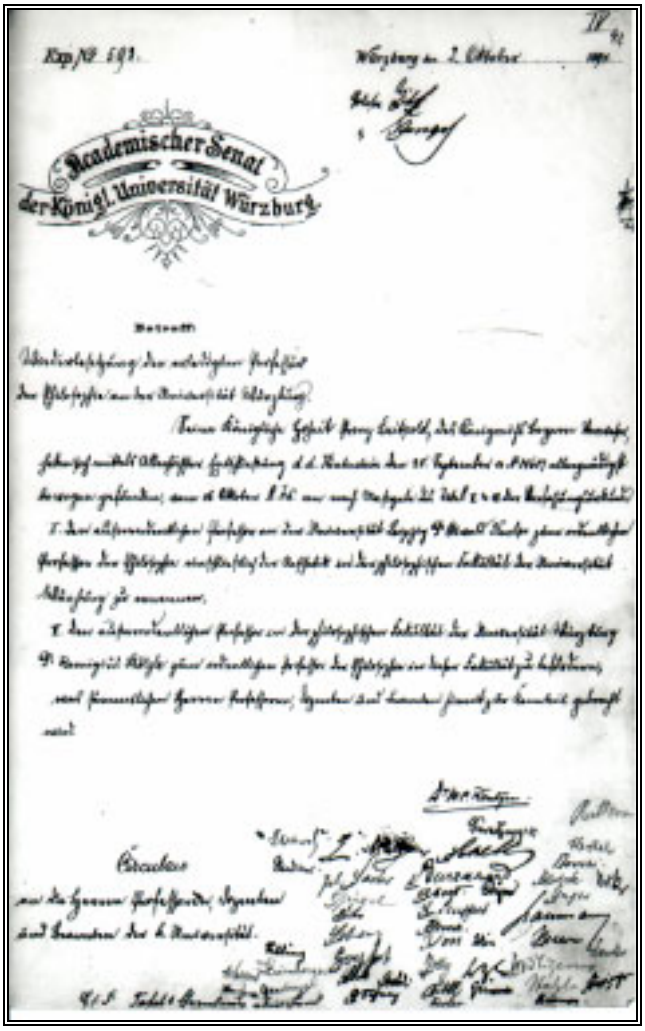
His pupil Külpe, however, came to the conclusion that an application of experimental methods was also possible for the investigation of higher psychical processes - in particular think-

ing. He encouraged procedures for the controlled induction of such processes and their systematic self-observation and thus opened up psychological research to areas such as judgement, knowing, understanding and interpreting. Looking back, in his work „Über die moderne Psychologie des Denkens“ (On the modern psychology of thinking) (1912, p. 1077), he wrote:

> *„What finally led us to a different theory in psychology was the systematic application of self-observation. It used to be common not to have the subjects report after the experiment on everything they had experienced during the experiment. Thus only a rough picture was obtained. In addition, the use of the common conceptions of sensations, feelings and presentations prevented the subjects from noticing and naming what was neither sensation, feeling nor presentation. As soon as we began to make people experienced in self-observation to give a complete and impartial report immediately after the experiment on what they had experienced during the experiment, the necessity for inventing new conceptions and definitions became obvious. One discovered in oneself procedures, states, directions and acts which did not fit in with the system of older psychology. The subjects began to speak in the language of life and assign less importance to the presentations for their inner world. They knew and thought, they judged and understood, they grasped the meaning and saw connections without receiving any real help from occasionally occurring imagery.“*

Why there nearly was no Würzburg School!

In 1894, the chair for philosophy and aesthetics in Würzburg became vacant and the commission first decided on Theodor Lipps as Johannes Volkelt's successor. As Lipps had already been offered a post in Munich, there seemed little point in offering him the chair in Würzburg. The next candidate was Prof. Falkenberg from Erlangen. It was only when he declined the Würzburg chair that Oswald Külpe was offered it. Later, in 1913, Külpe became Lipps' successor in Munich.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The most important pupils

In addition to the members of the Würzburg School, several world-renowned psychologists did dissertations for Oswald Külpe or worked with him for a time. Among them were Max Wertheimer, Kurt Koffka, Richard Pauli, Albert Michotte and Charles Spearman.

Karl Marbe (1869 - 1953). In Würzburg (1896 - 1905; 1909-1935)

Karl Marbe

Born:	31 August, 1869, in Paris.
1887	Went to Freiburg to study German, philosophy and psychology (Attended lectures by Münsterberg).
1890	Studied in Bonn.
1890-1891	Studied in Berlin (Attended lectures by Ebbinghaus).
1891	Studied in Paris, worked with Binet.
1891-1893	Resumed studies in Bonn, completed dissertation on „Untersuchungen zur pschologischen Optik und Akustik“ (Investigations of psychological optics and acoustics).
1893	Spent one year in Leipzig with Wilhelm Wundt, worked with Oswald Külpe.
1894	Worked in the private laboratory of Götz Martius in Bonn.
1896-1905	Lecturer in Würzburg for Külpe, with whom he founded the Würzburg institute. Postdoctoral thesis on „Zur Theorie des Talbot’schen Gesetzes“ (On the theory of Talbot’s law).
1905-1909	Professor at the Frankfurt Academy for Social and Commercial Sciences.
1909-1935	Professor in Würzburg, succeeded Oswald Külpe as head of the Würzburg institute, in addition from 1926 to 1931 Director of the Institute of Psychology of the School of Commerce in Nuremberg.
1935	Retired.
Died:	2 January, 1953, in Würzburg.

Karl Marbe, the „inventor“ of controlled self-observation

August Mayer and Johannes Orth, who were both pupils of Karl Marbe, published the first report on the results of controlled self-observation in the „Zeitschrift für Psychologie und Physiologie der Sinnesorgane“ (Journal for the psychology and physiology of sensory organs) in 1901. The title was „Zur qualitativen Untersuchung der Assoziation“ (On the qualitative investigation of association). A stimulus word was presented to the subject, who had to react to it by saying a word out loud. Immediately after having said the reaction-word, he was asked to

„report all conscious events which had gone on from the moment the stimulus word was given to the end of the reaction."

As the self-observations of this first investigation were not very fruitful, Marbe used tasks which were able to evoke more extensive conscious events: for example, the subjects had to determine which of two weights was heavier; to imitate the tone of a tuning fork; to answer simple questions (e.g. *„How long is a foot?"* or *„How many works did Anaximander write?"*); or to judge the accuracy of sayings such as *„One swallow does not make a summer"*. The results of these investigations were published in the monograph „Experimentell-psychologische Untersuchungen über das Urteil" (Experimental psychological investigations of judgement) in Leipzig in 1901. In one part, Marbe expresses one of the most important theoretical conclusions (p. 43):

„The present data are quite sufficient to draw the conclusion that no psychological conditions of judgements exist regardless of the nature of the experiences which become judgements in a given case."

and in another part he writes (p. 94):

„Thus in future one will no longer have the right to discuss problems of psychological judgement unless one is able to justify them by experiment."

Oswald Külpe as Karl Marbe's subject

The persons examined by Marbe were, without exception, colleagues from the institute, and also included Oswald Külpe. Below are some of the original protocols.

Task	Külpe's report
Subject hears the words „Where are we going afterwards?"	Acoustic-motor pronunciation of the words „To the cafe". But the words „Wherever you want" competed. State of consciousness which can be called doubt.
The question „Which do you think is the most commonly used particle in the German language?" is asked.	Reflective, acoustic - motor pronunciation of „and". Subject has an optical picture of the written word at the same time.
Two cylindrical objects differing in weight but not in appearance have to be lifted one after the other. The one which appears to be heavier has to be turned over. The objects weighed 25 and 110 grams.	Before turning over the weight, the acoustic pattern of the word „umkehren" (turn over) entered the subject's consciousness. (The subject did not feel any sensations apart from pressure and kinæsthetic sensations).

Marbe as an applied psychologist and methodologist

Karl Marbe was extremely interested in the problems of applied research and the development of new methods, as shown by the following selection of relevant publications:

(1896) Neue Methode zur Herstellung homogener grauer Flächen von verschiedener Helligkeit (A new method for the production of homogeneously grey areas of differing brightness)

(1908) Die Verwendung rußender Flammen in der Psychologie und deren Grenzwissenschaften (The use of sooty flames in psychology and its border sciences)

(1932) Über mathematische Wahrscheinlichkeit und Erfahrung (On mathematical probability and experience)

(1913) Grundzüge der forensischen Psychologie (Outlines of forensic psychology)

(1926) Praktische Psychologie der Unfälle und Betriebsschäden (Practical psychology of accidents and industrial damage

(1927) Psychologie der Werbung (Psychology of advertising)

(1928) Psychotechnische und faktische Eignung (Psychotechnical and real aptitude)

(1931) Die Abhängigkeit der Schulleistungen von Lebensalter und Millieu (The dependence of performance at school on age and class).

The most important pupils

Wilhelm Peters, Maria Schorn, Maria Zillig, Theodor König

Karl Bühler (1879 - 1963). In Würzburg (1907 - 1909)

Karl Bühler

Born:	27 May, 1879, in Meckesheim.
1899	Went to Freiburg to study medicine.
1903	PhD in medicine in Freiburg for Johannes v. Kries on the physiological theory of seeing colour.
1904	PhD in philosophy in Strasbourg for Clemens Baeumker on the psychology of Henry Home (Lord Kames).
1904-1907	Studied in Berlin under Stumpf and in Bonn under Erdmann.
1907-1909	Assistant to Külpe in Würzburg. Postdoctoral thesis on „Tatsachen und Probleme einer Psychologie des Denkens“ (Facts and problems of a psychology of thinking).
1909	Went to Bonn with Külpe.
1913-1914	Went to Munich with Külpe (Associate professor).
1918	Professor at the Technical University of Dresden.
1922-1938	Professor at the University of Vienna.
1926/27/29	Visiting professor in the USA (Stanford, Johns Hopkins, Harvard, Chicago).
1938	Briefly imprisoned by the Nazis. Emigrated first to Oslo, later to the USA.
1939	Scholastica College in Duluth, Minnesota, USA.
1940-1945	St. Thomas College, St. Paul, Minnesota, USA.
1945-1955	University of California, Los Angeles.
1960	Honorary president of the 16th International Psychology Congress in Bonn.
Died:	24 October, 1963, in Los Angeles.

Karl Bühler’s contribution to the acknowledgement of the Würzburg School

It is generally acknowledged that it was with the publication of Bühler’s postdoctoral thesis in the journal „Archiv für die gesamte Psychologie“ 1907/1908 and Wilhelm Wundt’s critical reflection on it that the Würzburg research came to be accepted as a consistent approach. Some important passages are quoted here:

The aim

> *„We ask the general question: What do we experience when we think?“ (p. 303)*

The method

„The most natural way to make someone think is to ask him a question. If this question is put in such a way that it can be answered with Yes or No, ... the subject will be able to tell us afterwards how he arrived at this Yes or No. ...My subjects were professors or had PhDs in philosophy. I will give you some examples of the questions I asked them: Was the theorem of Pythagoras known in the Middle Ages? Can the atomic theory of physics ever be shown to be untenable by any discoveries? Does monism really mean the negation of personality?“ (p.304)

Some results

„If we consider everything the subjects reported, the sensory presentations stand out from the others as a group of bits of experience which can easily be characterised, ...Then come feelings and the peculiar stretches of consciousness described as doubt, astonishment, recollection, expectation, ... for which one can retain as a provisional designation the term Bewußtseinslage (states of consciousness) coined by Marbe. But this is not all. The most important bits of experience are something that, in all the categories through which these formations can be defined, are not touched at all. Something which before all shows no sensory quality, no sensory intensity ...These entities (Stücke) are what the subjects, using Ach's term, have designated as awarenesses, or sometimes as knowing, or simply as 'the consciousness that', but most frequently and correctly as thoughts. Thought, that is also the term proposed by Binet.“ (p. 316)

„The thoughts alone can be regarded as the real constituent parts of our thought experiences.“ (p. 317)

„According to Wundt, it is almost a psychological demand that each act of thought has to be represented in our consciousness in the form of certain single presentations. But our protocols demonstrate this theorem as completely wrong. There are thoughts without any trace of imagery.“ (p. 318)

A careful analysis of the protocols of his subjects led Bühler to distinguish different types of thought, some of the most important of which are mentioned below:

- The Regelbewußtsein (consciousness of a rule): *„It is the coming to consciousness of a method of solution, ...knowing how to solve a problem in general.* (p. 335*) It is not simply thinking about a rule, rather it is thinking of a rule or in the form of a rule.“* (p. 339)
- The Beziehungsbewußtsein (consciousness of relation): *„If all that the subject remembers of the thought ‘How can the worm in the dust attempt to work out where the eagle will fly to’ is: the thought contained an opposition, then we can assume that the consciousness of an opposition was contained in the first experience as a ‘moment’.“* (p.343)
- The Intentionen (intentions): *„The thoughts which Husserl would describe as purely signitive acts are among the most striking thought experiences. In the ‘intentions’ the act of meaning, rather than what is meant, is in the foreground; it is as if the What were already fixed and the thought only consisted in the relation to this already fixed fact.“* (p.347)
- The Aha-Erlebnis (the aha experience): *„The subject encounters a rather difficult new thought, hesitates a moment, and suddenly comprehends as if by enlightenment. This leads us to the more general question as to what actually happens up to the moment when the characteristic ‘Aha’ occurs ...our protocols leave no doubt as to the fact ...that the characteristic experience of comprehension takes place between two wholes.“* (p.14)
- The Erinnerungserlebnis (the experience of remembering*): „There are (ideal) conscious relations to earlier experiences without a reliving of them.“* (p.62)

Karl Bühler, the language and developmental psychologist

In addition to the research on the psychology of thought of the Würzburg School, Karl Bühler made important contributions to the psychology of speech and, together with his wife Charlotte Bühler, to developmental psychology. His examination of the concept of sign in the book „Sprachtheorie“ (Speech theory) (1934) and the organon model of speech he developed in it formed an important basis for psychological language research. His book „Die geistige Entwicklung des Kindes“ (The mental development of the child) (1918) prepared the way for a cognitive developmental psychology.

The most important pupils

Egon Brunswik, Peter Hoffstätter, Lajos Kardos, David Klein, Paul Lazarsfeld, Konrad Lorenz, Neal Miller, Edward Tolman, Albert Wellek.

Narziß Kaspar Ach (1871 - 1946). In Würzburg (1899 - 1902)

Narziß Kaspar Ach

Born:	29 October, 1871, in Ermershausen.
1890-1895	Studied medicine in Würzburg.
1895	PhD in medicine in Würzburg.
1896-1897	Travelled as a ship's doctor to East Asia and North America.
1898-1899	Studied psychology in Strasbourg.
1899-1901	Returned to Würzburg to continue psychology, PhD for Oswald Külpe, worked on the psychology of will.
1902	Assistant in Göttingen, postdoctoral thesis for G.E. Müller.
1904	Lecturer in Marburg.
1906	Professor in Berlin.
1907	Professor in Königsberg.
1922-1937	Professor in Göttingen (succeeded G.E. Müller).
Died:	25 July, 1946, in Munich.

Ach's experimental analyses of will

Probably the most important contribution of Narziß Ach to the Würzburg School is in his monograph „Über die Willenstätigkeit und das Denken" (On the activity of will and on thinking) (1905). Here he reports on reaction experiments and hypnotic experiments which he began in Würzburg in the summer term of 1900 and later continued in Göttingen. The investigations aimed to *„carry out a treatment of the problem of the will upon an experimental basis."* (p. V). He further developed the method of reaction time measurement introduced by Donders and Exner in two ways:

> *„on the one hand, through the use of the method of systematic experimental self-observation and, on the other hand, through the introduction of experimental designs." (p. V)*

The method

Each individual experiment is subdivided into three sections (p 9):

The fore-period: which includes the time between the signal (Ready/Now) and the appearance of the stimulus.

The main period: which includes the actual experience to be investigated experimentally (Not the reaction itself but the experience that leads to the reaction is of interest).

The after-period: which follows the period which includes the reaction.

The instruction

„The instruction of the subject regarding the self-observation was to report in detail in the after-period the experiences during the fore-period and main period.“ (p. 9)

An example: reactions with two responses (p. 126 ff)

Stimuli:

„The letters O and E were used as stimuli. They were printed on white cards and appeared in random order in a card changer.“

Instruction:

„Cards with E and O will appear. On the signal word ‘Now’, press down both index fingers. If E appears, lift the right index finger. If O appears, lift the left index finger.“

Course of the experiment:

The duration of the fore-period was approximately three seconds. Afterwards the stimulus was applied and reaction time was measured using the Hipp chronoscope. The self-observations reported during the after-period were written down.

Results of the self-observation (Excerpts from two subjects A and B):

„During the fore-period, A at no time thought of a particular letter or of the movement to be made; rather, there was an imageless expectation of something coming ...that is, if a particular change was about to occur at the point he was fixating a uniquely defined change in behaviour would have to take place. Occasionally B had one of the two letters as an acoustic-kinæsthetic presentation. In this case, it influenced the course of the process when the stimulus appeared ..." (p. 127).

„In the main period it was only during the first trials that A had an intermediate link consisting of the word image „left" or „right" following the perception of the letter. The movement of the finger in question followed immediately. On the first day, after 16 trials, a shortening occurred to the effect that the letter appearing immediately evoked the movement of the finger (in question). On the second day, the presentation „right" or „left" appeared again during the first seven trials. From the eighth trial on, the letter immediately evoked the movement associated with it. ...For the subject B the elimination of the intermediate link did not take place as quickly. It was only after the tenth trial on the second day that the movement immediately followed the stimulus for the first time" (p.129).

Determining tendencies and abstractions

For Ach the most important conclusion from his experimental observations was that the course of the thinking process was not determined by associative and persevering reproductive tendencies alone, as was generally assumed at that time. He writes:

„The investigations show ...that the associative and persevering reproductive tendencies have to be complemented by other factors which have an important influence on the state of consciousness: the determining tendencies. By determining tendencies we understand influences proceeding from the presentational content of the aim presentation (eigenartige Vorstellungsinhalte der Zielvorstellung) which carry with them a determination in the sense of, or according to the meaning of, the aim presentation." (p. 187)

Among the effects of the determining tendencies Ach distinguishes among others the following:

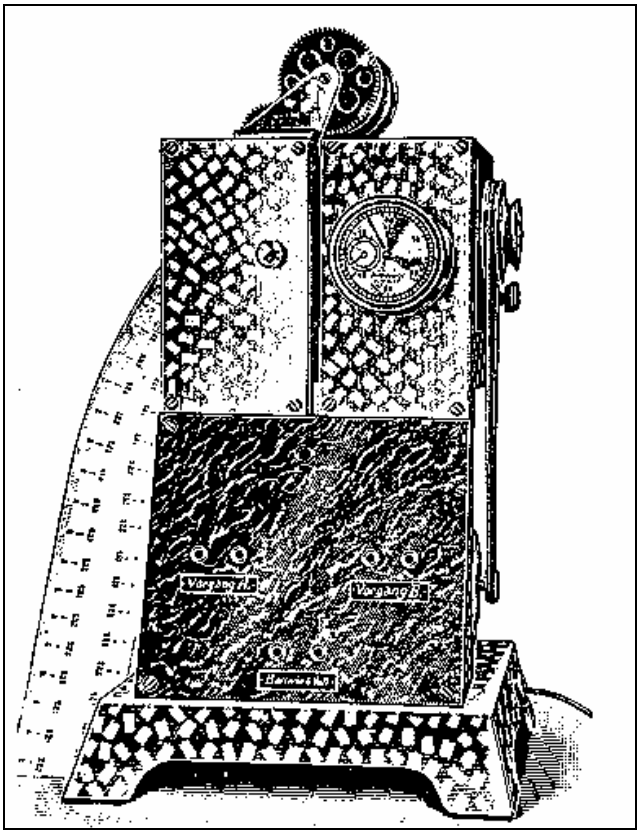
- **Referential presentation (Bezugsvorstellung*):*** *„The same stimulus reproduces different presentations, ...in a given case the presentation which is in accordance with the intention predominates.“* (p. 193)
- **Associative abstraction:** *„...when a meaning is given, only those presentations which regularly existed as experiences are consciously effective, while adventitious associations are abstained from.“* (p. 219) *...“Associative abstraction is fundamental for conceptual thinking.“* (p. 239)
- **Determined abstraction:** *„...among a certain number of simultaneously (or successively) given impressions only some of them are present in consciousness due to determining.“* (p. 239 f).

In conclusion, Ach writes*:*

> *„The effectiveness of the determining tendencies has been shown in various ways in our investigations. Needless to say psychology has not ignored these facts. Recently there have been repeated discussions which point to the phenomena in question on the basis of special observations, for example, v. Kries, O. Groß, and A. Binet.“ (p. 248).*

Ach, the technician

In addition to his scientific research, Ach was greatly interested in technical problems. He constructed most of the apparatus which he and his co-workers used. The apparatus which measured successive reaction times below 0.5s is especially worth mentioning. A major advantage of this chronotyper was that the reaction times were continuously printed on a strip of paper and thus did not have to be read. But he also developed technical solutions to problems outside psychology and had patents for more than 50 inventions; for example, for the perfecting of the gyrocompass and for the „auto-controller“, an early form of the tachograph.



Chronotyper

Otto Selz (1881 - 1943). With Oswald Külpe in Bonn (1909 - 1912)

Otto Selz

Born:	14 February, 1881, in Munich.
1900-1908	Studied philosophy under Lipps in Munich and Stumpf in Berlin.
1909	PhD in philosophy in Munich on „Die psychologische Erkenntnistheorie und das Transzendentalproblem“ (The psychological epistemology and the transcendental problem).
1910-1915	Investigations of thinking with Külpe in Bonn, postdoctoral thesis „Über die Gesetze des geordneten Denkverlaufs“ (On the laws of the ordered thought process).
1915-1918	Military service.
1919	Returned to the University of Bonn.
1921	Associate professor at the University of Bonn.
1923-1933	Professor of philosophy, psychology and educational theory at the Commercial College in Mannheim.
1929-1930	Principal of the Commercial College.
1933	Dismissed for being of Jewish descent.
1933-1938	Worked for himself in Mannheim.
1938	Arrested and sent to the concentration camp in Dachau.
1939-1943	Emigrated to Amsterdam, lectured for the Cursuswerk.
1943	Arrested and sent to the concentration camp in Auschwitz.
Died	27 August, 1943, while being transported to Auschwitz.

Otto Selz, the „perfecter“ of the Würzburg School

In the book „Thinking: From Association to Gestalt“, Mandler and Mandler (1964, p. 223) wrote:

> *„Probably the major turning point in the history of thinking came with the work of Selz... Not only does he deal ... with the problem of directed thinking, but he is the first psychologist who is both willing and able to deal with the problem of productive thinking under the same rubric as reproductive thought.“*

An example of the experiments conducted by Selz

Words were presented to the subjects, who were instructed to name another word which was related to the first word in a certain way: for example, for the word „scaffold“ a part was to be named (e.g. ladder); for the word „farmer“ a superordinate (e.g. occupation); or for the word „crystal“ a concrete whole (e.g. vase). In addition to the words produced and the reaction time the introspections during the search for the appropriate word were also recorded.

An exemplary result:

Subjects often failed to produce a correct reaction word. For example, a subject produced the word „tradesman“ for the word „farmer“, which is a coordinate to „farmer“, instead of the required superordinate. The analyses of the introspections revealed that such failures do not result from competing diffuse reproductive associations with „farmer“; instead they result from applying a false „anticipatory schema“ to the stimulus word.

The theory of specific responses

When discussing such observations, Selz proposed a theory of specific responses (all quotations from Selz, 1927, „Die Umgestaltung der Grundanschauungen vom intellektuellen Geschehen“, taken from the translation by Mandler & Mandler; 1964):

> *„The task „superordinate“ and the stimulus word „farmer“ cannot be treated as factors acting in isolation, but rather they act like the coherent question „What is the generic concept for farmer?“ This question already anticipates schematically the knowledge unit (Komplex) „Farmer is an occupation“ which the subject has previously acquired. The question contains one member (A) of the known facts of the case and the relation (γ) to the other sought-for member, ... it can, therefore, act as an eliciting condition for the intellectual operation of knowledge-production (Wissensaktualisierung), whereby the uncompleted knowledge unit (Aγ), which the question represents, is completed by restoring the reproductive unit (AγB). Instead of a diffuse play of competing reproductive tendencies, this theory offers a comprehensive process ...of structure completion, since the fragmentary structure of the question is made complete by the operation of knowledge production.“*

Further central concepts in Selz´s theoretical approach

Schematic anticipation

> *„The overweening importance of schematic anticipation becomes comprehensible as soon as we realise that the most primitive drive in mental life -desire- contains within itself an anticipation of the final state, and this anticipation becomes schematic even when the partial conditions for reaching the goal are still unknown.“*

Means production

> *„The primary operations of productive thinking are the operations of means-production....We are concerned here with the application of previously developed methods of solution to the mastery of a task in an analogous case...“*

Means abstraction

> *„..operations of means abstraction ...are designed for the discovery of new methods of solution and are arrived at by analysing the structure of the immediately given or reproductively restored problem (Aufgabesituation).“*

Determining and anticipating factors

> *„The determining or will-determining factor is part of each task ... and it makes the conditions of eliciting of the intellectual operations a dynamic process. The anticipating factor consists ...in the schematic anticipation of the complete structure of the solution.“*

Otto Selz, a pioneer of artificial intelligence

In their seminal paper „Elements of a theory of human problem solving“, published in 1958 in „Psychological Review“, Allen Newell, J.C. Shaw and Herbert Simon wrote (p153):

> *„Our position is that the appropriate way to describe a piece of problem-solving behavior is in terms of a program: a specification of what the organism will do under varying environmental circumstances in terms of certain elementary information processes it is capable of performing.“*

And in a footnote they add:

> *„We can, in fact, find a number of attempts ... to explain behavior in terms of programs. One of the most interesting, because it comes close to the modern conception of a computer program is Adrian de Groot´s analysis of problem solving by chess players. The theory of de Groot is based on the thought psychology of Selz, a somewhat neglected successor to the Würzburg School.“*

And in their book on „Human Problem Solving“ (1972) Newell and Simon confirmed: *„Our own work and de Groot´s owe large debts to Selz.“* (p. 875)

Otto Selz, one of the millions of victims of National Socialism

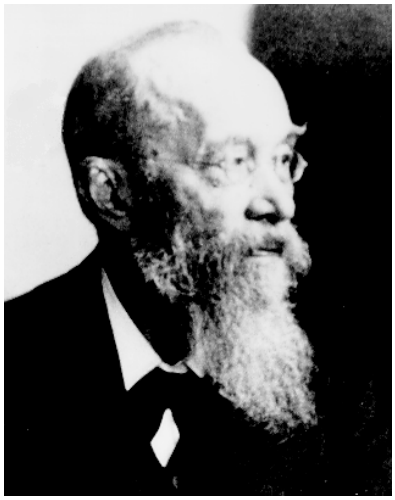
Under decree No. A 7642 of the Ministry of Culture and Education, Selz was suspended on 4 April 1933 and later, when the *Hochschule* was integrated into the University of Heidelberg, he was not given another post. The principal of the Commercial College, Sommerfeld, wrote to him on 26 October 1933:

> *„I am not aware of nor have I been informed by the appropriate Ministry what could argue against your person or your scientific reputation ... the reason can only be your descent, as non-Aryans cannot be offered posts at German universities.“*

In the *Reichskristallnacht*, Selz was sent to Dachau but was released in the middle of December 1938 - probably because he had agreed to emigrate. In the middle of May 1939, he went into exile in Amsterdam, where he lived in a small room in No. 6 Cliostraat. Selz’s Dutch colleagues supported him by giving him a scholarship and the possibility to lecture and take part in their research. In 1942, he lost his German citizenship. In July 1943, he was arrested by the *grüne Polizei* (the police force of the German occupying power) and taken to the concentration camp in Westerbork. On Tuesday 24 August 1943, train No. DA 703 departed for Auschwitz with hundreds of Jews. Among them was Otto Selz. He died of suffocation or exhaustion during transportation.

The Wundt - Bühler controversy

The rejection of the Würzburg School by Wilhelm Wundt



Wilhelm Wundt (1832 – 1920)

The awakening psychology at the end of the last century was characterised by the association theory and the enthusiasm for the applicability of scientific experiments to psychic phenomena. The associationists based their theory on the work of David Hartley, John Locke, David Hume and others, as well as the Aristotelian dogma that thought is impossible without images. It was assumed that the laws of mental life can be completely reduced to associative relations between elementary units (images, presentations). The application of the experimental method to psychic phenomena was encouraged by the success of psychophysics (e.g. Weber, Fechner, Helmholtz) as well as the successful application of the reaction time method (e.g. Donders, Exner, Wundt).

It was, however, confined to the analysis of the simple psychical processes, according to Wundt's dictum. The representatives of the Würzburg School doubted these two „essentials" of psychology at that time. To explain the directed aspect of thinking, they introduced completely new concepts such as the state of consciousness (Marbe), the thoughts (Bühler), the determining tendencies (Ach) or the schematic anticipation (Selz), which, according to their observations, could not be explained by elementary images, and they used the experiment for the analysis of more complex mental processes as well. Needless to say these views were fiercely attacked by the established representatives of associationism. To show the passionate nature of this dispute, excerpts from a discussion between Wundt and Bühler are given below:

The attack by Wilhelm Wundt

In his polemic entitled „Über Ausfrageexperimente und über die Methoden zur Psychologie des Denkens" (On the Ausfrage experiments and on the methods of the psychology of thinking) in 1907, Wilhelm Wundt subjects the Würzburg School to a thorough criticism. The most important point is the rejection of the method used by the Würzburgers, to which he ironically refers as the „Ausfrageexperimente". Wundt formulates four rules which must be observed by

any experimental investigation and argues that none of these rules are obeyed in the Würzburg work. The 4 rules for an experiment according to Wilhelm Wundt (1907, p. 308):

1. The observer must as far as possible be in a position to determine of himself the occurrence of the event to be observed.

2. The observer must be in a state of the utmost concentration of attention to observe the phenomena and to follow them in their course.

3. In order to safeguard the results, every observation must be capable of being repeated a number of times under similar circumstances.

4. The conditions under which the phenomenon occurs must be ascertained by variation of the accompanying circumstances, and, when they are ascertained, they must be regularly changed in the appropriately varied experiments. That is to say, in the different experiments they must be on the one hand completely isolated, on the other graded in their intensity or quality.

None of the rules are obeyed in the „Ausfrage experiments“ of the Würzburgers, according to Wundt (p. 329 ff):

1. In the „Ausfrage experiments“ the real observer is not the experimenter but the subject. „The question that is put to the subject is for him an unexpected event which constitutes the most unfavourable condition for precise observation.“

2. „Is the observer able to follow the course of events during the „Ausfrage experiments“ with concentration...? This question comes down to the other: Can there be psychic processes, e.g. acts of logical thinking, which require our utmost attention and which can be observed at the same time with an equal degree of attention? Every psychologist who has seriously worked on the problem of attention would agree that there are none.“

3. „The character of the ‘Ausfrage experiments’ precludes a repetition of the observation under the same circumstances. Each question must be a completely new one. The same one put a second time would almost unavoidably change the character of

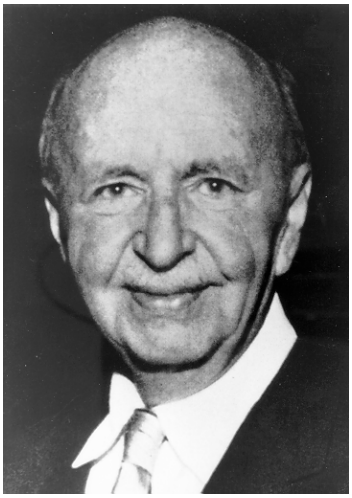
the experiments into a memory experiment or at least lead to a mixture and thus to an unforeseeable complication.“

4. „The order of questions ...in the judgment experiments by Marbe or in the thought experiments by Bühler, which I used as typical examples in the section above, shows no systematic variation whatsoever of the experimental conditions. For when in different experimental groups the type of question or the form of the answer was chosen differently, this was as little a variation of conditions in accordance with experimental methodology as if one were to have the answers recorded once in German and once in Latin. The fourth and, next to the first, most important rule, the famous rule of degrees according to Bacon, also fails in these experiments and even proves to be incompatible with them.“

Conclusion

„The „Ausfrage experiments“ are not experiments at all in the sense of a scientific methodology but they are sham experiments, which have the appearance of being systematic only because they take place, as a rule, in a psychological laboratory. In reality, they have no scientific value because they fall short when judged by all the criteria which distinguish the self-observations of experimental psychology from those of ordinary life.“

Karl Bühler’s reply



Karl Bühler (1879 – 1963)

In a paper entitled „Antwort auf die von W. Wundt erhobenen Einwände gegen die Methode de r Selbstbeobachtung an experimentell erzeugten Erlebnissen“ (Reply to W. Wundt’s objections to the method of self-observations applied to experimentally evoked experiences), Bühler (1908) goes into Wundt’s criticism in detail. The article begins with the sentence:

„Even before we were able to make the necessary additions, as promised, to the first part of our investigation, the method applied and the results were subjected to a criticism from someone whom I would have believed to be more understanding.“

Excerpts from the ensuing arguments are given below:

1. The accusation that the events to be observed were unexpected: „This is wrong, because on the word 'bitte' (ready), the subjects were asked to get ready... Of course, the subjects did not and were not supposed to know the special content of the questions which followed, but they knew the general form of the questions, which was sufficient to avoid a recurring surprise, just as in reading experiments it is sufficient to know that a printed word will appear on the fixation area." (p. 97)

2. The accusation that the subjects had to work something out in their heads and observe themselves at the same time: „Has Wundt never considered whether it might not be possible to report one's experiences without doubling one's self? ...Does he not know that it is possible to experience something and then report this experience by looking back on it? We have proof from the time when Wundt was a subject himself that he once knew it. ...It is, incidentally, vain self-delusion to think that it is possible to do without self-observation in psychology; if we do not use the subjects' statements, we base the interpretation of the experiments on our own uncontrollable opinions. ...Psychology ...has to develop an evaluation of the validity of different data sources - a general evaluation which includes a theory of self-observation as well as a specific one which is able to give us a measure of reliability for an individual protocol for a particular subject." (p. 100/101)

3. „A further claim of Wundt's is still a psychological mystery to me ... that is, the whole nature of the thought experiments precludes a repetition of the observations. ...The 'identity', which is required for the repetition of an observation, of course only needs to be equality concerning the concept the observation is directed towards. When the associationist obtains the sound association 'Himmel-Schimmel' (e.g. hip-ship), this sound association cannot be used again either; nor is it necessary to use it since the association 'Leder-Feder' (leather-feather) and many others are considered by him as sound associations equal to the first one and sufficient for the repetition of observations of the associations of sounds. ...What we want to find out is precisely the psychological equality despite dissimilarity in a physical or other respect." (p. 107/108)

4. In reply to the accusation that controlled experimental variations of conditions are impossible, Bühler describes some of the variations he made and writes: *„I see nothing which prevents us from varying the experimental conditions according to all rules of exact experimenting in the direction indicated. ...I think that it must be clear to anyone who wants to see it that this objection of Wundt's reveals an armchair approach to experimenting." (p. 106/107)*

Conclusion

„ ... for him (Wundt) the purist division is certain: the simpler processes for the experiment and the higher psychical processes for the ethnic psychological inspection.... After criticising our method, Wundt suggests how we should proceed in the psychology of thinking; one should combine occasional self-observation with ethnic psychological inspection. ... let us be happy that self-observation has come back into favour. And if we then have to choose between the occasional self-observation of the individual and the self-observation of our experiments, then there is no doubt as to the decision for anyone who remains free of Wundt's misunderstandings and first examines before he judges. They are opposites just as chance and method are." (p. 110/111)

Wilhelm Wundt and his pupil Oswald Külpe

On 26 October 1907, Wilhelm Wundt replied to a letter from his former pupil Oswald Külpe in which the latter had defended the „Ausfrage experiments". Among other things he wrote:

„Up to now I had thought that Marbe was the intellectual creator of this, in my opinion, totally reprehensible method, all the more because he first attempted to justify it in his investigations of judgement, and because Ach, as well as Bühler of late, credited the introduction of this method to Marbe. But the method made sense to me as Marbe's method. For I consider Marbe to be a man who is well able to construct an ingenious instrument but who has absolutely no talent whatsoever for psychology. For this reason, I have long been accustomed to consider his work on this subject as essentially non-existent. ...As far as your position in this matter is concerned, I assumed that you, because of the conciliatory attitude I know you have, would prefer to leave people working in this direction to their own devices and wait and see what

happened rather than be enthusiastic about it yourself. Now, of course, I can see how wrong I was, and I have to say that I regret this most of all...(and he adds by hand) ... and you may rest assured that I regret it all the more because I value your work, in particular your systematic philosophical and historical work, very highly."

Despite this dispute, the two researchers remained on friendly terms all their lives.

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