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Role of the Anatomical and Physiological Connections of the Tonic-Postural Body Tensions in the Perception of the Space in Mental Image

Vezio Ruggieri[1], Rossella Berardi[2]

[1,2]University of Rome Sapienza

Email: vezio.ruggieri@uniroma1.it

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ABSTRACT

We examined the **spatial transformations of mental images** of 34 participants male and female, undergraduate psychology students, who were asked - ***while they were looking with closed eyes at a mental image consisting of a table on which an apple was placed*** - to actively increase the distance between the first sacral vertebra and the 12th dorsal. The participants were previously subjected to a lengthening training of that section of the vertebral column. During the experimental task, while the participant observed the mental image, the experimenter measured in centimeters the lengthening of the sacrum-dorsal tract. Our research considers two interacting characteristics of visual space's perception both in external real and in imagined space. The first is constituted by concrete objects-stimuli which are visually perceptible and whose extension and mutual distance can be measured; the second has a *formless form*, i.e. an abstract form without concrete objects, always present, but which every person has full awareness and perceives its presence as a particular form of feelings, projecting it on the external environment. This form of space perception interposes between separate objects and envelops both objects and the observer himself, also defining the horizon of the world. This form is not visually perceivable, if not indirectly, like the distance between the objects. We can name this second component of space as "space-container". Starting from the reflection that the body as a unitary structure constitutes the first spatial experience, we hypothesize that the integrated proprioceptive perception of muscular tonic activity of the body scaffolding is at the basis of the "perceptual" feeling that characterizes what we named "space-container". Our hypothesis concerns the idea that the interaction between the two components is cross-modal. In this interaction the visual cerebral representation is connected, both in visual perception and visual imagery with the perception of postural muscular tensions (due to oscillations in muscle tone) of the different body districts directly or indirectly interacting with each other. The tensions are perceptually unified to produce a perception of an unitary feelings. In the present research we focus essentially on the role of isometric variations of relatively stable muscles tone. In conclusion we hypothesize that by modifying the relations between the muscular tensions of the bodily districts of the postural scaffolding, we can modify the visual spatial perception-like relations between the imagined objects. Our results seem to confirm these hypotheses. It is interesting that 23% of the participants observed, during the task, a lifting of the apple from the table.

Corresponding Author:

Vezio Ruggieri

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The aim of the present research is to identify some physiological components that underlie the perception-like (Finke,1980, 1985) of space which is present in mental visual representations of imagery. Investigations about imagery (for the extensive literature on the topic see below) has showed that visual perception and visual imagery have in common, in producing visual representations, similar anatomic neuro-physiological structures and processes. In the present research the process of the space of imagery is a first step in the study of space; the analysis of the perception of real external space will be developed in future investigations.

Hypothesis:

Now we examined the **spatial transformations of mental images of the 30 participants** who were asked to imagine, with their eyes closed, an apple placed on a table. Immediately afterwards they were asked, as they continued to produce the same image, to increase the distance between their sacral and thoracic vertebrae and to report what they observed. We hypothesize that by changing the distance between two body districts, we change the level of muscle tone in the postural musculature that connects them.

Space perception: the two components of the visual space. A perceptual paradox.

First of all, we believe that the perception of space presents a peculiarity due to the simultaneous presence of two interacting components: 1) the perception of concrete objects that have a visually perceptible and measurable space (both as an extension of the object and as a distance between objects) and 2) an empty space without objects, a formless shape, apparently not concrete, as abstract form, that interposes itself between objects, highlights its distance, envelops both objects and the same observer and draws the horizon and the boundaries of the perceivable external world. We define this second component of space as a “container-space ”. The perception of it is not visual, but we linked this form of perceptual awareness to the feelings of our presence in space.

The interaction between these two components generates the space’s perception as an unitary experience.

The psychophysiological problem that we pose is to help understanding how to connect visual sensory processes, on the one hand, with processes of this awareness concerning a particular form of feeling in the perception of space, on the other. Thus, we have initially focused our attention on the stable perception that the person has of "being in the world" by occupying a concrete physical space with *his body*. The second point is connected to the fact that the body, at the same time, presents itself as a unitary structure committed also by various articulated districts that can act independently (for example, I can move an arm without moving the leg or the pelvis, etc.) but they are always and always perceived as parts of the unitary structure. *So we start from the fundamental idea that the perception of one's body as an integrated unitary structure, is the first nuclear experience of space that is in dynamic interaction with visual perception of space.* Therefore our hypothesis can be considered a development of the idea, shared by a large part of the literature, on the cross-modal perception of space. This idea emphasizes the perception of body variables: its dimensions, its shape, its weight, the relations between the body and external world, the spatial positions assumed by the posture (vertical, horizontal, etc.), the gravitationnal components etc. (Gibson, 1979; Goldstein, 1981; Farah and Peer that reviewed only Full text available on Eric, 1988; Natsoulas, 1990; Bartolomeo, 2002; Carello & Turvey, 2004; Lalanne & Lorenceaua, 2004); (Linkenauger, Leyrer, Bülthoff, & Mohler, 2013; Witt & Riley, 2014; Favela, Riley, Shockley, & Chemero, 2018); Thus, as it emerges in scientific thought, the perception of space, albeit automated, is actually a complex process that involves different functional levels of the individual.

Reflecting on which sensory basis of the body could provide significant information about the "perception that the individual has of his own space", we also highlight the role of the muscular system – among the other roles - which has both motor and sensorial-perceptive components (proprioception of muscular activity both concerning movement and tonic-postural activity). About the muscular system, we share the opinion of Carello and Tyrney (2004) as they argue: ”The sensibility associated with muscles contributes little to the conceptual content current in psychology. In part, this is because perceptions achieved through the muscle sense typically go unnoticed. (…) nonetheless, researchers have discovered a rich variety of muscle-based perceptual capabilities (p. 25-28)”.

Integrated Perception

According to this background, we focused on analyzing the role of muscle tone in the muscles that characterize a certain posture, reflecting on the fact that besides maintaining a postural balance, the muscles themselves collaborate in the integrated cerebral representation of the perception of one's body. This cortical representation forms the basis of the Body Image. This functional conception overcomes the traditional distinction (Schilder, 1935) between Body Schema (which controls only motor activity) and Body Image (Fisher, 1986), which thus acquires a psycho-physiological role (Ruggieri, 2001,2011). Therefore we think that the cortical synthesis of the *variations* concerning the tonic tensions of the all body muscles, in turn generating the postural-bodily attitudes, plays an important role in perceiving the body as an *unitary structure*.

As is well-known, the characteristic of this muscular activity is the isometric contraction, which the physiology distinguishes from the isotonic contractions proper to the movement, though the two modes are mutually interacting. Isometric contractions (contractions without muscle shortening, but with continuous changes in tension) are characteristics of tonic-postural activity, whose role in tone regulation of postural equilibrium is well-known.

The muscles of the body are interconnected to form a single network

Our central assumption on the functioning modalities of tonic-postural activity *is that all bodily districts are functionally interconnected through a dynamic activity of all the muscles of the body tonic-postural system*. We think that by virtue of the activity of these interconnections between the muscles, the person perceives his body as a spatially compact one and as an unitary structure.

In other words, the muscular system shapes around the osteo-articular apparatus a sort of lining in which the muscle fibers, either working indirectly through the joints, or working directly by inserting on the same bone, are anatomic-functionally interconnected to form a *compact weave that wraps around the body like a sweater*. This structure that we can perceive as a wraparound mesh would be the basis of the sensorial perception of the subjective feeling concerning the presence of a unitary spatial corporeal reality which is in turn placed in the wider space of an external world.

What in philosophical reflection (Heidegger, 1926, reprinted 2006) is considered as "being", in the experimental approach is investigated using the conceptual category of "the perception of being" (Ruggieri, 2010). The perception of “being” as an individual is the result of a psycho-corporeal unit interacting with the external environment.

Some modifications of the level of tonic-postural tension regarding the fibers of the mesh, can evolve both in the isotonic contractions of the movement, with an evident shortening of the length of the fibers, and can show "variations of the tonic attitude" of the postural balance of the whole body that characterizes a certain posture. The changes in tone are produced by variations in isometric contractions that are the basis for minimal, but significant lengthening or shortening of the fibers of a district. These kind of movements produce effects of traction or relaxation which 1) can also extend to other neighboring districts and 2) can generate reflex muscle tonic adjustments of the whole body.

These adjustments are necessary for maintaining postural balance. This work of knitting can bring *body districts closer or further away. The mesh can therefore be narrow or wide initially in some districts but the tonic variation activity can extend in different degrees to the whole body. In this way variations in the distances between districts are created.*

We also think that this dynamic concerning the perception of postural tensions interacts with the visual perception of space and that the two perceptive systems influence each other.

Feelings

All modifications of the knit compactness are reproduced at the level of cerebral representation. We point out that the brain would not only record the variations in the shape of the "mesh" but also collect by unifying them, the formless proprioceptive "sensations" being generated by the same variations of muscular tension of the postural tone.

This second type of information, in addition to sensations of tonic-postural tension variation that is limited to a district, would be connected to all the proprioceptive sensations of the whole body that continuously reach the brain from the muscular periphery. We hypothesize that this last mechanism would be the basis of the *subjectively perceived feeling.* The term feeling can be applied to different types of experiences: for example to "feel light" or "heavy" or to particular emotional situations such as anger, joy, sadness etc. As regards to emotions, the variations in muscular tension would connect, in agreement with the theory of James and Lange (1890, 1887), to other types of sensory information (visceral) to produce the specific feeling of each emotion (Ruggieri, 1988 , 2011). A previous research (Ruggieri and Spinoso, 2017) has shown that changes in the body's global attitude, in which variations in postural tensions are evident, also produce in percipients significant changes in positive or negative emotional feelings.

In this work we intend to focus on a *particular feeling*, that is on the sensations that make us conscious of having a spatially unitary body structure immersed in the wider space of the external world.

The space in imagery. Mental representation in common for both perception and imagery.

Our research is also connected to the debate, which is also very extensive and controversial, on the physiological similarities and differences between visual mental representations generated by external perceptual stimuli, on the one hand, and those produced only by imagery, on the other. The majority of authors suppose that between the two processes there is a substantial similarity even in the construction of the components of mental images and in their mutual relations (Mast et al.,2003; Kosslyn, 1978; Farah, 1989, Farah, 1988; Farah et al., 1988; Finke and Kosslyn 1980; Finke, 1980; Finke, 1989; Finke, 1985; Ganis, Thompson and Kosslyn, 2004; Ishay, A., and Sagi, D., 1995; Kosslyn, 1994; Kosslyn, Ganis and Thompson, 2001; Kossslyn and Thompson 2003; Kosslyn Ganis and Thompson, 2003; Kosslyn, 1999; Kosslyn et al., 1996; Levine et.al. s 1985; Li, Piech and Gilbert; 2004; Mazard et al., 2004; Mechelli et al., 2004; Mellet et al., 1996; Nanai; 2010; Paivio, 1986; Slotnick Thompson and Kosslyn 2005, 2012 Segal and Fusella, 1970 Mechelli et al., 2004, Mast et al 2003; Ruggieri and Persico,2017;Joel et al,2015).

Thus, we start emphasizing the physiological similarity of the two processes, i.e. visual imagery and visual perception, highlighting the fact that they both produce *mental representations* that are similar and in some ways the representation of space in imagery is similar to real perception.

Therefore we believe not only that the “real” visual perception and the perception like (Finke 1980, 1985) of the imagery, have in common the mental “representation”. Moreover, we consider that the represented objects occupy a space in the imagery, with relative distances between the detectable objects and the subject he imagines.

Considering the hypothesized role of the unitary perception of individual’s own body as a basis, in interaction with visual perception, we refer to the research of Mast *et al*. (2003) that investigated the role of body position on the performance regarding four distinct types of mental imagery processing (abstract citation). They also support “that imagery tasks require a subjective reference frame, within the task is performed. In principle, we can distinguish between two different types of coordinates that define a spatial frame of reference, egocentric and exocentric coordinates. An egocentric frame of reference is defined by an axis of the observer’s body such as the longitudinal body axis, the normally vertical retinal meridian, the midline of the trunk or the head z-axis. In the current context, we will consider the unitary frame of the body as a whole. An exocentric reference frame is defined with respect to external space. It can be anchored to the midline of the visual environment” (p.1 and 2).

In conclusion in the present research we hypothesize **that changes** *in spatial distances between the districts generated* by changes *in muscle tonic tensions, in turn, modify the spatial relationships of the imagined objects.*

Materials and Method

Participants

The group consisted of 34 participants among undergraduate psychology students (11 males and 23 Females) who were invited to take part in a research on imagery.

Compliance with Ethical Standards

All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee (include name of committee + reference number) and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Informed consent

Informed consent was obtained from all individual participants included in the study.

Conflict of Interest

The authors declare that they have no conflict of interest.

Instructions

The participants wearing their daily clothes with a shirt or light shirt were invited to sit on a stool without a backrest. The experimenter asked them to imagine with their eyes open a mental image representing a table placed spatially at eye level, on which an apple was placed. The experimenter asked them if they had succeeded in producing the required image. He then said to them: "Now I will tactically show you, by gently pressing with my finger, on two points of the spine located respectively a) at the sacrum and b) at the last dorsal vertebra". While saying this, the experimenter indicated the two points with a slight digital pressure and immediately afterwards he/she applied a colored sticker on each of the two points. He then asked the participants to distance the two points and check their ability to make the spinal column lengthen, distancing the points.

In a second phase, participants were asked to close their eyes and to reproduce the same mental image of an apple on a table and to say "yes" when the image appeared clearly. The experimenter measured with a cm the distance between the two points marked by the colored adhesive. Then the experimenter asked to distance the two points (with a movement upwards) and to say if he observed changes in the image. Naturally the experimenter measured with the cm the degree of elongation produced.

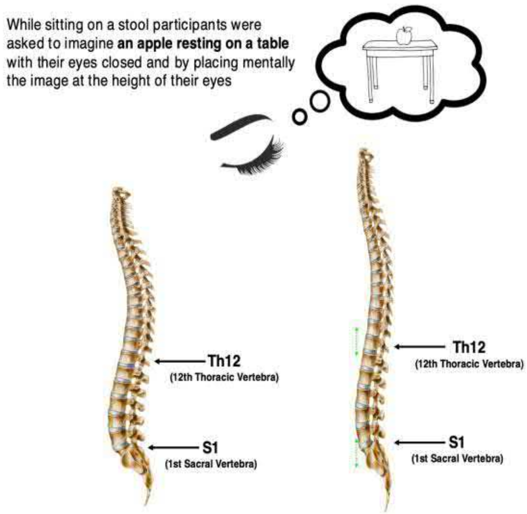

Fig. 1

Results

Two different ways of stretching have appeared 1) unidirectional (from bottom to top): mean value cm 2,917 SD.996 and 2) bidirectional: mean value cm 3.86 SD 1.054. In 12 (35%) participants the pelvis was motionless; in 16 (47%) the lengthening was bidirectional, in 6 (18%) was without lengthening.

30 participants (88%) observed changes in the mental image during the lengthening of the spine. The answers observed were: 1) Lifting the apple with respect to the table in 8 (23%) participants Fig.2; 2) enlargement of the image as a whole in 11 (32%) participants. Fig3; 3) change of perspective (as if the table and the apple were seen from above in 5 (15%) detail Fig, 4; 4) disappearance of the image in 4 (12%); 5) no change in 4 (12%); 6) other in 2 (6%).

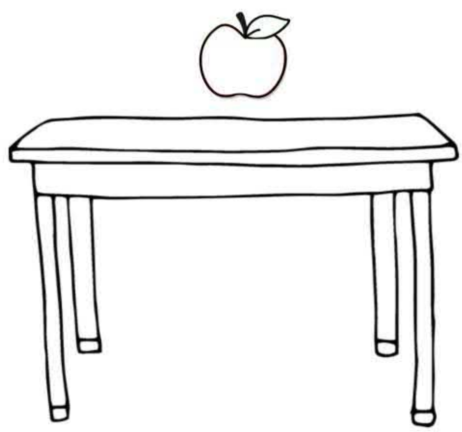

Fig. 2

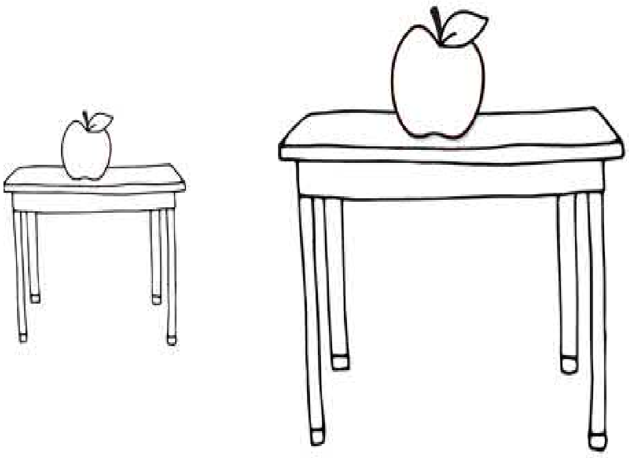

Fig. 3

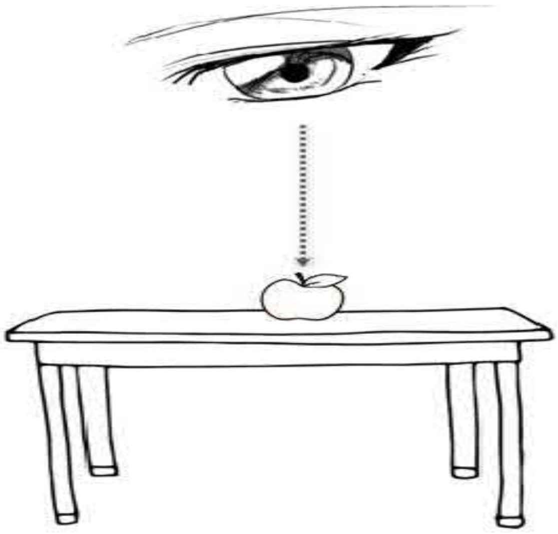

Fig. 4

Tab. 1 - Columns show spine lengthening variations. Rows show imagine changes

POSTURAL CHANGES	Apple rising	Apple growth	Perspective change	Apple disappears	No changes	Other	Total
Monodirectional lengthening	6	3	2	0	0	1	12
Bidirectional lengthening	2	7	3	2	1	1	16
No lengthening	0	1	0	2	3	0	6
Total	8	11	5	4	4	2	34

Table 1 shows the changes in the image in relation to the lengthening of the column. The differences are statistically significant. Chi2 square 21.755, p <.0164 df 10. Contingency co-efficient .625; Cramas V .566.

These results show a clear relationship between the form of imagination and the distance between body-muscle districts. Among the responses we underline that in the *23% of the group the increase in the distance between the sacral and dorsal vertebrae (relative body districts) generates an empty space without form.*

Conclusions and comment

The hypothesis that we wanted to verify with this investigation revolved around the identification of perceptive signals that had a possible role, alongside visual perception-like of imagery, in the construction of spatial experience. In fact, research in this area (see introduction) is increasingly oriented towards a cross-modal perception. In this sense we highlight a survey carried out in our laboratory (Ruggieri and Cocchia, 2012) which showed a relationship between the distances between objects which can be perceived visually and the listening of the rhythmic frequencies produced by a metronome. Listening to high metronomic frequencies greatly reduce, in a statistically significant way, the perception of the distance between objects.

In the present investigation we examined the relationship between visual representations (perceptive-like according to Finke 1985) and perception of one's body understood as a unitary structure. Let's start from the idea that the unitary perception of the body would constitute a first and fundamental experience of a first space that would enter into close interaction with visual perception.

We think that the formal unity of our body would be generated by a weaving of muscles which, in a basic condition, form a sort of mesh that envelops the whole body. The perception of this mesh would consist in the proprioceptive sensory perception of the tonic-postural activity of the whole body's muscles. This mesh therefore essentially presents variations of isometric contractions. These variations can modify the shape of the muscular texture producing effects on the interactive bonds of the body districts, determining their closer approach or relative distancing. Thus, the hypothesis is that significant changes in muscle texture can modify aspects of spatial perception.

As far as spatial perception is concerned, we start by finding a sort of paradox: the perception refers both to stimuli that have a concrete spatial extension (extension of objects-stimulus; distances between objects) and to an “abstract space” without concrete stimuli that is introduced between the objects, enveloping the individual and defining the horizon. This space that we have called "container-space" is not visually perceived but is nevertheless felt as an external reality. We therefore face an exclusively sensorial perception projected onto the external environment. We think that this global bodily sensation has a basis in the continuous perception of postural muscular tensions in the mesh. It would be the product of a cerebral synthesis of all the muscular signals that, starting from the periphery of the body, reach the brain and from there they are projected to the outside.

The results of the research seem to confirm our hypothesis. In fact a bidirectional lengthening of the vertebral column determines an enlargement of the imagined objects, while a unidirectional lengthening produces a different perspective point (as if both the objects were seen from above) the even more surprising result, was the creation of an “empty space”: 8 participants – i.e. 23% of the members of the group – saw the apple rising from the table, thus somehow introducing us to the understanding of the perception of what we have called - the "space-container".

These first results must be confirmed by further research. These investigations on the perception-like space of mental images must extend to the verification of the hypothesis in the "real" perception.

References

1. Bartolomeo, P., 2002. The Relationship Between Visual Perception and Visual Mental Imagery: A Reappraisal of the Neuropsychological Evidence. *Cortex,* 38(3), pp. 357-378.
2. Carello, C. & Turvey, M. T., 2004. Physics and Psychology of the Muscle Sense. *Current Directions in Psychological Science,* February, 13(1), pp. 25-28.
3. Farah, M. J., 1988. Peer reviewed only Full text available on ERIC. *Psychological Review,* 95(3), pp. 307-317.
4. Farah, M. J., 1989. Mechanisms of imagery-perception interaction. *Journal of Experimental Psychology: Human Perception and Performance,* 15(2), pp. 203-211.
5. Farah, M. J., Peronnet, F., Gonon, M. A. & Giard, M. H., 1988. Electrophysiological evidence for a shared representational medium for Visual images and Visual percepts. *Journal of Experimental Psychology: General,* Volume 117(3), pp. 248-257.
6. Favela, L. H., Riley, M. A., Shockley, K. & Chemero, A., 2018. Perceptually Equivalent Judgments made Visually and via Haptic Sensory-Substitution Devices. *Ecological Psychology,* 30(4), pp. 326-345.
7. Finke, R. A., 1980. Levels of Equivalence in Imagery and Perception. *Psychological Review,* 87(2), pp. 113-132.
8. Finke, R. A., 1985. Theories Relating Mental Imagery to Perception. *Psychological Bulletin,* 98(2), pp. 236-259.
9. Finke, R. A., 1989. *Principles of mental imagery.* Cambridge, MA: The MIT Press.
10. Finke, R. A. & Kosslyn, S. M., 1980. Mental imagery acuity in the peripheral visual field. *Journal of Experimental Psychology: Human Perception and Performance,* 6(1), pp. 126-139.
11. Fisher, S , 1986. Development and Structure of Body Image. London, Lawrence Erlbaum Ass. Publishers.
12. Ganis, G., Thompson, W. L. & Kosslyn, S. M., 2004. Brain areas underlying visual mental imagery and visual perception: an fMRI study. *Cognitive Brain Research,* 20(2), pp. 226-241.
13. Gibson, J. J., 1979. *The Ecological Approach to Visual Perception.* Boston: Houghton Mifflin.
14. Goldstein, E. B., 1981. The Ecology of J. J. Gibson's Perception. *Leonardo,* 14(3), pp. 191-195.
15. Heidegger, M. 1926. Sein und Zeit, Max Niemeyer Verlag, Tubingen. Reprint of 2006.
16. Ishay, A. & Sagi, D., 1995. Common mechanisms of visual imagery and perception. *Science,* 268(5218), pp. 1772-1774.
17. James, W., 1890. *Principles of Psychology.* New York: Rinehart and Wilson.
18. Kosslyn, S., 1994. *Image and Brain.* Cambridge, MA: The MIT Press.
19. Kosslyn, S. M., 1978. On the ontological status of visual mental images. In: D. L. Waltz, ed.

Theoretical Issues in Natural Language Processing-2 . New York: ACM, pp. 167-171.

20. Kosslyn, S. M., 1999. *Le immagini nella mente. Creare ed utilizzare le immagini nel cervello.* Firenze: Giunti.
21. Kosslyn, S. M., Ganis, G. & Thompson, W. L., 2001. Neural Foundations of imagery. *Nature,* Volume 2, p. 635–642.
22. Kosslyn, S. M., Ganis, G. & Thompson, W. L., 2003. Mental imagery: against the nihilistic hypothesis. *Trends in Cognitive Sciences,* 7(3), pp. 109-111.
23. Kosslyn, S. M. & Thompson, W. L., 2003. When Is Early Visual Cortex Activated During Visual Mental Imagery?. *Psychological Bulletin,* 129(5), p. 723–746.
24. Kosslyn, S., Thompson, W. L., Kim, I. J. & Alpert, N. M., 1996. Topographical representation of mental images in primary visual cortex.. *Nature,* Volume 378, pp. 496-549.
25. Lalanne, C. & Lorenceaua, J., 2004. Crossmodal integration for perception and action. *Journal of Physiology,* June, 98(13), pp. 265-279.
26. Lange, C., 1887. *Ueber Gemuts-Bewegungen.* Leipzig: Kurrel.
27. Levine, D. N., Warach, J. & Farah, M., 1985. Two visual systems in visual imagery: a dissociation of “what” and “where” in imagery due to bilateral posterior cerebral lesions.. *Neurology,* Volume 35, pp. 1010-1018.
28. Linkenauger, S., Leyrer, M., Bülthoff, H. & Mohler, B., 2013. Welcome to Wonderland: The Influence of the Size and Shape of a Virtual Hand On the Perceived Size and Shape of Virtual Objects. *PLoS ONE,* 8(7).
29. Li, W., Piëch, V. & Gilbert, C. D., 2004. Perceptual learning and top-down influences in primary visual cortex.. *Nature Neuroscience,* 7(6), pp. 651-657.
30. Mast, F. W., Ganis, G., Christie, S. & Kosslyn, S. M., 2003. Four types of visual mental imagery processing in upright and tilted observers. *Cognitive Brain Research,* Volume 17, p. 238–247.
31. Mazard, A. et al., 2004. A PET meta-analysis of object and spatial mental imagery.. *European Journal of cognitive psychology,* Volume 16, pp. 673-695.
32. Mechelli, A., Price, C. J., Friston, K. J. & Ishai, A., 2004. Where Bottom-up Meets Top-down: Neuronal Interactions during Perception and Imagery. *Cerebral Cortex,* 14(11), p. 1256–1265.
33. Mellet, E. et al., 1996. Functional Anatomy of Spatial Mental Imagery Generated from Verbal Instructions.. *The Journal of the Neuroscience,* Volume 16, pp. 6504-6512.
34. Nanay, B., 2010. Perception and Imagination : amodal perception as mental imagery.. *Philosophical Studies,* 150(2), p. 239–254.
35. Natsoulas, T., 1990. Perspectival appearing and Gilbson's theory of visual perception. *Psychological Research,* 52(4), p. 291–298.
36. Paivio, A., 1986. *Mental representations: A dual coding approach.* New York: Oxford Univ. Press..
37. Ruggieri, V., 2001. *L'Identità in psicologia e teatro.* Roma: Edizioni Scientifiche MAGI..
38. Ruggieri, V. & Persico, G., 2017. Psycho-Physiological Hypothesis about Visual Mental Images Projection. *Academy of Social Science Journal,* 2(9), pp. 969-979.
39. Ruggieri, V. & Spinoso, R., 2017. Relations between imaginative experience and feeling with postural attitudes and tensions. *Academy of Social Science Journal,* 2(10), pp. 1007-1012.
40. Schilder, P., 1935. *Immagine di Sè e Schema corporeo.* Milano: Franco Angeli.
41. Segal, S. J. & Fusella, V., 1970. Influence if imagined pictures and sound on detection of visual and auditory signals.. *Journal of experimental psychology,* Volume 83, pp. 458-464.
42. Slotnick, S., Thompson, W. & Kosslyn, S., 2005. Visual Mentally Imagery Induces Retinotopically Organized Activation of Early Visual Areas. *Cerebral Cortex,* Volume 15, pp. 1570-1583.
43. Slotnick, S., Thompson, W. & Kosslyn, S., 2012. Visual memory and visual imagery recruit common control and sensory regions of the brain.. *Cognitive neuroscience,* Volume 3, pp. 14-20.
44. Souchard, P. E., 1982. *Ginnastica posturale e tecnica Mezieres.* Roma: Marrapese.
45. Witt, J. K. & Riley, M. A., 2014. Discovering your inner Gibson: Reconciling action-specific and ecological approaches to perception–action. *Psychonomic Bulletin & Review,* December, 21(6), p. 1353–1370.