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Themata in science and in common sense

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Abstract Human thinking is heterogeneous, and among its different forms, thinking in dyadic oppositions is associated with the concept of themata. Gerald Holton characterises themata as elements that lie beneath the structure and development of physical theories as well as of non-scientific thinking. Themata have different uses, such as a thematic concept, or a thematic component of the concept; a methodological (or epistemological) thema; and a propositional thema. Serge Moscovici has placed the concept of themata in the heart of his theory of social representations which is based on 'natural thinking' and on forms of daily knowing, including common sense. In this article I shall explore some features of thematic concepts and of methodological themata in scientific theories and in common sense. More specifically, I shall refer to the significance of the methodological (or epistemological) thema the Self and Other(s) in common-sense thinking and in social practices.

Key words: themata; dyadic oppositions; a thematic concept; a methodological (or an epistemological) thema; the Self and Other(s).

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1. Introduction

Since the scientific revolution of the sixteenth and seventeenth centuries, the relations between science and common sense have been the subject matter of numerous explorations by scholars ranging from philosophers to social and human scientists (Marková, 2016). These explorations take diverse perspectives. Some of them treat common sense and science as continuous or discontinuous forms of knowledge; others emphasise the 'superiority' of science over 'inferiority' of common sense; still others are preoccupied with the public understanding of science;

and with attempts to 'scientify' common sense. Among these diverse perspectives, the suggestion that science and common sense are connected through *themata* brings new arguments into these debates. With this in mind, in this article I shall explore the nature of the relations between Holton's concept of themata in scientific explanations, and common-sense assumptions of *themata* in Moscovici's theory of social representations.

2. Holton's Dangerous Direction

Human thought is heterogeneous and it takes different forms. These may involve problem-solving, the formation of concepts, the search for similarities and differences between events, objects and people, the creation of images, thinking in dyadic oppositions, and many others. Among these different forms, thinking in dyadic oppositions is associated with the concept of themata, which was introduced into the domain of scientific explanation in 1973 by Gerald Holton. Holton characterised themata as basic elements that underlie the structure of physical theories and their development. These elements often appear in antithetical modes like 'evolution and devolution, constancy and change, complexity and simplicity, reductionism and holism, hierarchy and unity, the efficacy of mathematics (for example, geometry) versus the efficacy of mechanistic models as explanatory tools' (Holton, 1975, p. 330). These basic constituents motivate as well as constrain the creation of ideas and the development of concepts.

Antithetical modes of thinking to which Holton refers are widespread and one can hardly refute their existence. An enormous amount of scholarly literature has discussed thinking in oppositions throughout the history of humankind. It has referred to thinking in antinomies in all cultures of the world, comparing and contrasting their diverse forms in ancient Greece and China, as well as in modern philosophy and in human and social sciences (Lloyd, 1966; Marková, 2003). The broadly based anthropological, historical and sociological evidence of thinking in polarities and antinomies shows that some dyadic antinomies have been conceived as strictly separated from one another while others as mutually interconnected. With respect to the former, Aristotle's law of non-contradiction

prohibits the co-existence of oppositions in thinking, one excluding the other. Concerning the latter, the Chinese opposites Yin and Yang are conceived as interdependent and mutually transforming one another. Thinking in antinomies was also pervasive in European mediaeval mysticism, as well as in the Renaissance; it pre-occupied philosophers such as Jacob Böhm, Immanuel Kant, Georg Wilhelm Friedrich Hegel, to mention but a few (for a review of diverse conceptions based on oppositions in thinking see Marková, 2003).

And yet, when Gerald Holton came up with the idea of dyadic oppositions in scientific thinking that he called themata, he noted that he undertook 'an undeniably dangerous direction' (Holton, 1973, p. 215). The dangerous direction to which he referred concerned his defiance of the established rules of explanation in science, and specifically in physics. These rules were based on the manipulation of forces in Euclidean space, and expressed in the *xy* plane. Such well-established conventions assumed that physical explanations were founded purely on measurements, empiricism and formal analytic procedures. In referring to these reputed guidelines, Holton (1973, p. 186) recalls the famous quote of the nineteenth century British scientist Lord Kelvin who stated that if you cannot measure and express in numbers what you talk about, 'your knowledge is of a meagre and unsatisfactory kind'. Such knowledge, Lord Kelvin continued, can scarcely advance towards the stage of Science with the capital S. In contrast, Holton thought that such a narrow perspective was totally incapable of accounting for discoveries, inventions and the growth of scientific knowledge.

But how can one capture the human capacity to invent, imagine and create new knowledge? In his search for an answer, Holton postulated themata. Since these elements usually appear in antithetical modes, they may explain the diversities of scientific thinking. Holton was well aware that a hardnosed scientist could scarcely accept such a concept: themata are not objectively observable; they are implicitly assumed rather than being in the explicit awareness of the researcher; and they cannot be measured. But Holton committed even more significant offences against Science. He broke down the traditional division between sciences and non-sciences by emphasizing that themata belong not only to the world of science, but that they underlie human thinking in general:

they arise from humans' 'general imaginative capacity' (Holton, 1973, p. 214). Moreover, he argued that themata are shared by members of a community, although they are uniquely developed and transformed by individuals.

While thinking in oppositions has been widely discussed in historical and cultural treatises all over the world, Holton's idea of themata takes a new direction in scientific explanation. He argues against the oversimplified assumptions of science and non-science. Such assumptions conceive science as being concerned with empirical and analytic (analytic in the sense of formal rules) components, while non-science, such as literature, arts and other fields involve decisions that are predominantly aesthetic, qualitative or mythical. Totally rejecting this perspective, Holton claims that in a deep sense, science is a cultural and historical product: 'Science is in a dynamic interaction with the total intellectual activity of an age ... it may underlie the work of the artist, just as it penetrates into the explanation a mother gives to her child to help him understand the way things move' (Holton, 1973, p. 202). This is why science cannot be reduced to purely empirical and formal analytic claims. Instead, it is the thematic thinking, that is, the thinking in oppositions that enables human creativity and leads to discoveries. True, there are areas in physics in which, Holton (1975, p. 332) notes, thematic thinking does not seem to be of much help. This, however, does not belittle the argument concerning the prominent role of themata in many physical theories. Since human thought is diverse and heterogeneous, the researcher must be open to different kinds of explanation.

3. Themata in Social Representations

Serge Moscovici (1961) formulated the theory of social representations in his classic book on *La psychanalyse: son image et son public.* Social representing is rooted in 'natural thinking', that is, in daily thinking. It orientates modes of knowing, acting, and communicating about specific phenomena in social realities with which humans are engaged.

These pluralities of 'natural thinking' all coexist together. They may include contradictory forms, discontent, conflicts, desires, hopes, fears and otherwise. This means that in and through representing humans

make sense, create and imagine meanings of phenomena in their everyday realities, and transform them into new realities. Examples of these could be democracy, injustice, health, illness, and any other phenomena that create tension among individuals, groups and institutions, are publicly discussed, circulate and are transformed through communication. Moscovici (1984) was particularly interested in the transformation of scientific knowledge into common-sense knowledge. He used the term 'common sense' in a very broad sense and it originally included forms of practical, imaginative and symbolic knowing and reasoning that were part of 'natural thinking' (Moscovici, 1961). Later on, he distinguished two forms of common-sense knowledge (Moscovici and Hewstone, 1983). One form, which he called 'first-hand knowledge', is naïve and spontaneous knowledge based on tradition and consensus, which gives rise to the development of science. The second form of common sense arises from the public understanding of science: it is the science transformed into daily knowledge through communication, the diffusion of science by instruction and through the media.

Influenced by Holton's ideas, Serge Moscovici brought the notion of themata into the theory of social representations (Moscovici, 1993; Moscovici and Vignaux, 1994/2000). However, Jesuino (2008) notes that as early as in the first edition of *Psychoanalysis* (Moscovici, 1961), one finds forerunners to dyadic themata. Moscovici was well familiar with Marxist dialectics and it was this philosophical tradition that was already apparent in his first publications. For example, when he articulated social psychology as a discipline in movement, Moscovici conceived it as doubly orientated with respect to several kinds of dyadic micro-social versus macro-social oppositions in tension (Faucheux and Moscovici, 1962). These included oppositions like individuals versus groups, personality versus culture, psychology versus sociology, and so on. Moscovici thought that as a hybrid discipline in continuous movement, social psychology should focus its interest on different ways of coping with tensions produced by these dyadic relations. Later on, still other dyadic oppositions in tension dominated Moscovici's thought, such as majority versus minority, common sense versus science, and knowledge versus belief. He considered that the study of tensions between such dyadic oppositions constituted the challenge to, and specificity of, social psy-

chology. Holton's concept of themata as dyadic oppositions inspired Moscovici to develop this concept in his theory of social representations. He not only adopted the concept of themata, but and he placed them 'at the heart of social representations'; he likened themata to 'concept images', 'primary conceptions' or 'primitive notions' (Moscovici and Vignaux, 1994/2000, pp. 176–177).

We can conclude that while Holton focuses on the role of themata in scientific explanations, Moscovici emphasised the role of themata in daily understanding, knowing and believing, and therefore, in the theory of social representations. By placing themata 'at the heart of social representations' Moscovici linked together scientific and common-sense forms of thought. In the context of this article, I shall consider it sufficient to use the term 'common sense' in Moscovici's broadly based sense as implicitly and explicitly socially shared forms of knowing, acting and communicating. Yet we need to ask what exactly is it that makes themata such a significant feature of scientific and common-sense thought? Let us reflect on some of their characteristics.

4. From Dyadic Oppositions to Themata

4.1 Which Dyadic Oppositions become Themata?

Although all dyadic oppositions have the potential of becoming themata, it does not mean that all of them become so transformed. Moreover, sciences and non-sciences provide different responses to the question as to which dyadic oppositions turn the potentiality of becoming themata into actuality.

In scientific explanations, Holton notes that he could find no more than fifty themata in physical sciences, and he believes that it would not be possible to identify more than a hundred. They represent the basic elements of thinking in physics in terms of dialectic oppositions (although occasionally they appear as single elements or as triplets) such as stability and change, complexity and simplicity, analysis and synthesis, or symmetry and asymmetry. For example, complexity and simplicity was one of the two main themata (the other thema was necessity) in cosmology of Mikulas Copernicus (Holton, 1978). Analysis and synthesis were the dominant themata of Isaac Newton (Holton, 1978). Einstein's pref-

erence for symmetry over asymmetry is well documented (see below). Holton claims that in the history of science it is very rare to notice the appearance of a new thema. One example to which he refers is Niels Bohr's complementarity (see below) (Holton, 1974, pp. 115–161). However, when a new thema appears, it is long-lived and endures through the revolutionary changes of Kuhnian (Kuhn, 1962) scientific paradigms (Holton, 1975, p. 333).

Although Holton (1978) devotes the whole section in his book on *The Scientific Imagination* to the public understanding of science and to public education, he does not discuss themata in this context. Thus it appears that while scientific themata permeate discourses in scientific communities, they have no place in the public understanding of science. Instead, we could suggest that discourses which are concerned with the public understanding of science, are generated from themata that arise from common-sense thinking.

In contrast to physical sciences, the number of themata in common-sense thinking is potentially without limits. In human societies, dyadic oppositions may refer to regularities in life which could have physical, biological or social character and which, due to their uniform and repetitive natures, have become established in history and culture (e.g. Vico, 1744/1948; Husserl, 1913/1962; Lindenberg, 1987). Examples of physical dyadic oppositions could be warmth and coldness, hardness and softness, or heaviness and lightness. Biological dyadic oppositions could refer to birth and death, hunger and fullness, wellness and sickness. Social dyadic oppositions could refer to friends and enemies, to 'we' and 'they', to trust and distrust. Such physical, biological and dialogical uniformities and regularities are sensed as repetitions and relative constancies in daily life and in communication; they are passed on from parents to children over generations. Although they may change over time, they provide substantial resources of common-sense knowledge. They usually operate at a non-conscious level and they are implicitly shared by communities. In this sense they are potentialities that may enter into speech and communication whenever suitable circumstances arise. Any dyadic oppositions can become themata if they are sources of dispute, interest, negotiation, tension or conflict among individuals, groups and societies. When such situations occur, the relevant oppositions rise to

awareness; they start generating concrete contents, raise questions and produce disputes. Depending on the circumstances, they topicalise contents and arguments in different directions: they become thematised in speech and communication. In thematising opposing positions in public disputes humans respond to current problems. In this process themata transform and innovate themselves in social, political, cultural and historical contexts.

4.2 Commitment to Themata

Holton (1974) places emphasis on commitment, weight and the role that researchers attribute to particular themata which then become the guiding forces of their work. Let us think about the famous example of the power of commitment with reference to one of the most fundamental themata in physics, that of continuity *versus* discontinuity. At the beginning of the twentieth century physicists struggled with the problem how to explain the duality of light which presents itself sometimes as having a 'corpuscular' and sometimes as having a 'wave' nature. On the one hand, there was the perspective of physicists such as Schrödiger and de Broglie, who tried to explain the nature of light in terms of 'waves' as a continuous process. On the other hand, Heisenberg viewed light in terms of a discontinuous 'corpuscular' approach. What is so curious, Holton (1974, p. 133–134) emphasises, is that the involved physicists made their diverse interpretations of the nature of light on the basis of observations of 'the same' data. He comments that rarely ever has there been a more striking battle in the history of science between different themata. Correspondence from Schrödiger and Heisenberg, using very strong language on both sides, shows the mutual disgust of these two physicists with one another. It was allegiance to the thema or to the antithema that made these two scholars so outraged. It also explained why they, 'in the face of the same set of experimental data' (Holton, 1974, p. 132) made such diverse interpretations of the phenomenon in question[1]. In fixing attention on a thema or antithema, the weight of the researcher's obstinacy steers his/her activity. The attachment to a thema does not have necessarily a positive influence on the researcher's

1 Holton (1975, p. 331) notes that 'in his latest phase' of his work, Heisenberg changed his view on this matter.

thought: while in some cases it may facilitate his/her creative imagination, in other cases a thema leads the researcher down to blind alleys because of immovable convictions that possess his/her mind.

If we turn to non-science, the propensity of viewing the 'same' events in different ways is even more pervasive: indeed, it is a fact of daily life. Divergent perspectives taken on 'the same event' move societies forward and backward, they are at the heart of revolutions and of misunderstandings. They underlie passions, hopes and fears, imaginations and conflicts. Themata such as justice and injustice, freedom and oppression or equality and inequality are interpreted so contrarily that disagreements in daily life, politics and economics often threaten to undermine societal order and lead to violence. Although we could refer to limitless and brutal events in daily life, let us illustrate this point with reference to a single and long-lasting struggle for justice in the UK. This struggle, which culminated in 2016 had involved a request for the public inquiry concerning the event that originally took place in the UK in 1984 and implicated a clash between miners and police. Although nobody lost life and nobody was arrested, those who passionately fought for the public inquiry for 32 years, did this in the name of justice. Having lost the possibility of the public inquiry, the defendants promise to continue their struggle for justice in the future. Justice and injustice in public thinking has been found by a number of researchers to be one of the most important thematic components of social representations of democracy (e.g. Moodie, Marková, and Plichtová, 1995), besides freedom and oppression.

Themata orientate not only movements of social groups but also of individual dissidents who are steered towards a single thema: 'the truth'. Here again, rulers and defendants of a totalitarian regime on the one hand, and individual dissidents on the other hand, represent 'the same event' or 'the truth' in contrary terms, and are committed to different actions in pursuing their thema. Dissidents in regimes that forbid free expressions of speech and of other activities, whether religious (e.g. Jan Hus, Giordano Bruno, Galileo) or political (e.g. Sakharov, Solzhenitsyn, Patočka, Havel), endure physical violence, torture and are even prepared to die in pursuing their convictions.

4.3 Themata Arise from the 'General Imaginative Capacity' of Humans

We have seen that themata motivate and underlie a broad spectrum of human thought, whether scientific or non-scientific. We have noted above that they arise from humans' 'general imaginative capacity' (Holton, 1973, p. 214). Therefore, it would be wrong to make a sharp distinction between these two kinds of human enterprise; instead, themata play an integrative role between sciences on the one hand, and humanities and other forms of non-scientific thinking on the other. Their mutual relations are also given by the fact that physical sciences often adopt terminology from the world of human relations, for example, from psychology. Human sciences, in their turn – and psychology specifically – adopt terminology from physics in order to appear more scientific! (Holton, 1975, p. 332). Nevertheless, it would be equally wrong to claim that sciences and non-sciences are basically the same activities. Holton (1974, p. 66) notes, that we should treasure both their affinities as well as their differences.

Holton's (1978) analysis of scientific imagination, which is based on single case studies of physicists, draws attention to the unique nature of individual creativity within the scientific community. In and through interdependence between the psychological characteristics of the individual and his/her social circumstances, themata can be understood as having a life-cycle; they arise, are maintained and fade away. Concepts of thematic thinking and of thematic analysis are used in anthropology, art criticism, and indeed in any field that acknowledges the interdependence between motives, intentions, activities and other capacities of the individual and of the community in which he/she lives.

In conclusion, in its concrete forms the process of thematisation takes place both at the collective and individual plane. The collective component of thematisation is embedded in culture, social events and history, while the individual component is unique to each person and is due to his/her experience and general imaginative and thinking capacity. The collective component in which the thema is embedded, is interdependent with the individual's imaginative capacity to formulate narratives, explanations, hypotheses, arguments and justifications.

5. Beyond Themata as Dyadic Oppositions

In introducing themata as forms of scientific explanation, Holton (1974; 1975) finds it fruitful to refer to their three uses in physical sciences. These three usages fulfil different roles in thematic analysis. The first use is a *thematic concept* or *thematic component of a concept,* for example, continuity and discontinuity, symmetry and asymmetry or force and inertia. The second usage refers to a *methodological thema.* A methodological thema has an epistemological role: it guides the direction of the pursuit of science. The third use is a *thematic proposition* or a *hypothetical thema.* This last usage lies between the former two, and it can be considered as a potential for further development of a particular physical theory. In giving examples of *hypothetical themata,* Holton refers to Newton's hypothesis of an immovable centre of the Earth and to Einstein's hypothesis of the special theory of relativity (Holton, 1975, p. 330). Both hypotheses were later revised in the light of new discoveries. Holton's examples of *hypothetical themata* refer to strictly physical hypotheses and I cannot find any examples of these in common sense thinking. This is due to the fact that while a physicist can make scientifically based predictions about physical phenomena, unless one adopts a machine-like approach to humans, one cannot make predictions of this kind about intentions, motives and creative imaginations of human agents. Therefore, in the remainder of this article I shall focus on the two former usages, that is, on *thematic concepts* and on *methodological themata*.

Holton does not claim that some themata fulfil their roles *only* as *thematic concepts* and others *only* as *methodological themata*. I shall interpret his notion of 'different uses of themata' (Holton, 1975, p. 330) as a leeway that one and the same thema can be used in different ways and can serve different purposes, that is, as a *thematic concept* in one case and as a *methodological thema* in another case. What matters, is whether the researcher focuses on a particular thema in terms of the development and transformation of thematic concept, or whether he/she uses that thema as the law or the rule of the discipline in question, providing epistemological guidance with respect to the growth of knowledge.

6. A Thematic Concept or a Thematic Component of the Concept

Holton (1974, p. 28) notes that in science it is rare to find a pure thematic concept and that it is more common to refer to a thematic component of a concept. As I understand it, scientific concepts are complex and each concept may involve a number of thematic components, for example symmetry and asymmetry, continuity and discontinuity, stability and variability, and so on. In examining various dyadic themata throughout history, we usually find that proponents of a particular thema conceive their chosen dyadic component to be superior to the other, unchosen component. Nevertheless, for one reason or other, positions of chosen and unchosen components and of their superior and inferior status may change. Let us consider symmetry and asymmetry as examples of thematic components of concepts and their transformations over time. Symmetry and asymmetry belong to the oldest thematic components in European thought (Marková, 2012). The ancient Greek meanings of symmetry referred, on the one hand, to the ideal of beauty and perfection, and on the other hand, to symmetries in organic and inorganic nature (Weyl, 1952). Asymmetry, in contrast, was usually defined negatively, as a lack of symmetry. Etymologically, in ancient Greek thinking, asymmetry referred to disproportion or deformity. Crivellato and Ribatti (2008) analysed the representation of the human body in ancient Greece. The authors point out that symmetry as a symbol of beauty and harmony, which dominated almost all aspects of ancient Greece from arts to literature and sciences, was also present in anatomical representations. The Greeks visualised the human body not only as being symmetrical from the outside, but also internally. Therefore, they misrepresented asymmetries in a number of bodily organs, such as the vascular system, toes, and the brain, among others. These mistakes were due to the Greek craving for symmetry as a symbol of perfection as well as to religious and social restrictions prohibiting detailed dissections of human bodies.

It was the modern science of the 20th century that re-conceptualised and re-thematised the meaning of symmetry and asymmetry. Drawing on electrodynamics, Galam and Moscovici (1991; 1994; 1995) discuss the breaking of symmetry as a more general phenomenon that is 'evidenced at several levels of reality from cosmology to biology' (Galam and

Moscovici, 1994, p. 481). Both physical and biological systems emerge from the spontaneous movements of matter, from its symmetrical to asymmetrical states and, from static to dynamic states. The concept of symmetry in modern physics retains its importance with reference to laws of invariance and it still dominates certain fields in physics, e.g. the theory of relativity[2]. Nevertheless, the concept of 'spontaneous symmetry breaking' has become one of the most important ones to account for dynamic physical effects and has become widely discussed and researched. For example, Nambu (2008) titled his Nobel Prize lecture *Spontaneous Symmetry Breaking in Particle Physics: a Case of Cross-Fertilization.* He maintained that spontaneous breaking of symmetry may occur throughout the entire space-time. As the universe expands and cools down, this dynamic effect may undergo symmetry breaking and may change the laws of physics.

If we turn to the common-sense analysis of themata, here again, we find an interplay of dyadic components that change over time and socio-cultural conditions. For example, the complex concept (or better the social representation) of 'Roma' is construed around a number of thematic components such as nomadic versus sedentary, pure versus impure or beggars versus musicians, and so on. 'Roma' have been thematised either negatively, and referred to as beggars and delinquents living outside the law, or positively, as musicians and travelling entertainers (Moscovici, 2011, p. 457). Having been established and maintained for centuries, such and other thematic components circulate in public discourse and justify social interaction between majorities and 'Roma'. Their relative stabilities and changes are determined by temporarily held societal preferences and beliefs about minorities. Thus we find that, on the one hand, the taboo precluding the contact of members of majorities with Gypsies perpetuates their discrimination in various parts of European countries. On the other hand, in order to accord with demands for human rights, the legal protection of 'Roma' families and groups has been launched in all European countries (Moscovici, 2011, p. 459).

2 It is well known that Albert Einstein rejected asymmetry as too complex, disruptive and as unnatural. Elkana (1982) provides a number of examples of Einstein's preferences for symmetry over asymmetry noting that Einstein connected symmetry, harmony and beauty with simplicity of explanations and with the organising principle of intuition.

7. Methodological Themata

As I understand it, Holton's adjective 'methodological' does not refer to a single 'method' or to specific 'methods', but to 'methodology' as a domain of scholarship concerned with the *theoretical analysis* of the corpus of methods and therefore, with the direction in which the search for knowledge takes place. Therefore, I presume that Holton's *methodological themata* can be called *epistemological themata.*

Until now, Holton's followers, who have been concerned with themata in humanities, have neglected the usage of *methodological or epistemological themata,* or they recognised them only implicitly. And yet, *methodological or epistemological themata* are laws of science and therefore, the principal forces determining the direction in which any search for knowledge takes place. This would suggest that *methodological themata* also steer the manner in which *thematic concepts* and *thematic components of concepts* are thematised and comprehended. This suggestion will be verified below.

7.1 Analysis and Synthesis

Holton (1978) considers analysis and synthesis to be among the most pervasive and fundamental themata in all intellectual activities, both scientific and non-scientific. They have permeated methodological practices of philosophers and scientists from Plato and Aristotle through to Newton, Kant, Hegel and Einstein, as well as the techniques in chemistry, logic and psychology, among others. Although they are dyadic oppositions, analysis and synthesis are mutually related and complementary to one another. Holton (1978, p. 112) characterises this point by stating that '[T]he synthesis provides a framework for interpretation and analysis of particulars that help to propel thought and feeling to important truths'. Both analysis and synthesis take multiple forms and different scholarly and professional activities may prefer one or the other. Commitments of intellectuals and professionals either to analysis or synthesis is reflected also in other kinds of terms. For example, in dyadic oppositions such as reductionism versus holism, dichotomisation versus unification, fragmentation versus wholeness, and differentiation versus integration, the former term refers to analysis and the latter to synthesis.

Generally, different forms of synthesis denote unifying and synoptic frameworks in philosophy, natural and social sciences, humanities and arts, within which imposing projects are conducted, imagined and interpreted. Great achievements of Aristotle, Aquinas, Descartes, Darwin, Goethe and Tolstoy are only a few examples of magnificent syntheses. If considered as a cultural achievement, Holton remarks that synthesis has more prestige than analysis because its synoptic outlook is part of general education. One might wonder, however, whether this still applies to the contemporary consumerist outlook that dominates societies and their educational institutions.

In contrast, in professional and scientific domains, Holton insists, analysis is more valuable than synthesis. On the one hand, high achievements of analysis, for example, those made in mathematics by Descartes or Fourier, and in philosophy by Russell or G.E. Moore, strike one by their ingenuity and clarity. On the other hand, analysis often provides simplified and reductionist ways in which phenomena are considered. This has become particularly controversial in human and social sciences which, in order to be accepted as scientific disciplines, reduce their rich phenomena to measurable elements. Encouraged by technological achievements, the use of computers and the internet, school and higher education embraces mechanistic outlooks to their limits. Such extremist positions are far away from Holton's perspective on analysis and synthesis. Critical of the mechanistic and materialistic approach to the contemporary preoccupations with scientific objectivity, he draws attention to dangers and even pathologies that attempt to separate analysis and synthesis in seeking a unique and homogeneous perspective in nature and life. Instead, it is vital to understand the full imaginative and intellectual power of each of these two thematic components rather than be drawn by their asymmetric status, which may mislead scholars and direct them to reductionist approaches (Holton, 1978, pp. 112–113). Viewed in this light, analysis and synthesis as methodological themata provide a fundamental epistemological role in intellectual activities in directing the ways in which research and professional practices are conducted.

7.2 Complementarity

In 1927 the Danish physicist Niels Bohr proposed the solution to duality of light that was the subject of dispute by Schrödiger and Heisenberg discussed above. Bohr suggested that processes of continuity and discontinuity with respect to the nature of light are not separate, but complementary. He introduced complementarity as a methodological thema. Bohr argued that whether one interprets light as corpuscular or as waves depends on the experimental conditions that the researcher creates. In other words, the agent (the subject or the measuring instrument) and the phenomenon (the object of measurement) are in a unique and complementary relationship (Bohr, 1955). The measuring device shows either particle or wave descriptions, but not both at the same time. As he (Bohr, 1949, p. 210) explains, this is why 'evidence obtained under different experimental conditions cannot be comprehended within a single picture'. One needs to consider that it is the totality of different conditions under which the phenomenon is examined that provides the possible information about that phenomenon. Evidence under different experimental conditions must not be treated as something final, because only the totality of information under different conditions, which are complementary to one another, brings us closer to the truth. It is in this sense that Bohr's concept of complementarity is the perspective according to which the agent and the phenomenon under study are interdependent.

In the article on 'Science and the unity of knowledge' Bohr (1955) maintained that he was not searching for a universal description and observation of phenomena, but for specific conditions that apply to specific subjects and objects. He clarified that complementarity is not just a *methodological or an epistemological thema* in physics, but that it extends to all natural and human phenomena and to the explanation of the nature of reality. It is applicable to various spheres of life, such as psychology, biology, anthropology and others (Bohr, 1999). Each of these domains involves specific subjects and objects with their particular kinds of stabilities and variabilities, and continuities and discontinuities. Conditions for their description and observation differ from one domain to another, and it is not possible to reduce one domain into another. In its broadest sense Bohr referred to complementarity as an epistemology of life (Rosenfeld, 1963/1979, p. 535; Marková, 2014).

7.3 Self and Other as Methodological or Epistemological Themata

If we return to the theory of social representations, Serge Moscovici conceived themata as *thematic concepts* or as *thematic components of concepts*, rather than as *methodological or epistemological themata.* For example, the above mentioned dyadic oppositions such as nomadic and sedentary or pure and impure, were thematic components of the concept of 'Roma'. Thematisation of these components was dependent on the underlying social and cultural perspectives of the users. If we take another of Moscovici's thema in common-sense thinking arising from the dyadic opposition man versus woman (Moscovici and Vignaux, 1994/2000), here again we find that it fulfils the role of a thematic concept. As a thematic concept, man and woman has had a very long career in the history of humankind and has undergone tremendous variations in meanings across cultures and in history. It has been thematised in numerous ways, bringing out different thematic components such as 'feminism' versus 'male chauvinism' (Moscovici and Vignaux, 1994/2000), or 'female ethics of care' versus 'male concern with rights and rules' (Gilligan, 1982). This thematic concept can be further thematised in terms of thematic components focusing on differences between men and women in their anatomy, interests, motivations, and in many other ways. These differences still dominate public discourse in all parts of the world. While in Western countries the public discourse is directed towards the struggle to assure an equal treatment of men and women in all spheres of life (economy, politics, education), in various countries of Asia and Africa it is orientated towards the struggle for basic rights of women (in sexuality, against honour killing of women, their involvement in daily activities, and so on).

In sum, we can say that research on themata in social representations has explicitly referred to themata in terms of Holton's thematic concepts (or thematic components of concepts).

However, in and through expanding empirical research, a number of researchers have *implicitly* identified one thema as being a forceful epistemological (or methodological) thema: the Self and Other. Smith, O'Connor and Joffe (2015, p. 1.2) state: 'Research on social representations of risks has revealed that a single thema, *self/other,* shapes public

engagement with a diverse range of threats. The current paper leverages this case to develop theorization of the role played by themata in the construction of common sense, and to advance understanding of the underlying drivers of social responses to contemporary risk issues'. More than that, the centrality of the thema Self and Other(s) has been subsequently systematically explored. The research team led by Hélène Joffe has explored social representations of risks from emerging infectious diseases, climate changes and earthquakes (e.g. Joffe, 2011; Joffe and Haarhoff, 2002; Joffe, Washer and Solberg, 2011; Joffe et al. 2013; Smith and Joffe, 2013; Smith, O'Connor and Joffe, 2015). For these authors, the Self and Other(s) is a unifying thema that arises from common sense – in our terms, the Self and Other(s) is conceived here as a fundamental epistemological thema. It underlies the ways through which the public confronts the risks that threaten individuals, groups and communities. On the basis of the Self and Other(s) as epistemological thema, these authors derived other themata – or, in Holton's terms, *thematic components of concepts,* such as identity-protection versus identity-spoiling, clean versus dirty, moral versus immoral, among others.

Another research group led by Gail Moloney also focuses on the centrality of the Self and Other(s), in their studies of organ and blood donation (e.g. Moloney, Hall, and Walker, 2005; Moloney, Williams, and Blair, 2012; Moloney, Walker, and Charlton, 2013; Moloney, Gamble, Hayman and Smith, 2015). This research group, too, views the Self and Other(s) as 'the basic thema'having a 'generative potential'. These authors suggest that the thema Self and Other(s) underpins the public understanding of blood donation and that it affects the individual's engagement or disengagement with blood donation. This basic thema activates the occurrence of numerous thematic components and generates representations that are either salient for the Self, like anxiety, fear of needles, or for the Other, like helping Others and saving their lives. The authors emphasise that thematisation is driven by the ways these issues are understood in particular contexts, particular times and places. They show the co-existence of contradictory understanding of the issues in question which manifest themselves as multiple voices, created by fear of pain and danger to the Self, and at the same time by willingness to help Others, improve their health prospects and lives.

Our own research on HIVAIDS in Scottish prisons and in studies of haemophilia, also showed that the thema Self and Other served as a basis for creating other themata, such as the perception of risk, blaming the other, and the search for social recognition (Marková et al. 1995). In the case of haemophilia, we found that for many patients the knowledge of the disease and its spread was less important than their fear that they could be rejected by Others if the fact became known that they had been infected by HIV (Marková et al. 1990). Equally, although patients and their families were well aware that the virus did not spread by daily contact, the families tried to keep a 'clean house' and they associated the disease with uncleanliness. These representations resulted from mixtures of traditions, established common sense knowing, and the Self/Other interactions.

These studies, focusing on the Self and Other(s) interdependence, show asymmetric relations between the Self and Other(s): the Self usually associates the danger, threat and risk with the Other(s). Such representations have established themselves during the history of humankind, during which privileging the Self (his/her family, clan or group) over the Other has become a common-sense assumption. The eminent anthropologist Ruth Benedict (1942, pp. 98–99) observed that the belief in superiority of one's own group over another group has a very long history; already in human prehistory, 'we' and 'they' relations were fundamental to life. The preference for one's own group is very deeply and unconsciously rooted and therefore, it is hard to eradicate or even to reflect on it. The social psychologist Gustav Ichheiser (1940; 1949) noted that whilst beliefs in moral and intellectual superiority of one's own group over another one are difficult to abolish, one can at least recognize that these beliefs are part of life. Rather than admitting to ourselves our moral, intellectual and other kinds of shortcomings, we attribute them to Others, rationalize our thoughts and conduct, and invent fictitious notions and reasons to justify our behaviour (Ichheiser, 1951).

8. Conclusion

This article discusses the perspective according to which scientific and non-scientific knowing and thinking, including common sense, are

brought together in and through themata, the basic elements of thought which usually take form of dyadic oppositions. Themata both differentiate and connect science and non-science. Their vital convergences stem from the natures of scientific and non-scientific thinking as cultural products. In both activities themata provide a rich scope for imagination and creativity. Their divergences are due to the fact that only a small number of themata has been shown relevant to scientific activities and to the development of scientific theories. The expert's firm commitment to a thema results from the consideration of scientific procedures relevant to the theory in question and it precludes interference of other issues, e.g. values, personal interests, etc. Scientific communication is restricted to experts; the commitment to a thema may enrich or constrain scientific progress.

In contrast, themata in non-scientific thinking (and in common-sense thinking) are limitless. They are thematised in public discourses they circulate through communication. While scientific communication is restricted to experts and supposedly precludes values and interests, non-scientific communication is hardly ever neutral. In words of Niels Bohr, humans are suspended in language; thematisation involves judgements, evaluations and attribution of responsibilities with respect to events in question.

Among their different uses, methodological or epistemological themata, e.g. analysis and synthesis, give direction and coherence to scientific as well as to non-scientific thinking. In common-sense thinking, the Self an Others appear to be the central epistemological thema. The Self and Other are intimately bound together by ethical relations: humans evaluate one another, they trust and distrust each other, they take responsibility for one another and they attempt to avoid it (Marková, 2016). Selfhood arises in and through interdependence with others (Ricoeur, 1990/1992) through themata that involve ethical considerations, self-promotion and other-denigration. They often perpetuate implicitly through generations, without being brought into explicit awareness. Bringing themata to consciousness stimulates social change. It is up to humans to direct the actualisation of thematic components of the Self and Other(s).

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