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Asymmetries between Perception and Mental Imagery (Imagery and Blindness)

When we speak of mental images we refer to representations of objects in our mind. Typically mental images refer to visual representations. However, according to a constructive view of mental imagery (e.g. Cornoldi, De Beni, Giusberti & Massironi, 1998), a mental image is less modality-specific than the corresponding perception. Furthermore, the content of the mental images evoked may consist of more layers than the corresponding sensory perception. Thus we could imagine a dear friend or the long hours before obtaining the result of an exam with deep emotional involvement, and hence produce a specific emotional mental image, but also reconstruct it as a mental image involving many modalities simultaneously.

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The imagery process is strongly related to memory, thinking and perception. To find an exhaustive definition of mental images is not an easy task. In fact a number of different interpretations of the concept of mental images have been proposed. Holt (1964) observed that a mental image refers to all the subjective awareness experiences with an almost-sensitive modality, that is not only perceptual. Unlike perception, imagery is a mental process, difficult to ascribe to an exact stimulus-situation.

Based on sensory experience, we may represent the object in the knowledge system. Information about what we have experienced is registered in our memory system and then retrieved every time we need it. In many circumstances of our life the retrieval of mental images from memory represents a useful tool, as, for example, when we orient ourselves in a familiar environment using a visual mental map, or when -before leaving for a holiday- we imagine the optimal luggage arrangement in the boot of the car. The great use of imagery in everyday life and the close relationship between imagery and other cognitive processes justify the interest in this topic.

Mental images have been considered very similar to percepts in our mind. A debate is still running on the hypothesis that imagery and perception share common mechanisms. The analogical view of identity between perception and imagery was sustained by results deriving from the execution of certain mental operations using imaginal and perceptual representations. The mental rotation of 3D visuo-spatial configurations (Shepard and Metzler, 1971) or the dot-localization task using imagined stimuli showed that visual mental images are also subjected to the constraints of the physical world.

One interesting field of investigation as regards the relation between imagery and perception is the replication in the imaginal modality of certain phenomena effects or illusions obtained in the perceptual modality. This area is particularly open to criticism. Under imagery conditions different visual illusions may be obtained, such as the Mueller-Lyer illusion (Heller et al., 2002), Ponzo, Hering and the Wundt illusion in higher imagers (Wallace, 1984). However, Intons-Peterson and McDaniel (1991) reported a series of asymmetries between imagery and perception regarding the distance and magnitude estimations, relative contrast (brightness), structural factors, mental rotation and the role of knowledge. Giusberti et al. (1992) considered the different subjective experiences linked to imagery and perception and found that visual images and visual percepts differed in vividness ratings, and that visual perception involved more automatic and pre-attentive processes, while visual images generation implicated the involvement of controlled and non-automatic processes. Further studies by the same authors revealed that, when participants do not know the perceptual effect and/or the image is not based on a preceding perceptual exposition, the visual illusion is not present at the mental imagery level. For example the `pop-out` effect was examined by contrasting the representations of a reversed or inclined letter in a matrix made with the same letter under three different conditions, perceptual, memory perceptual and imaginal. Here are the instructions for the imagery situation described above (situation 1) and for another situation 2.

Table 1 – Instructions for the generation of mental images

Instructions
Situation 1
Imagine 5 rows each having 5 capital letters 'T'
Consider the second 'T' in the second row
Compare the vividness of a T within this context according to these two different conditions:
a) the 'T' is inclined 45 degrees
b)the 'T' is reversed 180 degrees
c) Which 'T' is more vivid and better stands out from the other 'T's?
Situation 2
Imagine a circle surrounded by other circles according to these two different conditions:
a) tthe circle is surrounded by 8 other circles which are a little bit smaller
a) tthe circle is surrounded by 8 other circles which are a little bit larger
In which case does the circle appear larger to your mind\s eye?

In the first two conditions of Situation 1 it was the inclined letter that 'popped out', and it did so very clearly, producing the most vivid representation. On the other hand, in the imagery representation the reversed letter appeared more vividly than the inclined one. Giusberti et al. (1998) confirmed the asymmetry between perception and imagery by using the Ebbinghaus (situation 2, the circle is larger in case a, i.e. when it is surrounded by smaller circles, but the effect is more evident in perception that in mental imagery) and Ponzo illusions (the superior line is longer in perception than in mental imagery) (examples of the materials used for studying these asymmetries are given in Figure 1 and Figure 2).

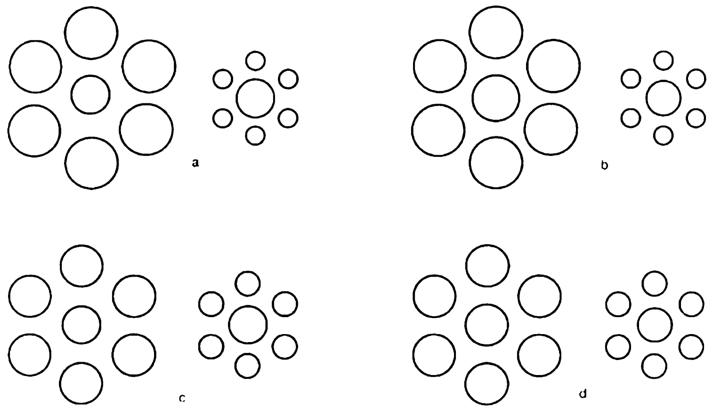

Figure 1. Examples of stimuli used for the Ebbinghaus illusion.
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Other results, problematic for an analogical theory of mental imagery, have been obtained with congenitally totally blind people who are able to do as well as the sighted on many imagery tasks (e.g. De Beni & Cornoldi, 1985). Thus given the contradictory results emerging from different studies the conclusions in this particular field are as yet difficult to draw. However, the distinction proposed by Cornoldi et al. (1998), between a visual trace, sharing characteristics with perception, and a generated image, with different properties, seems able to take into account the different results.

The possibility of "seeing" an object with our mind's eye seems to require that we have first experienced it in the perceptual world. This may be considered true if we refer to memory images, but we could also create original and totally new representations in our mind, not based on real perceptual representations. This assumption was sustained also by Hobbes, who affirmed that the generation of images is due to a combination, often new and original, of percepts stored in memory. The memory images can be generated on the basis of information retrieved from long-term memory. Cornoldi et al. (1998) called this type of mental image 'a generated image' and distinguished it from a representation directly derived from a recent experience or from a well-learned sensory pattern, called 'a visual trace'. According to their constructive view, generated images are the result of the combined synthesis of long term memory information coming from different sources and may be penetrated by beliefs, emotions, and conceptual knowledge.

The interest in studying mental imagery in congenitally totally blind people is motivated by different goals. Firstly, it allows us to establish the contribution of visual perception in the generation of mental images. Secondly, it shows whether and how it is possible to use mental imagery in order to improve memory performance in congenitally totally blind people. Third, if, on the one hand, a series of tools is suitable for discriminating performances between sighted and blind individuals, on the other hand, the same tasks can be used in the assessment of individual differences in order to highlight the different nature of the WM processes, in particular the distinction between the passive maintenance and the active manipulation and transformation of information.

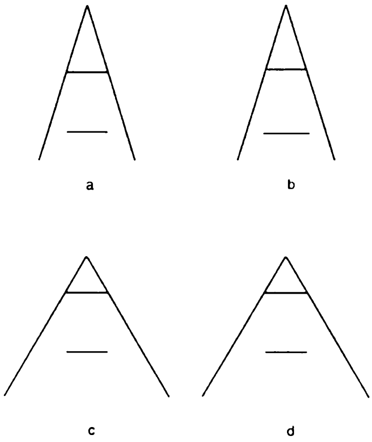

Figure 2. Examples of stimuli used for the Ponzo illusion.
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One of the first objectives that cognitive psychologists had to achieve was to design memory tasks requiring mental imagery strategies in which congenitally blind people could be compared with sighted individuals. This issue has been tackled by several researchers. For instance, it has been found that blind people can use interactive mental images in order to retrieve paired words (e.g. Zimler and Keenan, 1983), although it seems that they need a longer time in order to create their mental images (Kerr, 1983).

Other researchers investigated the qualitative differences characterising mental images processed by blind and sighted people. Those studies highlighted a large number of similarities in the mental representations created with and without visual knowledge, pointing out that some properties are not necessarily due to the visual experience (Marmor, 1978; Zimler and Keenan, 1983). For instance, it was found that in carrying out mental rotation tasks, the performance of blind people is subject to the same characteristics as the performance of the sighted ones: the time taken in order to judge the identity of two spatial configurations differently oriented in the third dimension depends on the performance.

The development of new specific experimental tasks largely contributed to the investigation of mental imagery in congenital blindness. For instance, a meaningful contribution came from a methodology that firstly requires a tactile exploration of stimuli and then the creation of a mental representation that is stored in visuo-spatial working memory. By using this experimental procedure many authors have shown that tactile exploration of a pattern of stimuli is sufficient to generate mental images in congenitally blind people.

In our studies we have investigated the nature of mental images and of visuo-spatial processes in blind people by evaluating the effects of different stimulus types and experimental instructions. One of our goals was to investigate the role played by subjective experience in mental imagery and the effect of imagery value in recalling three different categories of nouns. We used 1) concrete words evoking some mental image of objects experienced by the blind (HI, High Imagery value); 2) abstract stimuli for which it was harder to create a link with personal knowledge of the world both for blind and sighted people (LI, Low Imagery value); 3) stimuli that could evoke a mental image but that could not be associated with a direct personal experience, such as for the item 'spaceship' (HINE, High Imagery Not Experienced) (Cornoldi, Calore and Pra Baldi, 1979). Blind people judged HINE stimuli as having a low imagery value. However, data on their memory performance were not so clear. Indeed non-sighted participants recalled a greater number of LI names, whereas in other conditions their performance was poorer than that of sighted people. Furthermore, the accuracy of performance in blind people depended on whether the recall was intentional or incidental.

The pattern of results found in HINE condition was later on investigated by De Beni and Cornoldi (1988) and Tinti and colleagues (1999). These researchers replicated the early findings confirming that blind people have difficulty in recalling HINE words, but, if we take into account their limited knowledge of the world, their performance was less impaired than could be hypothesised.

In another series of research tasks differences between sighted and blind participants in using mental imagery were investigated by comparing their performance in recalling sequences of verbal information. In a study by De Beni and Cornoldi (1985), we asked sighted and blind participants to use the loci mnemonics— which consists in imaging to locate a series of stimuli along a well known pathway — in order to retrieve a list of twenty single, pairs and triplets of words. We found that also non-sighted people took advantage in this task of imagery instructions, because they preferred to use mental representations instead of using the rehearsal strategy in order to recall the items list. Moreover, congenitally blind participants could generate complex interactive mental images, but they had difficulty in creating a single mental representation containing different stimuli. The difficulty met by the blind in memorising triplets was not due to a generic increase in the memory request. In fact, according to Tinti and colleagues (1999) when complex mental images are processed and used in an auditory format non-sighted people are not impaired.

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