A Sign-Theoretic Study of Mental Imagery

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Declaration:
Hereby I declare that this doctoral thesis, my original investigation and achievement, submitted for the doctoral degree at Tallinn University of Technology has not been submitted for doctoral or equivalent academic degree.

Jelena Družinina

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Contents

List of Publications

The list of author's publications, on the basis of which the thesis has been prepared:

I   Issajeva, J. (2019). Can theory of mental representation adequately explain mental imagery? *Foundations of Science*, in press. https://doi.org/10.1007/s10699-019-09613-8 (1.1).

II Issajeva, J. (2015a). Sign theory at work: the mental imagery debate revisited. *Sign Systems Studies*, 43 (4), 584–596. (1.1).

III Pietarinen, A. and Issajeva, J. (2019). Phaneroscopy and theory of signs as theory of cognition. In Shafiei, M. & Pietarinen, A.-V. (Eds.). *Peirce and Husserl: Mutual Insights on Logic, Mathematics, and Cognition*. Logic, Epistemology and the Unity of Science Series. Dordrecht: Springer, forthcoming. (3.1.)

IV Issajeva, J. (2015b). Mental imagery as a sign system. In A. Benedek and K. Nyiri (Eds.), *Visual learning. Beyond words: pictures, parables, paradoxes* (pp. 99–107). Frankfurt/M.: Peter Lang Verlag. (3.1.).

V   Issajeva, J. and Pietarinen A. (2018). The heterogenous and dynamic nature of mental images: An empirical study. *Belgrade Philosophical Annual. Trends in Philosophy of Cognitive Science*, 31, 57–84. (1.2.)

Annex:

VI Issajeva, J. (2018). Sign-theoretic approach towards explanation of mental imagery. In Dario Martinelli (Ed.), *Proceedings of the 13th World Congress of the International Association for Semiotic Studies (IASS/AIS): CROSS-INTER-MULTI-TRANS* (pp. 46–55). Kaunas: IASS Publications & International Semiotics Institute. (3.4.).

Author's Contribution to the Publications

Contribution to the papers in this thesis are:

III   The author of this dissertation is a second author. She contributed to the theoretical part of the paper by writing several entries. The first author did the majority of the writing and Issajeva was the corresponding author.

V   The author of this thesis is both corresponding and lead author. The author has been responsible for the research design, organisation and conducting of the experiment, as well for publication correspondence and revisions of the manuscript. The second author has significantly contributed to the theoretical part and overall scientific quality of the paper.

Abbreviations

MI	Mental imagery
MR	Mental representation
DST	Dynamic systems theory
fMRI	Functional magnetic resonance imaging
EEG	Electroencephalography
TMS	Transcranial magnetic stimulation

Introduction

1.1. Focus and aim of the thesis

Human everyday life is perfused with imagery. Images are everywhere. A melody suddenly remembered, a face of an old friend, a familiar taste or smell, a new idea, a fantastic dream, or a detailed plan kept in one's mind – this is all about mental images. Except for the rare cases of "aphantasia"[1], mental imagery is considered to be a commonplace and essential cognitive experience that guides human internal life and influences a person's external behavior. Imagery-based techniques are widely used in medicine, education, music and sports studies. Furthermore, with the rise of the datafied society, imagery techniques (especially visual ones) have obtained increasing popularity as a means to transfer information, enable interaction between individuals and/or social institutions, promote the development of new technologies and their governance. In the light of this, a comprehensive study of imagery seems especially needed. A proper explanation of the nature of images will uncover the working mechanisms of the mind, improve educational and therapeutical methods, and enhance the development of high technologies and means of communication.

This thesis focuses on the problem of mental imagery (MI)[2] in human cognition. While imagery is a widely familiar aspect of human everyday mental life, it is remarkably difficult to give a comprehensive account of this phenomenon. The traditional rivalry (the Mental Imagery Debate) between the two main theories of MI – (quasi-) pictorial and propositional – was followed by manifold empirical tests that supported both accounts equally. Successors of the (quasi-)pictorial view argued that mental images[3] share genuine characteristics (size, colors, directions, shapes, spatial properties, etc.) with pictures and are representations of a pictorial format (Shepard and Metzler 1971; Kosslyn 1980, 1994; Shepard and Cooper 1982; Farah 1989; Finke 1989). Contrary to this, other thinkers claimed to have found evidence in favor of the propositional account, stating that the genuine features of mental images are similar to those of language, rather than pictures (Ryle 1949; Dennett 1969, 1992; Pylyshyn 1973, 1981, 2002; Fodor 1975, 1987; White 1990; McGinn 2004a, 2004b). The long-standing polemics between the (quasi-) pictorial and propositional theories focused on the primary representational format of MI and showed that the empirical evidence on the matter is ambiguous and divergent. As a result, the issue of the nature of MI still remains problematic and continues to evoke vigorous discussion among philosophers and scientists.

The main aim of this thesis is to investigate the highly ambiguous nature of mental images from a novel sign-theoretic perspective. The theory of signs (or semiotic) is an

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[1] The phenomenon of 'aphantasia' was first described by Galton (1880) as a condition where the subject is not capable of voluntarily visualizing images. Recently, the phenomenon was rediscovered by Zeman (Zeman et al. 2015), who also used the term 'aphantasia' to refer to a condition of reduced or absent voluntary imagery (p. 4).

[2] The term 'mental imagery' (MI) is used in this thesis to denote either **a)** a faculty of the mind that produces images and manipulates them or **b)** a mental experience that is based on mental images and is consciously accessible to the subject. MI should be understood in the first sense when it appears in the context of cognitive capacities and/or faculties of the mind. Otherwise, the term 'mental imagery' means mental experience (b).

[3] Here, 'mental image' means a mental entity that underlies conscious mental experience in the absence of outside stimuli.

account of signification, reference, and meaning, which demonstrates its usefulness in the study of mental signs and cognitive phenomena. Cognitive accounts that are (to various extents) grounded in semiotics – dynamic systems theory (DST), teleosemantics, and the pragmatic approach – try to overcome the pitfalls of the traditional representational-computational paradigm of cognition, which underlay the MI Debate for a long time. DST provides a better model for explaining the changing nature of mental entities in human cognition (Van Gelder 1995; Bechtel 1998). The pragmatic account focuses heavily on the ways mental representations (MR) are employed in various practices, such as arts (Ambrosio 2014) or scientific practices (Knuuttila 2005, 2011). Teleosemantics investigates MR from the evolutionary perspective as a developed function of carrying information to the subject, i.e. from the perspective of the cognitive user (Millikan 1984, 1993). These accounts convincingly show the usefulness and applicability of the sign-theoretic approach to the study of mental entities. Thus, semiotics might offer a fruitful ground for studying mental images as well.

The main research questions of this study can be formulated as follows:
a) Can the theory of signs be a useful candidate for investigating MI?
b) Can the theory of signs offer a comprehensive explanation of the diverse characteristics of images?

This thesis aims to show that the semiotic approach is a viable alternative for addressing the long-standing problem of MI. Moreover, it could potentially reconcile the divergent data on the matter and, thus, give a full-fledged explanation of the manifold imaginary properties. The latter fact, in turn, might be the first step towards the formulation of one unified account of the complex and ambiguous nature of mental imagery.

The formulation of one comprehensive account of MI, which would reconcile divergent empirical data, is especially important in cognitive sciences. The phenomenon of MI is subtly intertwined with most cognitive faculties of the mind and plays a significant role in human everyday life. Memory, learning capacity, problem solving, inner speech, dreaming, visualization, creative thinking, etc. – all these depend on mental images to various extents. Furthermore, MI also has a practical significance in medicine, education, music and sports studies (Kenitzer and Briddell 1991; Richardson 1995; Keller 2012). Thus, a full-fledged explanation of MI would enhance the research in other cognitive sub-disciplines, facilitate the development of new cognitive accounts, and improve medical, therapeutical, and educational techniques.

The novelty of this thesis is both theoretical and empirical. The first stems from the fact that the sign-theoretic account has not previously been comprehensively applied to investigating mental images. Although several attempts were made to study mental representations (MR) in terms of signs (Millikan 1984, 1993; von Eckardt 1993; O'Brien and Opie 2004; Knuuttila 2005, 2011; Ambrosio 2009, 2014), they were not employed to explain mental images as such. Thus, the study aims at filling this explanatory gap – systematically analyzing mental images from the perspective of sign theory.

The empirical novelty of this thesis lies in the application of a combined experimental methodology to studying the sign-theoretic account of MI. Semiotics is usually treated as a purely theoretical approach, which could hardly compete with the empirical methods of cognitive sciences. Nevertheless, several attempts to study signs experimentally have been initiated (mainly in linguistics). These focused mostly on the emergence of linguistic structures and the social manipulations of communication systems (Galantucci and Garrod 2011). The experimental methodology developed within

cognitive semiotics has not been applied to studying mental images before. This thesis suggests a novel approach based on both cognitive semiotics and experimental philosophy to study the diverse characteristics of mental images. The methodological contribution of this dissertation, thus, lies in an attempt to unravel the intricate problem of the nature of MI by bridging semiotic, philosophical, and psychological methods together to study imagery.

The main body of the thesis is composed of five original articles, which altogether provide a comprehensive analysis of the problem of MI and outline a new sign-theoretic approach. First, the article "Can theory of mental representation adequately explain mental imagery?" (**I**) analyses the existing theories of MR and argues that they cannot comprehensively explain MI. In particular, this article investigates the pitfalls of representationalism as a major cognitive paradigm that underlies traditional accounts of MI and searches for an alternative account. This article is accompanied by the discussion of Mental Imagery Debate in "Sign theory at work: the mental imagery debate revisited" (**II**), which outlines the solution to this debate in terms of sign theory. Next, the article "Phaneroscophy and Peirce's theory of cognition" (**III**) (co-authored with Ahti-Veikko Pietarinen) outlines the general theory of cognition, as based on Peirce's semiotic, and provides an explanation of its major terms and postulates. The latter, thus, presents the general cognitive paradigm and context within which the sign-theoretic account of MI could work. This article is followed by the "Mental imagery as a sign system" (**IV**), which focuses on the detailed explanation of MI as a sign system, provides a more detailed classification of signs and examples of how sign theory can be applied to analyze mental images. Finally, the article "The heterogeneous and dynamic nature of mental images: An empirical study" (**V**) (co-authored with Ahti-Veikko Pietarinen) systematically introduces an empirical study of the sign-theoretic account of MI and offers evidence that mental images are better explained in terms of signs. The main articles (**I-V**) are supplemented by the last one "Sign-theoretic approach towards explanation of mental imagery" (**VI**), which discusses various formulations of sign-theoretic accounts as proposed by Peirce, Saussure, and Morris and analyses which version of sign theory fits the explanatory needs of MI the best.

Altogether, considerations provided in **I-IV** and complemented by empirical evidence provided in **V** allow to make a general claim that sign theory provides a comprehensive explanation of the diverse and ambiguous nature of mental images. And thus, envisages a new framework for the development of one unified account of MI. All papers (**I-VI**) have been published in peer-reviewed journals and conference proceedings. Some of the articles included in this thesis are parts of the research projects (PUT267; PUT1305) carried out in Ragnar Nurkse Department of Innovation and Governance and were created together with colleagues (**III, V**) and financed (**V**) by the project.

The introductory discussion of the thesis develops in the following manner. First, the methodological approaches used in both the theoretical and empirical parts of the study are described. The methodological overview is followed by a theoretical discussion of the problem of MI, flaws of the representational-computational paradigm and the enactive approach as unsuccessful alternatives to account for MI. Next, sign theory, Peirce's semiotics and its applicability to studying MI are presented. The discussion continues with the experimental part, which outlines the empirical findings and conclusions based on these results. Finally, the thesis ends with recommendations for further research.

1.2. Methodological approach

This dissertation investigates the problem of mental imagery from the sign-theoretic perspective. MI constitutes a complex theoretical and interdisciplinary issue with a long tradition in philosophy and psychology. Given the multidisciplinary nature of the topic, several methods were applied to explain what underlies the problem of MI and whether sign theory is a viable candidate for solving it. In particular, definite and exact methodological approaches from cognitive psychology, philosophy, and semiotics guided the study.

First, a thorough theoretical analysis of traditional philosophical and psychological accounts of MI establishes a theoretical background of the problem and helps to sharpen the hypotheses. The in-depth philosophical analysis and comparison of traditional views of MI is undertaken in papers (**I**) and (**II**). The methods of conceptual and comparative analyzes, interpretation of the existing theories, and the evaluation of the explanatory power of the latter are used here. Furthermore, semiotics – as a science that studies signs and their application – was suggested as a new perspective for solving the old philosophical problem of MI. Hence, the semiotic analysis of MI was carried out to show that sign theory can be legitimately applied to study MI and combine different views about images into one coherent framework (**III, IV, VI**). Philosophical and semiotic analyses of MI together compose the theoretical part of this study and lay grounds for subsequent empirical research. Both primary and secondary sources were used for the theoretical analysis and discussion.

The theoretical part of the thesis is followed by the empirical part, which consists of the cognitive experiment on the semiotic approach to MI and its subsequent statistical analysis. The latter is a novel approach to studying MI and was established in order to conform with the previous investigation of imagery in cognitive psychology. It also enables to prove that the sign-theoretic approach may not only explain existing evidence, but also offer a prospective platform for further experimental investigation of MI (**V**). For these reasons, an experimental methodology was chosen as the most suitable way to test whether a mental image shares the same characteristics with a sign.

The empirical part of the study comprises of a series of short experiments based on the methods of cognitive semiotics and experimental philosophy. In particular, the methods of experimental philosophy are applied to philosophical problems from an empirical perspective. This is of a special value when approaching the theoretical debate about MI. Research methods and task examples from cognitive semiotics, in turn, offer a unique way to test the production of a sign in its dynamics and track the most fundamental features of the signification process. The choice of empirical methodology is described in detail in **V**.

The experimental design was also supplemented with an introductory pre-test questionnaire, the Psi-Q after-test (The Plymouth Sensory Imagery Questionnaire), and statistical analysis (SPSS and R-studio digital services) as is common both in experimental psychology and philosophy. The introductory test was used to check statistically relevant information about age, nationality, cultural background, educational, and/or professional occupation. Among other reasons, the choice of these parameters was guided by the consideration that these indicators might significantly influence the final production of an image: imagery degenerates with age, national and cultural background influences personal cognitive dispositions, and education/profession has an impact on the properties of MI as well. The Psi-Q after-test is a well-known evaluation of imaginary

capacities – its vividness and intensity – that was employed to check individual differences in the imaginary abilities of the participants (Andrade et al. 2013). The Psi-Q test was chosen for its sensitivity to images across a wide range of modalities: vision, sound, smell, taste, touch, bodily sensation, and emotional feeling, which allows to test individual differences in imaginary capacities in more detail. Finally, the methods of descriptive statistics were applied to analyze the experimental data. The experiment was carried out in the following order: it began with the introductory pre-test questionnaire, was followed by three different cognitive tasks (pictorial, verbal, diagrammatic) and was ended with the Psi-Q after-test (**V**).

Generally, the combined experimental methodology enabled a thorough and comprehensive analysis of MI. Both the theoretical and empirical data were consulted during the theoretical analysis of MI, experimental design, and statistical interpretation of the results. The prior theoretical analysis allowed setting the results of the empirical study in the context of the problematic nature of mental images widely discussed in philosophy and psychology. In sum, the theoretical and empirical investigations support the sign-theoretic approach to explaining MI.

1.3.   The problem of mental imagery

The problem of the nature of MI has a long tradition in philosophy and the excited minds of many thinkers. Aristotle believed that *Phantasia* (or imagery) constitutes a special and important faculty of the soul (*psyche*) and is responsible for forming and manipulating the *phantasma or phantasmata* (images) (Aristotle 1968, p. 53). Phantasia was also an important notion of the cognitive theory of Stoics and Epicurean philosophers. Both Descartes and Locke recognized the existence of imaginary ideas as a distinct and important aspect of human mental life (Descartes 1664/1996, p. 86; Locke 1689/1961, p. 129). Such interest towards uncovering the genuine nature of MI continued during the early age of scientific psychology (late 19th and early 20th century) and survived the era of behaviorism (early 20th century). It was revived after the so-called cognitive revolution of the 1960-70s.

Why is the investigation of mental imagery so important? It seems that MI plays a vital role in human cognition. It underlies such higher cognitive capacities as memory, learning, planning, (day-)dreaming, etc. Thus, the answer to the question about the true nature of MI will shed light on how human cognition really works. It is well known that MI is engaged in memory processes. In her work "The Art of Memory" (1966), Frances Yates gives a detailed historical description of the strong influence of imagery on memorizing. The pivotal role of imagery in memory was confirmed by the experimental work of Alan Paivio (1971, 1986). He demonstrated that subjects who use imagery-based mnemonic techniques to memorize verbal material remember it much better than subjects who do not use such techniques (Paivio, 1971). Paivio's work also uncovered the significant influence of MI on learning processes.

Further, mental imagery is claimed to be involved in decision-making and planning. Slovic, MacGregor and Peters (1998) conducted a series of experiments and concluded that imagery can provide a powerful framework for predicting both intended and actual behavior. In particular, MI acts as an organizing principle in theories of judgment and decision-making (Slovic, MacGregor and Peters 1998). Imagery is also an indispensable part of creative thinking. Several recent studies showed that imagery facilitates the emergence of new ideas and creativity (Palmiero et al. 2016; Zedelius and Schooler

2016). In particular, different aspects of MI (daydreaming styles, imagination[4], artistic behavior) are claimed to increase creativity, influence production of new ideas and are used to explain inner processes of creative thinking (ibid). Along those lines, Jankowska and Karwowski (2015) have recently developed a Test of Creative Imagery Abilities aiming at assessing creative imagery skills.

This is not an exhaustive list of the cognitive importance of MI. Imagery-based techniques are actively used for educational and therapeutic purposes, as a tool to enhance professional performance among athletes, musicians, public speakers, and even as a means to provide information and for interaction between individuals on social media. All of the above-listed reasons highlight MI's central role in human daily life and emphasize the need for a full-fledged explanation of images. However, the task of formulating one unified account of MI appears to be problematic (**I; II**). So, what underlies this problem?

Firstly, the empirical evidence on the matter is divergent and controversial (**I; II**). Most experimental results on MI can be interpreted in several, sometimes even opposite, ways (Pylyshyn 2002). In particular, both the pictorial and propositional theories of MI can explain the empirical outcomes of tasks such as mental rotation, mental mapping, mental paper folding, and mental scanning (Anderson 1978; Pylyshyn 2002; Ganis 2013). In the same vein, Anderson (1978) shows convincingly that a wide class of theoretical models can be used to explain the empirical data on MI and make behavioral predictions. For example, the enactivist and sensorimotor theories of MI (Thomas 1999; Nöe and O'Regan 2001; O'Regan and Nöe 2001; O'Regan 2011) rely mostly on empirical evidence of saccadic and spontaneous eye movements, eye gaze, and eye position during MI. Simultaneously, same evidence is claimed to support the (quasi-)pictorial theory that presupposes the existence of a visual buffer where the mind's eye operates (Fourtassi et al. 2013; Johansson 2013). In the latter case, saccadic eye movements are explained by mental movements of the mind's eye in the visual buffer that are repeated by the physical eye. Such an explanation contradicts the enactivist and sensorimotor theories in many respects. Thus, it appears that rival accounts on MI are equally supported by a variety of empirical evidence, which makes the formulation of a unified coherent theory of mental imagery extremely problematic.

Furthermore, similar experimental settings of MI, when replicated, give different results (**I; II**). In this vein, Pylyshyn (1981, 2002 p. 163) shows that replication of the mental scanning experiment of MI suggested different results compared to the original experiment (Kosslyn 1978). Along the same lines, Slezak (1990, 1991), following research by Chambers and Reisberg (1985), states negative results regarding the reinterpretation of mental images that directly contradict empirical data obtained by Pinker and Finke (1980); Finke and Slayton (1988); Finke, Pinker and Farah (1989). Yet another challenge to the mental rotation and mental scanning tasks, originally conducted by Shepard and Metzler (1971) (see also Kosslyn 1978, 1980; Shepard and Cooper 1982), comes from the empirical research of Rock, Wheeler and Tudor (1989), who found that subjects were unable to imagine how objects look from another viewpoint. Thus, it appears that mental imagery can exhibit various properties in a similar experimental environment. This makes empirical evidence on MI controversial and ambiguous.

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[4] The notion of 'imagination' is often confused with 'mental imagery'. In this dissertation, 'imagination' denotes the ability to produce a conscious experience in the mind in the absence of outside stimuli and is thus different from the term 'mental imagery' (see footnote 1).

Finally, empirical data about MI is multi-dimensional and comes from various disciplines. This makes the formulation of one coherent theory of MI problematic, since combining evidence into one unified account is extremely difficult to achieve. For example, data regarding imagery's influence on memory and learning comes from Paivio (1971; 1986). The evidence regarding developmental differences in imaginary capacities across gender, age, and profession traditionally originates from educational studies (Isaac and Marks 1994; Aspinwall et al. 1997). Next, MI's correlation with sensual perception was for a long time a question of philosophical speculation (Aristotle, Aquino Thomas, Descrates, Locke, Hume, Wittgenstein, Sartre), but experimentally it was addressed by psychologists (James 1890/1981, Titchener 1909; Perky 1910; Wundt 1912/2007) in the early 20th century and was often devoid of any previous theoretical accounts on the matter. Further, these issues fell under the newly emerged area of cognitive neuroscience, which investigated neuro-correlates of MI, brain mechanisms, brain lesions, impairments of MI and perception (Shepard and Metzler 1971; Kosslyn 1978, 1980; Farah 1989; Kosslyn et al. 1993, 1995, 2001 etc.). However, novel neuroscientific data on MI does not usually take into consideration previous findings or evidence from other fields.

In parallel, but unconnected to neuroscience, a significant amount of evidence was documented on the existence of multisensory mental images (motor, tactile, olfactory, and auditory MI) (Pascual-Leone et al. 1995; Richardson 1995; Plessinger 2007; Gregg and Clark 2007; Keller 2012; Lacey and Lawson 2013; Schmidt et al. 2014). The latter comes mostly from sports studies, music studies, and psychotherapy. For example, Keller (2012) states that rehearsing musical pieces in one's mind significantly enhances the actual performance of musicians during the concert. Similarly, the engagement of motor and tactile imagery during sports training improves the skills and performance of the athletes (Kenitzer and Briddell 1991; Parnabas et al. 2015). Studies regarding the practical application of mental images come from a large variety of disciplines and are often unrelated to each other. Along the same lines, MI is successfully used to improve the memory of patients with Alzheimer's disease (Hussey et al. 2012); to reduce the hallucinatory effects of Schizophrenia and other psychotic states (Ison et al. 2014); to enhance learning of surgical skills among doctors (Sanders et al. 2008); it has a significant impact on changing emotions (Pictet and Holmes 2013), etc.

In sum, the evidence on MI is fragmental and scattered across disciplines. Moreover, the evidence on the matter is divergent and controversial: **a)** same experimental results can be equally explained by various, sometimes contradictory, accounts; **b)** within the same replicated experimental setting, MI shows different results. All this yields to the conclusion that MI is an important part of human cognition, but it is extremely difficult to account for within one unified framework.

1.3.1.   Against the representational-computational paradigm

The problem of MI and formulating one unified account originates from the flaws and constraints of representationalism – a major paradigm of cognitive analysis of the mind (**I; II; V**). The dominant theoretical framework, which is used to analyze the human mind and cognition, determines the interpretation of MI significantly. Most research on the matter is done within the dominant scientific paradigm that also determines the interpretation of the outcomes of such research.

Since the second half of the 20th century, MI was commonly understood in terms of mental representations of some kind or format, which are computed[5] by our mind to produce higher-order cognitive states (more about the computational-representational paradigm can be found in **I**). The Mental Imagery Debate especially highlighted the representational understanding of MI. According to the (quasi-)pictorial theory, MI constituted a pictorial representation, whereas propositional theorists claimed that MI is primarily a linguistic-like (propositional) representation. Despite the fact that the (quasi-) pictorial and propositional theories are rival theories, they are both based on the same assumptions:

a) MI constitutes nothing more than inner mental representations of some format (representationalism);

b) Mental representations underlie higher cognitive processes, i.e. constitute elementary mental parts out of which all other capacities and states are computed (computationalism).

Along these lines, Kosslyn (1980) gives an illustrative example of how the representational-computational paradigm works to explain MI. For instance, a subject is asked to consider whether a fox has pointed ears. To answer this, according to Kosslyn, a subject will first derive relevant data from long-term memory in a form of 'deep representation'. Then, based on this data, they will construct a mental image or a quasi-picture of a 'fox' in a visual buffer – a functionally defined mental surface. Once an image is established in the buffer, it becomes a surface representation ready for inspection by the mind's eye. Finally, the mind's eye analyzes the mental image of a 'fox' and extracts required information regarding the pointed ears (Kosslyn 1980, 6). In short, Kosslyn considers MI to be analogous to a computer program, on the basis of which actual, viewable pictures are constructed on the computer screen (visual buffer) and can be further manipulated and computed. In this vein, Kosslyn and Shwartz (1977, 1978) developed a computer-simulation model of the key parts of Kosslyn's theory of MI.

The representational-computational paradigm, as described above, set the stage for the research on MI for a long time. However, the representational accounts severely constrained the interpretation of mental images (**I**; **II**; **V**). First, empirical evidence on MI is ambiguous and does not seem to support the idea of one dominant representational format of MI. In particular, both the pictorial and propositional theories of MI can explain the empirical outcomes of typical experiments of MI (Anderson 1978; Pylyshyn 2002; Ganis 2013). Moreover, in similar experimental settings, MI can exhibit (at least) both types of properties – verbal and pictorial (Pylyshyn 1981, 2002). This yields that there are significant difficulties in assigning one particular format to mental images.

Most recent empirical research aligns with this conclusion. Another set of experimental data shows that our understanding of imagery cannot and shall not be restricted to the dichotomy 'verbal'-'pictorial'. Evidence proves the existence of a wide range of various kinds of images in the human mind: motor, tactile, olfactory, auditory MI, etc. (Lacey and Lawson 2013). These properties of MI can hardly be accommodated by the (quasi-)pictorial or propositional accounts of MI. Hence, this empirical data falls

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[5] Representationalism and computationalism go hand in hand, although these are different theories. Adherence to the existence of mental representations in the mind (representationalism) does not necessarily mean that these representations are operated by computational mental processes (computationalism). However, these two theories are usually closely intertwined and one leads to the other. For this reason, both theories are used to signify one scientific paradigm here.

out of the scope of the standard representational interpretation of MI – either pictorial or propositional. The interpretation of MI within the representational-computational paradigm seems to put severe limitations on our understanding of the very nature of imagery. MI has manifold properties and cognitive functions, which are typically neglected by the standard representational accounts.

Next, the representational-computational paradigm of MI is typically supported by neurological data from brain scanning (fMRI, PET, TMS). Based on this evidence, it is often assumed that MI is a representation (usually pictorial), since it shares the same neuro-pathways with visual perception. According to this view, a mental image is nothing more than a pictorial representation in the 'mind's eye'. This idea was extensively investigated by Kosslyn and colleagues (Kosslyn 1980, 1994; Kosslyn et al. 1993, 1995, 2001, 2003, 2006a, 2006b; Ganis et al. 2004; Klein et al. 2004; Slotnick et al. 2005), who concluded that there is a substantial overlap between neuronal pathways in visual perception and visual MI (Ganis 2013, p. 11). However, cognitive scientists have recently found dissociations between brain activations in visual imagery and visual perception, thus claiming, contrary to Kosslyn and colleagues, that there are serious reasons to doubt that (visual) MI has a pictorial format (Chatterjee and Southwood 1995; Bartolomeo et al. 1998, 2002, 2008; Aleman et al. 2001; Cornoldi and Beni 2005; Dulin et al. 2008; Moro et al. 2008). Along these lines, Bartolomeo analyzed brain-damaged patients and found a double neuronal dissociation between visual perception and visual MI (Bartolomeo et al. 1998, 2002, 2008). Moro et al. (2008) reported the occurrence of visual imagery deficits in regard to preserved visual perception in subjects with brain lesions. Similarly, Bertolo (2005) empirically proved that visual imagery and visual experience are impaired when investigating congenitally blind subjects. Thus, the evidence, regarding whether MI and perceptual MR share the same neural mechanisms, is contradictory and cannot straightforwardly support the representational interpretation of MI.

Finally, the representational-computational theories cannot properly account for such features of MI as the changing nature of images, dynamic relations between its elements, context-dependence, and subjective differences in imaginary capacities (**I, V**). It is widely acknowledged that images change. For example, an image of 'Africa' might change from the simple picture on the map into something more, when the subject who produced the image actually visits this continent. New feelings, new experiences, and new understandings change the relations inside the image of 'Africa', and in fact, change the image itself (**I**). The dynamicity of MI is especially evident in the modern datafied society, where imagery techniques are actively used. An interesting TV show, a skype interview, a computer-simulation game, etc. – all these modern means of communication and information transfer produce a burst of constantly changing mental images in the human mind. Representationalism can hardly explain this dynamicity of MI. It posits an image as being a stable and static mental entity, thus guaranteeing that representing an object of the external world in the internal world (i.e. the mind) will function smoothly (Bechtel 1998: 314; Knuuttila 2005: 31).

Similarly, the representational-computational paradigm often neglects the context in which an image was produced. Representational accounts of MI view images as elementary parts, out of which other mental states are computed, irrespective of any possible changes in context, personal attitudes, or the environment where the process of imagining takes place. However, context matters. Factors such as the properties of the imagined object, the task that the image is intended to solve, any knowledge regarding

the object, the environment in which the object appears, and even personal dispositions of the cognizing subject, etc. might radically influence the final image. For example, the image of an 'apple' growing in someone's backyard may be completely different from the image of 'Apple' – the famous computer brand (**I**). Thus, the particular understanding of an 'apple' significantly depends on the context where it appears, as well as on subjective knowledge and previous experience. However, these influencing factors are not usually included in the representational explanations of MI, on the contrary, images are mostly interpreted as context-independent (**I; V**).

Along the same lines, the representational-computational theories do not account for individual differences in imaginary capacities, prejudices, and personal dispositions. Indeed, some people have an extreme talent for visualization, others are prone to auditory rehearsal. Some people tend to imagine emotionally rich details, others imagine things in a logical, algorithmic order. These differences are inevitably reflected in the formation of images. For example, the strong impact of professional and personal abilities on MI is clearly seen in recent research on athletes and musicians (Keller 2012; Buck et al. 2016). The production and usage of MI is strongly influenced by the subject who produces and interprets the image (**I; II**). Previous knowledge about the world, personal experiences, and memories, as well as individual cognitive abilities incline the subject to produce an image with particular properties and meaning. For instance, in one subject an image of a "bonfire" can evoke visual properties (big, red, blazing, flaming, spectacular) and be associated with positive emotions and memories (fun, summer, joy, friendship, etc.). Whereas in another subject, the same object ("bonfire") can produce a completely different image with prevailing tactile and olfactory properties (hot, burning, toxic, bitter smelling, smoky, etc.) and be accompanied by strong negative emotions (dangerous, damaging, threatening, frightening, etc.). So, two subjects can produce two different images, and the same object can be imagined and interpreted in various ways depending on personal imaginary capacities, prejudices, and dispositions.

Within the framework of representationalism-computationalism, it is extremely difficult to account for such individual differences. Representational theories are prone to 'objectivizing' images. In brief, they aim at giving universal explanation of MI across various subjects and their personal dispositions (**I**). The tendency to objectivize MI deprives it from including any individual differences and context variations, which significantly change the mental image that is produced. As a result, such an interpretation of mental images puts significant limitations on MI and precludes the full-fledged explanation of it.

All of the above-stated leads us to a two-fold conclusion:

a) The computational-representational paradigm puts severe constraints on a comprehensive understanding of the nature and function of MI;

b) Standard representational accounts of MI (either quasi-pictorial or propositional) cannot accommodate heterogeneous and divergent empirical data on the matter.

Thus, there is still the problem of a comprehensive explanation of MI that would embrace ambiguous and manifold empirical evidence. If the standard computational-representational paradigm limits our understanding of the nature and function of MI, then what alternatives are there?

A successful alternative approach would not just integrate all divergent data in the field but would also explain the functioning of mental images within a particular cognitive context and take into account MI's dynamic relations, subjective dispositions, as well as

the experiences and capacities of the individual who produced the image. All these elements are indispensable parts of the way MI is formed and functions in the human mind. Hence, a proper understanding of imagery should account for these constituent principles of MI's inner mechanisms. It seems that the computational-representational paradigm can hardly suggest any hybrid theoretical account to satisfy these conditions (**I**). Major weaknesses of representationalism have been widely acknowledged and criticized (Millikan 1984, von Eckardt 1993, Bechtel 1998, O'Brien and Opie 2004, Hutto and Myin 2013).

These circumstances lead to the appearance of non-representational paradigms to explain complex cognitive and mental states. In this vein, the so-called '4E' cognitive paradigm gained significant popularity and credit. According to this paradigm, the human mind and its operations are viewed as *embodied, enacted, embedded,* and *extended* to the activities of the physical reality (Varela *et al.*, 1991; Smith, 1991; Clancey, 1997; Clark, 1997). Our mind is actively engaged in the outside world and should not be viewed outside such context, but instead explained within it. The embodied cognitive paradigm seems to go beyond the idea of representations that are computed in the mind to form more complex mental entities. However, does the embodied paradigm constitute a viable alternative to the computational-representational paradigm when applied to explain MI?

1.3.2.   Beyond pictures and propositions: The enactive approach

If a mental image is not a pictorial-like, neither a verbal-like representation, then what is it? Several cognitive psychologists suggested an alternative approach[6] to MI, the so-called *enactive* (or *sensorimotor* or *perceptual activity*)[7] imagery theory (Hochberg, 1968; Hebb, 1968, 1969; Gibson, 1970, 1979; Sarbin & Juhasz 1970; Juhasz 1972; Sarbin, 1972; Neisser, 1976, 1978a, b), which generally follows the embodied cognitive paradigm (**II**). According to the enactivist approach, perception is the active engagement of the mind with physical reality and not just a mere passive registration of sensual impulses or stimuli. The perception is thus a form of action, something done by the organism/mind in the physical world, i.e. exploration of the physical environment (Thomas 1999, 2014 §5; O'Regan & Noë 2001; Findlay & Gilchrist 2003; Noë 2004, 2009; Land & Tatler, 2009; O'Regan, 2011). Following enactivism, MI is a mental capacity of an active cognitive search of information in the absence of actual perceptual stimulus (Thomas 2009: 454-455). Imagery is experienced when someone continues to explore their environment, seeking some particular information in the world, even though they cannot reasonably expect it to be there.

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[6] Another alternative account – attention-based quantification theory – explains imagery in terms of attentional processes that quantify spatial and visual information by operating upon two working memory structures, namely Qualitative Spatial Representation (QSR) and Visuo-spatial Attention Window (VSAW) (Sima 2011: 2880). Despite the fact that the attention-based quantification theory is postulated as somehow different from standard representational accounts, since it tries to integrate memory and attention to explain MI, it still relies on qualitative representations and, hence, encounters the same difficulties as other representational theories.

[7] Despite the diverse formulations of the enactive MI theories, some authors state their fundamental underlying similarities (Morris & Hampson 1983; Thomas 1999; Hochberg 2001). For this reason, sensorimotor, enactive, and perceptual activity theories will be considered to be following similar basic ideas of the functioning of the mind in general and MI in particular.

The question arises, then, whether the enactivist theory can integrate the manifold empirical data and suggest a unified account of MI. Some philosophers argue that the enactive theory can explain empirical findings about MI as well as the representational accounts do (Thomas 1999, 2010, 2014). Moreover, it is claimed that the enactivist approach deals with data on congenitally blind patients, syndrome of representational neglect, and imagery reconstrual better than the standard representational accounts (ibid). Other empirical evidence in favor of enactivism comes from studies of eye movements during imagery. Eye saccades are claimed to follow our visual system's exploration of the visual world and the extraction of information from it, which confirms the main idea of enacticism (Yarbus 1967; Noton & Stark 1971a,b; Stark & Ellis 1981; Findlay & Gilchrist 2003; Hayhoe & Ballard 2005; Martinez-Conde & Macknik 2007; Rothkopf *et al*. 2007; Rucci *et al*. 2007; Trommershäuser *et al*. 2009).

In general, substantial advantages of the enactivist account can be found as compared to the representational ones. First, since the enactive approach is non-representational, it avoids the typical problems inherent to most computational-representational theories (**II**). Second, enactivism regards MI not as a kind of static representation, but as a form of action. This makes the enactivist explanation of MI dynamic and allows to better understand MI's relation to other faculties (e.g. sensual perception, consciousness, memory, creative thinking) as being in a flux of cognition (Ellis 1995; Thomas 1999, 2009, 2014; Bartolomeo 2002). Finally, enactivism highlights the relational character of mental images. According to the enactivist approach, MI is related to sensual perception, to the environment as a context of active imagining, and to other cognitive activities that take place in the mind.

Despite such issues, enactivism, as applied to MI, encounters serious problems and remains, thus, a minority view. Firstly, the enactivist explanation of the empirical data still remains vague and partial (**II**). Enactivism views MI as a process, i.e. an action of searching for particular information in the absence of outside stimuli, but it does not say anything regarding the products of this process, i.e. the images themselves. Are they like percepts? What kind of properties they have? If they are just reflections of sensual perception, then how can one explain complex images of objects that do not exist in the physical world and thus cannot be perceived (e.g. centaurs, unicorns, dragons, angels, etc.)? So, it seems that enactivism is well suited for analyzing MI's relation to perception, but it does not explain the manifold (and sometimes even controversial) properties of MI itself.

Further, enactivism is criticized for the lack of explanation of the internal processes that take place during the mind's active engagement with the environment (Blakemore 2013). Along these lines, Block states that the enactivist cognitive models are limited to analyzing perceptual inputs and outputs, but do not account for internal mechanisms that take place between sensorimotor input and output (Block 2001: 978). Similarly, this problem concerns the enactivist account of MI. What the enactive theory in fact holds is that imagery is constituted by re-enactment of the perceptual acts that *would* be carried out *if one were actually perceiving whatever is being imagined* (Johansson *et al.*, 2010, 2012; Laeng *et al.*, 2014). But, it does not say anything about the internal structures or mechanisms that take place when MI is re-enacted. So, explaining MI's mental functioning is out of the scope of the enactivist approach.

Probably the most serious disadvantage of the enactivist approach, as applied to MI, is its inability to differentiate imagery from other cognitive engagements. If MI is the re-enactment of perceptual activity, then how and by what criteria can MI be

differentiated from memory or learning, or indeed any other cognitive capacity? Based on the major postulates of enactivism, memory is also the re-enactment of perceptual stimuli in the physical absence of the later. What is the difference then between the two? The enactivist answer to these questions still remains unclear. In a similar vein, Matthen goes even further and states that the enactivist cognitive model fails to differentiate between cognitive activities and bodily engagements or interactions (Matthen 2014). If the mental becomes „embodied", then a mere physical interaction, like wrestling, can hardly be differentiated from perceptual enactment of physical stimulus (ibid., 119).

Furthermore, a serious shortcoming of the enactivist approach concerns the content of cognitive states. Following enactivism, cognition is an action, or more precisely, interaction with and within the world. As Hutto and Myin put it: "…basic cognition is literally constituted by, and is to be understood in terms of, concrete patterns of environmental situated organismic activity, nothing more or less" (Hutto and Myin 2013: 11). Thus, enactivism, as a non-representational approach, seems to deny the 'representational content' of the mental states (Matthen 2014:120), yet does not suggest a viable alternative. Moreover, some theorists adhere to a more radical view arguing for cognitive experience and even the mind without content (Hutto and Myin 2013). In the case of MI, as truly in the case of other mental states, it is hard to see how images without content are possible. MI is intentional[8], i.e., it is about something or has an object. Although, enactivism does not deny the intentionality of images, they fail to give a comprehensive non-representational account of it.

In sum, enactivism solves some important issues that the computational-representational paradigm cannot, such as the dynamics of MI, continuous relations to other cognitive faculties (especially to perception and consciousness), and context/environment-dependence. But at the same time, it loses credibility and explanatory power (**II**). It lacks an explanation of MI's internal processes, cannot adequately differentiate between imagery and other cognitive activities, can hardly give a comprehensive account of imaginary content, and neglects the influence of individual traits on MI production. Thus, the enactivist account seems unable to explain the complexity and multiplicity of the properties and functions of MI. For these reasons, enactivism remains relatively unpopular in solving the problem of imagery, and the dominant accounts remain representational. Notwithstanding the extensive tradition of the Mental Imagery Debate, the question regarding the nature of MI still remains problematic and the need for one unified account relevant.

1.4.   The sign-theoretic approach

Several intermediate conclusions thus follow:

a) The representational accounts (quasi-pictorial and propositional) of MI, based on the representational-computational paradigm, significantly constrain the interpretation of images.

b) An alternative enactivist approach, based on the embodiment paradigm, avoids some limitations of representationalism but fails to give a clear and comprehensive account of MI's inner mechanisms and its multiple properties.

Thus, both representational and enactive approaches do not account for MI's constituent principles, such as its heterogeneous properties, context-dependence,

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[8] Here, the term *'intentionality'* denotes the 'aboutness' of mental states, i.e. the mental state being about something or standing for some object.

dynamic relations, and subjective differences, and cannot deliver a full-fledged explanation of mental images. The question then arises: are there any other candidates to account for MI? This study aims at showing that there is yet another alternative framework to fill the explanatory gaps, namely the theory of signs, and that it has great potential to provide a comprehensive explanation of MI (**II, III, IV, V, VI**). Although sign theory is a rich and manifold theoretical resource to guide researching the human mind, its potential remains widely unacknowledged. This thesis introduces the semiotic approach as a useful alternative to traditional cognitive interpretations of MI. In contrast to the representational-computational approaches, the theory of signs exhaustively accounts for MI's dynamic relations and the manifold properties of images, their context-subject dependence. As compared to the enactive approach, sign theory gives a detailed explanation of the way an image is formed in the mind, how it operates as a sign, and how it is interpreted and reacted upon by the subject. Thus, semiotics offers a unique framework within which the complex nature of MI can be fully uncovered. Thus, the novel contribution of this thesis lies in justifying the semiotic approach as a useful tool for studying mental images both theoretically and empirically.

1.4.1. How can a mental image be a sign?

How can the sign-theoretic or semiotic approach be a solution? Indeed, there are several reasons why to consider the semiotic theory as one of the possible candidates towards a comprehensive explanation of MI. Under closer examination, it appears that MI shares a similar trichotomic structure, functions, and properties with a sign (**II, IV, V**). First, just like a sign, MI is intentional, i.e. stands for some object that it represents (Marbach 1989; Harman 1998; Thomas 2018). Every image is necessarily about something or is directed towards something. Thus, just like signs, mental images have objects. The object of MI does not have to be previously experienced. An image can be about situations, properties, experiences, states, or feelings that have not been experienced before (Thomas 2018). Moreover, images can be detached from external reality in the sense of representing non-physical objects of fiction, such as unicorns, angels, dragons, etc. In any case, MI "stands for something" (CP 2.228)[9] and shares this property with signs (**II, IV**).

Second, an image also has something that enables it to represent its object – a ground element or representamen – i.e. something that represents something. The ground of the sign is the element that represents or stands for its object in some way. Peirce says that "a sign stands for [its] object, not in all respects, but in reference to some sort of idea, which I have sometimes called the *ground* of the [sign]" (ibid.). Intentionality of MI means that an image should definitely have this ground element, which would represent its object. In this respect, an image is a sign (**II, IV**).

Third, similarly to a sign, MI has a meaning (interpretant) that is comprehended by a subject. Indeed, our imaginings, even the most fantastic ones, are meaningful. Thus, an image, just like a sign, stands for some object in "some respect or capacity" or refers to some 'idea' (ibid.). This meaningful relation emerges from the signification of an object by the ground element/representamen of an image. In this sense, images are said to have content (Nanay 2015). They convey some meaning from a single property to complex networks of signification. Furthermore, it appears that even our largely involuntary

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[9] References to Peirce's sign theory are taken from the electronic edition of „Collected Papers of Charles Sanders Peirce" (CP).

images during sleep – dreams – can be interpreted after they have occurred. Thus, every mental image, similarly to a sign, has an interpretant (**II, IV**).

Furthermore, MI also seems to function similarly to a sign. Since an image consists of several elements, MI operates via multiple relations that exist between its three main elements (the representamen, object, and interpretant) (**II, IV**). Just as a sign can signify several objects, similarly, the same image can stand for various objects. For example, an image of an 'apple' can stand for a fruit, a computer, a tree, a particular taste, etc. Conversely, several images (representamens) can represent one and the same object. Along these lines, the object 'Africa' can be represented by images of a map, a hymn, a word, a flag, etc. The meaning of an image, just as the interpretant of a sign, also changes depending on the object, ground-element, as well as depending on the general context and individual traits of the cognizing subject, such as their memories, emotions, associations, previous experience, etc. (consider the example of imagining a "bonfire" suggested above).

Shortly, MI appears to be engaged in multi-leveled and continuously changing relations between the three elements and the subject who produced the image. Such functioning is similar to a sign and that of sign systems[10]. Thus, MI shares the structure, function, and properties with those of a sign in many respects. This yields that the semiotic theory is a viable solution for explaining MI and shedding some light on the complex nature of MI and its manifold properties (**II, III, V**).

1.4.2.   Peirce's semiotics

In general, the theory of signs (or semiotics) is an account of signification, reference, and meaning, which analyses signs and sign systems in their various manifestations in nature and society. There are several formulations of sign theories, which differ significantly from each other (see for example Saussure 1916/1969, 1983; Morris 1938, 1946, 1964). So, which formulation of a semiotic account suits best for comprehensively explaining MI? A detailed comparative analysis of this is given in **VI**. But, probably the most universal and comprehensive sign-theoretic account was developed by C.S. Peirce, the founder of modern semiotics (Colapietro 1989; Deledalle 2001). Indeed, Peirce's sign theory (or semeiotic as he calls it) is distinctive among others for its "breadth and complexity" (Atkin 2013: 1).

The central tenets of Peirce's semiotics are the philosophical origin of his account, pansemiotic view of the universe, phenomenology (or phaneroscopy), Peirce's triadic definition of a sign and classification of signs. These (and not only) features of Peirce's account make it a potential solution to the problem of MI. Let us analyze them stepwise.

So, why choose Peirce's semeiotic over other accounts to explain MI? First, Peirce's theory of signs has a philosophical background (Deledalle 2001; Pietarinen and Bellucci 2016; **III, VI**). It takes into account the previous philosophical investigation of MI, which is often neglected by contemporary cognitive psychologists. In particular, his work was strongly influenced by the philosophy of Aristotle, Kant's and Leibniz's theories of knowledge, and Locke's theory of ideas (Bellucci 2013; Pietarinen and Bellucci 2016).

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[10] Here, the notion of a 'system' relates to a set of elements and relations that work together as a whole and constitute an interconnected network, which is guided by the general rules of semiosis, i.e. by the signifying process.

Further, Peirce's semiotic theory aims at solving general and universal problems of knowledge and being, and thus, puts MI in the context of these fundamental problems (**III, VI**). Next, Peirce elaborates the pansemiotic view of reality, a general paradigm, within which all issues of physical and mental reality can be potentially solved (Kevelson 1987). This connects imagery not just to other faculties of cognition, but to reality and its knowledge (**III**). For example, Peirce claims that man, cognition, and reality can be interpreted in terms of signs: "The entire universe is perfused with signs, if it is not composed exclusively of signs" (CP 5.448). This means that human cognition, our thoughts, and man himself are semiotic by nature, and thus, can be interpreted within one unified semiotic framework. Therefore, for Peirce semiotics is a universal science that can equally explain the mental and the physical. This universality of the scope of Peirce's sign-theoretic account makes his semeiotic a possible candidate for a comprehensive explanation of the divergent, and sometimes even incommensurable, characteristics of MI.

The next essential trait of Peirce's semiotics is his complex phenomenology of human cognition or, as he calls it, phaneroscopy (from 'phaneron' meaning 'phenomenon') (Zeman 1977; Bellucci 2015; Champagne 2018). Peirce's theory of cognition offers a unique and subtle interpretation of the phenomenological and dynamic nature of MI and sets the scene for a versatile sign-theoretic account of MI (**III**). In particular, his phenomenological method is based on a system of categories. Peirce singled out three main categories used to analyze various phenomena. The three categories are firstness, secondness, and thirdness. "Firstness is the mode of being which consists in its subject's being positively such as it is regardless of aught else" (CP 1.25). Firstness is the category of unreflected feeling, mere potentiality, possibility of that, which is immediately given (CP 5.66-68; CP 1.531). Secondness involves the relation of the first to the second (CP 1.530). This is the category of reaction and action, facticity, reality, and experience in time and space (Nöth 1995: 41). "Category the Second is the Idea of that which is such as it is as being Second to some First, regardless of anything else [...] That is to say, it is *Reaction* as an element of the Phenomenon" (CP 5.66). Finally, thirdness is a category of mediation, it brings the second into relation to a third. "Had there been any process intervening between the causal act and the effect, this would have been a medial, or third, element. *Thirdness*, in the sense of the category, is the same as mediation" (CP 1.328). Following Peirce, all the phenomena that we experience, feel, live through and react upon can be analyzed in terms of firstness as the category of feeling, secondness as the category of reaction, and thirdness as the category of mediation. Thus, Peirce's sign theory can be properly understood only in the context of this system of categories, i.e. in the context of his theory of cognition (Pietarinen 2015a, 2015b; **III**). The same applies to our understanding of mental images. One can hardly give a comprehensive explanation of MI without accounting for its manifold, changing phenomenological properties. A unified approach to MI should account for MI's phenomenology. Peirce's semeiotic makes this possible.

Finally, based on his cognitive theory, Peirce developed a comprehensive typology of signs, which constitutes a significant part of his semiotics. According to Peirce, each of the three sign-elements – sign-vehicle, object, and interpretant - is divisible into three sub-types (CP 2.243). The first of the three thrichotomic divisions is Qualisigns, Sinsigns, and Legisigns (CP 2.244), the second – Icons, Indexes, and Symbols (CP 2.247), and finally, the third division is Rhemes, Dicisigns, and Arguments (CP 2.250). Thus, if we analyze each of the three sign elements and their features, then we can get ten different classes

of signs. Peirce later postulated sixty-six classes of signs. A thorough study of various types and classes of signs is an important endeavor of his semeiotic (Pietarinen 2015a). Such a detailed classification of signs, once applied to study MI, enables a thorough and overarching explanation of its diverse properties.

In general, Peirce's pansemiotic view of reality, philosophical origins, theory of cognition, and system of categories make up the unique context of his sign-theoretic account that allows for a thorough analysis of a large variety of mental images. These features distinguish his sign-theoretic approach among other alternatives and make it a viable candidate for an exhaustive explanation of MI.

1.4.3. Peirce's sign theory applied to mental imagery

So, what is MI according to Peirce's sign theory and how it can be explained? Based on Peirce's account, as described above, MI constitutes a complex system of signs, which consists of three main elements – the representamen, object and interpretant – and is characterized by the dynamic and flexible relations between these elements (**II, IV, V**). Such an understanding of imagery begins with the premise that the mind is of a signifying nature: "a *mind* may, with advantage, be roughly defined as a *sign-creator in connection with a reaction-machine*" (MS[R] 318:18)[11]. According to Peirce, the human mind is a sign-producing and sign-interpreting system, characterized by semiotic processes of signification, i.e. by the dynamic, changing, and context-dependent processes that create signs and manipulate them (**III, VI**). This yields that all our cognitive and mental states are signs and are ruled by signs. The same goes for MI as well.

Hence, the interpretation of MI as a sign system brings a two-fold conclusion. First, MI is of a signifying nature, i.e. it shares the same structure and features with a sign in the human mind (**II, IV, V**). Just as a sign is defined as "something which stands to somebody for something in some respect or capacity" (CP 2.228), MI can legitimately be characterized in the same way. Therefore, similarly to a sign, MI shares its triadic structure.

Second, to say that MI is a sign system means that MI is guided by dynamic, context-dependent signifying relations between its elements (**II, IV, V**). According to the sign-theoretic account, relations between the elements of a sign are dynamic, i.e. they continuously develop and change their characteristics depending on various factors (Savan 1988; Merrell 2001). Similarly, mental images are not stable or fixed, but are rather of a dynamic nature. MI evolves and develops continuously under the influence of factors that are both internal (e.g. subjective memory, experience, and dispositions) and external (e.g. changes in language, objects' features, and new knowledge). The latter entails that mental images are dependent on the context where they were produced, as well as on the subject who produced or interpreted the image.

Now, can the Peircean semeiotic suggest a framework for a full-fledged explanation of MI? This dissertation demonstrates theoretically and empirically that the sign-theoretic approach, as described above, can comprehensively account for the diverse nature of mental images. In particular, this semiotic account accommodates: **a)** the heterogeneous and manifold properties of MI; **b)** image's co-relation with the object (intentionality); **c)** image's dependence on the subject who produced the image and their individual traits; **d)** image's dependence on the context where the image was produced (**II, IV, V**).

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[11] MS[R] 318 refers to the manuscript of C.S. Peirce entitled "Pragmatism" (1907).

To begin with, the heterogeneous and manifold properties of MI can be easily accommodated by Peirce's sign theory. Various grounds of signification allow to apply his semeiotic to natural signs, images, linguistic signs, etc. The detailed classification of signs, which is based on his system of categories and the triadic structure of a sign, allows a thorough analysis of a great variety of mental images, their manifold properties, and all its diverse manifestations (**II, IV, V**). The context-dependence, flexibility, and dynamics of Peirce's conception of a sign allow to explain the process of signification, signifying relations, and the factors that influence the latter in most detail. All this provides a proper interpretation of the heterogeneous properties of MI (for theoretical examples of the sign-theoretic explanation of MI, see **II, IV**). Such outcomes also correspond with the ideas developed by other semioticians (Savan 1988; Atkin 2013; Pietarinen 2012; Pietarinen 2015a; Pietarinen and Bellucci 2016; etc.)

Secondly, image's co-relation with the object (intentionality) can also be comprehensively understood in terms of Peirce's semeiotic. He developed an interesting phenomenological account that underlay his sign theory and suggested a thorough explanation of how signs can be about the world and what relations there are between internal signs and external objects (**III**; Zeman 1988; Atkin 2013). This enables a deep insight into the intentionality of MI. Next, image's dependence on the subject who produced the image and their personal traits, can be substantially studied using Peirce's sign theory. The triadic structure of a sign includes an interpretant element, i.e. a subject's cognitive response to a sign. According to Peirce, feelings, emotions, thoughts, memories, and even actions – all can count as an interpretant, i.e. as an internal part of a sign. Thus, a subject and their individual reactions are clearly incorporated inside a sign system. This allows to arrive at a rich understanding of the way individual differences influence the formation of an image, as well as the way this image is interpreted by a subject (**II, IV**). Semiotic research of the conscious self by Colapietro (1989) and Champagne (2018) confirms these conclusions.

Finally, an explanation of image's dependence on the context where the image was produced, can also be given by Peirce's semeiotic. His sign-theoretic account embraces the context-dependence of a sign (**II, V**). This corresponds to the changes in the environment that significantly influence both the relations and characteristics of a sign (CP 2.265). Peirce's sign theory takes into account different influences and contextual changes and adapts them inside the sign system, thus enabling an in-depth understanding of the context-dependence of MI as well.

In sum, the above-mentioned features of Peirce's semiotics comprise a unique paradigm that enables a full-fledged explanation of MI. Although such potential of the sign-theoretic account has been unrecognized and widely underestimated, this thesis puts forward reasons to consider sign theory as a beneficial way to account for imagery. The philosophical origins of Peirce's theory of signs allow to account for the early views on MI. A pansemiotic view of reality puts MI in the wider context of epistemological and ontological problems and aims at its universal explanation. Peirce's theory of cognition and system of categories ensures a detailed study of the manifold properties of MI and its subjective phenomenological nature. All together, these elements constitute the core of Peirce's sign-theoretic account and enable a comprehensive understanding of the complex nature and function of mental images.

1.4.4.   Empirical study and outcomes

To prove the above-given sign-theoretic considerations about MI, an empirical study was conducted (**V**). In particular, it was an experiment aimed to test whether mental images can be legitimately viewed as sings, i.e. that **a)** MI shares the triadic structure with a sign; **b)** MI is guided by dynamic, context-dependent signifying relations between its elements. To test these hypotheses, the triadic structure of an image was manipulated to uncover the potential association between the properties of the imagined object and the properties of the final image produced. Such co-relation underlies the process of imagining. The experiment intended to detect how sensitive the image-object association is to the changes in object characteristics, context, and individual cognitive capacities. If the produced images exhibit heterogeneous characteristics across participants, as a response to the same object, then this result would mean that MI depends strongly on object features, context/task conditions, the individual and their cognitive dispositions. This, in its turn, would prove that MI is better understood via the triadic structure that incorporates a third subjective element into the MI system (a), and that MI is guided by dynamic and context-dependent relations (b).

The experiment was designed in the following way: the same object by meaning (that is, by keeping its interpretant fixed) was suggested in three different ways – pictorial, verbal, and diagrammatic – to experimental subjects. Such triple task division followed Peirce's typology of signs as related to the object of a sign – an icon, symbol, index – and was chosen to represent the distinctive differences in object-stimulus that were supposed to influence the final image (for details about the experimental design see **V**). Each experimental task included a short story that was thus presented either **a)** pictorially (as a sequence of related pictures, e.g. comics), **b)** verbally (a written story), **c)** diagrammatically (as a scheme with arrows and lines). Participants were asked to imagine the rest of the story and express what they imagined using any method of expression.

Forty international students with different cultural and professional backgrounds from the Tallinn University of Technology took part in this study. In total, students of 14 different nationalities and 20 professions or competencies (including humanities, social sciences, journalism, and engineering) participated in this experiment. Such diverse cultural and professional backgrounds of participants ensured sufficient heterogeneity of the sample size of the experiment.

All participants were randomly divided into two groups (the study and the control groups), 20 subjects to each. Each group received slightly different tasks to avoid the bias of recognizing the purpose of experimentation (tacit knowledge effect) and to additionally test the potential differences in subjects' performance on different cognitive tasks. The order of the tasks remained the same (pictorial, verbal, diagrammatic) across the two groups, but the stories differed by content. The experimental tasks were distributed in the following way: Group 1 received the first story pictorially, the second verbally, and the third diagrammatically. Group 2 (control group) received the third story pictorially, the first verbally, and the second diagrammatically. Instructions and task formulations were given in English and remained the same across the experimental groups. The response time was approximately 30 minutes (no strict time constraints were given, in order to eliminate anxiety, etc.). The number of answers was: 60 answers in each experimental group (20 subjects solved 3 tasks) and 120 answers in total. This number of responses was assumed to be large enough to show its statistical

relevance and make legitimate conclusions about the acceptance or rejection of the experimental hypothesis.

The expected reaction to a story-stimulus is the production of an image that is influenced by the suggested properties of the object – pictorial, verbal, or diagrammatic. Thus, the final image is supposed to be different across different cognitive tasks and have distinct similar characteristics within each task type. The expected result is that the same object (by meaning) expressed in different ways produces different images/representamens. The judgement about the statistical significance of the test results was made on the basis of the significance level, the value of which for the sake of this experiment was considered to be 0.05 (i.e. $\alpha = 0.05$)[12].

The results of the experiment were evaluated on a categorical (nominal) scale that reflects the type of answer participants chose to produce as their final image for each of the three cognitive stimuli. There were thus three general categories: pictorial, verbal, and diagrammatic. The responses of the experiment were distributed in the following way: for pictorial stimulus, 15 answers out of 40 were given pictorially (37.5% of all respondents). For the same task, 22 answers were verbal and 3 diagrammatic (55% and 7.5%, respectively). Altogether, 18 answers out of 40 were given in a non-verbal way (i.e. pictorial and diagrammatic), which constituted 45% of all answers (**V**).

Next, for verbal stimulus, 4 subjects out of 40 answered pictorially (10% of all respondents). For the same task, we received 31 verbal answers and 5 diagrammatic (77.5% and 12.5% of all respondents, respectively). The total number of non-verbal answers were the lowest among all three cognitive tasks, namely 9 answers (22.5% of all respondents). Finally, for diagrammatic stimulus, we received 4 pictorial, 22 verbal, and 14 diagrammatic answers (10%, 55%, and 35% of all respondents, respectively). The total amount of non-verbal answers was quite high: 18 answers out of 40, that is 45% of all respondents (**V**). The distribution of answer categories across the three types of cognitive stimuli is given in percentages in Figure I.
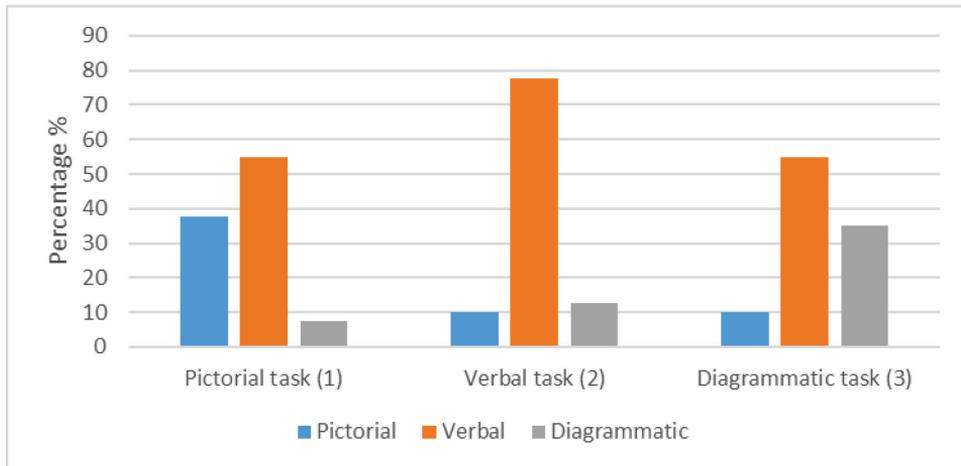
Figure I: Distribution of categories of answers across three types of tasks

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[12] The choice of the significance level $\alpha = 0.05$ was guided by the cognitive demands of the experiment: small sample size, equal sample groups, several cognitive tasks, and multiple categories of answers. The value of the significance level 0.05 is a common practice in most cognitive experiments of such kind, yet the results of this study can be interpreted using a stricter significance level $\alpha = 0.01$ as well.

So, what do these results actually show? Statistical analysis (the Pearson's Chi-squared test[13] and Fisher's test) was performed to calculate the p-value and to examine whether there is a significant relation between the properties of an object and those of an image. The Chi-square test showed $X^2(N=40) = 22.045$; $p = 0.0001963$ with df (degree of freedom) = 4. The Fisher's test showed a slightly different p-value, $p = 0.0004802$. However, both tests indicated highly significant results, confirming the relation between the two variables (the method of response and the type of task) (V).

Thus, the low p-value ($p \leq 0.05$) between the category of answer and the type of cognitive task confirms the hypothesis that there is a significant interrelation between the properties of an object and the properties of an image. The properties of an object influence the characteristics of an image that are formed to present this object. In particular, the largest number of pictorial responses (37.5%) was given to pictorial stimulus. Similar observations hold for verbal and diagrammatic answers. Thus, stimulus significantly influences the formation of a mental image. This leads to the conclusion that MI does not share certain characteristics that are independent of the characteristics of its object. On the contrary, various properties of the object evoke various images. This challenges the idea that one cognitive format underlies the production of mental images, which is implied by the computational-representational theories of MI. The dependence of image-formation on the characteristics of its co-related elements (such as the object's features) strongly suggests that MI is not the matter of a static, independent representation of a particular kind, but rather its characteristics are heterogeneous by nature and are embedded in a dynamic relational network (**V**).

The heterogeneity of the answer distribution confirms the conclusion that MI cannot be understood from the perspective of one type of mental format or representation. Based on the experimental results, we can observe that all three response types (pictorial, verbal, and diagrammatic) were used to solve the three tasks. Subjects tend to choose different methods for their image-formation that vary due to multiple influencing factors. This confirms the sign-theoretical account. Signs are subtle combinations of their elements and dynamic relations between them. Therefore, any image may have several (that is, iconic, symbolic, indexical) characteristics simultaneously. Such heterogeneity is clearly seen from the distribution of the answers in the experiment (Table I, Figure I; **V**). Thus, the particular properties of MI are influenced by multiple factors, including the characteristics of the object-stimulus, task demands, and the context as well as individual differences. In brief, there is no dominant format underlying MI.

Next, it was assumed that individual differences have an impact on image-formation. To analyze this, two tests were conducted. An introductory pre-test checked whether individual variations in native language, cultural background, or occupation influence MI. The after-test (Psi-Q test) evaluated subjective vividness of imagery capacity and its influence on the response type. These indicators have been assumed to influence the production of MI: cultural and language peculiarities underlie cognitive biases and dispositions of the imagining subject, educational background and professional

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[13] Pearson's Chi-squared test was chosen due to the demands of this experimental design, since it enables evaluating several sets of categorical data. Additionally, Cramer's V test can be used to measure the strength of the association between two nominal variables. However, this study intended to show whether there is an association between the properties of an object and the properties of an image in the first place and did not focus on the strength of such a correlation. For these purposes, Pearson's Chi-squared test and Fisher's test were chosen as the best methods to test the statistical significance of the initial hypothesis.

occupation is a well-documented factor that influences the properties of an image, whereas individual imaginary capacity notably differs across subjects. For the first test, no significant association between professional occupation and response type was found; $X^2(N=40) = 2.853$; p = 0.415 (with df = 3); according to Fisher's test this was p = 0.513. This means that participants answer similarly to the three cognitive tasks independently of any differences in their professions and cultural backgrounds (**V**).

The second Psi-Q test was used to assess individual differences in vividness and intensity of MI across a wide range of cognitive modalities (vision, sound, smell, taste, touch, bodily sensation, and emotional feeling). For this after-test, a significant association between individual differences in imagery's vividness and response type was indicated. Analysis showed that subjects with higher vividness of MI tended to answer pictorially, producing detailed and elaborated images, whereas subjects with lower vividness of MI tended to answer verbally, i.e. in a more abstract and general way. The significance value for this test was p = 0.004, which confirms the hypothesis that participants answer differently depending on subjective differences in the vividness of images. Having a more or less vivid MI capacity inclines a subject to produce images with particular characteristics. This means that individual cognitive capacities influence the formation of mental images. MI and its properties are biased by personal cognitive abilities, dispositions, and talents.

Taking all the above into account, a couple of general conclusions concerning the nature of MI may be drawn. First, this empirical study suggests that the characteristics of MI vary depending on multiple factors and thus appear to be heterogeneous by nature. In particular, the properties of mental images vary depending on the characteristics of the object-stimulus. MI does not share characteristics independent of the properties of an object-stimulus; rather, MI encapsulates the properties of the imagined stimulus, which suggests that the features of a mental image depend on the features of an object that it professes to represent. Second, the properties of MI are dependent on individual differences in imaginary capacities. Indeed, human cognitive capacities are not equal. Such differences in personal capacities and dispositions significantly influence the characteristics of the produced images.

This evidence leads to several important theoretical considerations. First, a coherent account of the nature of MI would explain such features as the heterogeneity of its characteristics, its task-context-object dependence, and the influence individual differences have on image formation, among other things. However, explaining all these facts through the traditional representational theories of MI appears to be problematic. Although the quasi-pictorial theory could easily accommodate pictorial data and the propositional theory verbal data, the explanation of the results through the traditional accounts would still remain partial (**V**). Similarly, the enactivist approach can potentially explain the dynamic relations and task-object dependence, but it can hardly account for the divergent characteristics of MI. This leads to a major conclusion: neither the computational-representational, nor the enactivist paradigm can suggest a framework for a comprehensive and overarching explanation of mental images. Outcomes of this study confirm this idea.

In contrast, the sign-theoretic approach, as advocated by Peirce, can propose the basis for developing one unified framework, within which diverse imaginary properties could be explained. In particular, the interpretation of mental images in terms of signs makes it possible to accommodate **a)** the heterogeneous and manifold properties of MI; **b)** image's co-relation with the object (intentionality); **c)** image's dependence on the

subject who produced the image and their individual traits; **d)** image's dependence on the context where the image was produced (**II, IV, V**). This study convincingly showed that MI can be legitimately viewed as a complex system of signs guided by dynamic and context-dependent relations, and that such an interpretation of MI allows to comprehensively explain its various manifestations. Thus, this semiotic approach offers a unique and beneficial framework to deal with the problematic nature of MI and unite the divergent empirical data. Based on the above-given considerations, sign theory may indeed solve many ambiguities in the field and become a useful tool for developing a unified account of MI in the future.

1.5. Conclusion and implications for further research

MI remains a complex and problematic issue in the philosophy of the mind and cognitive sciences. Although the importance of MI is widely acknowledged, it is still hard to give a comprehensive explanation of its diverse properties. This thesis contributes to the investigation of MI by approaching this problem from a novel sign-theoretic perspective.

Both the theoretical analysis and empirical research results show that the sign-theoretic approach advocated in this dissertation can accommodate the heterogeneity of imaginary characteristics and MI's task-context-object dependence. First, MI can be seen as a sign system that consists of three elements: the representamen, the object, and the interpretant. Considering MI to have this triadic structure allows to offer a detailed explanation of the nature and function of images in human cognition. Second, the theory of signs considers mental capacities to be of signifying nature. This connects MI with many other cognitive abilities of the human mind and explains individual differences and dispositions in producing MI. Third, sign theory postulates the dynamic and open signifying relations between the three elements of a sign, which allows to explain the divergent and changing properties of mental images.

In contrast, the computational-representational theories of MI fail to comprehensively account for these facts. The prevailing representational accounts consider MI to be a static mental representation of a particular (either pictorial or propositional) format. Such a view on mental images significantly limits our understanding of the heterogeneous and dynamic nature of mental images, and thus, cannot offer a full-fledged explanation of them. Experimental results revealed by this study confirm this conclusion.

Although our empirical findings support using the theory of signs for investigating MI, the proposed study gives rise to several further questions. What is the difference between MI and other mental faculties interpreted in terms of signs? Can the sign-theoretic account predict the character of a produced image in every single case? Are there any rules or regular patterns that govern image-production according to sign theory? If an image is a sign, then does it constitute a mental faculty inherent to the human mind or is it a product of human conventional action? New empirical investigations of the sign-theoretic approach are needed to address these questions. In particular, a more elaborated experimental design, greater variety of cognitive tasks, and a larger sample size would give more data regarding the actual function of mental signs in the human mind. Additionally, the application of the methods of cognitive neuroscience (e.g. brain-scanning techniques, such as fMRI, EEG, TMS, etc.) might also shed some light on the way mental signs are physically produced and manipulated in the brain. Future research in the field may fill the gaps in our understanding of applying sign theory to MI and to the study of the mind in general.

In spite of a large amount of questions yet to be answered, explanations of MI should not overlook the potential of MI as signs. The application may have long-term implications. First, sign theory overcomes some long-standing controversies and limits of the prevailing representational accounts. Second, it can comprehensively explain the heterogeneous characteristics of MI and its context-individual-object dependence. Finally, sign theory can accommodate manifold empirical evidence under the umbrella of one unified semiotic account. This study indicates, both theoretically and empirically, that the theory of signs is indeed a useful candidate for accounting for the complex nature of mental images. Just as multiple pieces of one puzzle are gathered together to provide a larger picture, similarly, various characteristics, functions, and evidence from various disciplines can be potentially integrated into one coherent model of MI, which is demonstrated by this study.

The application of the sign-theoretic paradigm to mental images poses further large-scale questions. How can imagery techniques be optimized for better transfer of information? How can MI as a sign system be manipulated to enhance interaction between individuals and social institutions? Are there any novel opportunities to utilize images for simplifying human everyday life? How can imagery techniques improve decision-making strategies in governance and across various types of policies? Can we use images as signs to code/decode important data, memories, or knowledge? How will the sign-theoretic approach to MI influence media, marketing, and advertising? Which impact will the relational and dynamic nature of images have on high-tech engineering, robotics, and development of AI? Etc. All these questions remain open for further research across a wide range of scientific disciplines. The implementation of imagery techniques goes far beyond cognitive sciences. In the light of this, the explication of the way mental imagery really works seems crucial to human daily life, as well as to the scientific enterprise in general.

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Acknowledgements

Abstract
A Sign-Theoretic Study of Mental Imagery

This thesis proposes a novel approach to studying mental imagery (MI). Although the importance of MI in human cognition is widely acknowledged, it is still extremely hard to give a comprehensive explanation of its diverse properties. Two main representational theories of MI – (quasi-)pictorial and propositional – suggest divergent empirical evidence regarding mental images. According to the (quasi-)pictorial view MI share genuine characteristics with pictures and are thus of pictorial format (Kosslyn 1980, 1994; Farah 1989). In contrast, propositional account claims that major features of mental images are similar to those of language (Fodor 1975; Pylyshyn 1981, 2002). This conflict between the two traditional accounts of MI (the Mental Imagery Debate) showed that empirical evidence on the matter is ambiguous and controversial. As a result, the issue of the nature of MI still remains problematic.

This dissertation aims at approaching this problem from a novel sign-theoretic perspective. Theory of signs (or semiotic) is an account of signification, reference and meaning, which demonstrates its usefulness in the study of mental signs and MI as well. In particular, present thesis claims that **a)** theory of signs can be a useful candidate to investigate MI; **b)** theory of signs suggests a comprehensive explanation of imagery's manifold characteristics. To test these hypotheses theoretical and empirical methods from cognitive psychology, philosophy and semiotics were applied. Such combination of research methods has not been applied to study mental images before, which allows to systematic analysis of MI. Theoretical approaches comprise conceptual and comparative analyses, interpretation of the existing theories and sources. The empirical approach consists of the cognitive experiment on the sign-theoretic account of MI and its subsequent statistical analysis.

Both theoretical analysis and empirical research show that sign theory can comprehensively account for diverse characteristics of images and thus appears to be a beneficial alternative to representational-computational accounts of MI. In particular, semiotic approach can accommodate **a)** heterogeneous and manifold properties of MI; **b)** image's co-relation with the object (intentionality); **c)** image's dependence on the subject, who produced an image and his individual traits; **d)** image's dependence on the context, where the image was produced. Experimental results confirm these facts.

In contrast, prevailing computational-representational theories meet serious difficulties in accounting for these features. Traditional representational accounts take MI to be a static mental representation of a particular (either pictorial or propositional) format, independent of context or individual differences. Such view of mental images significantly constrain our understanding of their heterogeneous nature and function. Due to these limitations, MI cannot be comprehensively explained by representational theories. This conclusion corresponds with the empirical data from various disciplines (Keller 2012; Lacey and Lawson 2013; Schmidt et al. 2014) and is confirmed by the evidence from current study.

The sign-theoretic approach as advocated in this dissertation overcomes constraints of the traditional computational-representational accounts and allows to a full-fledged explanation of mental images. The latter fact, in its turn, paves the way to the formulation of one unified account of MI that would reconcile divergent empirical data on the matter. The development of a unified account of MI is especially important in cognitive sciences, since mental imagery plays significant role in everyday cognition.

Memory, learning, problem solving, inner speech, dreaming, visualization, creative thinking, etc. – all these depend to various extent on mental images. Furthermore, MI has also a practical significance in medicine, education, music and sport studies, media, advertising, computer sciences and engineering. Imagery-based techniques are actively used to transfer information, improve professional performance, provide interaction between individuals and social institutions, promote the development of new technologies, etc. Thus, a comprehensive account of MI would enhance the research in many scientific disciplines: uncover working mechanisms of the mind, develop novel educational and therapeutical methods, enhance the progress of high technologies and means of communication.

Lühikokkuvõte
Kujutluse märgiteoreetiline käsitlus

Käesolev väitekiri esitab uudse lähenemise kujutluse (*mental imagery*) uurimiseks. Olgugi, et kujutlust peetakse inimtunnetuses väga oluliseks, on kujutluse mitmetahulise olemuse ammendav kirjeldamine osutunud väga keerukaks. Kujutluse käsitluse kaks representatiivset teooriat – (kvaasi)pildiline ja kirjeldusteooria – toovad kujutluse kirjeldamisel välja vastuolulisi empiirilisi tõendeid. (Kvaasi)pildilise lähenemise kohaselt on kujutlused oma põhiomadustelt sarnased pildile ja seega peaks neid käsitlema kui pilte (Kosslyn 1980, 1994; Farah 1989). Sellele vastupidisel seisukohal on kirjeldusteooria, mis väidab, et kujutlus sarnaneb põhijoontelt keelega (Fodor 1975; Pylyshyn 1981, 2002). Konflikt kujutluse käsitluse kahe traditsioonilise lähenemise vahel, nn kujutluse debatt, näitab ilmekalt, et asjakohane empiiriline tõendusmaterjal on mitmetimõistetav ja vastuoluline. Sellest tulenevalt on kujutluse põhiolemuse küsimus jätkuvalt problemaatiline.

Väitekiri püüab läheneda kujutluse debatile uudsest märgiteoreetilisest vaatenurgast. Märgiteooria ehk semiootika keskmes on tähistamine, viitamine ja tähendus, mistõttu saab seda edukalt kasutada ka mentaalsete märkide ja kujutluste uurimisel. Käesolev uurimustöö väidab, et **a)** märgiteooria võib kujutluse uurimisel olla kasulik valik ja **b)** märgiteooria pakub ammendava seletuse kujutluse paljudele erinevatele tahkudele. Nende hüpoteeside testimiseks kasutati uurimistöös kognitiivse psühholoogia, filosoofia ja semiootika teoreetilist ja empiirilist metodoloogiat. Sellist uurimismeetodite kombineerimist, mis annaks võimaluse kujutluse süsteemseks analüüsiks, ei ole varasemalt kujutluse uurimisel kasutatud. Töö teoreetiline osa põhineb kontseptuaalsel ja võrdleval analüüsil ning olemasolevate teooriate ja allikate tõlgendamisel. Empiiriline osa koosneb märgiteooriast lähtuvast kognitiivsest eksperimendist ja saadud andmete statistilisest analüüsist.

Nii teoreetiline analüüs kui ka empiiriline uuring näitavad, et märgiteooria suudab ammendavalt kirjeldada kujutluste erinevaid omadusi ja on seega ilmselt praktiline alternatiiv kujutluste representatiivsetele-arvutuslikele käsitlustele. Konkreetselt võimaldab semiootiline lähenemine kirjeldada **a)** kujutluste heterogeenseid ja mitmetahulisi omadusi; **b)** kujutluse ja objekti vastastikkust suhet (tahtlikkus); **c)** kujutluse sõltuvust subjektist, kes kujutluse lõi, ning tema isiklikest omadustest; **d)** kujutluse sõltuvust kontekstist, kus kujutlus tekkis. Katsete tulemused kinnitavad eeltoodud fakte.

Domineerivad arvutuslik-representatiivsed teooriad seevastu on kujutluse eelpooltoodud aspektide käsitlemisel suurtes raskustes. Traditsioonilised representatiivsed lähenemised peavad kujutlust teatud formaadi – olgu siis pildiline või kirjeldav - staatiliseks representatiivseks esituseks, mis ei sõltu ei kontekstist ega ka individuaalsetest erinevustest. Selline lähemine piirab oluliselt meie arusaamist kujutluse heterogeensest olemusest ja selle toimimisest. Nendest piirangutest tulenevalt ei ole representatiivsete teooriate varal võimalik kujutlust ammendavalt selgitada. See järeldus on vastavuses ka varasemate erinevate valdkondade uurimistööde empiiriliste andmetega ning leiab käesoleva uurimistöö tulemuste põhjal kinnitust.

Väitekirjas soovitatud märgiteoreetiline lähenemine suudab aga ületada traditsioonilise arvutuslik-representatiivse lähenemise piirangud ja võimaldab seeläbi kujutluse igakülgset käsitlust. Sellele tuginevalt saab rajada ühtse lähenemise kujutluse olemusele, mis võimaldab koondada olemasolevad kujutlust kirjeldavad erinevad

empiirilised andmed. Ühtse lähenemise väljatöötamine on eriti oluline tunnetusteaduste valdkonnas, kuna kujutlusel on igapäevases tunnetuses tähtis roll. Mälu, õppimine, probleemilahenduse oskus, sisekõne, unistamine, visualiseerimine, loov mõtlemine jne – kõik need tegevused sõltuvad suuremal või väiksemal määral kujutlusest. Veelgi enam, kujutlusel on praktiline tähtsus meditsiinis, hariduses, muusikas ja spordis, meedias, reklaamis, infotehnoloogias ja inseneritöös. Kujutluspõhiseid tehnikaid kasutatakse laialdaselt infoedastuseks, töösoorituse parandamiseks, tõhusamaks kommunikatsiooniks inimeste ja sotsiaalsete insitutsioonide vahel, uute tehnoloogiate väljatöötamiseks ja paljudes muudes valdkondades. Kokkuvõtlikult toetaks kujutluse laiapõhjaline käsitlus oluliselt edasiminekut mitmetes teadusvaldkondades, kuna seeläbi saab paremini mõista tunnetuslike protsesside toimimist, arendada välja innovaatilisi õppe- ja teraapiameetodeid ning toetada edasiminekut kõrgtehnoloogia ja kommunikatsioonivahendite arendamise vallas.

Appendix

Can theories of mental representation adequately explain mental imagery?

Introduction

Traditionally, it is taken for granted that mental imagery (MI) is mental representation (MR) of some kind or format. The Imagery Debate highlighted this relation between MI and MR (see, e.g., Kosslyn 1980, 1994; Pylyshyn 2002, 2004). Following the discussion of the Imagery Debate, Pearson and Kosslyn (2015) make a strong connection between imagery and representation. A mental image is called a "depictive mental representation" and the Imagery Debate "a debate about the nature of mental representation" (Pearson and Kosslyn 2015: 10089). Thus, a clear-cut relationship between image and representation – namely that MI is a kind of MR – is established in the discussion of the Imagery Debate.

Pearson and Kosslyn are not the only ones treating MI in terms of MR. Block adheres to the viewpoint that "mental images represent in the manner of pictures" (Block 1983: 499). In a similar vein, Marr writes that "it is quite proper to think of an image as a representation" (Marr 2006: 395). Gauker gives a representationalist definition of mental imagery: "Mental images are like perceptual representations" (Gauker 2011: 147). All in all, the notion of 'mental imagery' is a typical subaltern to the notion of 'mental representation', and this co-relation between the two is usually assumed to be unproblematic and natural.

But, what exactly does it mean to say that MI is a kind of MR? If MI is a kind of MR, then it follows that a theory of MR can provide an adequate and exhaustive explanation of MI. In this article, I am going to challenge this claim. In particular, I will argue that the dominant 'two-world' account of MR cannot adequately explain MI. Contrary to the dominant MR theory, there are reasons to believe that a) MI has a different cognitive architecture, that b) the relations that hold between elements of MI are dynamic, and that c) the relations between elements of MI are context-dependent. Thus, the standard 'two-world' account of MR neglects important characteristics of MI and, thus, fails to give a comprehensive explanation of the latter.

To justify this, I begin with an attempt to give a general definition of MR and briefly review some of the existing views. Section 2 is about theories of MR, following the analysis of Section 1. Section 3 is an attempt to define the MI phenomenon; subsections 3.1–3.3 are about reasons why the relationship between MI and MR is in fact problematic, concluding that the traditional accounts of MR fail to exhaustively explain MI, and therefore, should not be used to explain the latter. Finally, Section 4, which proposes an alternative – the semiotic theory, confronts the phenomenon of MR from a different viewpoint compared to the standard accounts: this semiotic alternative is proposed for adequately explaining MI.

1. What is a mental representation?

The notion of mental representation is an ambiguous and important notion in the philosophy of the mind and cognitive science. It became one of the cornerstones of cognitive theories of the mind, used to explain (directly or indirectly) most internal experiences and states. Clapin (2002: 19), for example, defines cognitive science as a '*representational* science of mind' (original emphasis). The interpretation of MR, however, depends on the prevailing scientific paradigm that underlies contemporary cognitive theories of the mind.

Since the second half of the 20th century, MR was commonly understood in the framework of the computational paradigm, which implied that all mental states and cognitive events are products of mental computations made by our minds from some elementary parts. In this context, mental representations are seen as the elementary parts out of which all mental processes and states are made (Clapin 2002; Marr 2006). Despite the extensive criticism of computationalism (Searle 1990, Dreyfus 1992, Van Gelder 1995), an alternative definition of MR still remains largely open. Nevertheless, a few general characteristics of MR can be singled out.

Firstly, it is widely accepted that an MR is an information-bearing structure, an internal object with semantic properties (Pitt 2017: 1). An MR has some *content*, i.e. it gives some information about the physical world to the cognizing subject. Similarly, it is usually said that mental representation *is about* some object or aspect of the world. The *aboutness* of MR constitutes the problem of intentionality of mental representation. In other words, how does

mental representation refer to or how is it directed at things, objects, or states of affairs (Clapin 2002; Siewert 2017)?

Secondly, a mental representation stands in some *representing relation* to the physical world (Churchland and Sejnowski 2006; Clapin 2002). There is a connection between the representation and what is represented. This relation makes the internal process of representing something outside the mind possible. The particular type of relation that holds between MR and the represented object can vary. The most common alternatives are relations of correspondence, reference, similarity, causation, and description. For example, Pylyshyn (2000: 197) compares representation with description, stating that MR functions in the same way as descriptions, by encoding properties of the external world.

However it is connected to its represented counterpart, an MR is usually distinct from the physical world. An MR is a product of the mind and despite its directedness towards external objects and events, it belongs to a *different domain*, namely to the mental one. In this sense, mental representations are often seen as mediators between the mind and the world. Clapin, for example, puts it straightforwardly: "According to much cognitive science, representations mediate mind and world" (Clapin 2002: 18). So, according to classical theories of MR, it is seen as an *internal model* of external reality which stays in a representing relation to the latter and describes it (Godfrey-Smith 2004; Ramsey 2007).

To summarize everything stated above, several necessary features can be singled out to account for MR:

1) the existence of a representing world

2) the existence of a represented world

3) representing relations

These three minimal conditions for a mental entity to be considered a mental representation are systematically described by Hubbard (2007), who claims that the notion of MR implies two separate but functionally related domains or worlds. An MR is thus an entity of the representing world, which stands for some aspect of the represented world in some corresponding relation. According to Hubbard (2007: 38), 1, 2, and 3 comprise a

representational system. Along these lines, Markman (2012) suggested four main conditions that should hold in order for a mental entity to qualify as a representation, adding a fourth:

4) a set of processes that use the information in the MR for some function

Markman defines these processes as acting upon the representing world. These are procedures that manipulate and use the information hidden in the representation. A similar idea was expressed by Gallistel (2001), who sorts out the fourth element as 'decision processes' that act upon the mental representation within the representing domain. However, the necessity of this condition for MR remains an open issue.

In sum, four major conditions for a mental entity to be considered an MR can be singled out: represented world, representing world, representing relations, and cognitive processes. Taking all this into account, the nature of MR can be schematized in the following way:

Representing world   **Represented world**

Representation of a flower

Representing relations

Real flower

Similarity, Correspondence, Reference, etc.

Procedures for manipulation with representation
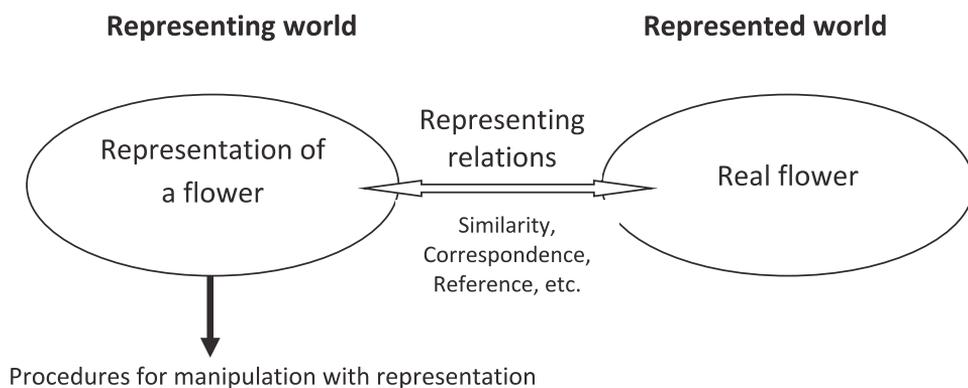
Figure 1: Mental Representation

2. The theory of mental representation

The nature and function of the elements of the representational system comprise the *theory of mental representation*. The previous definition of MR focuses on the existence of two distinct worlds – mental/internal and physical/external. It seems commonsensical that the two domains are different by their nature, properties, and characteristics. Philosophers and scientists tend to assume this duality. Bechtel emphasizes the separation "which has been prevalent in both experimental research and in cognitive psychology and modelling work in AI, between mind/brain and the world" (Bechtel 1998: 295). He calls cognitive systems that

sustain the *distinction between the two worlds* 'coupled systems' (ibid.). In a similar vein, Godfrey-Smith speaks about two distinct domains or systems – the real world and representation – where the latter constitutes an internal model of the former (Godfrey-Smith 2006: 733).

Despite the fact that the two worlds are different, they are inter-connected. This relation is a representing relation that holds between the two worlds and enables the inter-translation from one system to the other. Most theories of MR agree upon some level of inter-translation between the represented and representing domains. For example, while Bechtel (1998) recognizes that there are the two distinct domains of the physical and the mental, he emphasizes that "one of the functions of representations is *to stand in* for things outside the system" (Bechtel 1998: 297, emphasis added). This relation of "standing in" or representing (whatever type this relation is) is yet another feature entailed in the general definition of MR. The latter highlights the *dyadic*[1] character of the *relations* between the representing world and the represented world. These representing relations thus enable the transfer of semantic content to the subject, i.e. they enable the cognitive understanding of external reality.

Finally, there are mental procedures in the human mind that further manipulate MR. Condition 4 yields that the semantic content of MR is fundamental to higher-order cognitive abilities. Representations are the blocks of human cognition, later used by the human mind to solve cognitive tasks and to adapt behavior. This is another important consequence resulting from the above-given definition.

In general, various theories of MR aim to explain the nature of representation. Most of them share the general definition of MR given above. For example, causal-covariational theories state that an MR represents some external object or property due to a law-like causal connection (Kriegel 2013: 6). A similar line of thought is developed by Fodor's asymmetric dependency theory (Fodor 1987, 1990). Tracking theories of MR all share the idea that an MR correlates to its external object and carries information about it, though the correlation need not be a causal one (Mendelovici 2012). Yet another approach to mental representation – the functional role theory – claims that an MR represents its object by virtue of the functional

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[1] I call the representing relation between the physical and mental worlds *dyadic*, because this relation holds between *two* distinct domains. A dyadic relation is thus the type of relationship that holds between two entities.

role of MR in the mind, 'mirroring' or corresponding to the role of the external object (Field 1978; Loar 1981).

Despite how varied accounts of MR are, they all share the basic definition, namely that an MR is a mental entity that transfers some information about the physical world through the dyadic representational relation that holds between two distinct worlds. This broad account of MR (henceforth, the 'two-world' account) corresponds to common-sense accounts about how humans understand external reality, but it may not be correct.

3. On the nature of mental images

The main question of this article is whether the theory of MR as described above can give an adequate and full-fledged explanation of MI. In opposition to the dominant opinion that traditional theories of MR can adequately explain MI, I argue that there are serious reasons to doubt this view. In particular, I claim that the above-mentioned 'two-world' account of MR does not succeed in delivering an accurate and exhaustive explanation of the mental imagery phenomenon for the following reasons: **a)** mental imagery has a different cognitive architecture; **b)** relations between elements of MI are dynamic; **c)** MI is a context-dependent phenomenon.

3.1. On the cognitive architecture of mental images

First, there are reasons to assume that MI has a cognitive architecture[2] that differs from the dyadic structure of MR. How to define a mental image? Traditionally, a mental image is seen as an MR of some format, such as (quasi-)pictorial or propositional. This understanding of the nature of MI follows from the Mental Imagery Debate and the underlying computational paradigm (Kosslyn 1980, 1994; Pylyshyn 2002, 2004).

However, recent research on the nature and function of MI shows results that fall beyond the scope of the standard representational interpretation of MI. There are significant difficulties in assigning one particular format to MI. Most empirical results can be interpreted in several ways (for a detailed discussion of explanations of the experimental results, see Pylyshyn

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[2] I use the term 'cognitive architecture' following Z. Pylyshyn (2002) to signify the underlying structure of MI, that is "properties and mechanisms [that] are *intrinsic* to, or *constitutive* of having and using mental images…" (Pylyshyn 2002: 159, original emphasis).

2002). Both pictorial and propositional theories can equally explain the empirical outcomes of experiments on MI (Anderson 1978; Ganis 2013). Replicated experiments on MI suggest different results (Slezak 1990, 1991). Furthermore, it turns out that in similar experimental settings, images can exhibit various types of properties. Thus, empirical evidence is ambiguous and does not support the idea of one dominant format of MI to explain its cognitive architecture.

Next, it is often assumed that MI is a representation (usually pictorial), since it shares similar (if not the same) neuro-pathways with visual perception (Kosslyn 1980, 1994; Slotnick et al. 2005, Ganis 2013). However, recently cognitive scientists have found dissociations between brain activities in imagery and perception (Bartolomeo 2002, 2008; Dulin et al. 2008; Moro et al. 2008). Yet another set of experimental data proves the existence of motor, tactile, and auditory properties of MI that apparently cannot be accommodated neither by (quasi-)pictorial nor by propositional accounts (Lacey and Lawson 2013; Keller 2012). All this leads to the conclusion that both dominant representational accounts are inconsistent with recent empirical results and significantly limit our understanding of the nature and functioning of MI. As a result, there are obstacles in interpreting MI as MR in general.

So, if we assume that MI is not MR as traditionally understood, then what it is? A novel alternative approach[3] to MI is to account for images in terms of *signs*. According to this view, *MI is as a complex sign system*, which consists of various types of signs, their properties, and relations between them (Issajeva 2015a, 2015b). Along these lines, a particular mental image can be of both depictive and descriptive format or contain both pictorial (iconic) and propositional (symbolic) elements as parts of the complex sign. Moreover, in this case an image might contain not just pictorial or propositional properties, but also all sorts of other properties – auditory, tactile, motor properties, etc. The sign-theoretic account of MI states that various properties of signs can be combined, detached from each other, associated and manipulated by the imagining mind in various ways depending on the cognitive task the

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[3] Another alternative and non-representational approach to MI is the enactivist or sensorimotor theory (O'Regan and Nöe 2001; Thompson 2008; Thomas 2009, 2014). According to enactivism, imagery is a mental capacity of an active cognitive search of information in the absence of actual perceptual stimulus (Thomas 2009: 454–455). Although some empirical research (e.g. Bartolomeo 2007; Dulin et al. 2008; Moro et al. 2008) seems to support the enactivist theory, it still encounters serious problems (e.g. vagueness of the explanation of MI functioning) and thus remains unpopular among cognitivists.

produced image is intended to solve (Merrell 2001). Thus, the sign-theoretic approach to MI is a promising account that could give an adequate explanation of the functioning of images in various settings. Importantly, it could potentially consolidate divergent data on the matter.

What reasons are there to treat MI as a sign system? First, MI has the same characteristics and functions as a sign in the human mind. Just as a sign is defined as "something which stands to somebody for something in some respect or capacity" (Peirce 1994: CP 2.228), MI can be characterized along the lines of this definition (Issajeva 2015a: 102–103; Issajeva 2015b: 589–590). Further, just as a sign is composed of three main elements: representamen, object, interpretant (ibid.; Peirce 1998: 478), MI shares the same structure. Every image has a representamen – an element that stands for some object or event. It has an object, which it signifies, and an interpretant or the meaning that holds between the representamen and its object (regarding the justification of using the sign-theoretic approach to explain MI, see Issajeva 2015a, 2015b). So, it appears that images can be legitimately interpreted in terms of signs.

According to the sign-theoretic approach, MI is based on multi-leveled relations between the three elements and between MI's elements and the subject that produces an image. The set of elements and relations constitutes an interconnected network or a system, which is guided by general rules of semiosis, i.e. by the signifying process. Thus, to say that MI is a sign system means to adhere to the view that MI is of a signifying nature, just like a sign, it is structured by the three main elements – the representamen, object, and interpretant – and is characterized by the semiotic relations that exist between its elements and the subject. Schematically, the structure of a mental image can be depicted as follows:
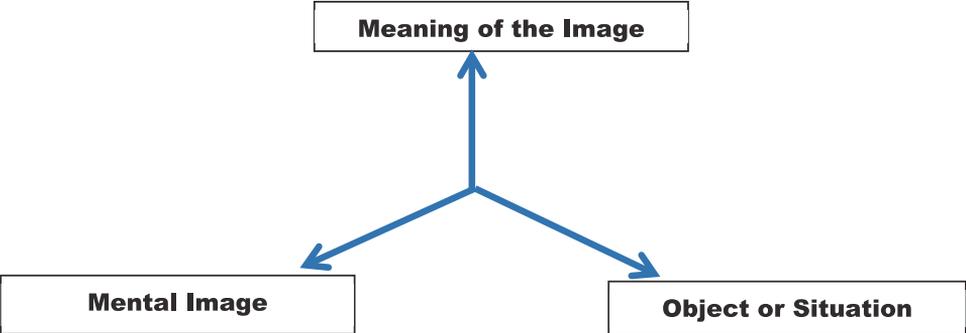
Figure 2: Structure of an image

The above-given considerations show that the difference between the 'two-world' account of MR and the sign-theoretic account of MI is fundamental. If the 'two-world' account explains MR (hence MI, too) through the existence of two different worlds and the dyadic relations between them, then the sign-theoretic account characterizes MI as consisting of three main elements (within one world) and the triadic relations between them. The sign-theoretic account denies the very dichotomy of the two separate worlds (Deledalle 2001: 41). There are no two different worlds which are dyadically connected to each other, rather there is one world – the world of signs, where the mind cognizes, interprets, and imagines (Peirce 1994: CP 5.448; Deledalle 2001). Signs can be of various types and have various characteristics, they can change with time and acquire new connotations, new signs can be produced, and the function of the old signs can change, but they still belong to the one world of signs.

According to this view, the nature of the imagery system is thus not merely to represent (in a dyadic way) some random aspect of the external world. Rather the nature of mental imagery is to signify (Issajeva 2015a, 2015b). The process of signification is different from the representing process as it is commonly understood. The latter consists mainly of inter-translation between two coding systems (two separate worlds), whereas signification is rather the process of the emergence, transformation, and comprehension of meaningful information inside one system in different ways depending on many influencing factors, such as type of information, context where the information is given, individual abilities, etc. (Atkin 2013; Deledalle 2013). Hence, the signification process is richer in details, more complex, and more dynamic compared to that of representation. Signification includes more than the conventional relations and syntactic rules that operate in representation to establish the inter-translation between the two worlds. It includes many transitory, changeable elements that considerably influence the signification of information.

In sum, there are important reasons for questioning the commonly held view that MI is a kind of MR and that the traditional 'two-world' account of MR can suggest a plausible and adequate explanation of the MI phenomenon. Among them is that 1) empirical evidence on MI is ambiguous, implies multiple and contradictory interpretations and does not support the idea of one dominant format of MI; 2) data on whether MI shares the same neuro-mechanisms with perceptual MR is also divergent and suggests that neuronally they constitute different brain structures; 3) most recent empirical research proves the existence

of various properties of MI – auditory, tactile, sensorimotor, etc. – that cannot be accommodated by the 'two-world' representational account. All this yields to the conclusion that apparently MI does not share the dyadic representational structure and thus cannot be adequately explained by the standard 'two-world' account of MR. Rather, MI has a different cognitive architecture. One of the promising explanations of the ambiguous and continuously changing evidence of MI can be given, in my opinion, by the sign-theoretic account. Under closer investigation, it appears that images are better characterized in terms of signs, sign elements, and dynamic relations between them. The comprehensive theory of signs, introduced by Peirce, can potentially give a full-scale explanation of the MI phenomenon.

3.2. Dynamic relations between the elements of MI

It was argued above that the traditional 'two-world' account of MR can hardly give a proper explanation of the nature and cognitive architecture of the MI phenomenon. The same goes for the explanation of the functions of MI and the relations between its elements. There are some substantial reasons to assume that the relations between the elements of MI are different compared to those of the 'two-world' account of MR. First, the *relations in a sign system are triadic*, i.e. they exist between the three elements of the system. In comparison, relations in the traditional account of MR are dyadic and exist between two worlds. This means that the 'two-world' account and the sign-theoretic account are fundamentally different with respect to the relations that they postulate. The triadic relational character of sign theory cannot be reduced to the dualistic one of the 'two-world' account. Atkin (2013) explains the importance of triadicity in sign theory: "signification is not a simple dyadic relationship between sign and object: a sign signifies only in being interpreted" (Atkin 2013: 2). Moreover, the three elements of the sign (the representamen, object, and interpretant) are indecomposable, as they constitute one whole and should be comprehended and examined as such (Deledalle 2001: 18). Hence, the MR theory that analyzes dyadic relations can hardly explain the triadic relations of MI. The traditional 'two-world' account of MR applied to explain MI will necessarily neglect one of the elements and relational connections of the cognitive structure of an image and suggest an oversimplified, restricted explanation of its relations. This oversimplification can actually be seen in the traditional attempts to explain MI representationally, which resulted in the long-standing controversies of the Imagery Debate.

Further, according to the sign-theoretic account, relations between the elements of the sign are *reciprocal and dynamic*. Here, the reciprocity of relations means that changes in one of the elements influence the characteristics of the others. If this may well be a feature of MR too, then the dynamics of relations can hardly be ascribed to the standard account of MR. Here, the dynamics of the relations means the constant evolution and development of the relations between sign elements. It means that the way in which the three main elements of a sign are connected, as well as the characteristics of these connections, are not stable or fixed, rather they continuously change under the influence of various factors (e.g. subjective memory, new experience, personal dispositions, changes in language and objects' features) (Deledalle 2001). Since, according to sign theory, there is only one system – the world of signs – then the relations and characteristics of MI are open to various influences inside this system. This makes MI less stable, more open, and thus vulnerable to immediate changes of every sort. As Merrell puts it: "signs simply cannot stand still" (Merrell 2001: 37). It is this dynamic and flexibility of the triadic relations of the sign system that allows it to accommodate the divergent properties of images under the umbrella of one sign-theoretic account.

In comparison, the 'two-world' account restricts the dynamics of the representing relations between the worlds. The existence of the two separate worlds of MR also presupposes the existence of the two sets of rules that govern each of the worlds and a system of relations that makes the connection between these worlds possible (see Fig. 1). This understanding of MR implies that each of the worlds (external and internal) constitutes a relatively independent and self-organized system with different characteristics (Godfrey-Smith 2006; Rowlands 2012). The dyadic relations of MR, hence, 'inter-translate' the properties of one world into the properties of the other. Thus, the relations of MR are restricted to the two worlds and their structures and cannot be easily changed or transformed, otherwise the whole system of 'inter-translation' would be ruined. This makes the dyadic relations in the 'two-world' account of MR quite stable and static, guaranteeing that the inter-translation will go on and the whole system of representing the object of the external world in the internal world will function (Bechtel 1998: 314; Knuuttila 2005: 31). But, it is precisely this structure of MR that makes any change of the relations if not totally impossible, then extremely hard to establish.

So, the 'two-world' account of MR implies more stable and closed, dyadic relations that are governed by two sets of rules of both worlds and the 'inter-translation' between them. In contrast, the sign-theoretic account presupposes a more open and dynamic system of continuously evolving relations between three sign elements within one world. The latter seems to provide a better explanation and analysis of the relations and functions of a mental image. Our imaginary experience shows that MI is always changeable, and it actually develops new characteristics and connotations along with human experience and memory. For example, an image of 'Africa' might (and actually will) change from the simple picture on a map to something more, if the subject who produced the image actually visits this continent. New feelings, new experience, and new understanding change the relations inside the image of 'Africa' and, in fact, change the image itself. The sign-theoretic account is flexible enough to account for all the diversity of these possible changes, whereas the 'two-world' account could hardly do so. Consequently, a representational explanation of MI's relations would necessarily neglect characteristics important and specific to the nature of MI, such as dynamics, trying to explain triadic dynamic relations by using a dyadic stable structure.

3.3. Context-dependence of MI

The sign-theoretic approach described above further implies the *context-dependence of MI* compared to the traditional representational account. The stability and closeness of the 'two-world' representational system points to the relative context-independence of MR. Each of the worlds of MR operates with its (separate) set of rules, and the inter-translation between the two worlds is also more or less stably fixed, regardless of the possible changes in the context. This makes MR, according to this view, relatively invulnerable to any influences that come outside of the established 'worlds' and the inter-translation relation between them. Hence, the 'two-world' account aims at objectivizing the process of representing, i.e. to interpret it as being universal to all human beings (Godfrey-Smith 2004; Churchland and Sejnowski 2006). Following this view, the mental representation of an object is comprised of the universally given physical world and the mental cognitive world, which works, according to the brain's neuro-structure, identically in all human beings. This allows the inter-translation between the 'two worlds' to go on irrespective of any possible changes in context, personal attitudes, and the environment where the process of mental representing takes place.

In contrast, the sign-theoretic account interprets MI as an open and dynamic system. This entails, contrary to the representational approach, the context-dependence of MI. Changes in the environment significantly influence both the relations and characteristics of the MI elements. Circumstances in which the image – as a sign system – is formed seem to influence the characteristics of the produced image. Consequently, the signification of an object may depend on the properties of the particular object, on the task that the image is intended to solve, on knowledge regarding the object, on the environment in which the object appears, and even on the personal dispositions of the cognizing subject, etc. Thus, the final image is influenced by all the factors mentioned above. As Peirce himself puts it, "all the circumstances of the case have to be considered" when the characteristics of a sign are analyzed (Peirce 1994: CP 2.265). To illustrate this point, the image of an 'apple' growing in someone's backyard may be completely different from the image of 'Apple', the famous computer brand. Thus, the context in which the object 'apple' appears, any previous knowledge and experience regarding this object influence the signification process and, hence, the final image of that object. The theory of signs seems to better accommodate the explanation of the changes in the environment of an image.

Furthermore, the sign-theoretic approach also explains the influence of *individual differences* and cognitive dispositions on the production of MI. Indeed, human cognitive capacities and mental abilities are different. Some people have an extreme talent for visualization, others are prone to auditory rehearsal. Some people are more emotional and tend to imagine emotionally rich details, others are more rational and tend to imagine things in a logical, algorithmical order. These differences are inevitably reflected in human mental states. For example, the strong influence of professional and personal abilities on the production of MI is clearly seen in recent research on athletes and musicians (Keller 2012; Buck et al. 2016). So, the production and usage of MI is strongly influenced by the subject who produces and interprets the image, as well as by the changes in individual cognitive capacities and states. The standard 'two-world' account can hardly accommodate these individual differences, since it aims at giving universal explanations across various subjects and their personal dispositions. To compare, sign theory presupposes that an interpreter, a user of the sign, is an essential part of the signification process. And therefore, the sign-theoretic account can explain the individual cognitive differences in the production and manipulation of MI.

In sum, the context-dependence of MI seems to be important for an exhaustive understanding of how the imagery system works. Features of MI seem to be dependent on the context, knowledge about the world, experience, personal memories, and cognitive abilities of the cognizing subject. Thus, context matters. It influences the whole process of signification. The 'two-world' account of MR fails to give a comprehensive explanation of the context variations and individual differences. The tendency to objectivize mental imagery stops it from including the individual differences and context variations that significantly change the mental image that is produced.

4. An alternative theory of MR?

So far, we have seen that the standard 'two-world' account of MR fails to put forward an exhaustive explanation of MI. But the question then arises, can there be an alternative theory of MR that would adequately explain MI?

Indeed, the problems and limitations of the 'two-world' account of MR have been recognized by many philosophers and psychologists (Millikan 1984; von Eckardt 1993; Bechtel 1998; O'Brien and Opie 2004, etc.). Knuuttila (2005; 2011) states that the traditional 'two-place' approach to MR is limiting and unfruitful (Knuuttila 2011: 262–263). Bechtel similarly sees one of the main problems of the traditional account in the "separation […] between mind/brain and the world" and seeks ways of fundamentally integrating the internal and external (Bechtel 1998: 295). Apparently, to some degree, it has been admitted that such features of the traditional 'two-world account' of MR as the separation into two worlds, the stability and closeness of the dyadic relations, context-independence, and the inability to account for individual differences are problematic.

However, the strategies by which these difficulties have been confronted differ from theory to theory. One of the alternative accounts is the Dynamical Systems Theory (DST) introduced by Tim van Gelder and colleagues (Van Gelder 1995; Van Gelder and Port 1995; Bechtel 1998). DST attempts to overcome the separation between mind/brain and the world and make the representing system more dynamic: "representations have often been static, and one of the salutary contributions of DST is to focus attention on changing processes within a system" (Bechtel 1998: 314). Interestingly, to dynamize and subjectivize the relations in MR, Bechtel

includes a third element into the standard 'two-world' account of MR, namely the user of the representation (Bechtel 1998: 299).

A similar idea was expressed in teleosemantic theory. According to Millikan (1984, 1993), a mental state represents something in virtue of a correspondence with external conditions that confer the right kind of adaptive advantage on the subject. Representation has an evolutionarily developed function of carrying information to the subject and can be only understood from the perspective of the user of an MR (Millikan 1984, 1993). While analyzing representations it should be noted that Millikan – a student of Charles Morris – uses the terms 'sign' and 'representation' (Millikan 1984: 85).

A pragmatist account of MR also introduces the subject (or the user of an MR) into the representational system. This approach follows up on the work of Peirce in order to interpret the nature and function of representation. Along these lines, Ambrosio (2009, 2014) suggests a pragmatic account of scientific representations. The focus of her analysis lies on the representative practices (Ambrosio 2014). A somewhat similar idea, but approached from the perspective of model-based representations, is expressed in the work of Knuuttila (2005, 2011), who adheres to the pragmatist approach (Knuuttila 2005: 36; Knuuttila 2011: 263), improving upon the ideas of Giere (2004), Suarez (2004), and Bailer-Jones (2003). According to Knuuttila, the 'two-world' account of MR, based on dyadic relations, is fundamentally problematic and restrictive and does not allow for users, their representing practices, and individual differences in interpretation (Knuuttila 2005, 2011).

An interesting aside to the pragmatic approach comes from von Eckardt (1993), who applies the triadic structure of the sign to the analysis of representations. Von Eckardt claims that representation is composed of three main elements: the representation bearer, the represented object, and the interpretant, as well as the triadic relation between them (von Eckardt 1993: 145–149). According to von Eckardt, MR functions in such a way that a representational vehicle (a bearer) produces a cognitive effect in a subject (interpretant), so that the subject is entered into some relationship with the vehicle's object (represented object). Following von Eckardt's sign-theoretic interpretation of MR, O'Brien and Opie (2004) developed a structuralist theory of MR, which aims at providing a naturalized explanation of MR. Notably, they transform the triadic relation of MR into two binary relations, one between

the vehicle and object and another between the vehicle and interpretant, and explain the interpretant in terms of the behavioral dispositions of a subject towards the represented object (O'Brien and Opie 2004: 3–4).

In summary, alternative ways of overcoming the theoretical problems produced by the traditional 'two-world' account of MR come from the Dynamic Systems Theory, Teleosemantics, and the Pragmatic approach. These alternative interpretations of MR make us consider the origins of those alternatives, which is Peirce's theory of signs. The inclusion of the user or interpreter in the representational system, the avoidance of the separation of the internal world from the external, and the tendency towards dynamic relations – all these are fundamental features of Peirce's theory. So, can his sign-theoretic approach be satisfactorily applied to explain MR? Further investigation is needed to answer this question. However, a brief and preliminary analysis, suggested above, shows that the sign-theoretic account is a potential novel view on mental representations. Once the notion of MR is approached from the perspective of sign theory, MR and MI could be theoretically accounted for in similar terms.

Additionally, sign theory might solve the standard problems of the 'two-world' account, such as the separation between mind/brain and physical reality, closed and static dyadic relations, the inability to account for the user's interpretation of MR and its individual differences, and so on. And if so, then perhaps the sign-theoretic perspective on MR could overcome the long-standing 'crisis' of mental representation (Knuuttila 2005: 12), integrate the allegedly separate worlds of mind and physical reality (Bechtel 1998: 297), and develop a "completely different approach to mental representation" (O'Brien and Opie 2004: 3).

Conclusion

So, where does the previous discussion leave us? The aim of this paper was to challenge the apparently unproblematic view that the traditional theory of MR could give an adequate and exhaustive explanation of MI. Taking previous considerations into account, we argued that the standard representational approach fails to adequately explain MI. Upon closer inspection, it seems that the dominant account of MR constrains the understanding of the nature of MI and neglects important characteristics of the way it functions. Contrary to the

'two-world' account of MR, evidence leads us to assume that a) MI has a cognitive architecture different from MR, that b) the relations that hold between the elements of MI are dynamic, and that c) the relations between elements of MI are context-dependent. This conclusion is corroborated by recent empirical results on the matter (Slezak 1991; Bartolomeo 2002, 2008; Dulin et al. 2008; Moro et al. 2008; Lacey and Lawson 2013). Hence, there are good reasons to claim that the traditional representational approach cannot adequately explain MI.

A better explanation of the cognitive architecture and relations of MI may be suggested by the theory of signs as elaborated by Peirce. The sign-theoretic account gives a broader framework for understanding the nature and function of mental images. In particular, it analyzes MI as a whole with a variety of specific interrelations, acknowledges subjects' individual cognitive differences, and interprets mental images inside a particular context. Sign theory, thus, seems a promising alternative way to understand the inner mechanisms of the cognitive structure of MI and accommodate divergent data in the field.

The question then arises whether the sign-theoretic approach can potentially explain MR as well. Although more detailed research is needed, our preliminary analysis has shown that the theory of signs can suggest an alternative perspective towards the explanation of MR and representational practices (Ambrosio 2009, 2014). It can help to overcome the widely recognized problems of the standard 'two-world' account of MR, such as the separation of the mind/brain and reality, stability and relative independence of the representational system, the exclusion of the user, and subjective interpretation of the analysis of MR, etc. (Von Eckardt 1993; Bechtel 1998; Knuuttila 2005, 2011, O'Brien and Opie 2004).

To conclude, our discussion has challenged the idea that the traditional 'two-world' account of MR can adequately explain MI. The way how MR is commonly understood can hardly explain MI. However, this does not mean that significant similarities between MR and MI could not be established, once MR is conceived differently. Indeed, if representation is analyzed within the framework of sign theory, different theoretical conclusions might follow.

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Sign theory at work:
The mental imagery debate revisited

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Abstract. This article attempts to give a plausible explanation to the long-debated question about the nature of mental imagery (MI). The traditional approach to this question is based on the representational paradigm, which, I claim, is misguided. Instead of representational aspects of mental imagery, I emphasize the *functions* of mental imagery, the *variety of properties* that images exhibit in experimental studies, and the *relations* between different characteristics of images, their functions and the subject of imagery. That is, I propose to account for mental imagery as a *sign system*, consisting of different types of signs. A mental image can contain important properties as parts of the complex sign. This approach to the explanation of the nature of MI is beneficial, since it suggests the phenomenon of mental imagery, which overcomes some long-standing controversies on the issue.

Keywords: mental imagery, internal representations, imagery debate, sign theory, Charles Peirce, semiotics, sign relations, classification of signs, cognition

Introduction

What is a mental image? This question remains one of the most debated ones in cognitive psychology, cognitive sciences and the philosophy of the mind. On the one hand, it seems quite evident that a mental image looks like something, i.e. it is a mental *picture*. We seem to exploit picture-like representations while imagining, remembering or dreaming about something. In this vein, Stephen Kosslyn, for example, has experimentally shown that mental imagery (MI) indeed has certain spatial and picture-like properties that can legitimately be treated as pictures in the mind's eye (Kosslyn 1980, 1988, 1994; Kosslyn *et al.* 2006). On the other hand, however, we are also forced to admit that mental images take propositional forms analogous to languages (Pylyshyn 1973, 2002, 2003, 2006). Still, as the empirical research results in ambiguous conclusions, the problem

of the nature of MI remains – what is mental imagery really like? Is it a picture in the brain, some propositional or verbal string of language-like characteristics or symbols, or something else yet?

In this article I am going to argue for that third (and promising) way to analyse mental imagery: namely to treat it as a *system of signs*. This paper starts with a brief discussion of the underlying assumptions of that approach, setting out the context for the problem of MI. Then in Section 2 I proceed with the explanation for why mental imagery is viewed as a sign system. In particular, Section 2.1 explains why a mental image can be viewed as a sign, supported by theoretical considerations. Finally, in Section 2.2 I argue that sign theory, applied to the analysis of mental images, suggests a viable interpretation of the MI phenomenon. In particular, I consider an example of an ordinary daydream in terms of a theory of signs. The analysis is intended to show that the MI phenomenon is better accounted for in terms of signs than in terms of pictures or language. My interpretation of mental images suggests an explanation of the MI phenomenon that overcomes controversies characterizing the field while avoiding typical problems concerning representational theories about MI.

1. The theoretical assumptions

The question about the nature of MI is typically based on the *search for particular* (or dominant) *formats* of mental representation, plus the manner in which this representation is formed and further operated on. From such a perspective, two main answers to the question of what MI is can be given: either MI is a picture-like representation or a language-like representation. It is no surprise that these two theses, both influential in the research of MI, are somewhat contrary to each other. It is these two postulates that underlie most empirical research on the MI phenomenon, either explicitly (as in Kosslyn *et al.* 2003 or Pylyshyn 2002) or implicitly (as in music studies, sport studies etc.). It is this irreducible controversy between the two theses that makes the MI Debate[1] seem almost insoluble.

But what if the question about the ultimate format of mental images or internal representations is, in itself, ambiguous? Are the two formats necessarily mutually exclusive? Indeed, it seems that we do possess both kinds of mental entities – pictorial/ analogue and propositional/verbal. Why should there be only one kind of MI? Recent

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[1]   By the Mental Imagery Debate, also called the analogue-propositional debate, I mean the ongoing dispute concerning the representational format of MI. The analogue, or quasi-pictorial, theory holds that images are ultimately picture-like, with intrinsically spatial representational properties. The propositional account, on the contrary, interprets mental images to be similar to linguistic descriptions.

experimental results also support the conclusion that mental imagery (in a number of experimental settings) can exhibit both types of properties, verbal and pictorial (see, e.g., Bartolomeo 2002, 2008). How to interpret such findings? The understanding of MI should not, it seems, be restricted to the plain dichotomy of verbal vs. pictorial. There is a significant amount of empirical data clearly showing the existence of motor, tactile and auditory properties of mental imagery (Keller 2012; Pascual-Leone *et al.* 1995; Richardson 1995).[2] No doubt much of the latter cannot be analysed and explained in verbal vs. pictorial terms. The discussions concerning the ultimate format of mental images fail to explain why experimental evidence on MI is so ambivalent.

The assumptions underlying what constitutes the MI phenomenon are, I believe, misguided. Instead of the format of mental imagery, one ought to look at the *functions* of mental imagery, the *variety of properties* that images exhibit in experiments, the *relations* between different characteristics of images and their functions, and the subject who employs the MI.

To investigate MI only from the perspective of its format is to narrow down and limit the scope of the research. The information that scientists get from controlled experiments given the format assumption suggests only partial explanations to MI. This actually happens when one attempts to explain new empirical evidence. The experiments directed at investigating a particular format of MI inevitably neglect other features, properties, possible explanations and *intrinsic relations* that might be essential parts of the mental phenomenon. That is, experiments tend to neglect other perspectives on understanding MI. However, if we place the experimental results concerning MI into the broader *context of properties and relations* in which particular images were formed and used, we might get more information regarding its nature.

In other words, the analysis of MI that ceases to be driven by the constraints of the representational, or the computational, paradigms[3] opens up new possibilities. How does MI appear to us? That is, exactly *how* do we experience mental imagery? When employing imagery in daily life, one notices that mental representations can have a variety of divergent properties: they can have colours, textures, shapes, sizes and so on. Or else they abstract from such properties and become something like general and more or less indefinite *ideas*.

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[2]   See also Plessinger, Anne 2007. The effects of mental imagery on athletic performance. At: http://healthpsych.psy.vanderbilt.edu/HealthPsych/mentalimagery.html.

[3]   Until recently, it was the computational paradigm that was the leading theory in cognitive sciences and widely acknowledged to underlie the representational accounts of MI (see, e.g., Kosslyn 1980; Fodor 1975; Glasgow, Papadias 1992, as well as Thomas, Nigel J. T. 2014. Mental imagery. In: Zalta, Edward N. (ed.), *The Stanford Encyclopedia of Philosophy* (Fall 2014 ed.), available at: http://plato.stanford.edu/archives/fall2014/entries/mental-imagery/). The main adherents of the pictorial-imagery theory explicitly expressed their commitment to the computational paradigm (Kosslyn 1980, 1994; Kosslyn *et al.* 2006).

How is it possible that we can have both detailed and abstract images, either at different times or even occurring in the same experienced MI phenomenon? For example, when someone dreams of some future event that has not happened yet, she from one perspective engages in an imaginary experience full of details of how the event could or would be. On the other hand, part of this complex and multidimensional process remains abstract and imprecise. For instance, she might mentally draw the connections between various parts of her dreams (say, how she would get at what she imagined or dreamed about) in those abstract terms. But she might employ a vivid and detailed picture-like image in which she imagines what the final goal of her dream looks like. To put it simply, she might experience some parts of her dream in words, yet other parts in pictures. Does it mean that her dream ceases to be imaginary, if it fails to fully fall within the scope of one of the two dominant formats?

One could say that an ordinary daydream[4] might just be the sum of the representations of either type. Yet if this were the case, one would encounter difficulties in explaining the variety of divergent properties engaged in a daydream from the perspective of a single format. And even if we for a moment leave aside the limitations of a dominant format account of MI, then how can the interconnections between different parts, characteristics and properties of the images be explained? Furthermore, how is the meaning of the daydream as a whole explained?

It seems that *a dream* is not just the mere sum of its constituent parts and their properties. It has something more, a meaning as a whole; it is something of its own. The sum total of random presentations is not yet a dream; it will not have the systematic structure and meaning required of one. In a similar vein, MI could be treated as a *complex system of signs and their properties,*[5] which can be combined and detached from one another, associated and manipulated voluntarily by our mind in various ways, and so on. Viewing MI as a sign system solves many problems.

It is worth noting that the interpretation of the image in terms of signs is compatible with the traditional representational accounts of MI, according to which MI is the

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[4]   By 'day-dream' I mean a voluntary conscious flow of images that are not based on the respective physical stimuli.

[5]   The definition of mental imagery as a "complex system of signs and their properties" needs some additional clarification. By 'system' I mean here a set of elements and relations that work together as a whole and constitute an interconnected network, which is guided by general rules of semiosis, i.e. by the signifying process. I call the system 'complex', because of the many-levelled and manifold relations and elements it includes. Firstly, this system of signs has several elements: representamen, object, interpretant and subject. Secondly, the system has several levels of relations: (1) between the relata; (2) in respect to each element of the sign; (3) in respect to the subject. For these reasons I call the sign system "complex". Finally, the 'property' is used here in a broader sense to denote various characteristics of signs, such as iconicity, indexicality and symbolicity.

internal representation of a particular format. In other words, both quasi-pictorial and propositional accounts focus only on one element of the sign, namely on the representamen[6] (or the sign vehicle) of the image, thus equating the very image with this one element. The centre of the analysis and investigation of the image shifts to the particular format of the representamen: does it have pictorial properties and constitute a picture in the mind, or does it have verbal properties and a propositional format? Such analysis necessarily restricts the investigation and understanding of the mental-imagery phenomenon, because (1) it takes the image out of the context of relations where it was formed and employed; and (2) it neglects the other two elements of the image – its object and meaning (which will be discussed later in more detail). We cannot truly understand the representamen without understanding the object it represents and the meaning that such representation conveys. A full-fledged understanding of the nature of an image is only possible when MI is viewed within the complex context of relations between the three relata. In this sense, an interpretation of MI in terms of sign systems broadens the understanding of mental imagery, accounted solely in terms of representation before.

Yet another difference between viewing mental imagery as a sign system in comparison with representation lies in the following: the representational account of MI sees an image as a *stable*, more or less *fixed* mental entity (be it a picture or a word) ready for retrieval and manipulation, whereas the understanding of MI as a sign goes beyond that. It views the mental image as a *dynamic*,[7] *continuous and changing* mental entity which can only be accounted for within the context of the relations and cognitive processes it is engaged in. This complex contextuality of MI means changing the nature and the dynamics in the usage of mental imagery to solve cognitive tasks.

2. Mental imagery as a sign system

In order to understand to what extent we can talk about mental images as mental signs, it is useful to begin with the brief explanation of *what a sign is and how it*

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[6] The fundamental difference between the representamen and representation, as considered with regard to mental imagery, is that the former is only one part of the triadic sign relation, whereas in the latter case, the image is identified only as a representation.

[7] The terms 'stable' and 'dynamic' are opposites. By the term 'stable' I mean a fixed, essentially unchangeable mental entity whose nature and properties remain the same despite changing the context or changing the way of its retrieval. By 'dynamic' I mean an open and changeable mental entity whose properties change when the context or the relations between its various parts are changed.

functions in the mind.[8] According to Peirce,[9] a sign is "something which stands to somebody for something in some respect or capacity. It addresses somebody, that is, creates in the mind of that person an equivalent sign, or perhaps a more developed sign. That sign which it creates I call the interpretant of the first sign. The sign stands for something, its object" (CP 2.228). This definition uncovers *two main aspects of a sign:* (1) Peirce defines a sign through its participation in a semiotic or signifying process (i.e. semiosis); (2) and he views a sign as consisting of *three relata* or three basic elements – a sign itself or *signifying vehicle* or *representamen* (as Peirce sometimes calls it), an *object* which the sign stands for and an *interpretant*[10] as the meaning of the relation between the signifying vehicle and its object. The sign, its structure and nature, is about the semiotic *relations* between its three elements.

2.1. Why can a mental image be a sign?

What is the rationale for treating mental imagery as a sign system? The main reason to account for mental imagery as a sign system and a mental image as a sign, respectively, is that *the mental image has a trichotomic structure, functions and properties that are similar to those of signs.*

Firstly, if we analyse the mental image outside of any particular premise or hypothesis, the very first characteristic that we will notice is the *intentionality*[11] of images. In short, an *image is* necessarily *about something*, or it is directed towards some object. It seems every image (of whatever kind) that the human mind produces is about

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[8]   The question of the signifying nature of mental imagery inevitably leads us to the question of the signifying nature of the mind in general. Peirce, for example, held that the mind indeed has a signifying nature, i.e. all our mental and cognitive capacities are by means of signs. However, the analysis and discussion of this more general claim is outside the scope of the present paper.

[9]   Many sign theories have been suggested (e.g. Saussure, Morris). I focus on Peirce's for the following reasons: (1) Compared to other accounts, Peirce's is the most developed, elaborate and flexible account of signs and semiosis, and it is compatible with pragmatism. (2) Its explanatory power is greater – it can be used for a full-fledged interpretation and thorough analysis of any sign. (3) His system is backed up by his thorough studies in history, logic and science. As a result he elaborated classifications of signs for the analysis of signs.

[10]   It is noteworthy that the interpretant, according to Peirce, has a dual nature – it is both a meaning and the sign itself (CP 2.228). So, the meaning of a sign also signifies something for a subject, i.e. it is a sign itself.

[11]   The term 'intentionality' is overloaded and ambiguous in cognitive sciences and philosophy. Leaving aside detailed discussions about the nature of intentionality or whether it can legitimately be ascribed to mental states, I will use this term to denote the "aboutness" of mental states, i.e. a mental state as being about something or standing for some object. Thus, I take it as an implicit premise that mental states are intentional in the sense stated above.

something or stands for something. Thus, just as signs, mental images have *objects* that those images represent. The object of a mental image need not be previously experienced but currently absent. The image can concern situations, properties, experiences, states or feelings. Images can be detached from external reality in the sense of representing, say, non-physical objects of fiction. But in any case a mental image "stands for something" (CP 2.228), i.e. it represents[12] an object.

Second, an image also has something that enables it to represent its object. In other words, an image should have some sort of a *ground element* or, in Morris's terms, a *sign vehicle*. The ground of the sign is the element that represents or stands for its object in some meaning. Peirce says that "a sign stands for [its] object, not in all respects, but in reference to some sort of idea, which I have sometimes called the *ground* of the [sign]" (CP 2.228). He also calls this element a *representamen*, since this part of the sign represents (in the broadest possible sense) its object in some meaningful relation. Since an image necessarily stands for some object, it follows that the image should *necessarily* have this ground element which would represent its object. In this respect, an image is a sign.

Finally, the relation of *representation* between sign vehicles and objects of an image should be *meaningful* to the subject of the image. Hence, as a sign, a mental image has an *interpretant*. An image stands for some object in "some respect or capacity" (CP 2.228). Clearly mental images have content. They convey some meaning from a single property to complex networks of signification. When voluntarily using imagery, we tend to interpret our mental images as meaning something. Furthermore, it appears that even our largely involuntary images – dreams – during sleep can be interpreted after they have occurred. In this sense every mental image has a meaning, produced as a result of (co)relation with its object and interpreted by the subject.

To summarize, a mental image necessarily stands for some *object*. It also has the ground element or *representamen* that enables the representation of this object. And as a result of the correlation between representamen and object, the *meaning* or *interpretant* of an image is produced. So, a *mental image has the same structure* as the sign *and* the (general) *definition* of the sign and thus can legitimately be interpreted as a sign. Just as a sign, a mental image consists of the three basic elements – representamen, object and meaning. Hence, just as a sign a mental image can be defined as "something which stands to somebody for something in some respect or capacity", an image is formed and should be interpreted in the context of the signifying (or semiotic) process

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[12]   It is in this sense that mental imagery is usually associated with the term "mental re-presentation". In brief, any representation has *an object which it represents*. By contrast, the two dominant accounts on MI agree about the existence of some sort of representation in the mind (i.e. they share the representational paradigm as a premise); what they disagree about is exactly how these representations represent their objects, i.e. which format of representation is used to represent an object.

and inside the network of sign relations. Based on these, the basic structure of a mental image is schematically depicted in Fig. 1.

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                    ┌─────────────────────────┐
                    │   Meaning of an image   │
                    └─────────────────────────┘
                         ↑
                    ↙         ↘
┌──────────────────────┐      ┌────────────────────────┐
│    Mental image      │      │   Object or situation  │
└──────────────────────┘      └────────────────────────┘
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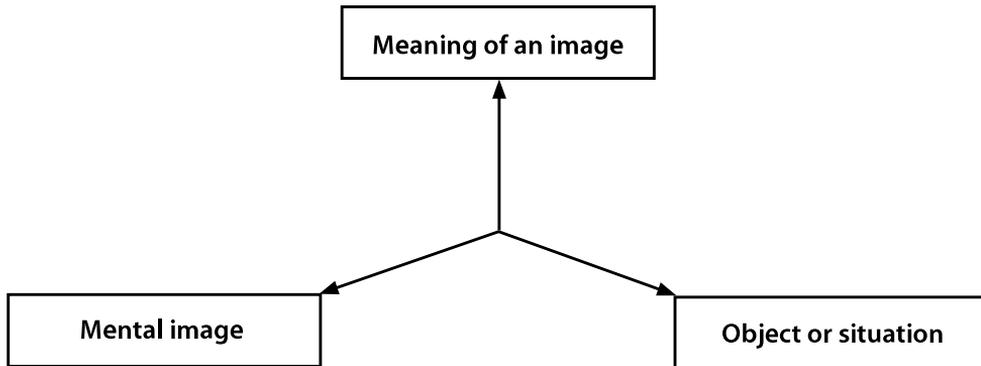
Figure 1. Structure of an image.

A characterization of mental imagery as a sign system has far-reaching consequences. This approach can, I believe, accommodate various properties of mental images into one coherent explanatory theory. It can reconcile divergent views and contesting empirical evidence and even provide further understanding of cognitive mechanisms of MI in the human mind. So far I have described the sign theory in general terms, but a closer examination is to view mental imagery as a sign system.

1.2. Analysis of mental imagery in terms of signs: An example

Peirce's sign theory amounts to a system of various classes of signs, the development of which was never fully completed though it occupied much of this time. As a result, comprehensive *classifications of signs* were produced. The general structure of the sign consists of three basic elements. According to Peirce, if we analyse each of the elements and the features they might have, we can get *ten different classes of signs*: "signs are divisible by three trichotomies; first, according as the sign in itself is a mere quality, is an actual existent, or is a general law; secondly, according as the relation of the sign to its object consists in the sign's having some character in itself, or in some existential relation to that object, or in its relation to an interpretant; thirdly, according as its Interpretant represents it as a sign of possibility or a sign of fact or as a sign of reason" (CP 2.243). Each of the three sign elements – sign (vehicle), object and interpretant – are divided into three sub-types. Peirce calls the first of the three trichotomic divisions

qualisigns, sinsigns and *legisigns* (CP 2.244), the second *icons, indexes* and *symbols* (CP 2.247) and the third *rhemes, dicisigns* and *delomes* (CP 2.250). Together, the relationships between these three trichotomies give rise to the 10 classes[13] of signs.

Once applied to analyse MI, this detailed account of sign theory and the ten classes of signs suggest a subtle and full-fledged explanation of the mental-imagery phenomenon. I propose to test the hypothesis. Consider the following example of the usage of mental imagery in ordinary daydreaming:

Imagine yourself experiencing the scent of a rose in the garden. You go out the back door of your house to enter the garden behind the house. You stand on the terrace, and while looking on the garden, imagine that you have the sensation of a flower scent. You don't yet see the roses, but you feel the subtle, sweet flower scent and you recognize this scent immediately as being a smell signifying that somewhere near roses grow.

How to analyse this simple daydream? I claim that MI is exhaustively explained in terms of signs. The example produces a compound image that consists of several elements and conveys a complex meaning. First, image as the sign vehicle represents an object of a particular quality – a smell. Thus the representamen of the image is a *qualisign*. But exactly what does the smell represent? The object of signification in the imaginary case stated above is a rose. A subtle and sweet smell is a sign of the presence of a rose in the garden. Hence, the rose is an existential actual object that is represented in the image. In relation to the object of the image that sign is an *index*. Finally, what is the signification of the image? What does it mean? The immediate interpretant that was conveyed by the image is the recognition of the subtle, sweet sensation as that of a rose's smell. Our understanding of the image focuses on the qualitative feature (smell) of the object represented (rose). From the sign-interpretant relationship we get that the image is a *rheme*.

This is a simple analysis of the example in terms of signs. But Peirce pointed out that there are no "pure" types of signs in our ordinary cognition. Usually every sign displays some combination of various characteristics. Thus, the analysis of the imaginary example continues, and more subtle characteristics and inter-relations between elements of the image might be uncovered. The sign vehicle also has the properties of a sinsign, namely existential properties. The quality – smell of a rose – is causally connected with

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[13]   Initially, the three trichotomies yield twenty-seven possible classes. But Peirce has further phenomenological constraints on how we combine the different elements of the sign. As a result, only ten permissible classes remain. In his later work, Peirce expanded the list of trichotomies and suggested more complex classifications of the signs, such as the sixty-six classes of signs. This later classification will not be discussed, mainly for two reasons: (1) Peirce did not complete that work, and his ideas remained conjectural; (2) the detailed discussion of the nature and derivation of classifications would in any case fall out of the scope of the present paper. My aim is to show that the mental-imagery phenomenon can be legitimately interpreted as a sign system.

the object – a rose. In other words, there is a subtle and sweet smell only if there is a rose. The existence of an object is the cause of your sensation of the smell. In this sense the sign vehicle represents not only as quality (smell) but also as the causal co-location (smell-rose). Thus the representamen has the properties of a sinsign.

Further, as regard its object (rose), an exemplary image also has iconic features. For example, in my dream I visualize a particular flower which resembles the real object of the outside world. If so, the object is represented in the image as an icon, since it is similar to the real object of the external world in the way it looks, smells or grows. When I dream about the rose, I might visualize those particular sizes, shapes, textures and colours. The image rich in such information possesses iconic features. And at the same time, my recognition of the presence of the rose in the garden remains indexical. The smell of a rose is an index of the presence of a rose: these two facts are interrelated, causally connected. If there is the smell of a rose in the garden, then somewhere in this garden a rose should grow.

Finally, the meaning of this imaginary experience can also be manifold. In regard to its interpretant an exemplary image can convey not only the immediate meaning of olfactory sensation (rheme), but also have an existential interpretant (dicent). The very first meaning that one will get about the image is, of course, the interpretant of a feeling, or as Peirce sometimes calls it, an emotional interpretant. The smell of the rose is immediately felt when I imagine myself going into the garden. It is directly given, immediately felt and recognized by the subject. At this stage this first recognition of the particular quality and immediate experience of this quality (the smell in our example) is not reflected upon yet, or as one might put it, is pre-reflective. This is the first interpretant of my image, a rheme.

But once I have reflected upon my immediate sensation of a sweet and subtle smell, I realize that if there *is* (i.e. exists) this sweet and subtle smell of a rose, then there also should *be* a rose itself as the carrier of this quality. This is already an analysed understanding of the existential relation between quality and object that goes beyond immediate meaning. If we accept the reflected or analysed meaning of the quality then the sign signifies the *existence* of a particular object (rose). Thus the interpretant of an exemplary image can also take the form of the dicent or energetic interpretant, namely the interpretant of the existential fact.

Next, the above-described imaginary experience seems to convey further meaning that goes beyond emotional and existential interpretants. The exemplary image also has the features of a delome, the conventional interpretant. The imaginary experience of feeling the smell of a rose uncovers a rule or habit that lies dormant in the situation. In the imaginary example the subject infers the existence of the rose from the presence of the particular smell only because he possesses the conventional (and often implicit)

knowledge[14] about where the roses grow, for example. In my dream, I imagined entering the *garden* to feel the smell of a rose, not some other place such as a seashore or a forest. Why is that? Because it is a general but fallible rule that roses grow in the garden. Thus, the imagined experience of smelling the rose is based on tacit knowledge shared by all. Moreover, the algorithm of my imagined actions – to go to the countryside, to enter the countryside house, to open the back door into the garden, to enter the terrace – is also conventional. It is based on the knowledge where the garden might be located, how to enter the garden, what one should do to have an olfactory sensation of a rose, etc. Without this tacit knowledge the co-relation of some elements of the image (smell-rose in our case) would be impossible. Furthermore, a dreaming subject might evoke some natural language in his daydream of sensing the smell of a rose. For example, verbal language might be used to signify the logical sequence of the imagined actions or other details of the dream. In this case, the interpretation of the exemplary image has conventional characteristics.

To sum up, in our example the signification of the object (rose) by the sign vehicle (smell) generates a compound meaning which consists of emotional, existential and conventional interpretants.

Conclusion

My case study of MI proposes two points: (1) mental imagery can legitimately be interpreted in terms of Peirce's theory of signs; and (2) such an interpretation suggests fruitful prospects to understand MI phenomena from new theoretical points of view. The nature and function of mental images ultimately can, I argue, be understood in that wider context of signification procedures, the three relata of the sign and the interesting relations between them. Representational paradigms that underlie dominant accounts on MI are limited in taking stock of the importance of relational elements.

MI constitutes a complex system of signs. Images exhibit features with complex meaning. The analysis of an imaginary mental image in terms of signs proposes that MI has properties of all three trichotomies of the signifying relata. Moreover, various properties of images can co-exist with each other, enabling a coherent and multi-level analysis of MI. Though a further investigation of such an account of MI as a sign system is needed, even these preliminary considerations warrant the proposed method of analysis.

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[14]   Conventional or implicit knowledge about the world is often termed 'tacit' in cognitive science. Pylyshyn has interpreted imagery experiments (e.g. mental scanning, mental rotation, mental mapping etc.) as those guided by tacit knowledge by the subjects experimented on about how things would have been if perceived in reality and not just imagined (see, e.g., Pylyshyn 2002).

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CP = Peirce 1931–1958.

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Теория знаков в действии: снова о дебатах по поводу ментальных образов

В статье я стараюсь дать приемлемое объяснение сущности ментальных образов, которая была предметом долгих споров. Традиционный подход к этому вопросу основан на репрезентационной парадигме, которая, по моему мнению, ошибочна. Вместо репрезентационных аспектов ментальных образов я выделяю *функции* ментальных образов, *множество различных характеристик*, проявляемых ментальными образами в экспериментальных исследованиях, а также отношения между разными свойствами образов, их функциями и субъектами образов. Предлагаю рассмотреть ментальный образ как знаковую систему, состоящую из разных типов знаков. Так, ментальный образ может содержать важные свойства как части комплексного знака. Такой подход к объяснению ментальных образов представляется продуктивным, поскольку он позволяет разрешить некоторые из давних споров по данному вопросу.

Märgiteooria toimimises: taas mentaalsete kuvandite debatist

Käesolevas artiklis püütakse anda usutav seletus pikki vaidlusi põhjustanud küsimusele mentaalsete kuvandite olemusest. Traditsiooniline lähenemine sellele küsimusele põhineb representatsioonilisel paradigmal, mis minu väitel on ekslik. Mentaalsete kuvandite representatsiooniliste aspektide asemel rõhutan mentaalsete kuvandite *funktsioone*, eksperimentaalsetes uuringutes kuvandite poolt üles näidatavate *omaduste mitmekesisust* ning kuvandite erinevate tunnuste, nende funktsioonide ja kuvandite subjekti vahelisi suhteid. Pakun välja, et mentaalset kuvandit võib vaadelda erinevatest märgitüüpidest koosneva *märgisüsteemina*. Mentaalne kuvand võib sisaldada olulisi omadusi, mis on komplekssse märgi osadeks. See lähenemine mentaalsete kuvandite olemusele on kasulik, sest viitab mentaalse kujundistiku fenomenile, mis aitab ületada mõningaid kaua kestnud vasturääkivusi sel teemal.

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Phaneroscopy and Theory of Signs as Theory of Cognition

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Abstract

Peirce's theory of signs is a rich and expansive theoretical option for cognitive sciences that does not assume the presence of the distinction between what the methods of natural and those of the human sciences are. The potential of the sign-theoretic account remains largely unacknowledged, however. The reason may be the conceptual jungle that one encounters at the moment one tries to penetrate it. The present paper explains the key terms of Peirce's theory from the viewpoint of the theory of cognition. In Peirce's own terms, this is to take the theory of signs to be influenced by phaneroscopy, the science of phenomenology that prepares ground for the sign-theoretic study of mind. We review the main technical terms of Peirce's phaneroscopy and provide an explanation of its central nomenclature, too, often drawing from unpublished manuscript sources. This extended glossary can serve as an integrated aid to both Peirce's theory of signs as well as to its phenomenological underpinnings, illustrating the unique character of this early method for the theory of cognition.

Keywords: Peirce, Phaneroscopy, Early Phenomenology, Theory of Signs, Philosophy of Mind, Representations.

1. Introduction

Peirce's theory of signs has for quite a long time been providing a rich theoretical resource in a number of fields across sciences and humanities. Its uses have been somewhat less visible in the mainstream cognitive sciences, however. Granted, the area of cognitive semiotics has been burgeoning of late, the methods of which having largely been defined by Peirce's semeiotic theory. But outside of that circle of research, especially in the mainstream cognitive sciences, philosophical psychology, phenomenology, and in the philosophy of mind and consciousness, Peirce's theory of signs has enjoyed a relatively negligible status.[1] It would be a rare acquaintance, for example, as the first method of choice for experimental studies conducted in these fields.

There is no real reason – other than some historical accidents and general unfamiliarity and unavailability of the key textual sources – why this has been so, or why the major representational theories, such as the quasi-pictorial and propositional ones in the philosophy of mind, cognition and consciousness have remained largely unaffected by Peirce's pioneering insights. In order to improve on this situation, and even ever so slightly, the present paper will explain some of the main but largely unacknowledged elements of Peirce's theory of signs, viewed as a theory of cognition. In doing so, we follow closely Peirce's own letter of exposition, much of which is thus to be drawn from his unpublished manuscript sources. The defining

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[1] This is calculated to change, however, with the recent appearance of Champagne, Marc. *Consciousness and the Philosophy of Signs: How Peircean Semiotics Combines Phenomenal Qualia and Practical Effects.* Dordrecht: Springer, 2018. See also Pietarinen, Ahti-Veikko. What Do Epistemic Logic and Cognitive Science Have To Do with Each Other? *Cognitive Systems Research* 4(22), 169-190, 2003. Pietarinen, Ahti-Veikko. Early Cognitive Science: A Challenge to Analytic Philosophy? H. J. Koskinen, S. Pihlström & R. Vilkko (eds.), *Science - A Challenge to Philosophy*, Frankfurt am Main: Peter Lang, 327-346, 2005. Pietarinen, Ahti-Veikko. Peirce's Pragmatic Theory of Proper Names. *Transactions of the Charles S. Peirce Society* 46, 341-363, 2010.

novelty of his architectonic is how *phaneroscopy*, his preferred method of phenomenology, permeates the study of signs and how it caters for the conceptual base of those sciences that are to depend on the phaneroscopical analyses.

Included in this extended glossary are the key phenomenological terms that Peirce employed, mostly in the early 20th-century, when he was erecting a full-blown theory of signs and revising the earlier accounts. The explanation of the key terms is calculated to aid our endeavours in seeing how the origins of that theory were indeed laid upon phenomenological bed-rocks and how the emerging theory would then at once serve not merely as a theory of *signs* but also as a theory of mind and cognition, and even that of consciousness. It is a guide to the largely uncharted phaneroscopic waters infested with signs.

Our excursus into phaneroscopy will lead us to the following conclusions: First, an early theory of cognition lurks in the theory of signs. As a theory of signs, Peirce's account of mind and cognition presents a structure that significantly differs from what the current and mainstream representational theories take cognitive architectures to be, however. This makes it a useful alternative when the standard terminology has run its course. Second, Peirce's theory is an attempt to integrate the living mind, subjective mental states, and dispositions to act with external influences, into one unifying account. The wider goal behind Peirce's theory may well be to make us see how the idea of the 'authorship' of the mind, or the self, is ready for retirement. Instead, Peirce saw it as a conglomerate of "quasi-minds", the "creatory" of various sign classes, including thought-signs. Any self-image that the complex mind is able to form of itself is a sign and is to be interpreted as such in order for the mind to contemplate any meanings. Third, the theory of signs may be viewed as a general theory of cognition that is neither internalist nor externalist concerning the meanings of mental representations. These conclusions resonate with the modern synthesis in contemporary cognitive sciences that has taken issues such as

embodiment of thoughts, enactment, as well as the illusory nature of the self and agency formation as one of the central concerns.

Peirce's corpus on these topics is vast, and much of it remains unpublished. In order to gain an overview of his though, one would have to canvass even the most inaccessible parts of the *Nachlass* to appreciate the relevance of his explorations in the intersection of philosophical, logical, phenomenological and psychological analyses to modern sciences, or what his preferred conceptual apparatus really was upon which one is to erect a general theory of signs and cognition.

We begin with what Peirce meant by a person being in some *state of awareness.* This sign-theoretic conceptualization of awareness is surely relevant to contemporary studies in mind and cognition, both empirical and theoretical. After having preliminarily assessed this relevance, we proceed to a conceptual clarification of the meanings of the terms "icon, index, symbol"; "qualia"; "sign"; "quasi-mind"; "mental representation"; "pheme"; "phaneron"; "phaneroscopy", and finally "cognition".

2. The Glossary of Key Terms

A State of Awareness. Peirce's meaning of a person being in the state of awareness is explained in detail in an unpublished manuscript R 654 (1910).[2] According to it, a state of awareness characterizes all that a person is aware of during a certain interval of time, together with all that a person might consider to be aware of under some conceivable circumstances at some other time. To characterize such "states" that the mind is occupied with, Peirce would take into account both the actual states of awareness as well as all the possible and conceivable states.

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[2] The reference R is to Peirce's manuscripts at the Houghton Library, followed by the Robin Catalogue number.

A state of awareness has three ingredients that a person finds to be present in those states that his or her own mind occupy. These ingredients do not exist separately although they are to be regarded as conceptually distinct. First, there is some "dominant quality of a single state of awareness".[3] Peirce calls these qualities *sensations*, or *quale*, or *feeling-qualities*.[4] They are non-compound and are not made of any further ingredients. They lack individual identity and are related to each other solely in terms of likenesses. Sensations are results of some effect, such as irritation of the receptors of our retina by the photons, causing sensations that vary with the difference in the wavelength of light. In addition to what is caused by irritation, sensations that influence other elements of consciousness are what Peirce calls *feelings*. Given the importance of this first ingredient of awareness, a separate entry below explains Peirce's use of the term "quale".

The second ingredient in the state of awareness is observed when agents, who perceive a relation that obtains between sensations, have entered into an area of consciousness which differs from mere sensations. There is an emergence of an activity, and that activity involved in the perception of relations now constitutes the main character of the second type of the ingredient in one's state of awareness. This character is present in mental states that agents are aware of, but it is distinguished from sensations in that there is now the idea of the 'authorship' of those states that emerges as the locus of the mind. This locus is able to regard mental states as happening to *it*, as some *thing*, as what is put before the mind as a certain *object* of those states. A recognition of two sensations as *different* would be to enter in the state in which a recognition of such a relation of difference has to take place. The sensation becomes the object of thought, and hence a conception of an agency arises: there is now some*one* who becomes aware, however faintly, of the fact that some such activity has taken place, and which is of the

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[3] R 654.

[4] R 502, 1898.

kind that enables the virtually formed agent to carry out the perception of that relation. At once, as soon as there is such perception, there is also a creation of the moment of experience, which in turn would constitute what we might typically call "the self"[5] as the author of these perceptions. What is more, the self and the object now create a contrast. The object is the object of awareness, but it need not be anything outside of the state of awareness. This perception of the contrast, Peirce importantly notices, need not be correlated with any recognition of some physiological change in the states of the brain, or come with an assumption that the object contemplated is real such as being present in the physical world. As soon as we would know what the relevant facts responsible for the recognition of these relations are, we could then say that the objects of those states *exist*.

The perceptions of these relations and differences, when increasing in activity and intensity, create what Peirce termed a "temporal contract"[6] between different states of minds. When that contract persists in the state of awareness, it may be called an *experience*.

It would thus not be quite correct to call qualia, which is the first type of the ingredient present in a single state of awareness, as an experience, or as an experience of an agent, or even as an experience that some first-person authority has at its possession. An agency is formed virtually from the ingredients of the second type. An agency, or a selfhood, assumes that such contract has already been drawn between the states of minds in a temporal succession, and it is only within such states of mind that are acting according to this contract that an authority, capable of real experience, becomes a present phenomenon.

We can see Peirce making a couple of noteworthy observations along the way of such descriptions and explanations. The first is that the self is an *idea* of the mind, and it is closely

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[5] R 654

[6] R 654

linked with the creation of an experience. Contemporary philosophers, psychologists and cognitive scientist have indeed been willing to concede that the self, as some present and coherent entity, as a persistent and active, rational and epistemic decision-maker or agency, is conspicuously lacking both empirical and conceptual support.[7] Conscious thought does not seem to be a process that needs to be ascribed to a person that would be conceived as some integral unity. Conscious thought need no *singular* unity responsible for executing the office of an autonomous authority of those thoughts.

The second point that Peirce is seen to be making here is that simultaneous sensations may be recognized as different because there might be a difference between "what is remembered and what is anticipated".[8] As this difference need to take place in actual time (it concerns simultaneous sensations), it need not be an *experience* of some change taking place, although it is a modification in the state of awareness in terms of a recognition of some difference. Cognitive neuroscientists call such phenomenon *predictive consciousness*, and it is taken to be an element of the *predictive brain*.[9] Neurobiologically, the explanation is in brief that in order for the brain to create coherent representations of events in its rapidly changing environment, it invents states that attempt to predict both the sources of the sensory inputs as well as their immediate implications. The respective mental states are *hypotheses* about what may happen in the chain of dynamically unfolding events, significantly before those predictions would actually come to pass.

We have two further comments to make on the predictive nature of mental states in relation to Peirce's classification. Mental states that bear hypothetical content may well be what experiments have proposed them to be. The fast and frugal neural-level reasoning would then

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[7] Haggard and Eitam, *The Sense of Agency*, 2010.

[8] R 654

[9] See e.g. Maldonato, *The Predictive Brain: Consciousness, Decision and Embodied Action,* 2014.

relate to the mode of inference which Peirce termed *abduction*: reasoning that reverse-engineers causes from effects. Second, the idea of mental anticipation is historically a theme that dates back to Hermann von Helmholtz's pioneering research on the topic. Indeed Peirce was well acquainted with Helmholtz's work and the related scientific advances. Anticipation, as well as the actual function of perception as involving these inferential processes that are often observed to be working backwards – from the presumed effect to expected causes – are both such elements of awareness that are to be classified according to this second ingredient of mental states.

The third ingredient in a person's state of awareness is the result of a volitional activity that agents exert upon their own states. An agent may, for instance, become cognizant of the objects of its own sensations by a deliberate and intentional attention drawn to its own mental states. Alternatively, the activity may concern recognition of salient characters of those objects, such as their relationships, which are driven by the interests that the object itself has, or perhaps by some unconscious and unintentional urge involved in the recognition at some sub-personal and semi-automatic levels. The objects agents are able to discern in these states of awareness by a sustained focus of attention need not be external to the states themselves: the recognition of an increased mental activity and awareness may itself be the object of those states. It is in the ingredient of this third type that the idea of *the sign* emerges: the presence of the sign means a recognition, in the state of awareness, that representations involve three subjects: first, the representation itself, second, the object of the representation, and third, the presence of the sign that interprets the former sign (namely its interpretant).

Peirce moreover divides this third ingredient into three qualities, which he at one point called its "generous", "degenerescent" and "perdegenerate" forms.[10] Perdegenerate thirdness "imparts

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[10] R 339, June 11, 1898

to its members as might belong to them though they were not existent".[11] This concerns the possibility of a volitional action or force, such as an agent imagining to perform a certain interpretative act (think of, say, illocutionary speech acts and moods). Degenerescent thirdness is, Peirce explains, "a thirdness which imparts to its member such characters as involves their brute existence but not their *significance*, or conformity to general law".[12] The illocutionary act itself, such as an act of asserting a performative locution, would mean that an agency is in such a state that involves degenerescent ingredients. Last, generous thirdness "is such as involves the significance of the members of the triad".[13] It is this third component that involves the presence of the sign which is irreducible to any of its further ingredients. This gives rise to the "indecomposable triad", and it is such triads that are involved in significance and meaning in the sense that they represent "that mode of being which is constituted by generous thirdness". Among them Peirce included a "continuum or law".[14] For example, an awareness of linguistic conventions concerning the use of explicit performative verbs would constitute what being in this state of mind have to involve. Consequently, it is not likely that other than human intellects are at present capable of achieving such states of awareness.

Qualia. As seen above, the dominant qualities present in a single state of awareness are sensations. Peirce coined the term *quale* (which he also termed the feeling-quality and quali-signs)[15] to refer to these non-compound, simple ingredients of a state of mind. Qualia lack individual identity, and they are related to each other solely by likenesses or resemblance.[16]

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[11] *Ibid.*

[12] *Ibid.*

[13] *Ibid.*

[14] *Ibid.*

[15] R 502, 1898

[16] Think of how gelatinous colonies of polychaete could be formed.

There is an important passage from a late 1913 letter in which Peirce explains qualia as self-independent, object-free and "undifferentiated" sensations:

> I recognize, after a long series of careful experiments, designed to intensify to the utmost one and another of the apparently elementary psychical ingredients of cognitions while all the other elements were as nearly abolished as possible, three elementary psychical ingredients. The first and hardest to find tolerably pure is Sensation or Feeling, which is characterized by its absolute simplicity. It is that consciousness in which subject and object are not at all distinguished.

> I have only been able to make out this characterization shortly after having been suddenly awakened from the deepest sleep in altogether strange surroundings having some one strongly dominant surroundings, when I have been brought to the strange place at night or put to bed in a state of complete exhaustion. Then after I have begun to recover my senses I become aware that at first waking my consciousness had been neither an awareness of self nor of objects as external but a mere undifferentiated *quale*.[17]

Peirce's characterization differs in important ways from what has defined modern discussion on qualia. Quale-sensations happen in states of mind that lack the sense of self-awareness, states devoid of first-person authorities. Such states resemble phenomena such as moving in or out of the last stages of the NREM cycles, or hypnotic and highly suggestive and receptive states similar to parasomniatic moments in which the mind is awake or aware of itself only in some altered manners inside the sleep states. Again, the fact that the experience of "the self" arises

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[17] Peirce to Woods, 1913, emphasis in the original, R L 477.

from the brains that are slowly switching on has gained attention in recent studies.[18] We do not know what the experiments may have been that Peirce alluded to in his letter – maybe he had been collecting data on some unusual states of mind from this own experiences, but no systematic notes on the data have been preserved.

At any event, the theory by which to analyze the nature of these states and experiences is the theory of signs. Given the absolute simplicity and undifferentiability of quale, for example, such a phenomenon is what is exhibited in pure *icons*.

Sign. In order to explicate Peirce's use of the term 'icon' in these contexts, we need to next define the main characters of his term "sign". Consider the following definition of a sign, which is from a draft letter he wrote to Welby:[19]

> A "sign" is anything, A, which,
>
>> (1) in addition to other characters of its own,
>>
>> (2) stands in a dyadic relation, r, to a purely active correlate, B,
>>
>> (3) and is also in a triadic relation *to* B *for* a purely passive correlate, C, this triadic relation being such as to determine C to be in a dyadic relation, ρ, to B, the relation ρ corresponding in a recognized way to the relation r.

This definition has not been presented in the secondary literature before. From it, we can observer that in its purest, mathematical form, the sign is simply a relational pattern. As a relational pattern, its principal factors are three-place relations, which are irreducible to one and two-place relations. Those are the *generous* (non-degenerate) signs. Classes of signs in various

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[18] Metzinger, *Why is Mind Wandering Interesting for Philosophers?*, 2017

[19] c.1904, Houghton Library. Not found in the microfilm edition.

trichotomies exhibit this irreducibility. Even simple qualities such as sensations of a property, cannot be conceived without their involvement in sign relations. The common triad is thus a relation between the sign, its object *and* its interpretant.

The sign is related to the minds (or more precisely speaking, the quasi-minds, to be discussed below), as the origin of the intellectual relationships involved in signification. Peirce characterized this relation in the following terms:

> [A] *Sign* may be defined as a Medium for the communication of a Form. It is not logically necessary that anything possessing consciousness, that is, feeling of the peculiar common quality of all our feeling should be concerned. But it is necessary that there should be two, if not three, *quasi-minds*, meaning things capable of varied determination as to forms of the kind communicated.
>
> As a *medium*, the Sign is essentially in a triadic relation, to its Object which determines it, and to its Interpertant which it determines. In its relation to the Object, the Sign is *passive*; that is to say, its correspondence to the Object is brought about by an effect upon the sign, the Object remaining unaffected ~~a circumstance otherwise expressed by saying that the Object is~~ *real*. On the other hand, in its relation to the intepretant the sign is *active*, determining the interpretant without being itself thereby affected.[20]

One novelty of this particular characterization of the sign is that the triadic relation is here defined as one in which the sign stands to its objects as a *passive*, and to the interpretant, as an *active* ingredient. This characterization is in agreement with his other late definitions in which object is taken to be that which determines what the sign is, while the interpretant is that which

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[20] R 793

is determined by the sign, as the effect of the sign.[21] In particular, the object is not something that is determined, but it is what is represented, by the sign.

Icon, Index and Symbol. This is the second, and no doubt the most famous, of Peirce's division of signs into three categories. We frame the presentation in relation to the above description of the states of awareness, and especially in relation to mental imagery that takes place in these states with respect to their first ingredient.

Beginning, as Peirce often did, with an outline of the second class of signs, an *index* has a special representative force because it is connected with the object that it represents as a matter of fact. Index has a power to signify, because such signs react with their objects and thus force the attention of the interpreter to them. An index functions as an indexical sign whenever it is so interpreted to function. A symptom is a functional index of a disease as soon as it is interpreted to be such. Cognitive anchoring is subject's unreflected and unmediated provision to interpret a given task in terms of a perception of an indexical connection created in the imagination between the representation (the task) and its object (the anchor). It may be nothing but an unconscious subjective association between beliefs. Framing of cognitive domains provides a further example of indexical connections in the minds of the interpreters that concern how information is presented to them, such as by suggestion, nudges, indications, selection pressures or coercion. These modify subjects' awareness of the situation. Framing can thus effectively influence the direction of subsequent interpretations. For example, a positive value may be mapped to lower risk-taking tendencies, while a negative value may correlate with higher risk-taking tendencies. These are well-documented phenomena in cognitive psychology.

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[21] SS: 80-81

While mental pictures of various cognitive sorts may exhibit indexical traits and short-cuts for the efficient management of decisions and everyday impressions, yet by far the most characteristic feature of mental images is found in the first type of the class of signs, namely *icons*. They relate representations to their objects by means of association and likeness. What is the vividness of which images in the mind consist? What is the characteristic trait of mental imagery? Peirce proposes an answer: there are icons that serve as signs whose being is wholly the matter of something occurring in the mind *as images*. What the icon is does not depend on the presence of its objects. Our experience of icons pertains to the temporal and transient moment of something having taken place that excites those images. The experiential element of imagery is due to its nature of being an icon of those sensations, recognitions and urges to draw attention to its objects. It is in these three varieties of ways that the mind can become aware of its own states. These varieties characterize the nature of mental imagery within Peirce's sign-theoretic setting. Images created in consciousness are such icons.[22]

Yet nothing actually is a pure icon or a pure index. Many signs are simultaneously both iconic and indexical. A suggestion implanted by a cognitive anchor bears resemblance to its baseline, and it is furthermore recognized as being so connected by virtue of an index that indicates the presence of the mappings which are iconically related to each other by some measure.

Icons differ from indices in that their representative character is of the nature of signs only if they are interpreted as executing the office of such representations. The imagery created in consciousness needs to be interpreted in order for a proposition to be true or false of it. For example, an image as an icon, when interpreted, is a *symbol* whose object is general and thus capable of representation. Such images, interpreted as symbols, are now parts of the

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[22] Some of these characters of icons as contributing to the vividness of mental imagery have been empirically investigated in Issajeva, J. and A.-V. Pietarinen, The Heterogenous and Dynamic Nature of Mental Images: An Empirical Study. *Belgrade Journal of Philosophy*, in press.

representational account. Images taken in this way indeed are what representational theories of cognition typically take them to be: interpreted elements of the mind which are generalizable and for that reason can be true of some *things*. A predictive rule would apply concerning the contents of imagery, and in this way imagery receives meaning that becomes commodity in the public domain. We explain, for instance, the pictorial character of mental imagery in some language, or perhaps as an integral element of a new scientific theory. Or it could be an artistic act or a performance. Signs are symbols when they signify their objects to the interpreter by virtue of being interpreted in certain ways in certain occasions.

Furthermore, symbols influence the future conduct of their interpreters by virtue of the force they have. This "representative force of language and of every other symbol depends upon the symbol's being made such as it is for the sake of the future".[23] Peirce calls this influence of symbols on the future *reason*. Symbols exhibit generous (non-degenerate) ingredients of thirdness in the minds of their interpreters. A reason is not simply a "combination of *imaging*" (as they are in the past) and "*force*" (as those are in the present). The influence of the future is, according to Peirce, to "evidently be a third element" of symbols.[24] It would be wrong to say that symbols are signs *in* consciousness, but they can be *indicated* to be in it, just as icons can be indicated, but really are not, things on a piece of paper on which we have drawn geometric figures. It is clear that cognitive anchoring, for example, is a bias that influences the future conduct of the interpreters in its indexical and iconic dimensions. In sum, a cognitive sign can be a symbol, an icon and an index simultaneously.

A noteworthy point concerning the process of interpreting various kinds of imagery as symbols is that this association is in Peirce's view "subconscious, uncontrollable, and not subject to

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[23] R 492, alt.

[24] *Ibid*.

criticism".[25] The study of how such interpretations take place belongs to the field of psychology and not to logic and reasoning. The study of the nature of *propositions* thus created is by logical analysis, but how symbols are attached to imagery is not a logical question. We could perhaps say that the study of the processes that lead from imagery to symbols would predominantly belong to the domain of social and cognitive psychology. What the properties of symbols are depends on the characteristics of the minds (both individual and collective) of their utterers and interpreters.

Let us take a stock. In the foregoing remarks and especially in the full versions of the manuscripts referred therein Peirce is seen to represent a viewpoint that we can briefly relate to the "Knowledge Problem".[26] Peirce proposes a perspective not hampered by the standard terminology. A quality is a feeling. It has no experience attached to it. "We can imagine", as Peirce writes in R 492 (alt.version), "that a being's entire life consisted in one changeless sensation of scarlet or crimson". This is an imaginary case, since our actual feelings come with varying "degrees of *vividness*". What our feelings are consist of sequences of changes in the state of awareness in which the relation between various sensations is expressed. Changeless sensations are impossible.

Then consider Mary, exposed to congenitally colourless sensations of all the physically possible shades of what in other people's experience are varieties of a red colour, in her contrived captivity which consists only of an infinite variety of grey hues of those particular wavelengths of light. In that world, the thought-experiment asks us to imagine, she would gain a complete physical knowledge of everything what it means to experience red, except the colour red itself. Does something change when she is released to our world in which she is no longer deprived of that colour? Would she learn something that was not there before?

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[25] R 492, 1903

[26] Jackson 1982

Peirce's answer would begin noting that a change in the state of awareness concerning two or more sensations represents a relation. Sensations of this kind must have an object. When the subject recognizes, due to an increase or decrease in mental activity which is inevitable when one is moving between the black-and-white and the full chromatic realms, that some such relation is bound to be present, the awareness of the relation increases or decreases in its vividness. The perception of this contrast need not be correlated with any recognition of a physiological change in brain states. One need not assume that the object of feeling is real or present in the physical world. In particular, one need not assume that the properties such as the full chromatic scale, or everything about the tinge, hue, luminosity, or intensity of the object would be at the subject's disposal.

Feelings and qualities are thus not themselves general, but they would need to be *capable of generalization*. Thoughts and other symbols have significance insofar as they possess some generalizing tendencies, such as repeated predicability. The movement between the two worlds is either a generalization of feelings of a particular kind, or else a deprivation of those feelings. It is a dynamic activity in the states of awareness. Even if the sensation of red would retain all its characteristics at the presence of the activity, the vividness of feeling that sensation remains generalizable in new circumstances. Would an increase in vividness count as learning? Yes, Peirce would reply, as soon as it is realized that Mary becomes aware of the objects of her sensations by some deliberate and intentional attention, which she is capable of drawing from the content of her own mental states. She will recognize certain characters of those objects because they are compelling and present some novelty and interest, albeit perhaps largely unconsciously and unintentionally. She would become aware of some new relationships that attain between her mental states that are present in her consciousness. As soon as that awareness translates into changes in Mary's action and behaviour, including mental action, we would have to call it learning.

This is not the argue that Peirce's theory of mind would neatly fit into any of the current compartments such as dualism, physicalism, materialism, epiphenomenalism or panpsychism. Does an initial exposure to the full physicalistic description of colours mean that we would have to grant Mary full understanding of how neurophysiological operations of our brains give rise to the qualitative experience of colour? Wouldn't anything new happen when she stepped out? These would be hasty questions. Under Peirce's account, there is a change in Mary's *habits of action*, including habits by which her mind generalizes qualitative feelings into actions to think in certain ways in certain kinds of circumstances. This would also mean an increase in Mary's knowledge, because a habit-change is an operation that underlies knowing.[27] Mary's acting in certain ways in certain kinds of situations are characterized by her tendencies to take certain habits and to control and modify the present ones. Even in the presence of a full understanding of the relevant neurobiology and what goes on in terms of her brain processes in and out of her twin worlds, her habits of feeling would still be generalizable (as they pertain to the world) and would undergo modification and evolution.

Neither a physicalist nor a dualist would thus find ultimate comfort in Peirce's pragmatistic theory of signs. But the really interesting fact is how deeply ingrained his theory of sign is in the area of phenomenology. To do this, we will more on explaining the meaning of the remaining terms, namely "Mental representation", "Quasi-mind", "Pheme", "Phaneron" and "Cognition".

Mental representation. The notion of mental representation is a popular term in contemporary theories of cognition, and it appears often in Peirce's corpus as well. However, in comparison

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[27] Cf. Engel, Friston and Kragic (eds.) *The Pragmatic Turn: Toward Action-Oriented Views in Cognitive Science* 2016

to the standard accounts in psychology and cognitive sciences, Peirce defined representation differently. For him, representation is not an internal, elementary component of mind, out of which mental states spring through informational or computational process. [28] Rather, representations constitute a general object of mind, which is of signifying nature. Along these lines, every idea, every thought, is a representation of something and functions as a sign.

Generally, Peirce defines mental representation as "something which stands for something".[29] Such a general definition conforms to his understanding of a sign as "something which stands to somebody for something in some respect and capacity".[30] Thus, for Peirce, sign and mental representation are virtually synonyms.[31] What does it mean? First, mental representation shares the structural relationships with that of the sign. It consists of three main elements – representamen, object and interpretant – and relations between them: "*Representation* is a relation of one thing, – the *representamen*, or sign – to another, – the *object*, – this relation consisting in the determination of a third, – the *interpretant* representamen, – to be in the same mode of relation to the second as the first is to that second".[32] Thus, mental representation is of signifying nature.

Peirce gives a more detailed definition of representation in terms of signs already in his early writings. He describes essential conditions to which every representation must conform:

> It must in the first place like any other object have qualities independent of its meaning. It is only through a knowledge of these that we acquire any information concerning the object it represents. Thus, the word 'man' as printed, has three

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[28] Clapin, *Philosophy of Mental Representation* 2002; Marr, *Vision*, 385-406.

[29] Peirce, *Lowell Lectures on The Logic of Science; or Induction and Hypothesis: Lecture VII* 1866, W 1:466

[30] Peirce 1994, CP 2.228

[31] Peirce, *A Draft of a Review of Herbert Nichols' A Treatise on Cosmology* 1904, CP 8.191

[32] Peirce *Logical Tracts. No. 1. On Existential Graphs* 1903, MS [R] 491:1

letters; these letters have certain shapes, and are black. I term such characters, the material qualities of the representation. In the 2nd place a representation must have a real causal connection with its object. If a weathercock indicates the direction of the wind it is because the wind really turns it round. If the portrait of a man of a past generation tells me how he looked it is because his appearance really determined the appearance of the picture by a train of causation, acting through the mind of the painter. If a prediction is trustworthy it is because those antecedents of which the predicted event is the necessary consequence had a real effect in producing the prediction. In the third place, every representation addresses itself to a mind. It is only in so far as it does this that it is a representation.[33]

In order for some mental entity to count as representation, it should (a) have qualities independent of its meaning, like the shape of the letters; (b) have a real, perhaps causal connection with its object (i.e., represent its object in reality); (c) be given to a mind of cognizing subject, such that every representation is inevitably part of the mind. Such understanding of mental representation follows the triadic structure of the sign, confirming that mental representation is, indeed, of signifying nature.

Secondly, representation functions as sign. In contrast to traditional cognitive accounts, mental representation is not a static element of cognition processed, computed or manipulated to induce higher cognitive capacities. According to Peirce, representation operates as a dynamic signifying entity inside the manifold and complex relations of the mind: "*Representation*, by which I mean the function of a sign in general, is a *combinant*, or *trifile*, relation; since it subsists between the *sign*, the *object* represented, and the interpretant or sign of the same object

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[33] Peirce, *On Representations* 1873, W 3:62

determined by the sign in the mind of the person addressed, or in other field of signification".[34] This means that mental representation is produced by cognizing mind inside semiotic relations that hold between three sign relata and the mind. Mental representation further operates as a mental sign in the dynamic, changing context of mental events. Thus, representation, as being of signifying nature, functions as a mental sign.

According to this view, a newly produced representation cannot be seen as (completely) independent from its relata and the context and history of where it was produced. It is strongly embedded in the set of dynamic relations of the mind. Such a view on mental representation echoes models proposed for the enactive theory of cognition (such as the 4E cognitive theories), which has gained some recent support. Moreover, mental representation is closely intertwined and associated with other mental signs. According to Peirce, every representation evokes another one associated with it: "The idea of the representation itself excites in the mind another idea and in order that it may do this it is necessary that some principle of association between the two ideas should already be established in that mind".[35] Thus, for Peirce mental representation is not a singular mental entity in the mind that can be computed and further manipulated. Rather, his understanding of representation differs significantly from such standard views.

Quasi-Minds. If objects determine signs, signs are representations of those objects, and representations are general objects of the mind, the question that remains is: What is a mind? Here we approach those concepts in Peirce's nomenclature that may be one of the least known.

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[34] Peirce, *An Attempt to state systematically the Doctrine of the Census in Geometrical Topics or Topical Geometry, more commonly called "Topologie" in German books; Being A Mathematical-Logical Recreation of C. S. Peirce following the lead of J. B. Listing's paper in the "Göttinger Abhandlungen"* 1905, MS [R] 145

[35] Peirce, *On Representations* 1873, W 3:62

They may also sound hopelessly cryptic at first. Instead of the mind, what he often used was the qualification "quasi-mind", in order to de-emphasise any anthropomorphic connotation of the mind. Indeed quasi-minds form an integral part of his overall architecture of cognitive signs. Recall first that in Peirce's account, there is a stepwise generalization of the concept of propositions, first to digisigns, then followed by the generalization of digisigns to phemes.[36] This development is both an increase in the complexity of signs as well as a move towards an increased centrality there is to the presence of "minds". After all, signs are not singular, non-relational, ahistoric, unowned, free-floating entities autonomous from their uttering and interpreting minds: signs have signification and are understood as conveying various effects and forces, including assertoric and illocutionary forces, both of which are characteristic of a living intelligence.

Indeed the fundamental feature of the theory of signs is that there can be no isolated signs.[37] The connectedness and situatedness of signs comes into full force in Peirce's later revisions of the theory, where he proposed to match the logical representation of relations with the sign-theoretic one. It is here that the nature and function of quasi-minds grows into a key theoretical element that maps the logical representation of relations to the sign-theoretic account.[38] According to Peirce, a quasi-mind is what he means by a "perfect sign", and a perfect sign is at once also "the sheet of assertion of Existential Graphs".[39] From the logical point of view, the sheet provides the space of interpretation for signs that are asserted with various pragmatic forces; from the semiotic point of view, those are the perfect signs. The sheet is perfect because

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[36] See below; cf. Stjernfelt 2014

[37] R 292a

[38] The former relation is characterised, in turn, in terms of the sheets of assertion and universes of discourse. The "sheet" is the representational medium in this mature theory of graphical logic (existential graphs), and the universe of discourse is that part of the world (either real or fictional), over which the discourse is understood to run.

[39] R 283(s), 117

it is continuous. The logical owner of cognitive signs is thus the sheet. Its phenomenological counterpart is what Peirce calls the Phaneron (see below).

This terminology calls for a further clarification. While Peirce was developing his system of existential graphs, he would realize that this method would furnish a "diagram of the contents of the logical Quasi-mind".[40] Such a diagram is the blank leaf and the blank leaf is the quasi-mind. Peirce explains this as follows. Every sign has its signification in something that functions as a mind. This "functioning as a mind" is the quasi-mind. The nature of quasi-minds is, Peirce says, "beautifully exhibited in the system of existential graphs, which, though far from perfect, is the most nearly perfect (for the purposes of the science of logic only) system of representation of logical relations which has hitherto been discovered".[41]

Peirce goes on to explain the role of quasi-minds in the theory of signs as follows:

> A *thought* is not *per se* in any mind or quasi-mind. I mean this in the same sense as I might say that Right or Truth would remain what they are though they were not embodied, and though nothing were right or true. But a thought, to gain any active mode of being must be embodied in a sign. A thought is a special variety of sign. All thinking is necessarily a sort of dialogue, an appeal from the momentary self to the better considered self of the immediate and of the general future. Now as every thinking requires a mind, so every sign even if external to all minds must be a determination of a quasi-mind. This quasi-mind is itself a sign, a determinable sign".[42]

Now the quasi-minds also exhibit the phenomenological categories:

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[40] R 296, PAP

[41] R 283(s)

[42] CSP to Welby, March 9, 1906

Looking upon the quasi-mind from another side, we see that it must have, in the first place, special qualities of susceptibility, or possibility of determination. It must in the next place, be subject to reactions, each of which is an actual event, happening once and never again. It has, in the third place, dispositions and habits. But it will be convenient to call them all habits, whether they are original or acquired.[43]

Possibility, actuality and habituality are the three categories of quasi-minds. These three categories are needed as the ingredients according to which signs determine their interpretants. Peirce is now able to draw the conclusion that quasi-minds themselves are signs. This follows from the thinking of a thought being a determination of the quasi-mind in its capacity of thirdness, together with the fact that all thoughts are signs:

For example, it will be semeiotically necessary that all the thinkings shall be determinations of a single something corresponding to a mind,—a *quasi-mind*, as I shall call it. For otherwise two distinct premises would by their being merely simultaneously thought, no more be thereby copulated into one, thus getting put together, than of one were thought by you, indulgent reader, at the instant when the other was thought by the Mikado. Since the thinkings are all determinations of the quasi-mind, and since they are signs, it follows that the *quasi-mind* is itself a sign.[44]

From these clarifications of quasi-minds and their role in the theory of signs we now need to turn to the question of the phenomenological origins of signs and cognition.

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[43] R 283(s)

[44] R 292a

Pheme. Phemes are signs that make assertions by extending the classes of propositions and dicisigns. Phemes may be written or scribed, and they may be linguistic as well as pictorial. Peirce explained phemes to embrace "all Propositions; but not only Propositions, but also all Interrogations and Commands, whether they be uttered in words or signalled by flags, or trumpetted, or whether they be facts of nature like an earthquake (saying 'Get out of here!') or the black vomit in yellow fewer (with other symptoms of disease, which virtually declare, or are supposed to declare, some state of health to exist)".[45] Images that phemes excite in consciousness may be provoked by auditory, tactile, muscular, olfactory, proprioceptic, or any combination of such multiple modalities and bodily sensations.

Certain specific aspects of phemes are worth appreciating further in this context. Peirce argues in those much less-known parts of his work[46] that icons, in the sense of "pure perceptual icons", cannot have phemes as their (direct, dynamical) interpretants. The logical reason for this is that perceptual judgments cannot in a certain sense fail to be logical. They are destined to result reasoning that is logically defensible. What Peirce means by logical reasoning may not be entirely clear. In his theory, not all interpretants are conclusions of arguments (think of emotional interpretants as those effects that are not products of any arguments), but all conclusions are interpretants. The latter is what it means for a reasoning to be *sound* (in the sense of the all-important property of soundness of reasoning). The other direction, which we may call *adequacy* of logical reasoning, may not generally hold, as not all interpretants are products of what is implied by ordinary rules of inference (Pietarinen 2019). But here Peirce thinks that there in fact are certain "generalizations" of such rules, and that we can in fact find those in instinctive and common-sense reasoning. Those forms of reasoning are not deliberate and voluntary and unlike inferences they do not proceed according to definite leading principles.

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[45] *Ibid.*

[46] *Ibid.*

Yet he holds that these generalizations are even more trustworthy in their own domains than rules of inference are in the domain of rational, logical inference.[47] Perceptual judgments are not under rational control as perceptions are something that is forced upon subjects; thus the lack of self-controlled habits makes certain natural, common-sense courses of judgments inevitable and incontestable, in a word, logically evident.

In terms of the nomenclature of signs, pure icons that are mental images cannot have phemes as their interpretants, because the firstness (their "initial interpretants") of icons cannot signify anything. A wholly uninterpreted image does not have any meaning. It is a vague nebula of undifferentiated form in which object and signification are indistinguishable. A pheme, in contrast, is a generalized proposition that makes a clear distinction between the object and the interpretant. A pure icon, without an index, does not convey information about its contents. A wiring diagram of a computer's CPU, without any explanations of what it is a diagram of, or without a description of systems of relationships that the diagram in question exhibits, will not produce a pheme. Thus a pure icon cannot have dynamical interpretants. It cannot have final (logical, eventual) interpretants, either, since those are not signs but *habits*.

Phaneron. This is Peirce's technical term for phenomena of any kind as its constituent, including phenomenal qualia, qualities of feelings, momentary experiences, memories, imagination, mental rumination, meditative states, spiritual awe, aesthetic ideas, feelings of inexpressibility – in brief, all the stuff thoughts are made of: "Let us call the collective whole of all that could ever be present to the mind in any way or in any sense, The *Phaneron*. Then the substance of every Thought (and of much beside Thought proper) will be a Constituent of

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[47] Think of domains of evolutionary theory, for example, in which to preserve stability of strategies no theory of rationality need not be assumed.

the Phaneron".[48] The collective whole means also phenomena in its various modalities, such as possibilities, future contingencies, the vastness of unconstrained, non-relational spheres of mental abyss.

Peirce argues that logic is a study that is to be founded upon phaneroscopy, and that phaneroscopy (see below) is the description of the phaneron. But logical analysis, which would be provided by the graphical method of logic, is called for in the analysis of the nature and the elements of the phaneron. Phaneroscopy is descriptive, logic normative. Logical and phaneroscopical analyses are complementary endeavours, connected in their interest in the study of the phaneron. During the last years of his life, Peirce would spend most of his days and hours in developing such a method of analysis, the theory of logical graphs, and concludes that "the system of Existential Graphs, whose fidelity in the iconization of thought is such that I have found in it precious help in *logico-phaneroscopic* analyses, expresses this well".[49]

The method of existential graphs is thus the instrument not only for logical but also for phaneroscopical analyses. Logical and phaneroscopical analyses become two sides of the same semeiotic coin. Here the normative-descriptive dichotomy loses much of its importance. There are important changes for instance in one of the fundamental conventions of the method of logical graphs, namely the "sheet of assertion", which Peirce now renames the "Phemic sheet". By this he wants to make room for a similar generalization he had already done for propositions which became dicisigns and phemes; propositions that can be asserted in all possible moods and that can convey any illocutionary force. The logical method likewise needs to perform

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[48] R 300, PAP

[49] MS 646, 41–42, 24 January 1910. What Peirce means by "this" in the last sentence is the property of duality, in other words the phenomenon of polarity, which shows up in the distinctions between positive and negative terms, in the separation of oddly and evenly enclosed areas of graphs by cuts, and in the opposite nature of the characters that for instance rhemas have.

analyses not only of declarative propositions but also of "questions" and "resolutions",[50] "commands", "requests" and "inquiries",[51] as well as "suggestions" and "intentions".[52] Thus all that is at any time scribed upon the phemic sheet is the "entire graph", and any entire graph is a representation of the essence of the content of the phaneron (namely the universe over which the discourse is understood to run). Graphs are projections on the sheet, which now includes all of its qualities, including moods and modalities.[53] As an icon of the phaneron, the Phemic sheet represents feelings and sensations, as an index of it the sheet is interpreted as being linked with the universe of discourse and drawing attention to it, and as a symbol it represents the essence of thoughts.[54]

The last term in this glossary is the glue between the above notions: an explication of what Peirce took the science of the study of the phaneron to be, namely phaneroscopy.

Phaneroscopy. Peirce's definition of the science of phenomenology is relatively succinct. He defines phenomenology as "the science which describes the different kinds of elements that are always present in the Phenomenon, meaning by the Phenomenon whatever is before the mind in any kind of thought, fancy, or cognition of any kind".[55] Coterminous with his more frequent

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[50] R 292a

[51] Letter to Risteen, R L 211, 1911

[52] R 292b

[53] "It is now needful to notice sundry defects and other peculiarities of the System of Existential Graphs from which we must not assume without sufficient proof that there are corresponding peculiarities in the Phaneron itself. Some of these are so obvious as not to call for any particular mention. Thus, from the fact that the Phemic Sheet has two dimensions we must not assume that the field of the Phaneron is two-dimensional, although I am inclined to think that it happens to be so. For this peculiarity of the System of Graphs is plainly due to a certain property of vision taken in connection with the fact that the diagrams that the System is designed to furnish are Visual Diagrams" (R 499(s)).

[54] R 300

[55] R 464, 1903

term, *phaneroscopy*, phenomenological analysis groups elements involved in consciousness in three categories. We already encountered them when explaining the three ingredients present in states of awareness. Since expositions of these three universal, or Cenopythagorean, categories (firstness, secondness and thirdness) have received their fair shares in the extant literature, we move on to a couple of less-known aspects of Peirce's phenomenology. It is such aspects that relate to the question of mind and mental representations that can be presented in sign-theoretic terms.

The first thing to appreciate in phaneroscopy is that the three elements in cognition are inseparable. It would not be possible to identify them regardless of how they are related to one another. Thus it is not be viable to think in terms of certain "phenomenal concepts" as a separate category.[56] Every possibility of thought involves all three. Yet it is a logical analysis that reveals that all these three kinds of elements in cognition are *real*.

Everything that we can possible think of has an element of what it is, regardless of anything else; without any relation to other things other than likenesses. Such are images created in the mind as icons. As to the second category, expectations are images formed in our minds, preserved until experience compels to change them, causing a thought to evolve into another thought. An image that partakes of the idea of reaction with something other than itself is an index of its object. That image is subject to be removed from consciousness whenever the mind moves onto an actual state of recognition, such as in a waking thought or in the awareness of the difference between dreaming and being awake.

Third, tendencies influence the future conduct of persons by conforming to the ways in which minds have been influenced to conform. Meanings of what a person believes in are influences

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[56] Stoljar 2005

that affect behaviour by compelling a change in the person's habits of behaviour. Images that are of this kind are of the nature of symbols.

Icons make truths evident. That is, what an image presents to the interpreter of that image is included in that image. Here the other major trichotomy of signs arises. What images present to the interpreter are conveyed by *rhemas* (predicates, semes). Rhemas are simple constituents of propositions. This does not yet yield understanding, as understanding requires that the truth of a representation is interpreted in a symbol, and the object of a symbol is always more or less general. Understanding can thus only be represented in *arguments*, which Peirce later renames "delomes".[57] Rhemas and arguments are the first and the third class of signs in the second trichotomy of sign categories. The second class consists of propositions, which Peirce in 1903 generalized into *dicisigns*[58] and further in 1905 into *phemes*. Pheme, as noted above, was an important late addition to Peirce's theory of cognitive signs.

3. Conclusions

Cognition. In conclusion, we end with a brief characterization of Peirce's use of the term "cognition" and draw a couple of conclusions.

The phemic sheet is an icon of all there is in the quasi-mind at any time and in any way. The phemic sheet is the object of the phaneron. Mental imagery belongs to the content of the phaneron and receives its form as a sign whose predominant quality is that of an icon. Imagery is generalized form of thinking whose character can be analysed – both logically and

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[57] R 292a

"A Delome (dee'loam) shall be represented by a series of such diagrams imagined to be phenakistiscopically combined" (R 292a). Notice that Peirce's technical use of the term "argument" should not be confused neither with the term's typical nor colloquial meanings.

[58] Stjernfelt 2014

phaneroscopically – in terms of thought-signs. As constituents of the Phaneron, these thought-signs are icons, and as graphs, namely as "moving-pictures of thoughts" that make the "system for diagrammatizing intellectual cognition",[59] these graphs have their representative force as symbols.

Briefly put, Peirce took it that "a thought is a cognition and therefore a sign".[60] This is the conclusion of the relatively complicated machinery expounded above, and to be able to draw it involves a parallel development of both it logical as well as semeiotic components. An illuminating version of this conclusion is provided in his unpublished note, probably written as a reply to the questions received from members of the audience attending his 1903 Lowell Lectures, in which Peirce wrote: "Consequently a Thought, being of the nature of a Representation, cannot be 'present' to consciousness. A thought is something that has to be enacted, and until it is enacted, its meaning has not been given, even to itself".[61]

The requirement for a thought to be *enacted* in order to be meaningful is quite striking, and not least because it resonates quite closely with what modern cognitive sciences have come to suggest. For Peirce's theory is not limited to enactment. Other concepts that can be related to contemporary studies of cognition show up in several other places in his writings as well. In commenting on Kant's theory of cognition, for example, Peirce recounts how Kant "sets out from the obvious truth that cognition is the result of the interaction of two independent agents, the mind and the real object". From this Peirce takes Kant to have jumped to the assumption that "cognition has two parts; its matter, which is determined by the object; and its form, which is determined by the mind". This Peirce finds erroneous. A musical note produced by the interaction of a violin-string and a bow does not entail that the sound has two parts, one due to

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[59] R 292a

[60] R 499(s)

[61] R 478, "Answers to Listeners' Comments". (These comments came from William James.)

the action of the string and the other due to the action of the bow. Peirce also asks whether we would have to take "the pain of having a tooth drawn necessarily consist of two parts, one due to the tooth and the other to the dentist's tug?"[62] In a similar fashion, in the phaneron, a thought-sign is an icon, and on the phemic sheet, it is a symbol. It does not follow that the thought has two parts, one coming from the representation of it in the phaneron and the other from the representation of it on the sheet as a proposition.[63]

Not only needs thought to be enacted, it needs to be embodied. Indeed all thought, being dialogical,[64] "is embodied in signs".[65] Embodied thought means that there are signs of which we have knowledge that they will be interpreted as signs. Clearly thought-signs, as embodiments of thought, are symbols. They are signs which "will be interpreted as being signs".[66] Thought-signs are in Peirce's terms "the signs that they are, neither by processing any decisive qualities nor by embodying effects of any special causation, but merely, by the certainty that they will be interpreted as signs, and as just such and such signs".[67] This is thus neither an internalist nor an externalist characterization of meaning. Enacted and embodied, thought-signs propose a different approach to cognitive architectures from those that we would

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[62] R 280

[63] The graphical representation on the sheet of course refers to Peirce's theory of existential graphs, which is the method of "diagrammatizing intellectual cognition" (R 292a) and is involved in the symbol.

[64] "[E]very cognition is a sign as Leibniz and other nominalists have sufficiently shown and all deliberate meditation is of the nature of a dialogue as Plato represented it to be" (R 499).

[65] R 298

"That which is communicated from the Object through the Sign to the Interpretant is a Form; that is to say, it is nothing like as existent, but is a power, is the fact that something would happen under certain conditions. This Form is *really* embodied in the object, meaning that the conditional relation which constitutes the form is *true* of the Form as it is in the Object. In the Sign it is embodied only in a *representative* sense, meaning that whether by virtue of some real modification of the Sign, or otherwise, the Sign becomes endowed with the power of communicating it to an Interpretant" (R 793).

[66] R 298

[67] *Ibid.*

gather from representational theories. As a theory of mind that contemplates icons, phaneroscopy is a theory of undifferentiated sensations. The theory of signs, in turn, is a general theory of cognition, where the mind is the repository that produces signs. The sign is the object of the mind (or the quasi-mind). The meaning of signs, including the meaning of thought-signs, is in their conceivable consequences, which are habits of the mind acting in certain ways in certain kinds of circumstances.

As to this last point, Peirce came to regard mind co-extensive with a "sign-creatory": mind is anything that is capable of uttering signs under any "mode of embodying the thought".[68] To be a thought-sign, thought has got to be embodied, and it has got to be enacted. Clearly, a thought is also extended. Or, more accurately speaking, being represented as a symbol by a quasi-mind, a "generous triad" is omnipresent in signs. Embedded? Naturally, but also not only: signs are not things but complex relations that obtain between utterers and interpreters, which may be things as varied as organisms and environments, assertions and their context, and much else besides. Thus the modern 4E-theories of cognition might do well in having a second look at the key elements of Peirce's theory of signs.

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[68] R 318: 18, 1907

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Jelena Issajeva

Mental Imagery as a Sign System

1. Introduction

The query about the nature of mental imagery (MI) is one of the most controversial and yet important questions for cognitive science to solve. Two dominant rival theories were proposed – quasi-pictorial/analogue[1] and descriptive/propositional[2] – to account for the mental imagery phenomenon.

According to the (quasi-)pictorial theory, mental images are picture-like representations in the mind. Such analog representations are, according to Kosslyn,[3] viewed on a surface display (or as Kosslyn calls it, "visual buffer") and possess properties similar to those that can be found in ordinary pictures: spatiality, size, colours, shapes, dimensions, distances, etc. Yet another popular account of MI – description theory or propositional theory – states that images might better be thought of as being a description rather than pictures, and presumably are formulated in language(-like) terms (see for example J. Fodor's "language of thought" hypothesis). Many of the adherents of the propositional theory severely criticize the notion of inner mental pictures that are reproduced on some visual inner display and then reperceived by the "mind's eye"[4]. This controversy between the

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1 S. M. Kosslyn, "Aspects of a Cognitive Neuroscience of Mental Imagery", *Science*, New Series, vol. 240, issue 4859 (June 17, 1988), pp. 1621–1626; S. M. Kosslyn, *Image and Brain: The Resolution of the Imagery Debate*, Cambridge, MA: The MIT Press, 1994; S. M. Kosslyn, W. L. Thompson, and G. Ganis, "Mental Imagery and the Human Brain", in Q. Jing et al. (eds.), *Progress in Psychological Science Around the World*, vol. 1: *Neural, Cognitive and Developmental Issues*, London: Psychology Press, 2006, pp. 195–209.

2 J. A. Fodor, *The Language of Thought*, Cambridge, MA: Harvard University Press, 1975; Z. W. Pylyshyn, "Mental Imagery: In Search of a Theory", *Behavioral and Brain Sciences*, vol. 25, no. 2 (2002), pp. 157–238; Z. W. Pylyshyn, *Seeing and Visualizing: It's Not What You Think*, Cambridge, MA: The MIT Press, 2003.

3 S. M. Kosslyn, *Image and Mind*, Cambridge, MA: Harvard University Press, 1980, the quoted passage on p. 6.

4 Z. W. Pylyshyn, "What the Mind's Eye Tells the Mind's Brain: A Critique of Mental Imagery", *Psychological Bulletin* 80 (1973), pp. 1–24; P. Slezak, "Artificial Imagery? Commentary on Janice Glasgow's 'Computational Imagery'", *Computational Intelligence*, vol. 9, no. 4, November 1993, pp. 349–352; P. Slezak,"The 'Philosophical' Case Against Visual Imagery", in P. Slezak, T. Caelli, and R. Clark (eds.), *Perspectives on Cognitive*

two theories constituted the well-known Mental Imagery Debate, which yet has not been solved.

Both dominant theories are based on the representational framework, i. e. on the search for a particular (or dominant) format of the mental representation and the way this representation is formed and further operated. Taken from this perspective, there indeed can be only two main answers to the question of what mental imagery really is – either a picture-like representation or a language-like representation. Hence, the problem of the nature of MI stays and the controversies remain unsolved. So, what is mental imagery really? Is it a picture in the head as Kosslyn et al. suggest? Or is it a string of language-like thoughts as Pylyshyn et al. propose?

In this paper, I am going to argue that mental imagery is, rather, a complex system of signs and their properties, which can be combined, detached from each other, associated and manipulated voluntarily by our minds in various ways. I believe that the starting-point question regarding what constitutes the mental imagery phenomenon has been strongly misguided. Instead of speculating about the format of mental imagery detached from experimental setting, one might look at the functions and properties of images themselves and within the broader context of relations where images are formed and used. In this case we might get much more information regarding what mental imagery really is. If one would look at the phenomenon of mental imagery as being a sign system, many questions on the issue could be easily accommodated and problems resolved. Let us have a closer look at the signifying nature of MI and at how such a sign system might work in human mind.

2. What is a Sign?

In order to understand to what extent we can talk about mental images as mental signs, it will be useful to begin with the explanation of what a sign is and how it functions in the mind. The most systematic and elaborated theory of signs was suggested by semiotician and philosopher C. S. Peirce. He viewed the general theory of signs (or semeiotics) as the logic of thinking. Indeed, all experience and all thinking of the human mind are carried, as he saw it, by signs.

Science: Theories, Experiments and Foundations, Norwood, NJ: Ablex Publishing Corporation, 1995, pp. 237–271; P. Slezak, "What Happened to the Imagery Debate?", in *Proceedings of the 24th Conference of the Cognitive Science Society*, Lawrence Erlbaum Associates Publishers, 2002.

So, what is a sign? In his work on "speculative grammar" Peirce gives the following definition of a sign: "A sign … is something which stands to somebody for something in some respect or capacity. It addresses somebody, that is, creates in the mind of that person an equivalent sign, or perhaps a more developed sign. That sign which it creates I call the *interpretant* of the first sign. The sign stands for something, its *object*."[5] This definition uncovers two main aspects of a sign: first, Peirce defines the sign through its participation in the semiotic or signifying process (i. e. semiosis), and secondly, he views sign as consisting of three relata or three basic elements (of a sign relation) – a sign itself or signifying vehicle or representamen (as Peirce sometimes calls it), an object which the sign stands for and an interpretant as the meaning of the relation between signifying vehicle and its object. What is crucial for understanding the nature of the sign is that it can only be understood as a part of semiosis – the sign relation. So, the sign, its structure and nature is all about the relations between its three elements. Schematically, the basic structure of the sign can be depicted as in Figure 1.

Figure 1: The structure of a sign
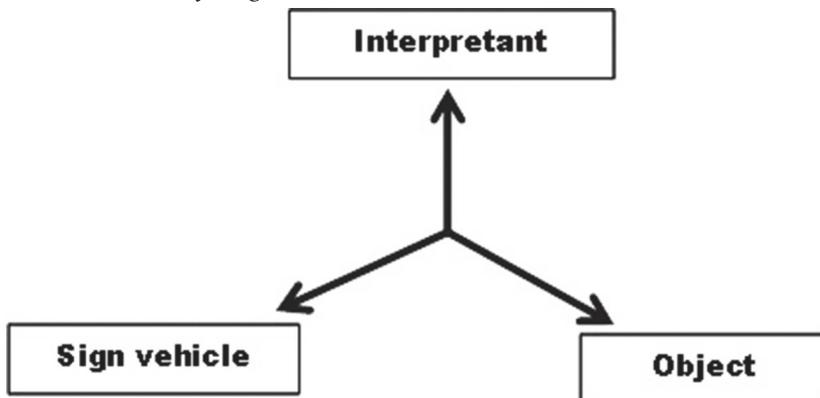
To summarize, a sign can be viewed the fundamental structural element of our cognition and the mind. It is through signs and sign relations that the production of meaning is possible. So, the existence of signs in one's mind and the relations between them enables the cognizing subject to truly understand the surrounding world, people and itself. Thus, mental signs play the role of a medium between the cognizing subject and the objects of the external world.

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5   *The Collected Papers of Charles Sanders Peirce*, electronic edition, introduced by John Deely, reproducing vols. I–VI of the edition by Charles Hartshorne and Paul Weiss (Cambridge, MA: Harvard University Press, 1931–1935), for the quoted passage see CP 2.228 Cross-Ref.

3. The Mental Image as a Sign

But why do I suggest that the mental image can be viewed as a sign? In my opinion, there are substantial reasons to account for mental imagery as a sign system and a mental image as a sign respectively. Namely, I believe that the mental image shares a similar trichotomic structure, functions and properties with those of a sign.

Firstly, if we analyze the mental image on its own, then the very first characteristic that we will notice is the intentionality of images. In other words, an image is necessarily about something, or is directed towards some object. Thus, just as a sign, the mental image has an object, which it (an image) represents. In the case of mental imagery, the object is not necessarily a particular thing that a person has previously experienced, and is now absent from his direct experience. The image can be about some situation, any property, experience, state or even a feeling. The image can be divergent from external reality, it can represent an object that does not exist outside in the physical world. But, in any case a mental image "stands for something", i. e. it represents an object.

Secondly, since an image stands for some object, the image also should have something that will enable it to represent its object. In other words, an image should have some sort of a ground element or sign vehicle. The ground of the sign is the element that represents or stands for its object in some meaning: "[A sign] stands for [its] object, not in all respects, but in reference to some sort of idea, which I have sometimes called the *ground* of the [sign]."[6] Peirce sometimes also calls this element a *representamen*, since this part of the sign represents (in the broadest possible sense) its object in some meaningful relation. As an image necessarily stands for some object, it follows that it should necessarily have this ground element, which would represent its object. In this respect, an image again resembles a sign.

Finally, since the mental image has a ground element, which necessarily represents some object, this relation of representation should be meaningful to the subject, who possesses the image. It is through the relation of representing its object that the image obtains a meaning. In other words, the image stands for some object in "some respect or capacity". Hence, as a sign, a mental image has an *interpretant*. Indeed, the image necessarily conveys some meaning, whether it is a single property, quality or even a more developed and complex meaning.

To summarize, the mental image necessarily stands for some object. It also has the ground element or representamen that enables the representation of this

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6   *Ibid.*

object. And as a result of the correlation between representamen and object, the meaning – or, speaking in Peirce's terms, the interpretant – of an image is produced. Thus, the mental image can legitimately be interpreted as a sign, because it shares the same structure as the sign and the (general) definition of the sign. Just as a sign, a mental image consists of the said three basic elements. Hence, just as a sign, a mental image can be defined as "something which stands to somebody for something in some respect or capacity". Thus, an image is formed and should be interpreted in the context of the signifying process or semiotic process, as well as within the network of the sign relations and the relations between the three relata. So, if we apply the above-given scheme about the sign structure to the analysis of mental imagery, a structure of the mental image as shown in Figure 2 can be suggested.

Figure 2: The structure of an image
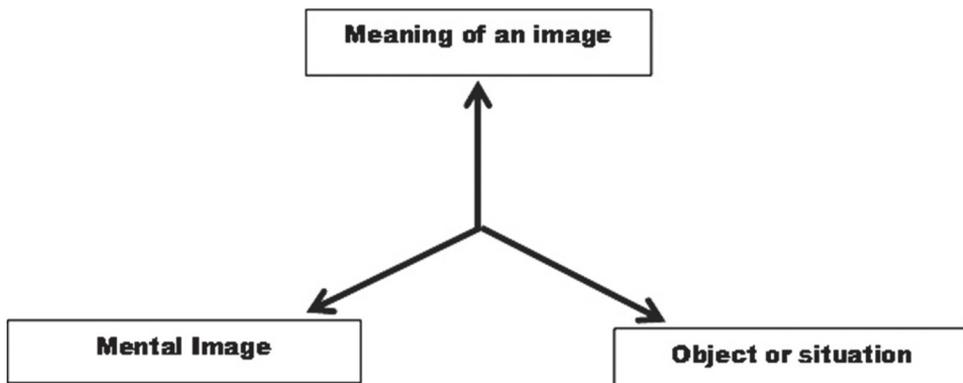
4. Classification of Signs

If we investigate the three relata of the sign and the relations between them in more detail, we come to be equipped with a profound analysis of the sign. In 1903 Peirce elaborated a fine-grained classification of signs, which became a significant part of his sign theory. According to Peirce, if we analyze each of the three elements and their features, we can arrive at ten various classes of signs. "signs are divisible by three trichotomies; first, according as the sign in itself is a mere quality, is an actual existent, or is a general law; secondly, according as the relation of the sign to its object consists in the sign's having some character in itself, or in some existential relation to that object, or in its relation to an interpretant; thirdly, according as its Interpretant represents it as a sign of possibility or a sign of fact or as a sign of reason". In other words, each of the three sign elements –

sign, object and interpretant – can be also seen as divisible into three sub-types. Peirce calls the first of the three thrichotomic divisions "qualisign", "sinsign" and "legisign", the second "icons", "index" and "symbol", finally the third division is called "rheme", "dicisign" and "argument"[7]. All together these three trichotomies give rise to the 10 classes of signs. The first of the trichotomies is based on the sign "as it is in itself", the second division is based on "the relation of the sign to its object", and the third trichotomy is thus based on the sign "as its Interpretant represents it". Hence, if we include this classification of each of the three relata of a sign into the general scheme depicting sign structure, the renewed scheme might look as shown in Figure 3.

Figure 3: Detailed structure of a sign
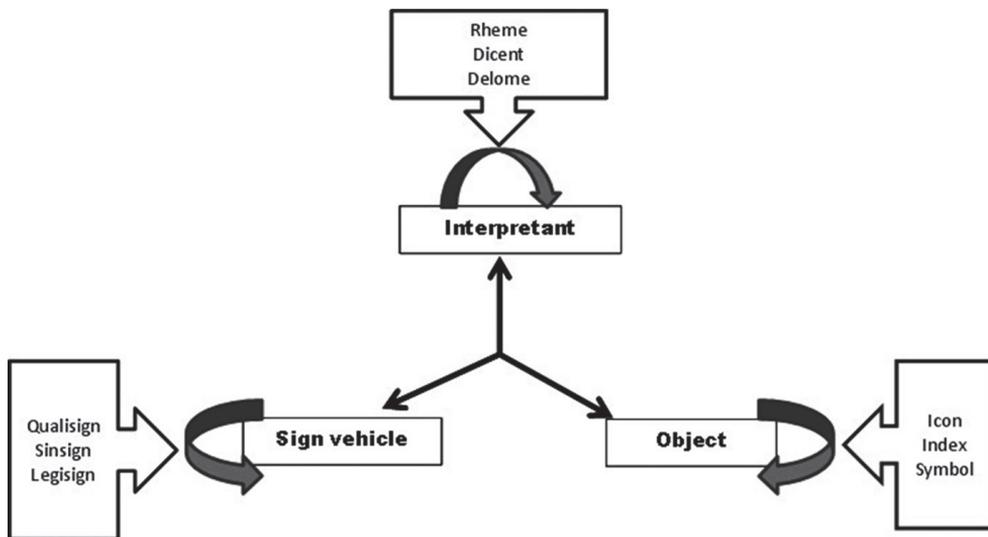
So, in relation to itself (i. e. in relation to its sign vehicle) every sign is either a quality or possibility (qualisign), an actual individual fact (sinsign), or a law, habit (legisign). Qualisign is a sign which consists in a quality of feeling, a possibility. It is immediately given and unreflected upon. Qualisign thus signifies in virtue of some quality. Sinsign signifies in virtue of some existential fact. Any sign, whose sign-vehicle relies upon the existential facts and connections with signifying object is a sinsign. Finally, sign-vehicle can signify in virtue of conventions and laws, such a sign is called by Peirce a legisign.

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7   CP 2.243 Cross-Ref., 2.244 Cross-Ref., CP 2.247 Cross-Ref., CP 2.250 Cross-Ref. to
     CP 2.252 Cross-Ref.

Further, signs are similarly classifiable according to how their object is represented by its sign-vehicle. If the sign represents its object based on some resemblance of characteristics or qualities of an object, then this sign is called an icon. If the sign represents its object based on some existential connection with its object, then this sign is called an index. Finally, if the sign represents its object based on some conventional law or habit, then this sign is a symbol. Thus, every sign refers to its object either through similarity to its object, through factual connection with its object or through habit and convention binding it to its object.[8]

The last thrichotomical division is based on the way the sign is interpreted, on the kind of interpretant it has. Hence, in relation to its interpretant a sign might be either a rheme, a dicent, or an argument. If the sign determines an interpretant by focusing our understanding on the qualitative features, such sign is called the rheme. If the sign determines an interpretant by focusing our understanding on the existential features, then such sign is called the dicent. Finally, if the sign determines an interpretant by focusing our understanding on the conventional or law-like features, such sign is called a "delome". So, the sign may appeal to its interpretant in one of the three ways – as being a rheme, dicent or argument.

5. Analysis of Images

I believe that if we analyze mental imagery from the perspective of the detailed sign structure and the various classes of signs, we will get a full-fledged explanation of mental imagery. Let us consider an example: Imagine yourself experiencing the smell of a rose in the garden. You go out from the back door of your house to enter the garden behind the house. You are standing on the terrace and while looking at the garden, imagine that you are having the sensation of a flower smell. You don't yet see the roses, but you feel the subtle, sweet flower smell and you recognize this smell immediately as being a smell signifying that somewhere near roses grow. How can this simple ordinary day-dream be analyzed?

I suggest that the most profound analysis of MI can be given in terms of signs. The above-given example produced a compound image consisting of several elements and conveying thus a complex meaning. Firstly, as a sign-vehicle this image will most probably be a qualisign. What signifies is the quality, a sweet

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8   CP 4.531.

and subtle flower smell that represents the object (rose). Thus, the quality (smell) will be here the representamen of its object (rose). Next, as regards the object of signification the image will be an index. In this imaginary example, the signification relation itself is based on existential and causal relations between the sign-vehicle and the existential object – the smell co-exists with the rose. The existence (or presence) of the rose is the cause of the smell. Thus, with respect to the object of signification an image is an index. Finally, the interpretant of an image will probably be a rheme. The immediate meaning that was conveyed by the image is the recognition of subtle, sweet sensation as being the smell of a rose. In this case the sign determines an interpretant by focusing our understanding on the qualitative feature (i. e., smell) that it employs in signifying its object (rose).

But, as Peirce himself pointed out, there are no "pure" types of signs, usually we have several features combined together.[9] So, the analysis of the previous imaginary example might be continued further and other characteristics of the image might be uncovered. Thus in the previous example, the sign-vehicle might have also some existential features. In this sense the sign-vehicle can represent not only as a quality (smell), but also as causal co-existence (smell–rose). Thus, the representamen here might have the properties of a sinsign as well. Further, the signification of an object (rose) can also have some iconic features. In your dream you might visualize the particular flower, which resembles the real object in the outside world. Finally, the above-described image can also convey an existential interpretant (dicent). Once you have reflected upon your immediate sensation of a sweet and subtle smell, you realize that if there is the sweet and subtle smell of a rose, then there also should be a rose itself, as the carrier of this quality (smell). This is already an analyzed understanding of an existential relation between quality and object that goes beyond immediate meaning. Thus, previous considerations, I believe, have shown two main points: 1) mental imagery can legitimately be viewed in terms of a sign system, and 2) such interpretation can potentially suggest a versatile understanding of the MI phenomenon.

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9   CP 2.302 Cross-Ref.

6. Conclusion

To conclude, the aim of this paper was to show that mental imagery is a complex and compound sign system. And there are serious reasons to believe so. The representational framework that underlies two dominant accounts on MI, inevitably restricts our comprehension of mental imagery. The true nature and functioning of a mental image can be only understood in a wider context of the signification procedure, the relata of the sign and the relations between them. Though a more developed investigation of this account is needed, I believe that this view might potentially have far-reaching consequences. It can accommodate various properties and features of mental images into one coherent explanatory theory, reconcile divergent views, theories and empirical evidence on the issue, and give a more profound understanding of the working mechanism and cognitive role of MI in the human mind.[10]

Publication V

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THE HETEROGENOUS AND DYNAMIC NATURE
OF MENTAL IMAGES:
An empirical study

Abstract. *This article addresses the problem of the nature of mental imagery from a new perspective. It suggests that sign-theoretical approach as elaborated by C. S. Peirce can give a better and more comprehensive explanation of mental imagery. Our empirical findings follow the methodology of cognitive semiotics and they show that (i) properties of mental images are heterogenous in nature; (ii) properties of mental images are dependent on the characteristics of object-stimulus; (iii) properties of mental images are dependent on individual differences in imaginary capacities. This suggests that, contrary to representational accounts, mental imagery is not based on one dominant representational format. Imagery constitutes a complex system of signs consisting of several sign elements and dynamic relations. A sign-theoretical account may give a better explanation of the nature of mental imagery, as it accommodates heterogenous evidence from this experiment.*

Keywords: *mental imagery, representation, experimental semiotics, theory of signs, Peirce.*

1. Introduction

Since the 'cognitive revolution' the question about the nature of mental imagery (MI) remains one of the most debated ones in cognitive sciences and philosophy of mind. This article presents new empirical evidence on the matter that follows the methodology of cognitive semiotics. The experimental results showed that (i) properties of mental images are heterogenous in nature; (ii) properties of mental images are dependent on characteristics of object-stimulus; (ii) properties of mental images are dependent on individual differences in imaginary capacities. These results conform with empirical data in neuroscience (Bartolomeo 2008; Moro et al. 2008; Dulin et al. 2008), which claim that one dominant representational account does not adequately

explain MI. Supported by empirical findings, this paper argues that mental imagery is better explained in terms of sign theory as proposed by C. S. Peirce.

What is MI? Traditionally, two dominant rival theories have been proposed, (quasi-)pictorial and propositional. According to the (quasi-)pictorial theory, mental images are picture-like representations in the mind (Kosslyn 1978, 1980, 1994; Pinker and Finke 1980; Finke, Pinker and Farah 1989). Proponents of propositional theory, on the other hand, claim that MI constitutes verbal representations or language-like descriptions (Pylyshyn 1973, 1981, 2002, 2003; Fodor 1975, 1990). The controversy between the two constitutes the Mental Imagery Debate.[1] It is common to understand both rivals in the framework of computational-representational paradigm[2] of mind, which implies that all mental states are products of mental computation. In this context, representational theory is focused on a search of one dominant format or code[3] that underlies mental imagery, as well as other mental states.

Adherents of both representational theories have deployed empirical methods to prove their respective claims. Kosslyn and colleagues have experimentally shown that mental imagery (MI) has certain spatial and picture-like properties (size, colors, shapes, dimensions, distances, etc.) and thus concluded that images are most likely pictorial representations (Kosslyn 1980, 1988, 1994; Kosslyn et al. 2006; Shepard and Metzler 1971; Pinker and Finke 1980; Shepard and Cooper 1982; Slotnick et al. 2005). In contrast, Pylyshyn and colleagues (Fodor 1975, 1990; Slezak 1990, 1991, 1995) argued that there is substantial empirical evidence to think of images as being descriptions formulated in language(-like) terms rather than pictures (see for example Fodor's "Language of Thought" hypothesis, 1975).

Despite persistent ambiguities of data on the matter, Imagery Debate was claimed to be solved in favor of (quasi-)pictorial theory of MI (Kosslyn 1994; Pearson and Kosslyn 2015). However, in the light of new experimental methods and results the previous long-standing theories of MI have been reconsidered. Research shows that there are significant difficulties in the representationalist (either pictorial or propositional) approach, some of which are inherent to the representational-computational paradigm (Milikan 1984; von Eckardt 1993;

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1   On the Imagery Debate and details on the theories of MI, see Thomas 2010, 2014; Kosslyn 1980, 1988, 1994; Kosslyn et al. 2006; Pearson and Kosslyn 2015; Pylyshyn 1973, 1981, 2002, 2003; Tye 1991.

2   On representational-computational paradigm of mind see Van Gelder 1995; Clapin 2002; Marr 2006.

3   The discussion of whether there are two mental codes that underlie our mental states is called dual-common coding debate. The latter stems from Alan Paivio and his work on memory and learning effects (Paivio 1971, 1986). Noteworthy, dual/common coding debate is different from Imagery Debate (which is also called analog/propositional debate), but has often been confused. Dual-common coding debate focuses on whether we learn and memorize information by using one mental code or another. The analog/propositional debate, in contrast, investigates the nature of MI. It is the latter, which is the focus of present study.

Bechtel 1998; Knuutila 2005, 2011). First, under similar experimental settings mental imagery can exhibit (at least) both types of properties – verbal and pictorial (Anderson 1978; Pylyshyn 2002; Ganis 2013). Also, most empirical results on MI yield multiple interpretations (for a detailed discussion of explanations of the experimental results, see Pylyshyn 2002). Most replicated experiments on MI often show differing results (Pylyshyn 1981, 2002; Slezak 1990, 1991; Chambers and Reisberg 1985; Rock, Wheeler and Tudor 1989). There is also a significant amount of empirical evidence proving the existence of motor, tactile, auditory properties of mental imagery (for details, see Lacey and Lawson 2013; Keller 2012; Pascual-Leone et al. 1995; Plessinger 2007; Richardson 1995; Gregg and Clark 2007; Schimdt et al. 2014). All this yields to the conclusion that current empirical data cannot be fully accommodated either by (quasi-)pictorial or by propositional accounts of MI. Maybe understanding of mental imagery cannot be restricted to the dichotomy verbal-pictorial and the search of one dominant format[4] of MI is misleading. What is mental imagery really like? Is it a picture in the brain, some propositional or verbal string of language-like characteristics, or something else still?

Most of the novel approaches have emerged in this context, such as enactive and attention-based quantification theories.[5] Both attempt answering the question of what the true nature of mental imagery is (Thomas 2010; Sima 2011). According to the enactivist approach, mental imagery is a mental capacity of an active cognitive search of information in the absence of the actual perceptual stimulus (Thomas 2009: 454–455). Although enactivism is a representational account, it encounters problems such as vagueness of explanation of the nature of MI and inability to explain deep complexity and multiplicity of properties of images. Yet another alternative account – attention-based quantification theory – explains imagery in terms of attentional processes that quantify spatial and visual information by operating upon two working memory structures, namely Qualitative Spatial Representation (QSR) and Visuo-spatial Attention Window (VSAW) (Sima 2011: 2880). The attention-based quantification theory tries to integrate memory and attention to explain MI, but it relies on qualitative representations and encounters the same difficulties as other representational theories. In sum, increasing diversity of alternative theories has not solved the question.

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4   By the term "representational format" we mean internal structure of the mental image, or its "cognitive architecture". We use the term "cognitive architecture" largely in the sense of Z. Pylyshyn (2002), namely to mean the underlying structure of MI, that is "properties and mechanisms [that] are *intrinsic* to, or *constitutive* of having and using mental images" (Pylyshyn 2002: 159, original emphasis). Noteworthy that we do not take "representational format" to mean phenomenal modality.

5   Alternative theories – enactivism and attention based quantification theory – are relatively unpopular views in solving the issues of MI. Dominant accounts remain representational. Thus, current empirical study was designed to test the consistency of most dominant representational accounts on MI.

This article suggests a novel semiotic approach to address the question. In particular, it argues that Peirce's theory of signs as proposed applies well to the analysis of mental imagery and that it can give a coherent explanation of diverse empirical data. We begin with a brief analysis of the theoretical premises of the theory of signs as contrasted with traditional representational accounts. Section 3 describes the experimental design, hypotheses, experimental methodology and procedure. Section 4 provides the results of the experiment. Section 5 is the discussion of the results and their analysis.

2. Theory of signs and MI

Peirce's theory of signs (or semeiotic) is an account of signification, reference and meaning (Pietarinen 2015). There are several formulations of theories of signs (see for example Saussure 1983; Morris 1938, 1946, 1964), but Peirce's account is distinctive for its "breadth and complexity" (Atkin 2017: 1). It interprets MI[6] as a complex *system of signs,* which consists of three elements – representamen, object and interpretant – and is characterized by dynamic and flexible relations between these elements (Issayeva 2015; Pietarinen 2012). Such an approach begins with the premise that the mind is of a signifying nature. In particular, the human mind is a sign-producing and sign-interpreting system, characterized by the semiotic processes of signification, i.e. by dynamic, changing and context-dependent processes that create signs and manipulate them. Peirce associates cognition with signs. According to Peirce, all our mental states are signs: "we think only in signs" (Peirce 1994, CP 2.302) "a theory of experience, a theory of consciousness" (Zeman 2014: 1). The human mind constitutes "a historically existing continuum of interpretants (which are signs)", i.e. the the history of signification of objects in one's mind (Zeman 2014: 2). Peirce's famous claim was that "man is a sign" (Peirce 1994, CP 5.314; Peirce 1998, EP 1:54), a person consists of her own thinking, and since all thoughts are in signs, a person is a historical series of signs.

But what does it mean to say that MI is a sign system? First, mental imagery has a signifying nature. MI shares the same structure and features with a sign in the human mind. Just as a sign is defined as "something which stands to somebody for something in some respect or capacity" (Peirce 1994, CP 2.228) in the same way a MI can be legitimately characterized. Thus, just as a sign, MI is comprised of three main elements: representamen, object and interpretant (Peirce 1994, CP 2.228; Peirce 1998, 478). MI also has a

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6   Noteworthy that sign-theoretical definition of MI is twofold. According to Peirce imagery can be understood 1) in a narrow sense meaning the representamen element or something that stands for something, or 2) in a broader sense meaning a mental entity consisting of three elements and constituting a signifying whole, i.e. a system of signs. We take mental imagery as a faculty to mean the second. Though, both definitions can be met in the discussion.

representamen, which is an element that stands for some object or event. MI has necessarily an object, which it signifies. And it has an interpretant or the meaning that holds between representamen and its object. Hence, every mental image signifies something.

Second, to say that mental imagery is a sign system means that MI is guided by dynamic, context-dependent signifying relations between its elements. According to the sign-theoretical account, relations between elements of the sign are dynamic, i.e. they continuously develop and change their characteristics dependent on various factors. As Floyd Merrell (2001) puts it: "signs simply cannot stand still" (Merrell 2001: 37). Similarly, mental images are not stable or fixed, but are rather of dynamic nature. MI evolve and continuously develop under the influence of both internal (e.g. subjective memory, experience and dispositions) and external (e.g. changes in language, objects' features and new knowledge) factors. The latter entails that mental images are dependent on the context, where they were produced, as well as on the subject, who produced or interpreted an image. The changes in the environment significantly influence both the relations and characteristics of the MI elements. Shortly, context as well as personal experience and cognitive dispositions matter. These influence the whole process of signification. Sign-theoretical account as proposed by Peirce can accommodate these features. The dynamics, openness and flexibility of the triadic relations allows to explanation of divergent and changing properties of images under the umbrella of one sign-theoretical account.

To sum up, a sign-theoretical approach towards the explanation of mental imagery yields that a mental imagery is a sign system, which consists of three main relata – a signifying-vehicle or representamen, an object and an interpretant – and is characterized by dynamic, context-dependent semiotic relations between them. Together they – a set of sign-elements and semiotic relations – constitute an interconnected network that works together as a whole. Schematically, these assumptions can be depicted in the following way:
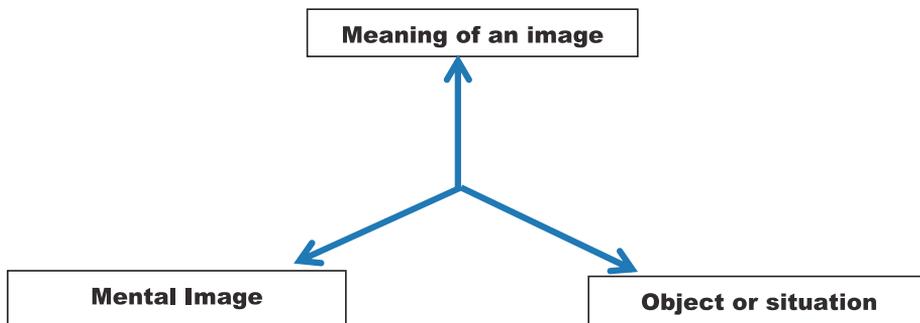
Figure I: Structure of a mental image

Based on the triadic structure of a sign, Peirce elaborated a fine-grained classification of signs. Each of the three sign elements – representamen, object and interpretant – can be further analysed and divided into three sub-types (Peirce 1994, CP 2.243). In relation to representamen a sign can be divided into Qualisigns, Sinsigns and Legisigns, in relation to its object to Icons, Indexes and Symbols, and finally the third division, Rhemes, Dicisigns and Arguments, is related to the analysis of interpretant (Peirce 1994, CP 2.244–2.252). Together these three trichotomies give rise to ten classes of signs. Applied to MI, classification guides a comprehensive investigation of a mental image and each of its relata, and makes Peirce's semiotics a promising method for an in-depth analysis of MI.

A sign-theoretical approach, thus, might provide a new perspective to MI. It can potentially overcome traditional controversies and limits of the representational accounts and might eventually give a sound and coherent explanation of the MI and its relata.

3. Methods

How to test these assumptions? How can we prove that mental imagery indeed can be legitimately interpreted as a sign system?

To test this, we have conducted a test using the methodology of cognitive semiotics and experimental philosophy. The choice of the method of investigation was not arbitrary. First, semiotics is the science that studies signs and their use. In particular, methods of experimental cognitive semiotics and examples of cognitive task design offer a unique way to test the production of a sign in its dynamics and track the most fundamental features of the signification process.

Second, MI constitutes a complex theoretical and interdisciplinary problem with a long tradition in philosophy of mind. Thus the research methods from philosophy sharpen the theoretical hypotheses and our experimental design. In particular, the methodology of experimental philosophy was employed to empirically investigate MI. Experimental philosophy approaches philosophical problems from empirical perspectives. This is of a special value in approaching the debate about MI.

Finally, experimental methods[7] conform to the investigation of imagery in cognitive psychology. The latter has resulted in divergent empirical data

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7   Although current study uses mostly qualitative research methods and does not rely on the brain scanning techniques (fMRI and EEG), the results of our study are still taken to be contributive to the discussion of MI. There are a series of high-powered qualitative research that gives important results on the functions of images without brain scanning and physiological response potential techniques. Actually, some of the classic and most influential experiments on MI (e.g. Perky 1910; Shepard and Metzler 1971; Paivio 1971) are qualitative in nature. Besides, traditional representationalist experimentations on MI (mental scanning, mental mapping and mental paper folding), while based on EEG or

regarding the nature of MI. Hence, these experimental methods seem appropriate and they take into consideration the relevant previous research. Thus, to show the applicability of the sign-theoretical approach towards the investigation of MI, the relevance of its results to the understanding of the nature and function of MI, as well as its correspondence to the previous research, the experimental method was chosen as the most suitable way to test whether mental imagery shares the same characteristics with a sign.

The experimental design is based on the standard methods and cognitive tasks used in cognitive semiotics and in experimental philosophy. The experimentation began with the short introductory pre-test questionnaire to check the statistically relevant information about age, nationality, cultural and educational backgrounds of the participants. The pre-test was followed by an actual experiment that consisted of three different cognitive tasks. An experiment was finished by the Psi-Q after-test (The Plymouth Sensory Imagery Questionnaire).

The latter constitutes a well-known test on evaluation of imaginary capacities – its vividness and intensity – that was elaborated by psychologists at Plymouth University (Andrade et al. 2013). The essential advantage of the Psi-Q test as compared to other similar questionnaires[8] is its sensitivity to images across a wide range of modalities: vision, sound, smell, taste, touch, bodily sensation and emotional feeling. This allows to test individual differences in imaginary capacities in more detail. For this reason the Psi-Q test was chosen to measure individual imagery capacities. Finally, the data gathered was analysed using the methods of descriptive statistics –SPSS and R-studio digital services.

3.1. Experimental hypotheses

Based on the theoretical premises of a theory of signs the following experimental hypotheses were formulated. The **main theoretical hypothesis** is that mental imagery can be legitimately viewed as a system of signs:

1) MI shares the same structure with a sign. In other words, MI has an object, interpretant and representamen.
2) MI is formed in a semiotic process, i.e. inside a network of the signifying relations. The relations between MI's elements define the particular properties of the final image produced.

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fMRI, also rely on qualitative methods, including introspection and self-reports. Thus, we believe that our choice of experimental methodology is justified and conforms both to the standards and the practice of the methodological choices used to investigate MI.

8   There are several tests to evaluate vividness of MI: Betts Questionnaire upon Mental Imagery (QMI; Betts 1909; Sheehan 1967), Marks' Vividness of Visual Imagery Questionnaire (VVIQ and VVIQ2; Marks 1973), Gordon's Test of Visual Imagery Control (TVIC; Gordon 1949). The Psi-Q test was chosen before other alternatives, because it allows to evaluate not only the visual MI, but vivdness of images across all sense-modalities.

To test these the triadic structure of an image was manipulated to uncover the potential correlation between the properties of imagined object and the properties of the final image produced. As a result theoretical sub-hypotheses 1 and 2 were simplified into the following experimental hypotheses:

> **H0:** Mental image has the same or similar characteristics, regardless of the characteristics of an object.

> **Ha**: Mental image has different characteristics. Particular properties of an object influence the characteristics of an image formed to present this object.

In order to analyze these hypotheses, cognitive experimentation was divided into three tasks given to each participant: pictorial, verbal and diagrammatic. Following Peirce's typology of signs, such a task division was chosen to represent distinctive differences in object-stimulus that were supposed to influence a final image. The judgement about statistical significance of the test results will be made on the basis of significance level, the value of which for the sake of the current experiment is taken to be 0.05 (i.e. $\alpha = 0.05$). The choice of the significance level was guided by the cognitive demands of the experiment: small sample size, equal sample groups, several cognitive tasks and multiple categories of answers. Next, the probability (p-value) that measures the evidence against the null hypothesis, i.e. the probability of either acceptance or rejection of null-hypothesis for the current empirical test is $p \leq 0.05$.

3.2. Materials and tasks

The experiment was designed in the following way: the same object by meaning (that is, by keeping its interpretant fixed) was suggested in three different ways – pictorial, verbal and diagrammatic – to experimental subjects. These three ways of object's presentation refer to Peirce's classification of signs and, in particular, to the three sign types as related to the objects of a sign – icon, index, symbol. An icon has some resemblance with the stimulus, such as something comprehended as a picture. A symbol represents by generality of its objects (such as a convention, language, text). Finally, index represents by causal connections. Hence, diagrams were chosen as the way to introduce causal connections, pictures as a way to represent iconic connections, and language/text to represent symbolic connections respectively. This typology[9] underlies the three ways in which the object was given in experimental tasks: pictorial, verbal and diagrammatic.

Each experimental task constituted a short story presented either i) pictorially (as a sequence of related pictures, e.g. comics), ii) verbally (written in language story), iii) diagrammatically (as a scheme with arrows and lines). Participants were asked to imagine the rest of the story using any method of expression. The choice of the stories was not arbitrary. Main criteria were the following: **a)** the story is easy to understand, vocabulary and formulation

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9　　The same typology was applied to evaluate experimental answers as belonging to pictorial, verbal or diagrammatic categories.

of the sentences are simple and straightforward to be understood by non-native speakers with a good command of English; b) the story is concise so that the participants could easily hold in their minds the entire plot; c) the story provokes imagination, i.e. narrative and the plot that it develops is sufficiently interesting for subjects to proceed imagining the end of the story. Stories were written by actual writers, story-tellers and narrators (Chopin 2016; Baum 2016) and were chosen from material similar to children's books, ensuring the points (a)-(c). Considerable attempts were made to have all three modalities (picture, text and diagram) reflect the content of the story as precise as possible, and a professional sketch artist was used for that purpose. In total, there were three different stories presented in each of the three ways.

In addition, the choice of the stories was influenced by semantic differences and cognitive demands. It was important to choose semantically different stories, i.e. those that would put forward a different set of questions in front of the subjects and in this way would suggest different images to be produced as the solution for each of the cognitive task. The existence of such differences was expected to prove one of the sub-hypotheses of the project, namely that mental imagery is task- and context-dependent.

The expected reaction to a story-stimulus is the production of the image that is influenced by the suggested properties of the object – pictorial, verbal or diagrammatic. Thus, the final image is supposed to be different across different cognitive tasks and have distinct similar characteristics within each type of the tasks. An expected result is that the same object (by meaning) expressed in different ways produce different images/representamens.

In sum, the correlation between the image and the object is the target of the experimental investigation. Generally, each experimental task is structured in the following way: the manipulated object (story-stimulus) constitutes the independent variable, while the affected representamen (an image) constitutes the dependent variable. The fixed interpretant (i.e. the same meaning) is the control variable. Schematically, this is depicted as follows:
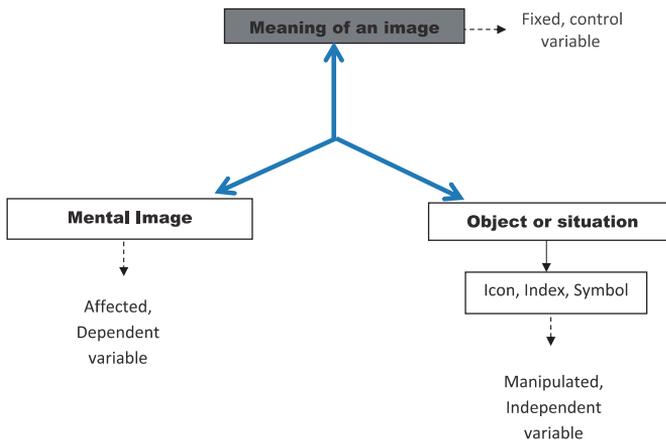
Figure II: Structure of an image experiment

3.3. Population and sampling

The target population of the experiment (i.e. the target sample) was international students of Estonia.[10] The choice of the target sample was guided mainly by the principle of convenience sampling, but with the several advances. First advantage was internationality of a sample. In current empirical study participated students of 14 different nationalities. Second advantage of sampling was differences in economic backgrounds of participants. Subjects of 20 professions or competencies took part in current study. Such diverse national, cultural and professional backgrounds of participants make them a suitable and available target population to investigate main hypothesis of the research project. Moreover, a target population of international students from various backgrounds might be a good representative of a wider international population.

At all events, the current research professes to be the first step in the investigation of the sign-theoretical account of MI. The sample of the current experimentation consisted of international students of Tallinn University of Technology (TalTech),[11] mostly bachelor-degree students. The sample size was 40 sampling units, i.e. 40 subjects participated in the experiment. Participants were chosen by the volunteer sampling. Although subjects were not randomly selected, the equal probability of participation was guaranteed by an equal information distribution among all international students via the institute's international office. A complement of free cinema tickets was offered to volunteers. Age of the participants ranged from 18 to 37, whereas an average age of the participants was 26.7 years.

Next, the experimentation was conducted among those international students whose English competence was ascertained to be very good. We asked participants' English language competence in the introductory pre-test setting. It showed that average level of language competence varied between "upper-intermediate (B2)" (42,5%) and "Advanced (C1)" (32,5%), which was taken to be sufficient for comprehension of the tasks. 10% of all participants evaluated their English language competence as "intermediate". Native English speakers constituted 15% of all participants.

All participants were randomly divided onto two groups, 20 subjects each. Each group received slightly different tasks to avoid the bias of recognizing the purpose of experimentation and to additionally test the potential differences in subjects' performance on different cognitive tasks. Instructions and task formulations were given in English and remained the same across

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10   In recent years Estonia has gained significant popularity among international students. Just for the academic year 2015/2016 Estonia has hosted 3800 international degree students, more than 1500 exchange students and ca 400 participants of summer or winter schools. (From http://www.studyinestonia.ee.)

11   Tallinn, as being the capital of Estonia, attracts more international students compared to other cities of Estonia. So, Tallinn University of Technology currently hosts most of the international students in Estonia. For these considerations international students of TalTech were taken as a sample population of the research project.

experimental groups, but the stimulus of cognitive task differed. The number of answers was: 60 answers in each experimental group (20 subjects solved 3 tasks) and 120 answers in total. This number of answers is assumed to be large enough to show statistical relevance of the answers received and make legitimate conclusions about acceptance or rejection of the null-hypothesis.

3.4. Procedure

The experiment took place in an ordinary classroom of TalTech. In order to minimize cognitive bias and to reduce (to the extent possible) the tacit knowledge effect, the experiment was silent, i.e. participants did not know that they are participating in an empirical test, nor did they know the theoretical background or the hypotheses tested. Subjects were invited to help their university's researcher in accomplishing several game-like tasks for her doctorate dissertation. All instructions of the cognitive tasks were given directly by the experimenter before the participant started fulfilling the task. The experimenter made sure that participant understood the task and instructions by receiving a personal confirmation from the participant and answering all the questions (if there were any). During the performance of the task there was no interaction between the experimenter and the subject. The experimentation was conducted in English.

The experimentation began with a series of pilot experiments, which were conducted to check whether subjects correctly understood cognitive task, whether task instructions are clear enough, and whether the order in which tasks are given influences the responses. In total, two pilot investigations were conducted and 63 students participated in the pilot tests. Pilot experiments showed that change of the order, in which cognitive tasks are given, does not influence the responses. Additionally, subjects were sensitive towards the precise formulation of the instructions of the tasks. Thus, the results of the pilot tests helped to sharpen experimental design, formulate instructions in a clearer and more comprehensible way, eliminate the difference in task order and simplify the experiment.

The actual experiment began with the short introductory pre-test questionnaire to provide experimentally important information about participants (age, nationality, educational background, profession or field of study, English competence level). The pre-test questionnaire was followed by the three cognitive tasks given to each participant. Forty participants were divided into two groups (the study and the control groups), and were introduced with the three short stories which were the material on the three cognitive tasks for them to solve (Appendix A). The first task was a pictorial story (a sequence of pictures), second task a verbal one (text), and the third diagrammatic, including both verbal and pictorial elements. The diagram expressed the story via abstract relations (Appendix A). The order of the tasks remained the same across the two groups. By their content, these tasks were

distributed in the following way: Group 1 received the first story pictorially, the second verbally and the third diagrammatically. Group 2 received the third story pictorially, the first verbally, and the second diagrammatically. Participants were equally instructed on each of the tasks as follows: "a) Look/Read carefully the story. What will happen next? b) Imagine the rest of the story, and c) Express the imagined on the next page using any method of expression". The experimentation was finished with the qualitative after-test – the Psi-Q test – where participants were invited to evaluate the "subjective vividness" of their imagery capacity.

In total, there were three stories or stimuli presented via three different modalities, totalling six tasks, with the same instructions on how to solve them. The response time was approximately 30 minutes (no sharp time constraints were given to eliminate anxiety etc.). The answers were expected to differ on various stimuli within each group and to coincide on similar stimuli across the two groups.

The experimentation was fomulated and manipulated in this way in order to be able to show that a difference in the initial traits of the imaginary object – pictorial, verbal and diagrammatic – influences "the sign" that represents this object in the final image. To minimize the tacit knowledge effect among experimental subjects and to account for cognitive biases concerning understanding the theoretical background, the content of the stories differed across three tasks within each of the group, while the stories were the same by their content across experimental groups. This ensured that "the interpretant" of the final image was fixed and repeated across experimental groups.

The after-test (Psi-Q test) was then assumed to reveal individual differences in the imaginary abilities of the subjects. That test would check for a correlation between individual imaginary capacity and the response type across three cognitive tasks. We expected those participants who estimate their scores to be high on the vividness of their MI to use a more detailed iconic imagery, while subjects with a lower vividness scores would use more symbolic or abstract imagery.

4. Results

The results of the experiment were evaluated in a categorical (nominal) scale that reflects the type of answer participants chose to produce as their final image on each of the three cognitive stimuli. There were thus three general categories: pictorial, verbal and diagrammatic. The reason for the choice of the method of classifying responses in this way[12] comes from the

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12   Noteworthy, according to Peirce's theory, there can hardly be found "pure signs", i.e. the features (symbolic+indexical, indexical+iconic etc.) are often occur to be mixed in signs. This does not preclude us to evaluate responses, following his typology of signs, as belonging to three general categories: pictorial, verbal, diagrammatic (as described

theoretical framework of Peirce's typology of signs, which corresponds to the three ways in which the objects of the stimuli are presented, namely iconic, symbolic, indexical, in the formulation of the three cognitive tasks.

The classification of the responses was made using the following reasoning: a) If the imaginary answer *resembled* its respective stimulus, then it corresponded to an iconic sign and was categorized as 'pictorial'. b) If the final image expressed *generality* (i.e. is a symbol), then it was classified as 'verbal'. c) If the produced image represented some *causal connections* (i.e. index), then it was labeled 'diagrammatic'. In this way, all three categories of answers conform to the theory as well as to the demands of the study design.

The responses of the experiment were distributed in the following way: for pictorial stimulus (Task 1) 15 answers out of 40 were given pictorially (37,5% of all respondents). For the same task, 22 answers were verbal and 3 diagrammatic (55% and 7,5%, respectively). It is noteworthy that altogether 18 answers out of 40 were given in a non-verbal way (i.e. pictorial and diagrammatic), which constituted 45% of all answers.

Table II: Answers for pictorial stimulus (Task 1).

Method/Frequency	Frequency	Percent
Diagr	3	7,5
Pictor	15	37,5
Verbal	22	55,0
Total	40	100,0

Next, for verbal stimulus (Task 2) 4 subjects out of 40 answered pictorially (10% of all respondents). For the same task we received 31 verbal answers and 5 diagrammatic (77, 5% and 12,5% of all respondents, respectively). The total number of non-verbal answers were the lowest among all three cognitive tasks, namely 9 answers (22,5% of all respondents).

Table III: Answers for verbal stimulus (Task 2).

Method/Frequency	Frequency	Percent
Diagr	5	12,5
Pictor	4	10,0
Verbal	31	77,5
Total	40	100,0

Finally, for diagrammatic stimulus (Task 3) we received 4 pictorial, 22 verbal and 14 diagrammatic answers (10%, 55% and 35% of all respondents, respectively). Similarly to the answers for Task 1, we found that the total amount of non-verbal answers was quite high: 18 answers out of 40, that is 45% of all repsondents.

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above) by the most dominant/prevalent feature of the answer (i.e. either iconic, indexical or symbolic).

Table IV: Answers for diagrammatic stimulus (Task 3).

Method/Frequency	Frequency	Percent
Diagr	14	35,0
Pictor	4	10,0
Verbal	22	55,0
Total	40	100,0

No significant difference between two experimental groups and the type of the answer was found. For this reason, all results were evaluated together. The general distribution of answers across all three categories can be seen in Table IV and in the corresponding graph in Figure III:

Table V: Frequencies of answer distribution

Method/Task	Pictorial	Verbal	Diagrammatic
Diagrammatic	3	5	14
Pictorial	15	4	4
Verbal	22	31	22
Total	40	40	40
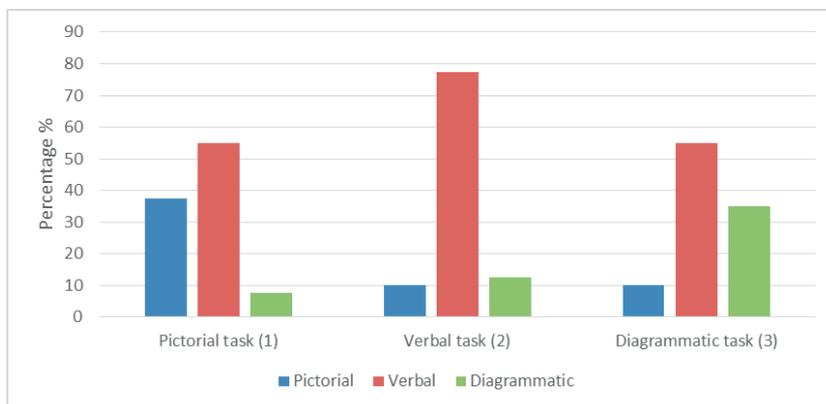
Figure III: Distribution of answers in percentage

The methods of descriptive and inferential statistics were used to analyze these results. In particular, statistical programs SPSS and R-studio were both used for statistical analysis and relevant calculations.

5. Discussion

What do these results show? Can we confirm or deny the initial hypothesis? The Pearson's Chi-squared test[13] was performed to calculate the p-value and to examine whether there is a significant relation between

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13   Pearson's Chi-squared test was chosen due to demands of current experimental design, since it allows evaluating several sets of categorical data.

properties of an object and those of an image. The R-studio statistical calculations showed $X^2(N=40) = 22,045$; $p = 0,0001963$ with df (degree of freedom) = 4. To check and confirm these calculations, we applied Fisher's test using R-studio program. The Fisher's test showed slightly different p-value, $p = 0,0004802$. However, the results of both tests confirmed that the relation between two variables (the method of response and the type of the task) was strongly significant, with $p < 0,01$. Similar calculations were performed using SPSS. It confirmed previous findings with $X^2(N=40) = 22,045$; $p = 0,0001963$. Our results suggest that the null-hypothesis, namely that the characteristics of mental images remain the same regardless of the characteristics of its object, should be rejected.

The low p-value ($p \leq 0.05$) confirms the alternative hypothesis, which proposes that there is a significant interrelation between properties of an object and properties of an image. Particular properties of an object influence the characteristics of an image formed to present this object. It can be seen from Tables I-III that the distribution of answers across three types of tasks was heterogeneous. In particular, the largest number of pictorial responses (37,5%) was given on pictorial stimulus (Task 1). Similar observations hold for verbal and diagrammatic answers. Stimulus influences the formation of mental image significantly. This leads to the conclusion that mental imagery does not share certain characteristics that would be independent of the characteristics of its object. On the contrary, various properties of the object evoke various images. This challenges the idea that one cognitive format underlies the formation of mental images.

At the same time, we can observe from Tables I-III that all three response types (pictorial, verbal and diagrammatic) were used to solve the three tasks. Heterogeneity of how answers were distributed confirms the hypothesis that mental imagery cannot be understood from the perspective of one type of mental format or representation. Subjects tend to choose various methods for their image-formation that varies with multiple influencing factors. This conforms to the sign-theoretical account, as according to it there cannot be pure images of some particular type. Signs are subtle combinations of their elements and dynamic relations between them. Thus, any image might have several (that is, symbolic, iconic, indexical)[14] characteristics simultaneously. Such heterogeneity is clearly seen from the distribution of the answers in the experiment.

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14   The triadic division on icons, symbols and indices refers to Peirce's classification of signs (Peirce 1994, 1998). The explanation of the theoretically important elements of the classification is presented in another paper. In brief, a sign is an *icon* if it has a power to signify its object doe to a similarity with that object, an *index* if it has a power to signify its object due to a real relation with the object of its signification, and a *symbol* if it has a power to signify its object to an interpreter solely because it will be so interpreted. A sign can be an icon and an index simultaneously, and nothing real can be a pure icon or a pure index. Likewise, a sign can be a symbol, an icon, and an index simultaneously.

In addition, the tendency towards the mixture of answer-types was confirmed by an observational part of the study, namely the experimenter's interaction with the participants. While receiving the instructions on how to solve the tasks, several students asked whether they can use the mixture of several methods. Since this question occurred frequently, we concluded that they were inclined to use multiple modes of imagining. This could be seen as a confirmation that there is no one unified format underlying MI. Also the answers indicate this tendency towards the mixture of the response-types and the characteristics. Under a closer investigation, it occurred that students tended to use (at least) some mixture of answer-types. For example, while giving a pictorial answer to the imagined stimulus, a participant might have used arrows (diagrammatic method) to show the order of the pictures drawn; sometimes there were small linguistic 'clouds' indicating a direct speech etc. Observations did not conflict with the interpretation of the experimental data and can also be read as confirming the main hypothesis, that mental imagery, as signs, has different characteristics. Particular properties of MI are influenced by multiple factors, including characteristics of the object-stimulus, task demands, the context as well as individual differences. In brief, there is no dominant format underlying MI.

Next, we assumed that individual differences influence the image-formation. To analyze this two tests were conducted. An introductory pre-test checked whether individual variations in native language, cultural background or occupation influence mental imagery. The after-test (Psi-Q test) evaluated subjective vividness of imagery capacity and its influence on the response type. In particular, we checked whether a) participants across different backgrounds answered similarly (H0) or differently (Ha). For the Psi-Q test, we tested whether b) all participants, regardless of any subjective differences in the vividness of images, answer similarly (H0) or differently (Ha). The same programs (SPSS and R-studio) were used to statistically analyse the results. The significance level was $\alpha = 0.05$. For the first test we found no significant correlation between occupation and response type; $X^2(N=40) = 2,853$; $p = 0,415$ (with $df = 3$); according to Fisher's test this was $p = 0, 513$. Since the p-value was over 0.05, H_0 should be accepted. We interpret this as participants answering similarly to the three cognitive tasks independently of differences in their professions and cultural backgrounds.

Interestingly, for the second test (Psi-Q test) we found a strong correlation between individual differences in MI's vividness and response type. Analysis showed that subjects with higher vividness of MI tended to answer pictorially, producing detailed and elaborated images, whereas subjects with a lower vividness of MI tended to answer verbally, i.e. in a more abstract and general way. The significance level for this test was $p = 0,004$, which confirms the alternative hypothesis, namely that participants answer differently depending on subjective differences in the vividness of images. Our interpretation is that individual differences in cognitive capacities influence the formation of MI.

Taken all the above into account, a couple of general conclusions concerning the nature of mental imagery may be drawn. First, our empirical research suggests MI to exhibit characteristics that varies with multiple factors, and thus appears to be heterogeneous in nature. Our proposed interpretation is that MI would be poorly understood assuming it to be of some general or universal mental kind or format. Second, properties of mental images vary with the characteristics of the object-stimulus. MI does not share characteristics independent of the properties of an object-stimulus; rather, MI encapsulates properties of the imagined stimulus, which suggests that features of mental image depend on features of an object that it professes to represent. Finally, properties of mental images are dependent on individual differences in imaginary capacities. Indeed, human cognitive capacities surely should not be assumed to be equal: having more or less vivid imageries is well documented, both within a person and across people. Personal capacities and dispositions influence the characteristics of the produced images.

We could read these conclusions to propose that MI cannot be comprehensively explained by the prevailing representational theories that take MI to be, alternatively, matters of quasi-pictorial or propositional representations (Kosslyn 1980, 1994; Pylyshyn 1981, 2002). Our evidence showed that no dominant representational format underlies imagery. In the very least, MI can hardly be viewed as a static mental representation of a fixed particular format, which is implied by computational-repesentational paradigm (Clapin 2002; Marr 2006). Rather images change their characteristics dependent on the context, task, and the features of the objects. Dependence of an image-formation on the characteristics of its co-related elements strongly suggests that MI is not the matter of a static representation, and that dynamic mental activity occurs within the context of the creation of mentally depicted relations.

A coherent account on the nature of MI would explain such features as the heterogeneity of its characteristics, its task-context-object dependence, and the influence differences have on the image formation, among others. It might be difficult to explain all these facts by traditional representational theories of MI. Although, quasi-pictorial theory could easily accommodate pictorial data, whereas propositional theory – verbal data, the explanation of the current results by traditional accounts will still remain partial. The restriction of MI to quasi-pictorial – propositional dichotomy inevitably neglects at least some of the above-stated characteristics of MI. The reason for this might be hidden in the implicit demand of the dominant computational paradigm: the search of the primary code, which would unravel the complex mechanisms of human mind. However, new research methods and empirical data show that above-stated demand might be misleading (von Eckardt 1993; Bechtel 1998; Knuutila 2005, 2011). The results of current empirical study confirm this idea. Similarly, enactivist theory can potentially explain the dynamic relations and task-object dependence, but it could hardly account for divergent characteristics of images. Enactivism lacks a comprehensive explanation of MI's structure and diversity.

In contrast, the sign-theoretical approach that we have advocated can accommodate heterogeneity of MI's properties, its task-context-object dependence, and individual differences in imaginary capacities within one framework. First, MI can be seen as a sign that consists of three elements: representamen, object and interpretant. Taking MI to be of this triadic structure allows a detailed explanation of the nature and function of images in human cognition. Second, the theory of signs proceeds to take mental capacities to be of signifying nature. This would connect MI with many other cognitive abilities of the human mind, and would explain individual differences and dispositions in the creation of MI. Third, the theory is concerned with the dynamic and open nature of semiotic relations between the three elements of a sign. This allows it to be applied to the explanation of divergent and changing properties of mental images.

Although experimental findings support the theory of sign towards investigation of MI, one might also argue that there are certain weaknesses in experimental studies conducted on MI. First, our three cognitive tasks might evoke different cognitive capacities (e.g., decision-making, creative thinking etc.) as well. How can one be sure that it was MI that was used to solve these experimental tasks? Now the employment of mental images was ensured by the precise and detailed instructions given by the experimenter and by receiving personal confirmation that each participant understood the task. Nevertheless, it is not straightforward to separate MI from other cognitive faculties or to eliminate their influence on the response rate. Also, the design of the task is not free from criticism, especially if compared with previous studies on similar matters. To this we reply as follows. In contrast to standard cognitive tasks testing MI where subjects are asked to memorize some stimulus, our task to *imagine* the rest of the story is markedly different. It allows testing the production of an image in natural way, such as what people might use in their daily life while planning, thinking, analysing, reasoning or daydreaming. There are in fact indications that two-thirds of our waking life mind is actually wandering and not well controlled or self-controlled by us, the self, by some cognitive agency (Metzinger 2017). In light of mind-wandering theories, it is only natural to test the nature of MI in the proposed manner. The MI produced as a response to our cognitive task is not artificial but spontaneous and may in fact be more 'ecologically valid' – subjects were free to choose any method to imagine and were not asked or expected in any way to remember the stimulus.

Further, one could read the results of the study differently, saying that shown heterogeneity of imaginary characteristics might be understood on phenomenal level only, while internal structure of MI remains one and the same. In this case, internal structure of MI is supposed to be hidden and consciously[15] inaccessible. While current study does not apply brain-scanning

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15 According to the sign-theoretic account, there are several levels of conscious access to a mental sign (for details, see Champagne 2018). The 'sub-personal' level corresponds to single sensations and qualities that are registered by the mind, but are not yet attended by

techniques in demonstrating the underlying difference in neurophysiological terms, it does show the structural difference of the various images produced as a response on different stimuli, which implies the former. If the representational format of MI would indeed be sub-personally and unconsciously one and the same across different images, then the answers to imaginary tasks would be expected to be similar. But this is not the case. Moreover, one would expect one and the same subject to answer similarly to all stimuli, but this was not the case either. One and the same subject typically used various types of images to answer different stimuli. Based on the above-stated data this difference is statistically significant. Thus, we are inclined to conclude that shown heterogeneity of MI's properties is not (just) phenomenal: the difference in the modes of expression of an internal image does say something about sub-personal and unconscious level of image formation.

Finally, the limited sample size and the volunteer sampling method instead of full randomization may be a limitation of the current research, conducted under limited organisational allowances, and random sampling method and larger sample size is suggested for replication.

To sum up, limitations notwithstanding, explanations of MI should not overlook the potential of seeing them as *signs*. A sign-theoretical approach might overcome some long-standing controversies and limits of the prevailing representational accounts. In particular, the experimental approach suggests a new perspective where divergent properties of mental images come together under the umbrella of a Peircean theory.

5. Conclusion

We studied the nature of mental imagery by an experiment in the theoretical context of Peirce's semiotics (the theory of signs). An empirical test was carried out that hypothesised that mental imagery can be accounted for in that theory. According to the theory, MI is a sign that consists of three relata: representamen, object and interpretant, and it is characterized by dynamic and context-dependent semiotic relationships. To test the hypothesis, an experiment was designed. The analysis of the results showed that 1) the characteristics of mental images are heterogeneous in nature; 2) properties of mental images are dependent on the characteristics of object-stimulus; 3) properties of mental images are dependent on individual differences in imaginary capacities. These results were interpreted to indicate that, contrary to standard representational accounts, MI does not emerge from one dominant

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the conscious self. The internal structure of the mind and MI, however, does not change dependent on the level of conscious accessibility. Higher level of conscious access – which is the level of current study – is the indicator of the internal (sub-personal/hidden) structure. The sign-theoretic account that we are applying can accommodate these levels within one theoretical framework.

representational format (such as quasi-pictorial or propositional). Standard representational accounts may fail to provide comprehensive explanations of heterogeneous characteristics of MI and their context dependence. Our study concludes that these features can, however, be explained by Peirce's theory of signs. The results support the idea that MI can be seen as signs. Under that light, MI constitute complex mental phenomena with manifold traits and dynamic, continuously changing relations between its elements. While new empirical investigations that exploit the sign-theoretical approach are needed, this interpretation of the results of the present experiment is also a strong indication that the theory of signs is a viable methodological alternative that accommodates heterogeneous empirical evidence.

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Appendix A: The Examples of cognitive tasks

Task 1: a) Look carefully at the story. What will happen next? **b)** Imagine the rest of the story, and **c)** Express the imagined on the next page using any method of expression.

Task 2: a) Read carefully the story. What will happen next? **b)** Imagine the rest of the story, and **c)** Express the imagined on the next page using any method of expression.

One night, Millie was up late reading in bed. She finished the book she was reading and looked over to her shelves to see what else she might read before she went to bed. Right there on her shelf was something she had never seen before. It was a blue bottle. The blue bottle was about as tall as a small book, had a round bottom, and a thin neck. And while the bottle looked as if it were made out of glass, Millie could not see through it. Millie got out of bed and went over to the bottle. She picked it up, carefully, afraid that it might break. She was surprised at just how heavy it was. Certainly heavier than any other bottle this size she had ever before lifted.

She looked down into the bottle, but it was too dark inside to see anything. So she shook it. She heard a rattling sound. There was something inside! She turned the bottle upside down and shook it again, to see if anything would fall out. Something almost fell out and then it didn't. Whatever was inside was now stuck in the bottle's neck. Millie shook harder and harder. Finally, something small fell onto the floor. It was a ...

Task 3: a) Look carefully at the story. What will happen next? b) Imagine the rest of the story, and c) Express the imagined on the next page using any method of expression.

Millie

Was reading in bed and saw ...

Never seen before ← → As tall as a small book

Has a thin neck — Has round bottom

Millie could not see through it

Millie got out of bed and picked the bottle → Heavy → Surprise!

Looked down into the bottle → Too dark

Mille shook the bottle → Heard a sound → Something inside!

Shook it harder → Something fall onto the floor

It was a...

?
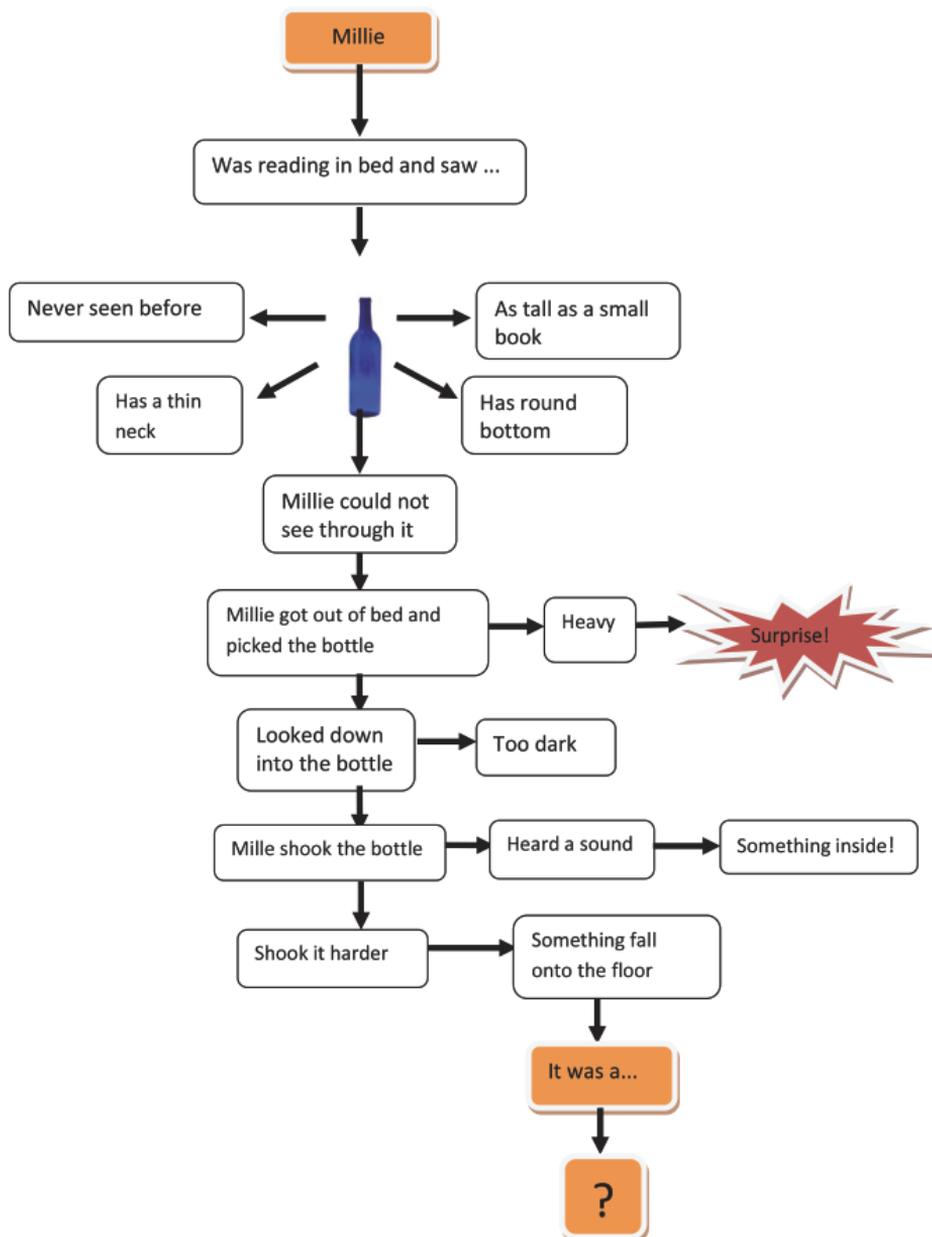
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SIGN-THEORETIC APPROACH TOWARDS EXPLANATION OF MENTAL IMAGERY

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Abstract

The nature of mental imagery is one of the most controversial issues in cognitive sciences. Contrary to the traditional representational theories, which view images as either propositional or pictorial representations, I propose to account for mental imagery using semiotic approach, i.e. in terms of signs and signifying relations. This article reviews two alternative sign-theoretic accounts developed by C.S. Peirce and F. Saussure and analyses what kind of sign theory serves better to explain mental imagery. Brief analysis showed that Peirce's semiotics is better suited to account for the diverse nature of mental images. In particular, I will argue that Peirce's sign theory fulfils four main conditions of a comprehensive explanation of mental imagery. Namely, it accommodates:

a. heterogeneous and manifold properties of mental imagery;
b. image's co-relation with the object (intentionality);
c. image's dependence on the subject, who produced an image and his individual traits;
d. image's dependence on the context, where the image was produced.

In sum, a sign-theoretic approach towards the explanation of mental imagery, based on Peirce's universal semiotic, could suggest, I believe, a new perspective on the complex nature of mental imagery.

1. Introduction

Since cognitive revolution in 1950-60s, the question about the nature of mental imagery (MI)

became one of the most debated ones in cognitive sciences. Traditionally, two representational theories were proposed – (quasi-)pictorial and propositional – to answer this question. According to the (quasi-)pictorial theory, mental images are picture-like representations in the mind (Kosslyn 1980, 1994; Finke, Pinker and Farah 1989). Proponents of propositional theory, on the opposite, claim that mental imagery constitutes verbal representations or language-like descriptions (Pylyshyn 1981, 2002, 2003; Fodor 1975). However, representationalism towards the explanation of MI encounters serious problems, such as: different results of replicated experiments (Pylyshyn 2002; Slezak 1991; Chambers and Reisberg 1985; Rock, Wheeler and Tudor 1989); multiple interpretations of empirical evidence (Anderson 1978; Pylyshyn 2002; Ganis 2013); and manifold properties of mental imagery, e.g. motor, tactile, auditory properties (Lacey and Lawson 2013; Keller 2012; Pascual-Leone et al. 1995; Richardson 1995; Schimdt et al. 2014). In sum, existent empirical data showed that MI cannot be comprehensively accommodated nor by (quasi-)pictorial, neither by propositional accounts.

An alternative way to answer the problematic question about the nature of mental images is to say that MI is a sign system[1]. Indeed, there are several reasons to consider semiotic theory as one of the possible solutions towards proper explanation of MI. Just as a sign a mental image is intentional, i.e. stands for some object that it represents. Next, it also has some ground element or representamen, i.e. something that represents. Similar to a sign, a mental image has a meaning comprehended by the subject. Shortly, it seems that MI shares similar structure and properties with a sign. Thus, semiotic theory might shed some light on the complex nature of MI.

However, what kind of sign theory serves better to explain MI and what conditions a comprehensive semiotic account of MI should satisfy? This article gives a brief overview of the two alternative sign-theoretic accounts developed by Charles Peirce and Ferdinand de Saussure and suggests that Peirce's sign theory is better suited to account for diverse nature of mental images. In particular, I will argue that a sign-theoretic account of Peirce fulfils four main conditions of a comprehensive explanation of MI, namely it accommodates:

  a. heterogeneous and manifold properties of MI;
  b. bimage's co-relation with the object (intentionality);
  c. image's dependence on the subject, who produced an image and his individual traits;
  d. image's dependence on the context, where the image was produced.

In order to show that, I will begin with the analysis of Peirce's sign-theoretic account in Section 1. Then, I will proceed with the description of semiotic theory developed by Saussure in Section 2. Finally, in Section 3 I will analyse both semiotic theories as applied to explain MI. I will try to show that Peirce's sign theory constitutes a more complex and elaborated account compared to its alternative, it satisfies four conditions of explanation of MI and thus suits better to account for the latter.

2. Peirce's sign theory

Peirce's theory of signs or semiotic is a unique account of signification, reference and meaning, distinctive among others for its "breadth and complexity" (Atkin 2017: 1). Central tenets of Peirce's sign theory are the philosophical origin of his account, pansemiotic view of the universe, phenomenology, Peirce's triadic definition of sign and classification of signs.

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1   For detailed justification of why mental imagery can be legitimately seen as a sign system see Issajeva 2015a,b.

To begin with, Peirce's theory of signs has philosophical background. His work was strongly influenced by philosophy of Aristotle, Kant's theory of knowledge and Locke's theory of ideas. In particular, the very term 'semeiotic' was borrowed from Locke, who used it to name a new 'doctrine of signs' (Short 2007: 2). Following its philosophical origins, Peirce's semiotic theory aims at solving general and universal problems of knowledge and being, i.e. those questions that are philosophical by nature. In this vein, Nöth rightly noticed that "Peirce's semiotics aims at epistemological and even metaphysical universality" (Nöth 1995: 39).

Philosophical origin, epistemological and metaphysical universality of Peirce's semiotic give rise to his pansemiotic view of reality. Peirce claims that man, cognition and reality can be interpreted in terms of signs: "The entire universe is perfused with signs, if it is not composed exclusively of signs" (Peirce 1994, CP 5.448). In particular, Peirce claims that human cognition, our thoughts and the man himself are semiotic by nature. He clearly states, "man is a sign" (Peirce 1994, CP 5.314; Peirce 1998, EP 1:54) and "we think only in signs" (Peirce 1994, CP 2.302). Based on this view, a whole human life is interpreted as a historical sequence of signs. Thus, semiotics for Peirce is a universal science. It is the science that equally explains cosmological processes, physical events, mental and cognitive states and makes rigid conclusions about them using the method of logic. In his letter to Lady Welby on December 23, 1908, Peirce writes: "It has never been in my power to study anything […] except as a study of semeiotic" (Peirce 1977: 85), thus clearly stating that whatever discipline is under investigation, it will eventually lead us to the study of semiotics. This universality of the scope of Peirce's sign-theoretic account makes his Semiotic distinctive among other theories and sets the stage for his triadic definition of sign and sign typology.

Next essential trait of Peirce's semiotics is his system of categories. Peirce singled out three main categories, based on which he developed a complex phenomenology of human cognition. Three categories are firstness, secondness and thirdness. "Firstness is the mode of being which consists in its subject's being positively such as it is regardless of aught else" (Peirce 1994, CP 1.25). Firstness is the category of unreflected feeling, mere potentiality, and possibility of that, which is immediately given (Peirce 1994, CP 5.66-68; CP 1.531). Secondness involves the relation of the first to the second (Peirce 1994, CP 1.530). This is the category of reaction and action, facticity, reality and experience in time and space (Nöth 1995: 41). "Category the Second is the Idea of that which is such as it is as being Second to some First, regardless of anything else […] That is to say, it is *Reaction* as an element of the Phenomenon" (Peirce 1994, CP 5.66). Finally, thirdness is a category of mediation; it brings second into relation to a third. "Had there been any process intervening between the causal act and the effect, this would have been a medial, or third, element. *Thirdness*, in the sense of the category, is the same as mediation" (Peirce 1994, CP 1.328). Following Peirce, all the phenomena that we experience, feel, live through, react upon can be analyzed in terms of firstness as the category of feeling, secondness as the category of reaction and thirdness as the category of mediation. Peirce's sign theory can be properly understood only in the context of this system of categories.

In general, Peirce's pansemiotic view of reality, philosophical traditions and system of categories comprise the unique context of his sign-theoretic account. So what is a sign, according to Peirce? Following his triadic system of categories, Peirce, claims that sign has triadic structure and consists of three main relata or three basic elements – a signifying-vehicle or representamen, an object and an interpretant – and is characterized by dynamic, context-dependent semiotic relations between them. All together, they – a set of sign-elements and semiotic relations – constitute an interconnected network that works together

as a whole and constitutes a sign. "A sign, or *representamen*, is something which stands to somebody for something in some respect or capacity. It addresses somebody, that is, creates in the mind of that person an equivalent sign, or perhaps a more developed sign. That sign which it creates I call the *interpretant* of the first sign. The sign stands for something, its *object*" (Peirce 1994, CP 2.228). Schematically the structure of a sign could be depicted in the following way:
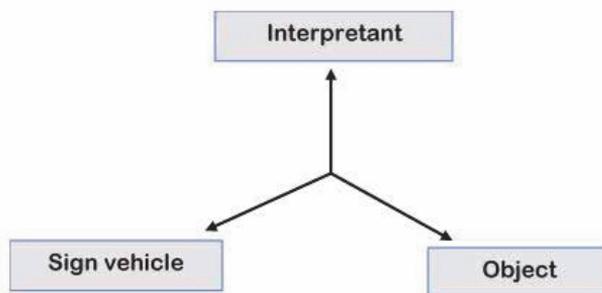
Figure 1. Peirce's structure of a sign.

This definition uncovers two main aspects of a sign*:*

1. Peirce views sign as consisting of three relata – a signifying vehicle or representamen (as Peirce sometimes calls it), an object which the sign stands for, and an interpretant as the meaning of the relation between signifying vehicle and its object;

2. He defines sign through its participation in semiotic or signifying process (i.e. semiosis).

According to Peirce, the sign, its structure and nature is about the semiotic relations between its three elements. Thus, Peirce's sign theory has a distinct relational and functional character (Nöth 1995: 42). It is the relations between sign-elements, i.e. semiosis that defines the nature and function of a sign. By 'semiosis' Peirce means "an action, or influence, which is, or involves, a cooperation of *three* subjects, such as a sign, its object, and its interpretant, this tri-relative influence not being in any way resolvable into actions between pairs" (Peirce 1998, EP 2:411). Strictly speaking, semiosis is the subject of Peirce's semiotic study and analysis.

According to Peirce's semiotics, relations between elements of the sign are dynamic and context-dependent. Dynamics of signifying relations means that they continuously develop and change their characteristics dependent on various factors. As Floyd Merrell (2001) puts it: "sings simply cannot stand still" (Merrell 2001: 37). Context-dependence corresponds to the changes in the environment that influence both the relations and characteristics of the sign elements significantly (Peirce 1994, CP 2.265). Thus, Peirce's theory accounts for sign in terms of three sign relata and dynamic, context-dependent relations between them.

Based on three universal categories and triadic structure of a sign Peirce elaborated a comprehensive typology of signs, which became the significant part of his sign theory. According to Peirce, each of the three sign elements – sign-vehicle, object and interpretant - is divisible on three sub-types.

> signs are divisible by three trichotomies; first, according as the sign in itself is a mere quality, is an actual existent, or is a general law; secondly, according as the relation of the sign to its object consists in the sign's

having some character in itself, or in some existential relation to that object, or in its relation to an interpretant; thirdly, according as its Interpretant represents it as a sign of possibility or a sign of fact or as a sign of reason (Peirce 1994, CP 2.243).

Peirce calls the first of the three thrichotomic divisions – Qualisigns, Sinsigns and Legisigns (Peirce 1994, CP 2.244), the second – Icons, Indexes and Symbols (Peirce 1994, CP 2.247), and finally the third division – Rhemes, Dicisigns and Arguments (Peirce 1994, CP 2.250). Thus, if we analyse each of the three sign elements and their features, then we can get ten various classes of signs. Later Peirce postulated sixty-six classes of signs. A comprehensive analysis of classes of signs was one of the Peirce's main interests of study.

To sum up, Peirce's semiotic has distinct features. First, it has philosophical origin. Second, Peirce's sign theory aims at epistemological and metaphysical universality that gives rise to his pansemiotic view of reality. Next, an essential feature of Peirce's semiotic is his phenomenology and three universal categories – firstness, secondness and thirdness. Finally, Peirce gives a triadic structure of a sign and elaborates a detailed classification of signs. All together, these elements comprise the core of Peirce's sign-theoretic account.

3. Saussure's semiology

An alternative sign theory, elaborated independently by Ferdinand de Saussure, is the so-called 'semiology'. In contrast to Peirce's semiotic, Saussure's sign theory has linguistic heritage. As being the father of modern linguistics and precursor of structuralism, Saussure embedded his semiology in linguistic studies. His primary focus of interest is, thus, on linguistic signs, such as words: "Saussure focused on the linguistic sign and he 'phonocentrically' privileged the spoken word" (Chandler 2007: 16). For Saussure, the spoken, acoustic words comprised a primary sign system, whereas the written words were seen as "a separate, secondary, dependent" sign system (ibid.).

Focusing on linguistic signs, Saussure defined a sign as being composed of a 'signifier' and a 'signified' (Chandler 2007: 14). The signifier is the form of the sign. Saussure defined the signifier as a 'sound pattern', i.e. hearer's auditory impression of a sound or '*image acoustique*' (ibid.). The signified is the concept, to which the signifier refers. It is more abstract and general element of a sign.

> A linguistic sign is not a link between a thing and a name, but between a concept [signified] and a sound pattern [signifier]. The sound pattern is not actually a sound; for a sound is something physical. A sound pattern is the hearer's psychological impression of a sound, as given to him by the evidence of his senses. […] The sound pattern may thus be distinguished from the other element associated with it in a linguistic sign. This other element is generally of a more abstract kind: the concept (Saussure 1983: 66).

The relationship between the signifier and the signified is called signification. A sign, according to Saussure, is then the whole that results from inter-connection between signifier and signified (Chandler 2007: 14-16). Schematically the Saussurean model of a sign can be depicted as follows:

Noteworthy that in contrast to Peirce's sign theory, Saussure suggests a dyadic structure of a sign. A sign consists of two elements – signifier and signified. Saussure compares bilateral structure of linguistic sign with the two sides of a sheet of paper: "Thought is the front and the sound is the back; one cannot cut the front without cutting the back at the same time" (Saussure 1916/1969: 113). This simile of diadicity of the sign clearly shows that two elements

of a sign are inseperable from each other and together constitute a "two-sided psychological entity" or a sign (ibid., p. 66). Along the lines, Chandler rightly notes that Saussurean sign
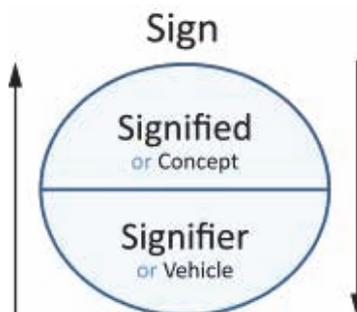
Figure 2. Saussure's structure of a sign

must have both elements to count as a sign: "A sign is a recognizable combination of a signifier with a particular signified" (Chandler 2007: 16). In the same vein, Short states that according to Saussure "sign is a two-part entity, consisting of a material signifier (*signifant*) coupled with a signification (*signifie*)" (Short 2007: 17). Thus, contrary to Peirce, he does not elaborate the third element of a sign – an interpretant – a meaningful reaction of one's mind towards the process of signification.

The latter circumstance yields further the lack of phenomenological explanation of significa-tion in Saussurean semiology. Despite the fact that for Saussure both 'signifier' and 'signified' are purely psychological, 'non-material' entities (Chandler 2007: 14-15; Nöth 1995: 60), he does not develop a comprehensive account of the mind to explain them. Quite on the contrary, his explanation of what is going on between 'signifier' and 'signified' remains vague (Short 2007: 18). In particular, Saussure admits the notion of intentionality of thought and language, but fails to give clear explanation of how thought and language manage to be about the world. Along the lines, Short states that Saussure makes the intentionality of speech dependent on intentionality of mind, but still fails to account for the latter (Short 2007: 18).

Next, Saussurean semiology employs different to Peirce's structure and notion of the sign. Peirce sees a sign as being essentially a part of the world, which "is perfused with signs" (Peirce 1994, CP 5.448). As being such a sign is context-dependent, i.e. continuously develops dependent on the changes in the environment in which a sign is produced and used. Shortly, Peirce's sign interacts with the world. In contrast, Saussure claims that sign is independent of the world, its relation to the world is arbitrary (Saussure 1983: 131). Saussure did not deny the existence of world independent of language. But his semiology establishes a relative autonomy of the language from reality, which it stands for. Thus, Saussure embraced the mentalistic conception of a sign (Nöth 1995: 60). Such notion of 'arbitrariness' of a sign supports the structuralist idea that language constructs the world, rather than reflects it. In the same vein, Charles Ogden and Ivor Richards (1923) criticized Saussure for "neglecting entirely the things for which signs stand" (Ogden and Richards 1923: 8). This makes semiological account of a sign independent of any extralinguistic influences.

The arbitrariness of a sign implies also the closed structure of the sign. If a sign and its elements – signifier and signified – are independent of the external world, then they are com-pletely determined by intralinguistic system. Hence, Saussure's semiology operates totally

inside the sign system, i.e. inside the relations between signified and signifier, and thus is closed to any other influences and changes. In comparison, Peirce's semiotic presupposes dynamicity of relations between its sign elements. Peirce's sign is opened to the world, since it is indispensable part of the latter. Saussurean sign is not the part of the world as such, rather it arbitrarily structures formless mass of reality, i.e. constructs the world. Here is the place for Saussurean linguistic structuralism, which constitutes the background for his semiology. In the same vein, Sturrock rightly noticed "since we come to know the world through whatever language we have been born into the midst of, it is legitimate to argue that our language determines reality, rather reality our language (Sturrock 1986: 79). Thus, Saussurean semiology constitutes a structuralist theory of sign rather than a phenomenological-cosmological one as was proposed by Peirce.

All this yields to the relative narrowness of Saussurean theory of signs. Indeed, Saussure clearly deals just with linguistic signs, abstracted from their particular uses, natural signs and the users' responses to them (Short 2007: 19). In contrast, Peirce aims at universal explanation of reality in terms of signs, and hence investigates various classes of signs; grounds of signification; as well as thoughts, feelings and actions as responses to signs. Such difference in applicability of sign theory in Peirce and Saussure appears to be one of the reasons that caused semiotics to be favoured over semiology (ibid.).

To sum up, Saussurean theory of signs differs significantly from that of Peirce. Firstly, it has linguistic origin and focuses on investigation of linguistic signs. Secondly, Saussure defines a sign as a purely mentalistic dyadic structure comprised of signifier and signified and relation between them. Finally, the scope of Saussure's semiology is also different. He abstracted the sign from reality and focused on the structural analysis inside the sign system of language. As a result, the phenomenological explanation, intentionality of a sign, grounds of signification, as well as its pragmatic uses remain either undeveloped or vague.

4. Sign-theoretic account towards the explanation of mental imagery

So, where does the previous discussion lead us? The main question of this paper is what version of sign theory can better explain the complex nature of MI? In other words, which sign-theoretic account, if any, can fulfil main four conditions to explain comprehensively mental imagery?

Firstly, heterogeneous and manifold properties of MI can be easily accommodated by Peirce's semiotics. Various grounds of signification allow applying his semiotic to natural signs, images, linguistic signs etc. The detailed classification of signs suggests an explanation of manifold sign properties. The context-dependence, flexibility and dynamics of Peirce's conception of sign allow to comprehensive explanation of the process of signification, signifying relations and factors that influence the latter. All this yields that Peirce's sign theory can give a proper explanation of heterogeneous properties of MI.

In contrast, Saussurean semiology encounters serious difficulties with explanation of divergent properties of MI. The major focus of his semiotic investigation is a linguistic sign. However, not all images contain verbal properties. Other manifold properties of mental images remain unattended by Saussure's semiology. Thus, he fails to account for wide diversity of imagery properties. He also fails to discern among different grounds for signification, putting arbitrary relation as the only signification ground. In addition, Saussurean account abstracts the concept of sign from their particular uses, natural signs and the users' responses to them. All this makes his account hardly applicable to investigate heterogeneous nature of MI.

Secondly, image's co-relation with the object (intentionality) was sufficiently investigated by Peirce. He developed an interesting phenomenological account that underlay his sign theory

and suggested a comprehensive explanation of how signs can be about the world and what relations there are between internal signs and external objects. Contrary to Peirce, Saussure remained ignorant to the problem of intentionality. Although, he admitted that signs are somehow connected to the world, Saussure fails to properly account for the latter.

Next, image's dependence on the subject, who produced an image and his individual traits, is clearly manifested in Peirce's sign-theoretic account. The triadic structure of a sign proposed by Peirce includes an interpretant element, i.e. a subject's cognitive response to the sign. According to Peirce, feelings, emotions, thoughts, memories and even actions – all can count as an interpretant, i.e. as internal part of a sign. Thus, he clearly incorporates a subject inside his sign system. To compare, Saussure quite differently abstracts the sign from its particular uses as well as from area of individual influences. Saussurean model of sign is dyadic and lacks an element that would represent subjective differences inside the sign system. On the contrary, Saussure tries to abstract the sign from all subjective elements and analyse the sign intralinguistically.

Finally, the explanation of image's dependence on the context, where the image was produced, can also be given by Peirce's semiotic. His sign-theoretic account embraces the context-dependence of a sign. The latter corresponds to the changes in the environment that significantly influence both relations and characteristics of a sign (Peirce 1994, CP 2.265). Peirce's semiotic takes into account different influences and contextual changes and adapts them inside the sign system. In contrast, Saussurean semiology neglects contextual/circumstantial changes as being influential upon sign system. His sign theory tries to analyse the signification process and the sign structure outside of any changes in context.

To sum up, it occurs that Peirce's theory of signs can give a better and more profound explanation of MI compared to that developed by Saussure. In particular, Peirce's semiotic satisfies all four criteria of comprehensive theory of mental imagery. It explains:

    a. heterogeneous and manifold properties of MI;

    b. image's co-relation with the object (intentionality);

    c. image's dependence on the subject, who produced an image and his individual traits;

    d. image's dependence on the context, where the image was produced.

In contrast, the alternative sign theory developed by Saussure is dedicated to the investigation of linguistic sign, lacks the universality and breadth inherent to Peirce's semiotic and thus can hardly explain all characteristics of mental imagery.

5. Conclusion

To conclude, this article suggests a sign-theoretic approach to explain the problematic nature of mental imagery and analyses what kind of sign theory serves better to explain MI. Based on the divergent empirical data four main conditions of a comprehensive account of MI were singled out:

a) heterogeneous and manifold properties of MI;

b) image's co-relation with the object (intentionality); c) image's dependence on the subject, who produced an image and his individual traits; d) image's dependence on the context, where the image was produced. Thus, a full-scale explanation of mental imagery should accommodate these characteristics of MI.

Two alternative sign-theoretic accounts developed by Charles Peirce and Ferdinand de Saussure were analysed in order to check whether any of these accounts can satisfy all four conditions and thus suggest a comprehensive explanation of MI. The above-stated analysis has shown that Peirce's semiotic is better suited to account for diverse nature of mental images compared to its alternative and that is for the following reasons:

1. Peirce developed a more profound, detailed and wide-scaled theory of signs. His semiotic has philosophical origin and aims to solve general metaphysical and epistemological questions;

2. Peirce's semiotic is universal (pansemiotic), it accounts for the (external) reality and explains the co-relation between object and the sign;

3. Peirce's sign theory includes subject inside the semiosis. It accounts for subjective differences, influences and reactions, i.e. his semiotic is phenomenological as well;

4. Peirce elaborated a detailed and flexible account of sign and semiosis. Peirce's triadic definition of sign and sophisticated classification of signs can give a full-fledged interpretation and thorough analysis of any sign.

Based on these characteristics, it appears that Peirce's sign theory fulfils four main conditions of a comprehensive explanation of MI and can be legitimately applied to explain the latter. Whether studies about MI can benefit from the sign-theoretic approach and semiotic methods of investigation is the issue for further research. So far, it seems that the complex nature of mental images needs another perspective. In addition, perhaps Peirce's detailed and universal semiotic could suggest a new look on a very old problem of the nature of mental imagery inside human mind.

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