

GESTALT PSYCHOLOGY AND THE MIRROR NEURON DISCOVERY

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It is sometimes the case that scientific speculations from an earlier era anticipate with surprising precision later discoveries that occur long after the original hypothesis and even the theory within which it was formulated have been abandoned or absorbed. In such cases, historical excavation can direct credit for prescience where it is due. It can also reveal the surprising predictive power of earlier theories, even suggesting that they be revisited for the insights they might still yield.

The main purpose of this brief historical paper is to excavate an instance, not previously recognized, of just such a historical anticipation of a recent discovery as well as a theory formulated on the basis of that discovery. Specifically, in important respects, the theoretical speculations of the Gestalt psychologists, Köhler and Koffka, during the 1920's through to the 1940's

- (1) anticipated the recent discovery of mirror neurons and other related work and
- (2) also anticipated a current theory, based on these recent discoveries, of how one understands another's mental states.

Recently, a class of neurons has been discovered in the macaque monkey's premotor cortex which have been called mirror neurons because they fire both in the brain of a monkey who performs a particular action (e.g., grasping an object) and also in the brain of a monkey who merely observes the action (Gallese et al. 1996, Rizzolatti et al. 1996). There is some evidence that a similar system exists in humans. For example, Fadiga et al. (1995) reported that when subjects observed the experimenter grasping an object, motor evoked potentials from the hand muscles of the observer (and presumably, the corresponding areas of the observer's motor cortex) markedly increased relative to other control conditions (e.g., observing the experimenter's aimless movements with his arm). Furthermore, an enhancement of the motor evoked potentials occurred in those muscles that the subjects would use were they actively performing the observed movements. Other studies employing Positron Emission Tomography (PET) have localized the areas of the brain that are activated when one observes another's action (Rizzolatti et al. 1996, Grafton et al. 1996).

There is evidence that a similar process operates, not only when one observes another's actions, but also when one observes another's emotional facial expressions. For example, observation of happy faces evoke increased zygomatic major muscle activity in the observer, while observation of angry faces evoke increased corrugator supercillii muscle activity - the same muscle areas involved in, respectively, happy and angry facial expressions (Dimberg 1982; Dimberg & Thunberg 1998; Dimberg, Thunberg, & Elmehed 2000; Lunqvist & Dimberg 1995).

The above and related evidence has led some contemporary investigators, such as Gallese, to propose a theory of "embodied simulation" and to conclude "that the same neural structures that are involved in processing and controlling executed actions, felt sensations, and emotions are active also when the same actions, sensations, and emotions are to be detected in others" (Gallese 2003, 519). According to Gallese

& Goldman's version of Simulation theory, the fundamental basis for our general 'mind-reading' ability is the creation "in the observer of a state that matches that of the target" (Gallese & Goldman 1998, 498).

This contemporary formulation of "embodied simulation" is remarkably similar to the early account of the Gestalt psychologists, Köhler and Koffka, of how we understand another's mental states. Indeed, the discovery of mirror neurons, if interpreted through the lens of embodied simulation theory, appears to be a confirmation of a hypothesis put forward and defended by these Gestalt theorists in the 1920's through the 1940's. At that time, Köhler and Koffka proposed that understanding another's mental state is largely attributable to the operation of the general principle of isomorphism. In effect, the Gestaltists identified two forms of isomorphism, an internal or intrapersonal isomorphism and an external or interpersonal isomorphism. It is the external proposal that, when applied to the observation of the behavior of others, anticipates the mirror neuron discovery and forms the basis for the Gestaltists' account of how one understands another's mental state. However, the interpersonal isomorphism proposal builds on the foundation of the intrapersonal proposal, so we first briefly elaborate the latter.

The Gestaltists proposed that there exists an internal or intrapersonal form of isomorphism in which common formal or structural characteristics are shared by

- (1) a person's mental state (e.g. the experience of an emotion);
- (2) the person's expressive movements that accompany his/ her mental state; and
- (3) the neural processes underlying both the person's mental state and behavior.

To take an example from Köhler (as quoted in Koffka [1924, 130]),

"if we were to represent behavior graphically by means of a time-curve, the behavior of fright might show an abrupt rise in the curve, followed by a gradual fall. The dynamics of the phenomenal or mental processes accompanying this behavior would then be indicated by a curve of essentially the same character...".

One would then also find, Köhler adds, a dynamic structure of neural processes that is isomorphic with the mental state and its accompanying behavior.

The external form of isomorphism postulates common structural properties between the observer and observed objects in the world, including both inanimate objects and other people. In both cases, the principle of isomorphism proposes that, when one perceives an object, there are formal similarities between the structural properties of the object and the perceiving individual's brain processes. There is recent evidence supporting this hypothesis in the case of inanimate objects. Damasio cites work by Tootell et al (1988) who

[have] "shown that when a monkey sees certain shapes, such as a cross or square, the activity of neurons in early visual cortices will be topographically organized in a pattern that conforms to the shape the monkey is viewing. In other words, an independent observer looking at the external stimulus and at the pattern of brain activity recognizes structural similarity" (Damasio 1994, 103).

Applying the external isomorphism principle to the special case of the perception of other people, the Gestaltists proposed that when one perceives another's behavior or expressive movements, neural processes are activated in the perceiver that are isomorphic or structurally similar to the neural processes accompanying the observed person's expressive movements. As Koffka puts it,

“Now, if the terms ‘abrupt rise’ and ‘gradual fall’ in these...cases, be not merely analogous, but in some sense truly identical, then in principle at least, it is possible that an intrinsic relation exists between the mental processes of a living creature, and the total impression made by movement of the creatures’ limbs upon one who witnesses the movement” (Koffka 1924, 130).

Koffka then states the general proposition in the following way:

“... every form of behavior has a certain articulation or phrasing. This articulation issues from a similar articulation of the central nervous processes of the acting individual. This central articulation in turn corresponds to the individual’s ‘experience,’ which is articulated in like manner. Thus the perception in the mind of an onlooker, if it so constituted as to embrace what is going on in the agent, must itself possess a similar articulation. *And hence the experience of agent A and the observant B must resemble each other*” (Koffka 1924, 130-131) (*our emphasis*).

In short, Köhler and Koffka propose, not only an internal or “intrapersonal” isomorphism among the structural properties of Person A’s experience, corresponding expressive behavior, and neural processes, but also an external or “interpersonal” isomorphism between Person A’s experience, behavior, and neural processes and the neural processes activated in Person B when he or she observes Person A. It is specifically these speculations regarding interpersonal isomorphism or the “resemblance” between the neural processes of the observer and the observed that appear to anticipate the discovery of motor neurons and related phenomena.

The Gestaltists argued further that one implication of the principle of external or interpersonal isomorphism is that understanding another’s person’s emotions, intention, and actions is a direct perceptual phenomenon and is part of the very phenomenological experience of the other. It is not the case, they argued, that one normally first perceives a person behaving in a particular way or exhibiting certain expressive movements and then, as an additional intervening step, infers or theorizes the other’s actions, emotions, and intentions as an integral aspect of one’s phenomenological experience. Because, the Gestaltists reasoned, A’s expressive movements “map” A’s experience (e.g. his or her emotion) and since B perceives A’s movements, B’s understanding of A’s experience is directly perceptual rather than indirect and inferential. As Koffka (1935) puts it,

“If [...] A as he is perceived by B, were a more or less true map of M_A [A’s overt movements] then we could understand how B becomes aware of A’s emotion without association or inference by analogy” (Koffka 1935, 659).

The main point Köhler and Koffka are making is that since the observer’s neural processes are isomorphic with the observed’s emotion-expressive movements and inner experiences which, in turn, are isomorphic with the observed’s neural processes, the observer directly and immediately perceives the other’s mental state. As Köhler states,

“If I refer to the calmness of a man before me, I refer to a fact which I perceive” (Köhler 1947, 241); “Similarly, if the man ‘gets excited’, the *crescendo* which occurs before my eyes and ears is not, of course, a neutral sensory fact; rather, the dynamics of the perceptual event *is*, or *contains*, what I call the man’s ‘excitement’” (242).

Köhler makes a similar point with regard to other people’s “hesitation,” “restlessness,” “determination,” “depression,” “avoiding,” “reaching for,” “and so on” (242).

In arguing that understanding another's emotions, intentions, and actions is a direct perceptual phenomenon and does not require explicit inference or theorizing, the Gestaltists appeared to anticipate a specific one of the three competing important contemporary theoretical formulations regarding the nature of our 'mind-reading' ability. The Gestaltists' view that understanding of another's mental states is perceptually immediate and does not necessarily require inferential higher cognitive functions appears to be at odds both with traditional Simulation theory, which proposes that one understands another through explicitly putting oneself in the shoes of the other (e.g., Gordon & Cruz 2004; Jung 2003); and theory theory, which proposes that one understands another through inference from a general acquired folk psychology theory (e.g., Carruthers & Smith 1996; Stich & Nichols 1992). However, it is entirely compatible with and seems to anticipate, in important respects, Gallese's (2003) theory of "embodied simulation". In passages that could virtually be taken from Köhler's and Koffka's writings, Gallese proposes that "the meaning of expression of affective behavior seems to be automatically understood by the observer without the necessity of any intervening complex cognitive mediation" (Gallese 2003, 519). Also,

"This *implicit, automatic, and unconscious* process of embodied simulation enables the observer to use his/her own resources to penetrate the world of the other without the need of explicitly *theorizing* about it [...]" (Gallese 2003a, 174) (*author's emphasis*).

Gallese also writes:

"Whenever we are exposed to behaviors of others requiring our response, be it reactive or simply attentive, we seldom engage in *explicit and deliberate interpretative acts*. The majority of the time our understanding of situation is immediate, automatic, and almost reflex-like" (Gallese 2003, 520) (*author's emphasis*).

It should be noted that in seeming contrast to the position taken by Gallese & Goldman (1998), Gallese strongly suggests that no act of pretending to be in another's mental state or any other mediating cognitive process is necessary in order to understand another's intentional action or affective expression. In this sense, Gallese's position is very close to Köhler's and Koffka's.

The Gestalt concept of isomorphism, particularly external or interpersonal isomorphism, as well as its implications for understanding our 'mind-reading' ability, are good examples of important theoretical formulations and concepts in psychology that lie dormant and then become 'filled out', relevant, and heuristic by virtue of new findings, such as the mirror neuron discovery. One wonders whether there are other concepts in psychology that have been dormant and are awaiting profitable excavation. We know that Gestalt psychology is no longer an active 'school' and that many of its discoveries and theoretical formulations have been assimilated into mainstream psychology. Yet many of its distinctive claims, such as the general non-inferential perceptual directness of our understanding of others' internal mental states, although embraced and developed by phenomenological philosophers such as Merleau-Ponty, remain controversial and even generally rejected in mainstream psychological theory. Thus it is especially interesting that it is this Gestalt hypothesis that has been resurrected due to recent empirical discoveries and resultant theoretical formulations. These developments represent an example of the remarkable, almost prescient contributions of the Gestalt psychologists, and suggest that the full measure of their insight has yet to be adequately revealed let alone appreciated.

Zusammenfassung

Neuere Forschungsergebnisse aus der kognitiven Neurowissenschaft zeigen, dass bei der bloßen Beobachtung einer bestimmten Handlung einer anderen Person im eigenen prämotorischen Cortex die gleichen Neuronen aktiv werden, die bei der Ausführung dieser Handlung durch den Beobachter selbst aktiv würden. Man spricht in diesem Zusammenhang von „Spiegelneuronen“. Das Prinzip eines „externen“ oder „interpersonellen“ Isomorphismus, das die Gestaltpsychologen Köhler und Koffka in den Zwanziger- bis Vierziger-Jahren des vorigen Jahrhunderts postuliert haben, nahm wichtige Aspekte dieser Entdeckung der „Spielneuronen“ vorweg. Mehr noch: Die auf dem Prinzip des interpersonellen Isomorphismus aufbauenden Thesen der Gestalttheoretiker und Gallese's neuere, von der Entdeckung der Spielneuronen inspirierte Simulationstheorie stimmen in der zentralen Annahme überein, dass die menschliche Fähigkeit, die Handlungen, Gefühle und Intentionen eines anderen zu verstehen, in einem impliziten, automatischen Vorgang unmittelbar gegeben ist und nicht einer vorausgehenden Verarbeitung im Sinne des Schließens und Interpretierens bedarf.

Summary

Recent work in cognitive neuroscience reveals that, when one observes another person performing some action, neurons fire in one's own motor cortex that are the very same neurons that would fire if one were also performing the observed action; these have been dubbed "mirror neurons". The principle of external or interpersonal isomorphism, formulated by the Gestalt psychologists, Köhler and Koffka, during the 1920's through to the 1940's, anticipated important aspects of the mirror neuron discovery. Moreover, both the Gestaltists' theory, based on the principle of interpersonal isomorphism, and Gallese's (2003) contemporary theory of "embodied simulation", inspired by the mirror neuron discovery, converge on the central claim that our general ability to understand another's actions, emotions, and intentions, is implicit, automatic, and non-inferential.

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