



Articles

Some Reflections on the Relation Between Whitehead's Process Philosophy and Gestalt Psychology

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ABSTRACT: Although it is beyond doubt that there were historical connections between Whitehead and some of the proponents of Gestalt psychology, it is difficult to determine on the available body of historical evidence whether they were substantive or just marginal. A detailed comparison of Whitehead's process metaphysics and the theories of Gestalt psychology is a task yet to be undertaken. Whitehead's process philosophy and (some forms of) Gestalt psychology share basic similarities in their major principles. This is substantiated by two of Ehrenfels' well-known gestalt qualities: (1) superadditivity, and (2) figure-ground relation. Both approaches can profit from one another: while Whitehead's concept of consciousness and its interrelatedness with unconscious processes seems to be more elaborate, the Gestalt psychological approach, on the other hand, shows how these topics can be investigated by using experimental research designs. This is illustrated by an experiment on complex problem solving which demonstrates that unreportable (functionally unconscious) hints can improve even such sophisticated processes as complex problem solving. Since this is what should be expected from a Whiteheadian point of view, the results empirically confirm the process position on perception and thinking. Finally, further interesting possibilities of undertaking future empirical process research are outlined.

1. Whitehead and Gestalt Psychology

When Alfred North Whitehead developed his process philosophy in England and later in the United States (starting in 1924, at the age of 63), in Germany a group of researchers elaborated what came to be called *Gestalt psychology*. Before answering the question as to whether it is possible to substantiate similarities in content between the two approaches, it is of interest to explore what kind of historical connections between Whitehead and the proponents of Gestalt psychology can be found.

1.1 Some Historical Comments

When investigating if there were relations between Whitehead and exponents of Gestalt psychology, it must be mentioned that there was not just one Gestalt psychology, but several different schools. At least we have to distinguish between the most well-known Berlin Gestalt school (Wertheimer, Köhler, Koffka, Duncker, Lewin, Maier); the second Leipzig school, also called *Ganzheit* psychology (Sander, Krueger, Werner); the Würzburg school (Külpe, Bühler); and the Austrian Gestalt school located at the university of Graz (Brentano, von Ehrenfels, Meinong). And, of course, not only did each school emphasize and explore different aspects of the Gestalt phenomenon, but even the different proponents of each of these Gestalt schools held distinct positions in respect to specific topics.

At the beginning of the 20th century Gestalt psychology was a challenging new and flourishing paradigm within German psychology. Many of its leading proponents were forced to leave Germany after the *Machtergreifung* of the Nazis in 1933 because they were—as the Nazis called them—non-Aryans. Graumann (“Psychologie” 5) lists twenty-four names, among them such reputed scholars as Rudolf Arnheim, Egon Brunswik, Charlotte and Karl Bühler, Karl Duncker, Kurt Goldstein, Fritz Heider, György Katona, David Katz, Wolfgang Köhler, Paul Lazarsfeld, Kurt Lewin, William Stern, Heinz Werner, and Max Wertheimer. Most of these scholars went to the United States and played a crucial role in preparing what later on has been called the *cognitive turn* in psychology.

While there was this enormous brain drain for German psychology, some members of the second Leipzig school of *Ganzheit* (wholeness) psychology applied their holistic concepts to societal phenomena, thereby strongly approximating the then reigning Nazi ideology. For instance, Felix Krueger conceived the family as “a supra-personal whole” (“Sinn” 6) and claimed that the “people’s community . . . is more than the sum of

its single units” (*Bund* 14). Friedrich Sander even went so far as to write: “The elimination of the parasitically sprawling Judaism has its deep ethical justification in this will to pure Gestalt [figure/form] of the German nature [essence]” (“Deutsche” 642; for equally disturbing and even disgusting passages see Graumann, *Psychologie*; Renneberg and Walker; and Vine). As a result of their incredible ingratiations, these scholars were able to occupy scientific positions at German psychology departments and to hold most of them even until the late 1950s. But that such a fascist, totalitarian interpretation of Gestalt principles is by no means necessary is shown by the works of Wolfgang Köhler, Kurt Lewin, Heinz Werner, William Stern, Kurt Goldstein, Charlotte Bühler, and many others.

After 1960—apart from solitary persons such as Wolfgang Metzger in Germany, Richard Meili in Switzerland, or Eino Kaila in Finland—Gestalt psychology survived in Europe at the Psychological Department of the Lund University in Sweden. Here Ulf Kragh and Gudmund Smith developed their so-called *percept genetic approach* which was based on the micro genetic and actual genetic approaches of Heinz Werner and Friedrich Sander.

Having made clear the complexity and heterogeneity of the Gestalt movement (see also Tocafoondi), let us now turn to the question whether there were any relations between exponents of Gestalt psychology in its many facets and Whitehead.

In respect to Whitehead, who ordered that all his unpublished papers and correspondence should be destroyed after his death, we have little evidence concerning specific connections to Gestalt psychologists. There is, however, one letter to Charles Hartshorne, one of his prominent followers, in which he mentioned “the great merit of the Gestalt people” (see Kline 198ff.). This quote at least proves that Whitehead knew Gestalt psychology and did in fact value it highly. It is interesting to note in this context that Max Wertheimer, one of the founding fathers of the Gestalt movement, after his immigration to the United States, had many contacts with American psychologists and philosophers. His son Michael Wertheimer notes that his father “also had some contact with the American philosopher Charles Hartshorne at the University of Chicago, who had a strong interest in the psychology of sensation” (King and Wertheimer 250). So Whitehead’s reference to the Gestalt people may also have been a reaction to Hartshorne’s information about his contacts with Max Wertheimer.

But Whitehead’s general positive attitude towards Gestalt psychology was also returned by some Gestalt psychologists. For instance, Wolfgang Köhler, one of the leading exponents of the Berlin school and the only

German university professor who protested publicly in a newspaper article against the dismissal of Jewish colleagues in 1933 (see Geuter 105), in the preface of his book *Gestalt Psychology* (1929), when speaking about works similar to his own, refers to “Professor Whitehead’s imposing work with all respect” (ix). Köhler, who was a visiting scholar at Harvard in 1934-1935, where he delivered the prestigious William James Lecture on “The Place of Value in a World of Facts,”¹ tried to apply Gestalt principles beyond psychology. In particular, he developed the “hypothesis of the ‘isomorphy’ of physical and psychical Gestalten [forms]” (Ley 200) and also tried to “‘ontologically’ found the Gestalt-concept” (Ley 200). This, of course, comes close to Whitehead’s approach. For instance, John Cobb (82-87, 192-196) has drawn attention to the compatibility of this approach with Whitehead’s process metaphysics. I will return to this point when dealing with the Gestalt principle of “superadditivity.”

Yet even more interesting than the Berlin school of Gestalt psychology, which focused on the static structures of given figures (*Gestalten*), is the second Leipzig school of the so-called *Ganzheit* psychology, since the scholars working within this approach were interested not so much in the static aspects of *Gestalten*, but much more in the genesis or formation of figures. Their ideas come surprisingly close to Whitehead’s theory of perception which, at its core, also consists of a genetic process towards a definite, consciously apprehended pattern, which we may also term *Figur* (figure), *Gestalt* (form), or *Ganzheit* (whole) out of a multifold of vague and unconsciously grasped situational influences (which we, following the Gestalt psychologists, may also call *Hintergrund* or background). On this topic Victor Rosenthal wrote: “It may be convenient to view microgenesis as a rectification of the Berlin School of Gestalt theory especially in regard to its overly structural and agenetic character” (see Rosenthal). Friedrich Graumann, in a survey article about the concept of *Aktualgenese* (actual genesis) and its refinements over time, draws attention to certain publications from the year 1926, which, according to him, mark the birth of actual genetic research paradigm (see Graumann, “*Aktualgenese*” 410). But it should not be forgotten that at about the same time the Catholic friar Agostino Gemelli, who was a physician and a psychologist, was developing very similar ideas on Gestalt dynamics (see Gemelli).

Friedrich Sander introduced the term *Aktualgenese* for this process, while Heinz Werner coined the term “microgenesis.” It is interesting to point to the fact that Friedrich Sander’s only paper that was published in English, “Structure, Totality of Experience, and ‘Gestalt,’” was translated

by Susanne K. Langer who, as a student of Whitehead, was deeply influenced by Whitehead's philosophy (see, for instance, Dryden; also Lachmann). Langer had a very good relationship with Whitehead, which is reflected in the dedication of her major book, *Philosophy in a New Key*, to, as she put it, "Alfred North Whitehead, my great teacher and friend." When Langer did the translation for Sander's article, she transformed Sander's original term *Aktualgenese* into "genetic realization," an expression that does not keep close to the German ("actual genesis" would have made more sense), but which does come closer to Whitehead's idea of concrescence. So it seems to be a good guess that Whitehead did know about Sander's position through Langer.

Concerning another member of the second Leipzig school, Heinz Werner, who became a well-known developmental psychologist at Clark University after his forced emigration to the United States, one can also add evidence for a connection to Whitehead. Werner, after his immigration to the United States, visited Harvard in the academic year 1936-1937 (two years after Wolfgang Köhler's stay), which was Whitehead's last year at Harvard. During this stay Werner wrote his paper "Process and Achievement." This essay, as indicated by the use of the term "process" in the title, shows considerable affinity with Whiteheadian ideas. It cannot, however, be claimed conclusively on the basis of the historical evidence available to us at this point if Whitehead met Werner.

The exponents of the Lund school of percept genesis also knew Whitehead's work. For instance, Gudmund Smith occasionally recommended that scholars interested in a process approach should read the books written by Whitehead (Smith, "Vademecum" 135), since they are "one way to clear the misconceptions [concerning the term 'process']" (Smith, "Unraveling" 286).

Also, Mary Parker Follett, the founder of the case-study approach in social work, has to be mentioned. In her book *Creative Experience* (1924), she applied Gestalt principles for the analysis of political systems. And as far as Whitehead's influence on her thinking is concerned, Tor Hernes writes: "In fact, Parker Follett in her influential writings, made reference to both Whitehead and James, although it is not obvious how either of them actually influenced her process thinking" (Hernes 22; also see Tonn). Stout and Staton have published a detailed analysis of the process ontological underpinnings of Parker Follett's theory of political governance.

In closing this section it is important to mention that this short historical sketch is not exhaustive. A definitive treatment of the historical relations

between the exponents of Gestalt psychology and Alfred North Whitehead has yet to be written. Interesting indirect historical strands of influence from Gestalt psychology on Whitehead (such as, for instance, by George Frederic Stout, who was influenced by Franz Brentano, Carl Stumpf, Christian Eherenfels, and Alexius Meinong, all central figures in the development of Gestalt psychology) have been convincingly presented by Ronny Desmet at the 9th International Whitehead Conference in Krakow (See Desmet's article in the present issue of *Process Studies*).

1.2 Some Similarities in Basic Concepts

Beside these historical relations between Whitehead and some Gestalt psychologists, one can ask if it is possible to demonstrate an agreement in basic principles. In order to respond to this question, we will turn to two of the three well-known Gestalt qualities which were proposed by Christian Eherenfels and which are accepted widely as the core axioms of Gestalt psychology: Superadditivity (*Übersummativität*) (1.2.1); Figure-Ground Relation (*Figur-Hintergrund-Beziehung*) (1.2.2); then we will turn to the phenomenon of the unconscious and compare Whitehead's ideas on this topic with those of some Gestalt psychologists (1.2.3).

1.2.1 Superadditivity

According to Eherenfels, a Gestalt (figure) is more than the sum of its parts; put differently: "The basic premise is that the entirety of an object has properties that are different from those of its parts, thus an object which is structurally composed of elementary features cannot be defined only by some isolated features" (Hamburger and Röser 363).

Wertheimer, for example, illustrated this characteristic by turning to music: "[W]hat is given me by the melody does not arise . . . as a secondary process from the sum of the pieces as such. Instead, what takes place in each single part already depends upon what the whole is" (see Wertheimer).

Whitehead also held this principle of superadditivity and gave an example from the arts to illustrate this basic assumption: "This principle may be illustrated by our visual perception of a picture. The pattern of colours is 'given' for us. But an extra patch of red does not constitute a mere addition; it alters the whole balance" (*PR* 44; also see 28).

According to Köhler, the "possibilities of self-organization in the sense of gestalt-like principles like Superadditivity, Transponposability" (see Ley 201) can be found not only in perceptive activities, but throughout

the whole of nature. Tocafofondi has put it this way: “One rather has to speak of the spontaneous tendency of each natural system (physical, organic, perceptive) to achieve the most regular and most stable among the possible forms [Gestalten]” (145). In order to support this claim, Köhler presented examples from several domains of physics: electrostatics, hydrodynamics, thermodynamics, etc. “According to Köhler, the regulation of these processes can be thought of in such a way that *ordered systems are created which already at the level of physical processes anticipate certain features and laws of Gestalt-perception*” (Ley 202, emphasis added). This again comes very close to Whitehead’s approach: “The relation of part to whole has the special reciprocity associated with the notion of organism, in which the part is for the whole; *but this relation reigns throughout nature and does not start with the special case of higher organisms*” (SMW 149, emphasis added). Whitehead gives an illustration of this idea from the domain of physics so as to clarify his position: “The concrete enduring entities are organisms so that the plan of the whole influences the very characters of the various subordinate organisms which enter into it Thus an electron within a living body is different from an electron outside it, by reason of the plan of the body. The electron blindly runs either within or without the body; but it runs within the body in accordance with its character within the body; that is to say, in accordance with the general plan of the body, and this plan includes the mental state. *But the principle of modification is perfectly general throughout nature, and represents no property peculiar to living bodies*” (SMW 79, emphasis added). He continues: “The prompt self-preservative actions of living bodies, and our experience of our bodies following the determinations of will, *suggest the modification of molecules in the body as the result of the total-pattern*” (SMW 149, emphasis added).

Whitehead even claimed that this superadditivity holds at the metaphysical level: according to him an actual entity is “not...a mere multiplicity” (PR 44) and “in no sense is it the sum of its parts” (PR 140), but instead it is a “synthetic givenness” (PR 44). So an actual entity is the synthesizing of given elements into a definite pattern (a so-called eternal object), which is more than the addition of its elements. Any additional element which would be accepted in this process of concrescence toward a definite pattern would alter the whole result (or would have to be excluded or negatively prehended). Whitehead, in describing the process of concrescence, writes: “The actual entity is seen as a process of integration

and of reintegration *Each phase in the genetic process presupposes the entire quantum*, and so does each feeling in each phase. The *subjective unity dominating the process* forbids the division of that extensive quantum which originates with the primary phase of the subjective aim” (PR 283, emphasis added). It should now be clear why Köhler spoke of Whitehead and his œuvre with such great respect.

1.2.2 Figure-Ground-Relation

Turning now to the figure-ground principle of Gestalt psychology, we again can observe far reaching similarities. For instance, Koffka (*Growth* 131) stated: “The phenomenal appearance in consciousness divides itself into a given quality and a ground on which the quality appears It is, however, a part of the nature of a quality that it should lie upon a ground Such a coexistence of phenomena in which every member ‘carries every other,’ and in which every member possesses its peculiarity only by virtue of, and in connection with, all others, we shall henceforth call a configuration. According to this view the most primitive phenomena are *figural*.” About the same time, Harry Helson, an American psychologist who tried to introduce Gestalt psychology to his colleagues in a series of articles in the 1920s, wrote: “[A] figure protrudes from a more or less undifferentiated background Qualities emerge from a general level, and hence must be considered with reference to their background if their properties are to be fully accounted for in perception If we examine our perceptions as we find them, we observe that certain parts of the perception have a clear, well-defined pattern while the rest are more or less homogeneous and in the background The ground, however, must not be regarded as wholly unformed. The ground possesses certain vague, positive determinations” (Helson 495f).

Similar passages can be found in Whitehead’s opus. For instance, when criticizing what he called the “conventional view of experience” he presents his alternative position of perception which comes close to the figure-ground relation of the Gestalt psychologists: “There is a conventional view of experience, never admitted when challenged, but persistently lurking in the tacit presuppositions. This view conceives conscious experience as a clear-cut knowledge of clear-cut items with clear-cut connections with each other. This is the conception of a trim, tidy, finite experience uniformly illuminated. No notion could be further from the

truth. In the first place the equating of experience with clarity of knowledge is against evidence. In our own lives, and at any moment, *there is a focus of attention, a few items in clarity of awareness, but interconnected vaguely and yet insistently with other items in dim apprehension, and this dimness shading off imperceptibly into undiscriminated feeling*" (FR 78, emphasis added). To put it even more directly: "In the background there is triviality, vagueness, and massive uniformity; in the foreground discrimination and contrasts, but always negative prehensions of irrelevant diversities" (PR 112). When consciousness appears the contents of the foreground are in focus, while the contents of the background, grasped in the primitive, pure perceptive mode of causal efficacy, are only dimly illuminated (PR162). But as dimly and vaguely prehended as these primitive contents may be, they form the necessary unconscious background or context of the determination of the clearly grasped forms. The clearly and consciously given forms are abstractions sculpted out of a complex ongoing net of subliminal processes.

1.3 Gestalt Psychology and the Unconscious

The assumption of unconscious processes, although not at the center of any school of Gestalt theory, was nevertheless occasionally addressed in Gestalt research (see Metz-Göckel 201; also Koffka, "Structure"; and Metzger). In particular the exponents of the second Leipzig school of *Ganzheitspsychologie* and those of the Swedish Lund school of percept genetic research, who elaborated and deepened the research of the the second Leipzig school (see Draguns), focused in their research on the development or formation of forms [*Gestalten*]. These scholars were understandably confronted with the phenomenon of unconscious perception since the process of Gestalt formation starts at an unconscious level. For grasping the process of *Aktual-* or *Mikrogenese*, different techniques and experimental designs were developed "in which participants were presented with a series of stimuli beginning in suboptimal conditions (blurry, small, at a distance, for a short time, at the edge of one's peripheral field, etc.) and progressively moving toward greater stimulus clarity, recording participants' percepts at each step" (see Wagoner 99; for a detailed discussion of the criticism of these microgenetic fragmentation techniques also see: Riffert 154-162). Tracing the development of a perceptive act from the onset of a stimulus (of whatever sensory-channel or even the body as a whole) until it reaches a (more or less) stable form (*Gestalt*,

Ganzheit) naturally shifts attention to the question of whether there exists a phase of unconscious information processing (as we tend to term it today) at the very start of this micro process. It is not surprising that Sander wrote the following about the perceptual process “[T]here seem to be unconscious formative causes at work, which let phase upon phase evolve with internal necessity and ever increasing complexity” (190). Heinz Werner introduced the term “microgenesis” in his 1956 article “Microgenesis and Aphasia” in order to characterize the development of psychic processes in general, from perception to thinking (Rosenthal 221). In his paper Werner refers to the German neurologist Fritz Lotmar, who had described a phenomenon that he had termed “spheres of meaning.” Although aphasic patients are not able to get conscious access to the meaning of a linguistic sign (a single word or a phrase), they nevertheless are able to spontaneously perform meaningful motor acts or utter words of similar meaning. For instance, a patient confronted with the phrase “bread and butter” may perform the movement of spreading butter on a slice of bread thereby stumbling “butter . . . butter . . . bread and butter.” So the aphasic is able to somehow vaguely grasp the meaning of the presented stimulus and act in a meaningful way without gaining full conscious access to it at first. Werner speculated if it should not be possible to “demonstrate spherical meaning in normal persons trying to decipher verbal material too difficult to grasp immediately” (Werner, “Microgenesis” 348). In order to demonstrate this possibility, he tachistoscopically presented verbal phrases to subjects starting at a short duration of 20 milliseconds and gradually increased the presentation duration. He summarizes the results of his experiment in the following way: “[T]he stimuli aroused ‘feelings of word meanings,’ inner experiences of the semantic sphere of the linguistic forms that were apparently prior to any specific articulation of the words” (Werner, “Microgenesis” 348).

Tachistoscopic experiments of this type (introduced by Sander and Werner) became the paradigm for research activities of psychologists more or less closely attached to the research group working at Lund University, Sweden under Ulf Kragh and Gudmund Smith (see Kragh; Kragh and Smith; and Smith).

John Flavell and Juri Draguns (198) give the following condensed description of the robust findings of microgenetic research: “When a perceptual stimulus is presented under conditions of gradually increasing clarity the initial perception is that of a diffuse, undifferentiated whole.

In the next stage figure ground achieve some measure of differentiation, although the inner contents of the stimulus remain vague and amorphous. Then comes a phase in which contour and inner content achieve some distinctness and a tentative, labile configuration results. Finally, the process of Gestalt formation becomes complete, with the addition of elaborations and modifications of the 'skeletal Gestalt' (*Gestaltgerüst*) achieved in the previous stage." So the micro genetic process proceeds from a state in which the stimulus content can hardly be grasped consciously and, if so, only in a vague, diffuse way, to a stage of full conscious awareness of the given details. However, only after the introduction and combination of the so-called masking procedures and forced choice techniques can a decisive psychological demonstration be possible that an unconsciously perceived stimulus can have an impact on the perceiver's performance (see Marcel). Early uncertainties concerning the unconscious dimension of a genetic micro process were later counter-balanced by supporting results of research in the field of neurology (see works by Brown).

Given these results, the questions come to mind: Do unconscious micro processes influence thinking and even problem solving processes and, if so, how? There are many anecdotes from different fields of scientific research supporting this idea: Kekulé finding the ring shape of the benzene molecule during a daydream in which a snake was seizing its own tail after a long period of having studied the nature of carbon-carbon bonds (see Benfey; Larsen). Poincaré's discovery of Fuschian function transformations occurred to him when putting his work aside and entering a bus while on a geological excursion (see Poincaré 53). Roger Shepard, referring to his own work in his book *Mental Images and Their Transformations*, reports: "In any case, the very line of chronometric studies of the transformations of mental images assembled in this volume had its origin in a state of hypnopompic suspension between sleep and wakening, in the early morning of November 16, 1968" (see Shepard and Cooper 7). Many more scientists who provide anecdotes from their research work could be added: Archimedes, Isaac Newton, Joseph Priestley, Carl Friedrich Gauss, Alfred Wallace, Hermann von Helmholtz, Albert Einstein, Louis de Broglie, Enrico Fermi, Linus Pauling, John Watson, John Nash, Freeman Dyson (see, e.g., Hadamard; Koestler).

Norman Maier, an American researcher who came to Berlin to work with the scientists of the Berlin Gestalt School, was probably the first to come up with experimental results on at least one aspect of this question

by using his so-called “two ropes problem”: Two ropes were hanging down from the ceiling and the participants had to tie them together; however it turned out that the two ropes were too far removed from each other to be both grasped at once. There were a few items, such as a chair, a stick, a pair of pliers, a wire, and a clamp in the room that could be used in order to solve the problem. Those participants who had not solved the (difficult) problem after ten minutes of work on it were given several aids. Hint 1 consisted of an unnoticed, subliminal hint: the experimenter walked across the room to the window to open it; one of the ropes was thus put into slight pendulum motion. The results show “that subjects who experienced the solution as a whole [after hint 1 was given] failed to report that hint 1 aided them in finding the solution” (Maier 187). Maier showed that an incidental aspect of the situation, that was not recognized as a hint by the participants and therefore was unconscious as far as its function as a hint is concerned, was able to improve the solution rate dramatically.

Karl Duncker in his 1935 book *Zur Psychologie des produktiven Denkens* [*The Psychology of Productive Thinking*] touched on the same phenomenon of the effectiveness of incidental hints when he was discussing the “radiation problem.” The participants had to find a way to free a patient with a malignant inoperable tumor in the stomach. They were told that there exists a special kind of ray, which, albeit harmless at a low intensity, at a sufficiently high intensity would destroy the tumor; however, the rays would also destroy the healthy tissue. How can the latter be avoided? The solution consists in finding that several low dosed rays have to be applied from different angles, but all converging at the location of the tumor. By adding doses at this location it was possible to destroy the malignant tumor while leaving the surrounding tissue unaffected. Duncker claimed that an incidental hint could facilitate the solution process: Either talking about a crossing or painting a cross might trigger the solution in the subject if the problem representation and conceptualization of potential solutions already pointed in that direction (see Knoblich and Öllinger 35f).

Despite the fact that the use of incidental (functionally subliminal) cues for solving problems is an interesting technique for investigating subliminal information processing, Maier’s famous experiment has not stimulated much research. To date only a handful of experiments have been conducted based on this paradigm. While the impact of incidental subliminal cues during an impasse has been explored by Knoblich and Wartenberg , and also by Moss, Kotovsky, and Cagan, in the experiments

of Judson, Cofer, and Gelfand, as well as in the experiments by Grant and Spivey (especially experiment 2), the impact of cues which were presented right from the start of the problem solving process were investigated. While such a small number of experiments may raise some doubts concerning the robustness of this phenomenon, neurological support for it has been provided by Reverberi and colleagues demonstrating that a group of patients with lesions in the prefrontal cortex, usually associated with higher cognitive functions such as decision making, reasoning, and planning, outperformed a group of healthy subjects on complex arithmetic matchstick tasks. Before turning to an experiment inspired by Maier's and Duncker's work, we will first sketch Whitehead's theory of perception.

1.4 Whitehead's Theory of Perception and the Unconscious

Whitehead proposed a tri-modal theory of perception. There are two so-called pure modes of perception: the more primitive one, causal efficacy, locates the human being amidst the processes of nature. It consists of prehensions by which the perceiver's environment is vaguely grasped; the perceiver is more passive, being acted upon by the environmental influences via physiological inputs. Perceptions in this primitive mode are emotion- laden. The second one, the more advanced mode of presentational immediacy, builds on the contents of the first mode. It develops out of it by actively emphasizing some of the aspects of the content given in the mode of causal efficacy and transmuting them into more stable patterns (*Gestalten*, forms); it abstracts some elements, combines them, and by doing so transforms them into a clear form (*Gestalt*); emotions are mainly neglected in this perceptive mode. Both of these modes are unconscious modes of perception. Consciousness shows up only if these two unconscious modes of perception are integrated. In this case Whitehead speaks of the mixed mode of perception; he terms this perceptive mode the mode of symbolic reference. The content of one of the two modes functions as the symbol of the content of the other mode. Which one plays what role is not predetermined, although usually the contents of the mode of presentational immediacy take over the role of the symbol because they are much more open to flexible manipulation (which leads to favorable consequences, e.g., for communication).

Here Whitehead holds a more sophisticated position than do the Gestalt psychologists, who identify the formation of a definite form (*Gestalt*) with the process of becoming conscious of it. As we have seen, Whitehead

holds that the abstraction of a clear form out of vaguely given complex processes does not reach consciousness per se in that it needs the additional activity of (re)integrating the result of this process with its basis, which thereby opens the possibility for an affirmation-negation contrast which is accompanied by the subjective form of consciousness.

Summing up, according to Whitehead each act of perceiving is a process of growing together of many antecedent entities; this process may stop at different levels of integration. The most primitive and unconscious level is that given in the perceptive mode of causal efficacy, the next one being the more elaborated though still unconscious one of presentational immediacy, and finally we arrive at the highest level of conscious perception in the mode of symbolic reference. At the level of symbolic reference, according to Whitehead, the Rubicon is crossed: consciousness has entered the stage and the path is paved for conscious thinking: "In sense-perception we have passed the Rubicon, dividing direct perception from the higher forms of mentality, which [consciously] play with error and thus found intellectual empires" (*PR* 113). It is also important to remember that all of these higher forms of mentality are rooted in subconscious processes which may have an impact on the higher forms of thinking. Therefore, in our context it is important to draw attention to the fact that in the more primitive, unconscious mode of causal efficacy all preceding actual entities are perceived, although those closer (spatially and temporally) to the developing actual entity may be of greater importance for its process of concrescence. Here the experiments of the Gestalt psychologists Norman Maier and Karl Duncker come into play: if incidental (unnoticed) hints for the solving of a problem are presented, then from a Whiteheadian perspective an impact of these hints on the process of solving a problem should be expected.

This is exactly the case in the experiments of Maier and Duncker and the other researchers mentioned above. However, the body of evidence is still meager. Therefore, in the remainder of the present paper we will present another problem solving experiment in the tradition of incidental (functionally unconscious) hints, which again will corroborate the position of the Gestalt psychologists and of Whitehead.

2. An Experiment on Incidental Hints in Complex Problem Solving Processes

In what follows an experiment will be presented that is inspired by

the experiments of the Gestalt psychologists Maier and Duncker presented above. It investigates whether it can be demonstrated that an incidental (subliminal) stimulus can contribute to the solution of a series of four complex problems. That is, it tries to demonstrate that the sheer presence of a stimulus, where the solver is unaware of its function as a solution hint, has an impact on: (a) the frequency the tasks are solved, and (b) the time necessary for finding the solutions.

2.1 Participants, Materials, Design

Ninety-nine participants (all native German speakers, with an average age of 20.3 years) volunteered in this experiment (convenience sample): twenty-six were students from the Department of Educational Science at the University of Salzburg (average age: 26.4 years) and seventy-three were students of an Austrian Secondary School (grades 12 and 13; average age: 18.1 years); 94 percent of the participants were females. Subjects were randomly assigned to one of four different rotation variants of one of two groups. Group one was a control group (no treatment); group two was a treatment group (to which a hidden, unconscious solution cue was presented from the start of working on the first of the four tasks).

The participants had to solve four geometric match stick problems which were taken from Gestalt psychologist Georg Katona's 1940 book *Organizing and Memorizing Studies in the Psychology of Learning and Teaching*. These problems had not previously been used in this type of research.



Figure 1: Two of the four match stick problems were of the “tower” and “u” type. The participants had to rearrange three match sticks (black lines) in order to arrive at exactly four squares of the same size.

The participants had to transform the five-square-figure into a four-square-figure by changing the position of exactly three match sticks. The four squares had to be connected at least at their corners and the match sticks were not allowed to be simply replaced, broken, or put on top of each other. Each participant was given a detailed instruction sheet which they had to study before starting to solve the tasks. For each one of these

four tasks there existed at least two different solutions; one of the solutions of each task was identical in form. This solution is called a “wave solution” (see Figure 2).

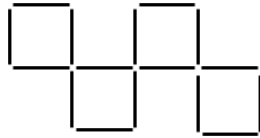


Figure 2: The wave solution was one of two possible correct solutions of each task.

The incidental solution hint was hidden by embedding it into the logo of a fake research group (MBED–Mind, Brain, and Education Division) conducting this experiment (see Figure 3).

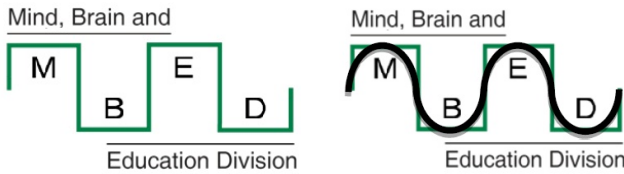


Figure 3: Fake logo with embedded incidental solution cue (so-called “wave form” of logo)

The logo (i.e., the incidental hint) was printed in green and appeared at the upper right corner of the test booklet.

After the participants had worked on all four match stick tasks, they had to answer a questionnaire, which consisted of items that: (a) collected information on social statistics (e.g., gender, age); (b) evaluated the quality of the instruction, motivation for doing the work on the tasks and the level of familiarity with the four employed tasks; and (c) explored (via three different items) whether the participants had consciously noticed the relevance of the logo for solving the tasks. Those participants who had recognized the incidental hint were excluded from further calculations.

There were two groups: Group 1 was the control group; the participants were given the instructions and had to solve the four problems in the given sequential order. The participants of group 2 (intervention group) in addition received a hidden cue (unconscious hint). This cue was present from the start of the experiment (first page of the test booklet).

The four geometric match stick tasks had to be worked on in the sequence presented in the test booklet. For each task the participants had

a maximum of ten minutes to find a solution.

2.2 Results

Impact on solution rate: Five participants had noticed the relevance of the embedded incidental hint for solving the problem; therefore they were excluded from further calculations.

The participants of the control group (group 1) on average solved 1.54 tasks while the subjects of the treatment group (group 2) solved 2.34 tasks; this is a gain of about 50%. The Mann-Whitney rank sum test showed that the treatment group differed significantly from the control group ($z=-2.27$, $p=.023$); Cohen's d showed a medium effect: $d=.47$.

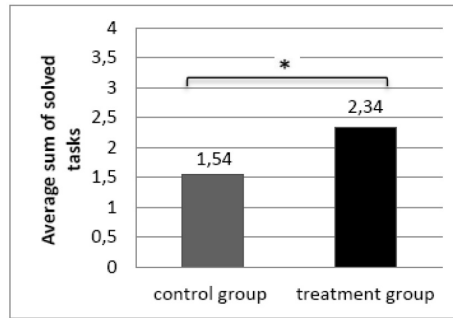


Figure 4: Average solution rate of both groups (control vs. treatment) *... $p<.05$

Impact on solution time: In order to investigate whether the unconscious hint also has an effect on the solution time, a variable was created which contains the average solution times of all four tasks for both groups (Figure 5).

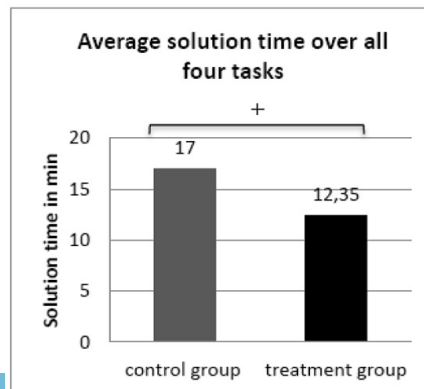


Figure 5: Average solution time for all solved tasks and both +... $p<.1$ ($p=.078$)

Figure 5 shows the comparison of the average solution time for all four tasks for both groups: the subjects of the control group on average solved all four tasks after 17 minutes; the subjects of the treatment group only needed 12.35 minutes to reach the solutions. Since only those subjects could be included in the calculation who had solved *all four tasks*, the attained test power was very weak (28%). For the test of significance the Mann-Whitney rank sum test was again performed. A control v. treatment group comparison shows a tendency towards significance: $z=-1.77$, $p=.078$. Despite the fact that on average treatment group is 4.65 minutes faster in solving all four tasks (about one quarter less time is needed in the treatment group than by the control group), the test only yields a so-called “tendency.” This, as already indicated above, is due to the extremely low test power of 28%. This interpretation is confirmed by Cohen’s d , which shows a medium effect: $d=.58$.

For more detailed results of this experiment and the discussion of methodological topics, see Bröderbauer, Huemer, and Riffert.

3. Discussion and Final Remarks

The parallelism between basic concepts of Gestalt psychology and Whitehead’s process philosophy is advantageous for both sides: While it seems that Whitehead’s theory of perception and in particular of microgenesis of conscious perception is more sophisticated than the Gestalt position, the Gestalt experiments on perception and problem solving (see Maier; also Duncker) open possibilities to investigate Whitehead’s theory of perception empirically by experiments.

The results of the presented experiment on a complex problem solving task confirms that incidental (subliminal) hints have a strong positive impact on: (a) the solution rate; and (b) the time necessary for solving the tasks, which demonstrates the effectiveness of incidental (unconscious) hints even in sophisticated problem solving processes. These findings are in line with the results published on this topic (see Knoblich and Wartenberg; Moss, Kotovsky, and Cagan; Judson, Cofer, and Gelfand; and Grant and Spivey) and add to the empirical evidence that there are conscious as well as unconscious processes involved in problem solving (see Berry and Dienes; Shames; and Dienes and Berry).

The use of Katona’s match stick experiment opens exciting possibilities for future research: Since each problem has exactly two different solutions, it is possible to investigate the interaction between subliminal and conscious

information processes, which has hardly been done thus far (for some exceptions see Berry and Broadbent; Sun, Slusarz, and Terry; Sun, Mathews, and Lane; and Helie and Sun). Due to the fact that there exist exactly two different solutions for each task, it is possible to present one supraliminal (conscious) hint for one solution (say solution A), while a second hint for solution B (which is incompatible with solution A) is presented subconsciously. We term this the divergence condition since each of the two hints aim at different solutions. But a so-called convergent condition is also possible: Both hints, the conscious and the subconscious, aim at the same solution (either A or B). A comparison between the divergent, the convergent, the purely supraliminal, and the purely subliminal condition opens a window for investigating the interaction or relative importance of supraliminal and subliminal processes in problem solving. First experiments using these divergent and convergent designs have been undertaken by our own research group and the interesting results are in the process of being published.

Research on incidental (subliminal) cues has generated further research options: For instance, it would be fertile to systematically vary presentation time, duration, and frequency of the incidental hint; this would allow for investigating how and to what extent the incidental solution stimuli function in the solution process. Also the incidental cue can be varied from only slightly constraining the problem space up to the presentation of the full solution (since three match sticks have to be altered in order to reach the solution). But also the type of hint can be varied since each of the tasks has two different solutions. This would open the possibility to test whether the less preferred solution (under normal solution conditions) can be just as effectively primed as the preferred one. To investigate the role of impasses on the problem solving process by presenting incidental hints at different points in time during the solution process is another option for future research.

The incidental (subliminal) research approach also holds considerable potential applications for the educational domain. For instance, it would be interesting to investigate the impact of improved solving activities, which have been evoked by incidental subliminal hints, on the development of self-efficacy attitudes. According to Bandura, persons with higher self-efficacy convictions select more difficult tasks and work harder on solving the tasks than people with a lower self-efficacy characteristic. To improve such self-efficacy convictions is particularly important for online learning settings where students have to motivate themselves. But also the design

of worksheets can be informed by the results of this kind of research. Results from a first explorative study (post measurement only design) point in that direction. For both groups (control and treatment) we have obtained strong and highly significant positive correlations between solution rate and self-efficacy scores: control group ($p < .0001$, $r = .73$); treatment group ($p < .0001$, $r = .66$). These results indicate that success attained with the help of incidental (subliminal) hints contributes to the building up of self-efficacy convictions; of course further investigation is necessary to substantiate this claim.

Also, research on the impact of incidental hints adds empirical support for Whitehead's three-phased learning theory: Whitehead did not get tired of pointing to the necessity that a learning process always has to begin with the direct exposition of the learner with a concrete problem; he termed this first phase "romance." In this first learning phase, the learner is exploring a (complex) problem situation "which holds within itself unexplored connexions with possibilities half-disclosed by glimpses and half-concealed by the wealth of material" (*AE* 17). Such rich problem situations can hold many incidental hints for solving the problem which may in fact lead to a solution; the solution can and should later be reflected on and elaborated systematically in detail (phase two: "precision"), culminating in systematic knowledge, which then again should be confronted with new problems (phase three: "generalization") (*AE* 17-19).

Finally, it is important to draw attention to the shortcomings of the presented experiments. Future research will have to ensure that acceptable test power is given. Also, a more balanced sample concerning gender is desirable in the future. Concerning the question of replicating the results, we can communicate that a first replication study was successful.

Despite the just mentioned shortcomings of this particular experiment, the general similarity between process philosophy and Gestalt psychology seems to hold many exciting possibilities for future research.

ENDNOTES

1. What role Whitehead played in inviting Köhler to deliver the William James Lecture, an endowed lecture series starting in the 1930s, I do not know, but the lecture series was co-sponsored by the Departments of Psychology and Philosophy, so it seems possible that he was at least involved in the selection of the presenters.

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