2   HISTORICAL DEBATES ON MENTAL IMAGERY

2.1   The analog-propositional debate

The revival of research on imagery was an important element of the cognitive revolution of the 1960s and 70s, contributing greatly to rise scientific interest in mental representations. How could the findings on imagery be reconciled with the functionalist, computational symbol manipulation approach to cognition that was emerging during the same period? Far too many discussions of visual mental imagery fail to draw a clear distinction between the claim that people have quasi-visual experiences and the contention that such experiences are to be explained by the presence of representations, in the mind or brain, that are in some sense picture-like.

The picture theory (or pictorial theory) of imagery experience is deeply entrenched in our language and our folk psychology. The very word 'image,' after all, suggests a picture. However, although the majority of both laymen and experts probably continue to accept some forms of picture theory, many 20th century philosophers and psychologists, from a variety of theoretical traditions, have argued strongly against it and, in several cases, they have developed quite detailed alternative, non-pictorial accounts of the nature and causes of imagery experiences (Skinner, 1953, 1974; Dennett, 1969; Pylyshyn, 1973, 1978, 1981, 2002a, 2003a; Neisser, 1976; Hinton, 1979; Slezak, 1991, 1995; Thomas, 1999b, 2009). Others have developed and defended picture theory in sophisticated ways in the attempt to meet these critiques (Kosslyn, 1980, 1983, 1994; von Eckardt, 1988, 1993; Tye, 1988, 1991; Cohen, 1996).

2.1.1 Propositional Theory

Pylyshyn, in a series of influential papers (1973, 1981), argued (in effect) that all the genuine phenomena associated with imagery (indeed, all truly mental phenomena) can and must be explained entirely in terms of mentalese representations. According to Pylyshyn and his allies, the computational paradigm of cognitive science demands that representational reality of imagery (and of actual perceptual experience) is not picture-like, but it is rather a detailed mentalese description of a scene. "What the Mind's Eye tells the Mind's Brain: a critique of Mental Imagery". With this article Pylyshyn officially opened a lively and high-profile controversy, commonly known as the analog-propositional debate.

According to Pylyshyn the basic error in the quasi pictorial metaphor is having assigned to images the properties that belong to percept in their introspective experience. Hence pictorialists confuse the distinct terms of mental imagery and perception. So, the fundament is the false analogy between imagery and vision, namely the idea that mental images are perceived in the same way of pictures. This false analogy led to the conception of mental images as internal objects with the same properties of external objects. This conception can be schematized in this way:

 (Image of object X) with properties P (not legitimate)

 Image of (object X with properties P) (legitimate)

Against this conception, Pylyshyn considered that what people refer are not the properties of their images but of the objects they are imaging. He critics Kosslyn, the main exponent of picture theory, for having fallen into the trap and having supported the idea that mental imagery represents physical distances, or the idea that it has spatial extent. With his critics Pylyshyn did not want to call into question the existence of mental imagery, but he did not want to recognize its symbolic independence and its irreducible way to an abstract representational code.

2.1.2 The Quasi-Pictorial Theory

Shepard and Kosslyn argued that imagery is a distinct, non-language-like form of representation. Kosslyn, in particular, developed a "quasi-pictorial" computational theory of visual imagery based on an analogy with computer graphics (Kosslyn,

1980). Computer graphics files store information in a compressed, non-pictorial form, but when they are displayed, they are translated into a mathematical map (bitmap) of the computer monitor screen, that specifies the color at each pixel (tiny dot) on the screen itself. Likewise, Kosslyn suggests, visual information may be stored in the brain as compact descriptions and we experience an image only when this information is used to create a two dimensional map of visual space in a special, functionally memory area he calls the "visual buffer". A picture, in Kosslyn's theory, is merely "quasi-pictorial", because there is no an equivalent instrument to the monitor screen to display it. What we experience as imagery, and what is available to the cognitive processes that use imagery, is the functional picture, the mathematical map, in the visual buffer. Later, Kosslyn (1994) identified the "visual buffer" with the several retinotopically mapped visual areas of the brain.

"Propositional" and "quasi-pictorial" theorists disagree sharply over what sorts of computational symbols, or data structures, are acceptable within cognitive theory and which best capture the empirical properties of imagery.

Propositional theory still finds philosophical defenders (Slezak, 1995), but Tye (1991) has undermined much of its appeal with a persuasive defense of the conceptual legitimacy of quasi-pictorial arrays as a distinct form of computational representation. Furthermore, many propositional explanations of empirical findings seem worryingly ad hoc (Kosslyn and Pomerantz, 1977). However, Kosslyn's (1994) declaration of victory in "the imagery debate" may be premature, even though he has certainly developed the venerable picture theory to an unprecedented level of empirical and conceptual sophistication.

Pylyshyn (2002) has now launched a major counter-attack, not only restating his empirically and conceptually based objections to quasi-pictorialism, but arguing that (despite many claims and some superficial evidences of the contrary) there is no firm evidence whatsoever to support it. Even the (much disputed) results, suggesting that visual imagery experience is correlated with activity in retinotopically mapped visual cortex (Kosslyn et al, 1995), are quite consistent with non-pictorial theories (Pylyshyn, 2002; Thomas, 1999). Furthermore, the quasi-pictorial theory does not parsimoniously account for a range of experimental results showing that people have

difficulty, in many circumstances, in finding new representational meanings in their images, meanings that are relatively easily found in an actual picture (Slezak, 1995; Thomas, 1999). Picture theory is unequipped to explain the fact that processes like mental rotation, mental scanning, mnemonic effects and so on occur also in congenitally blind as well as in sighted subjects. The blind experimental subjects apparently employ haptic (touch) imagery, but any haptic analogue to a quasi-picture image would be quite unsuitable to play an equivalent explanatory role (Thomas, 1999).

Before considering the predominance of pictorialism it is better to make two considerations. The first is that in mental imagery study it is necessary to distinguish imagery as representation and imagery as an experience that follows representation. Pylyshyn is right when he says that we cannot confuse these two aspects, but is wrong when he says that pictorialists can support their idea only on the basis of this confusion.

2.2 The supremacy of picture theory and basic functional theories

Let us consider, the title of the book *"The case for mental imagery"*, by Kosslyn, Thompson and Ganis (2006). The book is an extended and quite polemical defence of the much disputed view that visual mental imagery consists in representational brain states that are, in some significant and important ways, genuinely picture-like. Book's deeper purpose is to refute the view that imagery, even in sense of quasi-perceptual conscious experience per se, does not really exist (or, at least, that imagery will find no place in a properly scientific ontology). The book (intentionally or otherwise) invites us to considerate the hypothesis that mental images are picture-like entities and that people really have quasi-perceptual experiences, experience of which the science of mind must take count.

If mental images are not pictures in mind, how can we justify their representational independence? The real dilemma of pictorial theory is to ensure the picture features of images without falling into the error of the photographic hypothesis. Kosslyn

claimed that the difference between propositional/not propositional elaborations processes may be explained only admitting the spatial nature of pictorial representations: images incorporate the space in their nature. So, if the representation belonging to an image is pictorial, thus its spatial nature must have effects on how mental images are elaborated. If, on the contrary, representations are propositional, we haven't reason to expect that distances influence response time. The starting point, for Kosslyn, is that the space is an intrinsic property of mental imagery. To demonstrate his hypothesis Kosslyn made mental scanning experiments on visual images. The variable measured was the time necessary to "visually scan" the image. If subjects employed more time to mentally do great distances, than the representation of spatial properties through mental images was obvious.

A merit of the Kosslyn's model consists in the fact that images are dynamically generated, rather than recovered in memory, in this way explaining the creative feature of imagery. Moreover, this model allows to state that a configuration in the visual store is really an image of something, deriving from the point-to-point correspondences between each pixel. So the spatial properties of an image depend on the properties of the hosting medium: images exist in a medium which operates like a space. In this sense Kosslyn's theory allows to give a scientific basis to the traditional picture theory, also if the problem to explain how we can "see" the image remains.