

# 1 MENTAL IMAGERY

## 1.1 What Mental Imagery Is

Mental imagery is commonly defined as a product of cognitive processes consisting in retrieving, constructing and manipulating the mental representation of objects and/or events, so that they keep many features of the corresponding percepts. Such a representation occurs also in absence of a specific sensorial stimulation.

From a linguistic point of view, the term “image” seems not appropriate referring to a complex mental process which involves perceptual aspects and knowledge itself (as concepts, shapes and relationships). In particular, in the Italian language doesn’t exist a specific term to define the generation process of mental imagery. For this reason scientists prefer to use the English term “imagery”.

Mental imagery – an activity which is sometimes colloquially referred to as “visualizing,” “seeing in the mind’s eye,” “hearing in the head,” “imagining the feel of,” etc. - is a quasi-perceptual experience. It resembles perceptual experience, but occurs in the absence of the appropriate external stimuli. It is also generally understood to bear intentionality (mental images are always images of something or other), and thereby to function as an actual form of mental representation. Traditionally, visual mental imagery - the most investigated kind of imagery - is thought to be associated to picture-like representations (mental images) in the mind, but this is no longer universally accepted.

Imagery experiences are, very often, understood by people as echoes, copies, or reconstructions of actual perceptual experiences from their past. At other times they may seem to anticipate possible, often desired or feared, future experiences. Imagery has often been believed to play a very large, even pivotal, role in both memory (Yates, 1966; Paivio, 1986) and motivation (McMahon, 1973). It is also commonly believed to be centrally involved in visuo-spatial reasoning and inventive or creative thought. Indeed, according to a long dominant philosophical tradition, it plays a crucial role in all thought processes and provides the semantic grounding for

language. However, in the 20th century vigorous objections were raised against this tradition which was widely repudiated. More recently, it has once again begun to find a few defenders. The expression ‘mental imagery’ (or ‘mental images’) may be used in any or all of at least three different senses, which are only occasionally explicitly distinguished, and all too often conflated:

- 1) Quasi-perceptual conscious experience per se;
- 2) Hypothetical picture-like representations in the mind and/or brain that give rise to sense (1);
- 3) Hypothetical inner representations of any sort (picture-like or otherwise) that directly give rise to sense (1).

What is the nature of mental imagery? Are “picture-like” representations in the mind? How are they generated and manipulated?

### **1.1.1 Experience or Representation? Different Meanings of Term**

#### **“Imagery”**

Defining the nature of mental imagery has always been a hard work and the attempts to explain it are countless. Starting from Plato’s, through Berkeley’s, Hume’s and Locke’s theories, until the most recent claims, philosophical tradition is really very vast. The problem is to understand in which way the knowledge of external reality occurs, through which channels and thanks to which kind of representations. Imagery, in sense of representation, has its origins from linguistics and iconism and shows, in fact, particular and unusual characteristics common to the concept of “sign”. The feature of the “sign” is to be something that refers to something else, something that exists for something else; so, the sign is like a mediator with the reality it refers to. Mental imagery is the representation of something in absence of this “something” itself, namely, in absence of the appropriate and immediate sensorial stimulus, from which the image is generated. We can have sensorial experiences thanks to imagery: we can visualize the shape of an object, remember a familiar music and feel a scent or a taste of something that is not present. Commonly we refer to this as “having mental images”. Although there is the possibility to experience mental images in all the sensorial modalities, most studies refer to the ability to

construct visual mental images like “seeing with the mental eye”. We can distinguish and classify different kinds of mental images:

- Eidetic images, that is visual images which are so clear and so vivid that they seem very similar to percepts;
- Consecutives images, namely, the product of the persistence of the stimulus also if it has stopped to stimulate the target;
- Hallucination images, characterized by physicality (you can have a real sensorial experience) also if they are not a product of a specific stimulation;
- Illusory images, provoked by an external stimulus distorted by the subject who perceives;
- Oniric images, of which dreams are made;
- Corporal images that are representations of one's body
- Thought images, defined by Holt (1964) a “subjective representation of a sensation or perception in absence of an adequate sensorial input, during the alert state as part of a thought”.

Than we can include mnemonic and verbal images. Piaget made a distinction between “reproductive images” and “anticipative images”: the first ones evoke objects or events already known, whereas the second ones represent events the subject never experienced, but only imagined. The reproductive images are differentiated in “static”, “kinetic” and “transforming”. The static images refer to objects or static configurations, contrary to the kinetic ones, that represent moving configurations. The “transforming” images, instead, represent objects changing in shape.

Presumably the idea is that a mental representation deserves to be called an image if its presence to mind (for example by playing a role in some currently occurring cognitive process) can give rise to a quasi-perceptual experience of whatever is represented (in the sense that we can experience something similar to the perception of an object, in every sensorial modality (auditory, odour and so on). But this idea relies upon our already having a grasp of the experiential conception of imagery, which must, therefore, be more fundamental than the representational conception. Furthermore, imagery as a form of representation rises basic and controversial questions about the nature of the mind and the ground of the quasi-perceptual

experiences. A number of scientists and philosophers do not accept that imagery experiences are caused by the presence to mind of representational tokens (e.g., Sartre, 1940; Ryle, 1949; Thomas, 1999b; Bartolomeo, 2002; Bennett & Hacker, 2003). It should be admitted, however, that focusing too narrowly on the experiential conception of imagery produces its own potential dangers. In particular, it may obscure the actual possibility, fore grounded by the representational conception, that important elements underlying representations or cognitive mechanisms may sometimes be operative both when we consciously experience imagery and sometimes when we do not consciously experience it. Some evidences, such as those provided by Paivio's (1971, 1991) about the differential memorability of words with different "imagery values", suggest that this is indeed the case.

In practice, both the experiential and the representational conceptions of imagery are frequently encountered in the literature of the subject. Unfortunately, it is often hard to tell which is intended in any particular case. We can refer to imagery experiences (or quasi-perceptual experiences) on the one hand, and imagery representations (or imagery processes) on the other.

### **1.1.2 Does Imagery Really Exist?**

In the first decades of the history of scientific psychology, the problem of the existence of mental imagery was debated by the Structuralism and the members of Würzburg School, who claimed the existence of forms of thought unaccompanied by mental images. Later the hegemony of Behaviourism made this subject of study expelled from scientific research and discussion, since it concerned an internal representation not directly detectable by means of observation. Piaget and Inhelder (1966) referred to image as "a field that modern psychology has curiously abandoned".

In accordance with definitions given by psychologists such as McKellar (1957), Richardson (1969) and Finke (1989), mental imagery was characterized as a form of experience (as in definition (1) see prg. 1.1). However, this is far from being unproblematic. Evidence for the occurrence of any experience is necessarily subjective and introspective and, because of this, those who doubt about the validity

of introspection as a scientific method may well be led to the question whether there is any place for a concept, such as imagery, within a truly scientific world view. J. B. Watson, the influential initiator of Behaviourism (that dominated scientific psychology, especially in United States, for much of the 20th century), questioned the very existence of imagery for just these sorts of reasons (Watson, 1913; Thomas, 1989; Berman & Lyons, 2007). Although few later Behaviourist psychologists (or their philosophical allies) expressed themselves on the matter in quite the strong and explicit terms sometimes used by Watson, the age of Behaviourist psychology was characterized by a marked scepticism about imagery (if not its existence, at least its psychological role was questioned). Imagery was not widely discussed again among scientific psychologists (or philosophers of psychology) until around the end of the 1960s, when Behaviourism began to be displaced by Cognitivism as the dominant psychological paradigm. Most informed contemporary discussions about imagery, amongst both philosophers and psychologists, are still very much shaped by this recent scepticism about imagery and the subsequent reaction against it.

Holt's article (1964) entitled "Mental imagery: the return of the "ostracised" is often conceived as the starting period of the imagery revival. By contrast with their Behaviourist predecessors, most cognitive psychologists today hold that imagery has an essential role to play in the mental economy. Many scholars share some of the reservations of their Behaviourist predecessors about the place of introspection and subjectivity in science, but they take the view that imagery must be real (and scientifically interesting) because it is explanatorily necessary. The results of many experiments on cognitive functioning, they argue, cannot be satisfactorily explained without making reference to mental images. The belief that such mental representations are real is justified in the same sort of way than belief in the reality of electrons, or natural selection, or gravitational fields (or other scientifically sanctioned "unobservable" concepts) is justified. From this perspective, some theorists recommend that the term "imagery" should not be understood to refer to a form of subjective experience, but, rather, to a certain type of "underlying representation" (Dennett, 1978; Block, 1981a; Block, 1983a; Kosslyn, 1983; Wraga & Kosslyn, 2003; Kosslyn, Thompson & Ganis, 2006). Such representation is

“mental” in the sense that it is conceived as embodied in brain states, but it is distinguished from other mental states by its functional (and computational) role in cognition. As Block (1981a, 1983a) pointed out, an advantage of defining mental imagery in this way is that it does not beg the controversial question of whether the relevant representations are, in any interesting sense, picture-like. However, what is that makes these mental representations mental images, if they are not picture-like? The debate shifts toward the nature of the symbols and pattern of symbols that constitute mental images.

## **1.2 Imagery in Cognitive Science**

The revival of interest in imagery was an important component of the so-called cognitive revolution in psychology during the 60s and early 70s, when the Behaviourist hegemony was broken and the concept of mental representation was established as central and vital to psychological theorizing. The first textbook of the emerging cognitive approach (Neisser, 1967) devoted substantial space to mental imagery and several books reviewing and reporting new findings on imagery were published between at the end of the 60s and the beginning of 70s (Richardson, 1969; Horowitz, 1970; Paivio, 1971; Segal, 1971a; Sheehan, 1972).

It was the recognition, in that period, of the powerful mnemonic effects of imagery that changed the situation, leading to a thriving tradition of experimental research and securing imagery a firm place in cognitive theory. The mnemonic effects, it turned out, could be clearly demonstrated in repeatable experiments that did not rely in any way upon introspective reports. The Canadian psychologist Allan Paivio was working on the mnemonic effects of imagery in the early 1960s (Paivio, 1963, 1965). His interest in the subject was apparently sparked by a demonstration of imagery mnemonics he witnessed at a public speaking course (Marks, 1997). However, the considerable attention that Paivio's theoretical speculations and painstaking quantitative experiments were attracting by the end of the decade surely owed much to the interest aroused by the more eye-catching historical and anecdotal studies of Yates and Luria.

By the later 1960s, and in the 1970s, many other psychologists would take up research in this area, but Paivio was well established as the field's leading figure and discussion focused largely upon the implications and merits of the Dual Coding theory of mental representation - which supported the notion of an imagery system as distinct from the verbal one - that Paivio proposed to explain his results (Paivio, 1971, 1986, 1991, 1995, 2007). This controversy between the Dual Coding and the rival Common Coding theories of memory (such a controversy should not be confused with the better known, later debate between analog (pictorial) and propositional (descriptive) theories of imagery (see chapter 2). The former debate is about the function of imagery in cognition, the latter is about the nature and mechanism of imagery itself.

### **1.2.1 Allan Paivio's Dual Coding Theory**

Paivio suggested a neo-mentalist hypothesis that must be considered as an alternative to behaviourism and to old mentalism. He aimed to understand the functions of ideas, images and meanings and all other components that may be conceptualized as cognitive information processing by studying their behavioural expression and relating them to a theoretical model.

Paivio distinguished different conceptions of imagery. According to the introspective conceptions, mental images are weakened sensations that have perceptive modality characteristics. According to the behaviourist conceptions, images are implicit answers. These conceptions were too naive, since they were based on a not reliable and fallacious research method to be really empirically supported. The latter conceptions gave rise to the same critics advanced against cognitivism (against imagery as concrete, empirically observable cognitive phenomena). For example the critics Paivio moved to the propositional theory (theory about which mental imagery is not picture-like but rather a detailed mentalese verbal description of a scene) were the roundness argumentation: if conceptual units are considered crucial points that represent objects and their properties (and relations among objects and properties), an infinite regress is determined. For instance, a unit tagged as BIRD is defined in terms of properties tagged as "has wings", "has feathers", "can fly": these properties,

in turn, are referred to other tagged properties, and in this way to infinity. This regress is due to translation of perceptive content in an abstract-arbitrary code in which any trace of dependence relation, linking the content to the specific sensorial modality that produced it, is lost.

Against the propositional theories based on linguistic thought, Paivio contrasted the Dual Coding Theory (DTC). By assuming that cognition consisted in the activity of representational-symbolic systems, specialized in information exchange with the environment for adaptive and functional behaviours (Paivio, 1986), he maintained the existence of two separate systems: one specialized in representation and elaboration of information about objects and non verbal events, the other specialized in relation with language. These two subsystems are functionally and structurally distinct. A guiding theoretical assumption was that internal mental representations had their evolutionary origins in the perceptive, motor and emotional experience and that they preserved the characteristics experientially derived in the way that representational structures and processes are modality specific, rather than amodal. Assuming that representations preserve modality specific properties coming from the sensorial modality they depend on, the DTC may be considered as the first explicit alternative to the linguistic-propositional theory claiming that propositions are abstract, amodal representations. The important point was that there is not a univocal relation between images and words: connections are not one-to-one but always one-to-many (we can produce different images starting from a word and we can describe with different words the same image). What makes particular this association between an image and the description is only the sensorial experience of the image itself.

Summarizing, Paivio, starting from the observation that apparently similar verbal stimulus (as words of the same length with the same value of use frequency) are remembered in different ways and that figural stimuli, objects or drawings of familiar objects are remembered better than verbal stimuli, maintained that such effects depend on the different way in which verbal and imaginative systems are involved in stimulus processing. The pictures are easier to remember because they immediately activate an “image coding” (analogical) and, if it is the case of a familiar object, it

also activate the “verbal coding”, that gives to the stimulus its verbal tag (the name). In this way the item is coded two times, one by the imaginative system the other by the verbal system. A similar process occurs for some verbal stimuli that describe objects and situations which evoke easily vivid images. Stimuli with low “value of image”, that is, words to which is difficult to associate a mental image, activate instead the verbal coding, resulting to be more difficult to remember because they are coded by only one system. The better memory strategy consist, therefore, in involving the double coding possibility, giving verbal tags to figural stimulus and developing mental images for verbal ones.

### **1.2.2 Mental imagery in Jean Piaget’s perspective**

Contemporary to Paivio’s Dual Coding theory, in Europe Jean Piaget and Baebel Inhelder supported the theory about which motility and imitation are also fundamental in the generation of mental imagery. To understand Piaget’s conception of mental imagery in the light of the general context of his theory, the first distinction to be done is between the figural and operative aspects of thought processes. Figural forms of knowledge are three: perception, imitation and mental imagery. The operational aspect of knowledge (possible only starting from 7-8 years of age) concerns the transformation of objects or of known events. Although mental images are directly connected to the figural aspect, also the operative one pays a fundamental role in Piaget’s issue. The figural aspect represents the particular symbolic state of images, its role in meaning processes.

To understand the peculiar symbolic nature of images is necessary to distinguish them from percept. Mental images do not have “sensory” nature; they are at the most “quasi-sensory”: they can be of an extraordinary precision, can reproduce visual features as shapes or colours of an object with extreme correctness. But the real point of distinction between mental imagery and sensation is due to the role of imitation. Mental imagery are not a simple copy of the object or the symbolized event: strictly linked to movement and, more in general to action, mental imagery is a case of internalized imitation, and we can find the starting point of representation in its nature of motor reproduction. The figural aspect and the operative aspect of

knowledge have their corresponding in two forms of imagery: reproductive images and anticipatory images. The reproductive images, resulting from the development of symbolic function (18-24 months), are first-built: they are able to evoke only the figural features of known objects; they link thinking to a pre-logic and pre-conceptual stage.

The coming of anticipative images marks a substantial change from a cognitive point of view: they are in fact the repercussion of knowledge structures reorganization, due to the formation of operational thought. Anticipative images allow representing “operations” on objects not yet perceived. To do this they must be understood: it’s impossible forming an image that anticipates an operation that we cannot understand. In the epistemological perspective of Piaget’s thought mental imagery highlights the peculiarity of its contribution to the knowledge, despite the subordination to general laws of the thought.