Chapter 2
The Epistemological Grounds of the Conceptual Profile Theory

Charbel N. El-Hani, Waldomiro José da Silva-Filho, and Eduardo F. Mortimer

2.1 The Conceptual Profile Theory and the Charge of Relativism

Let us begin by considering an idea that plays an important role in the conceptual profile theory, namely, the notion of heterogeneity despite genetic hierarchy, proposed by Wertsch (1991). Wertsch assumes that different forms of thinking can be ranked genetically (in the sense of development or generation), but more recent forms are not assumed to be more powerful. Based on the notion of "spheres of life" put forward by William James (1907) in his description of where common sense, science, and critical philosophy may be adequate and appropriate, and on the "activity-oriented" approach outlined by Tulviste (1991), Wertsch claims that the development of new forms of activity gives rise to new types of thinking, but, since the earlier forms of activity continue to fulfill some role in culture, older types of thinking are preserved and continue to function well in appropriate contexts. This idea can lead to a charge of relativism. Although we do not consider this to be a fair criticism of either Wertsch's or our position, it is indeed necessary to build a case against this interpretation. The goal of this chapter is to directly face

C.N. El-Hani (✉)
Institute of Biology, Federal University of Bahia, Rua Barão do Geremoabo, s/n, Campus de Ondina, Ondina, 40170-290 Salvador, Bahia, Brazil
e-mail: charbel@ufba.br; charbel.elhani@gmail.com

W.J. da Silva-Filho
Department of Philosophy, Faculty of Philosophy and Human Sciences, Federal University of Bahia (UFBA), Salvador, Brazil

E.F. Mortimer
Faculty of Education, Federal University of Minas Gerais, Av. Antônio Carlos 6627, 31.270-901 Belo Horizonte, Minas Gerais, Brazil
e-mail: mortimer@ufmg.br

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this criticism, discussing whether or not the conceptual profile theory is committed to relativism. We will argue that this theory is not relativistic, offering an alternative stance as its philosophical ground. More specifically, we will appeal to objective pragmatism, as advocated by Peirce, Dewey, and other thinkers, to build such a position, instead of a Jamesian, more subjective pragmatism, which influenced Wertsch's argument. But, first, let us briefly come back to the nature of learning in the conceptual profile theory.

Assuming the existence of conceptual profiles as a manifestation of the heterogeneity of thinking implies recognizing the possible coexistence in an individual of two or more meanings for the same word or concept, which can be accessed and used in the appropriate contexts (or not). In the face of this heterogeneity, learning is conceived in the conceptual profile theory as involving two interwoven processes: (1) enriching an individual's conceptual profile and (2) becoming aware of the plurality of modes of thinking that constitutes the profile and the contexts in which they can be fruitfully applied (El-Hani and Mortimer 2007). In science teaching, the first (cognitive) process typically involves learning scientific modes of thinking, while the second (metacognitive) process demands that the students acquire a clearer view about which modes of thinking are appropriate in which contexts. This view is compatible with Wertsch's notion of heterogeneity despite genetic hierarchy, albeit we stress that, even though modes of thinking are not inherently better, some modes can be pragmatically better than others, depending on the problem posed to the individuals.

It is important to consider that students can be in a cognitive developmental state in which they master a scientific idea but are not yet aware of how it fits into the heterogeneity of their own thinking. As Vygotsky (1934/2001, p. 229) argues, the existence of a concept and the consciousness of this concept do not coincide, either in the moment of their emergence or in their functioning. That is, the analysis of reality grounded in concepts appears much earlier than the analysis of concepts themselves. Thus, the application of knowledge to concrete and authentic situations should be always given a central role in science teaching, since this will prepare the students to understand in the future that knowledge is to be applied in solving problems, and, thus, that we can differentiate between ideas more applicable to some kinds of problems than to others.

To come back to an example discussed in Chap. 1, a student can become aware that the scientific concept of "heat," as a process of energy transfer between systems at different temperatures, is complementary to her everyday concept of heat, which assumes heat as being proportional to temperature. However, there are contexts in which one of the meanings is more appropriately used than the other. In the science classroom, students should learn the scientific way of understanding the concept. But the pragmatic value of everyday language will preserve meanings that are at odds with the scientific view. For example, to ask in a shop for a "warm woolen coat" is far more appropriate than asking for "a coat made from a good thermal insulator." Nevertheless, if the students know that the warmth of the wool is conceived from a scientific perspective as being due to the warmth of our body as the wool isolates it from the environment, they will show a conscious awareness of this profile, being capable of drawing on everyday and scientific ideas of heat in a complementary and appropriate manner.

The conceptual profile theory stresses the need of dialogue between scientific and everyday meanings in order to develop conceptual understanding in science, clearly distinguishing between different forms of knowledge and the contexts in which they can be best applied. It is not that nonscientific modes of thinking and meaning making should be devalued, as if they were inherently inferior, but that they have to be recognized as culturally adequate for some but not all spheres of life in which we act and talk.

Is this view about learning committed to a relativist stance about knowledge appraisal? To obtain a clear view about this issue, we should consider the meaning of relativism and its counterpart, rationalism, in order to provide an explicit account of how we understand these terms, since they have been and are still used in a variety of ways. For the purpose of our arguments, we will also introduce pragmatism as a putative via media between rationalism and relativism.

2.2 Rationalism and Relativism

The debate about rationalism and relativism mostly concerns theory appraisal and choice but is also related to the problem of demarcation between science and nonscience. A rationalist thinker claims that there can be atemporal and universal criteria to evaluate the relative merits of rival theories. For a Popperian falsificationist, for instance, such criterion would be the degree of falseability of theories that have not been falsified yet. Falseability or refutability also provides a criterion of demarcation. For Popper, the solution to the problem of demarcation between the scientific and nonscientific (which includes a broad set of beliefs from metaphysics to ideology and common sense) lies in the refutability, since to be classified as scientific a proposition or system of propositions should be capable of entering into conflict with possible or conceivable observations (cf. Popper 1962/2002). Against "dogmatic" intellectual attitudes, which intend to either impose a theory to the world or assume that the world somehow offers us the best theory, Popper advocates a "critical" attitude (a "critical rationalism"). This "critical" attitude can be described as the conscious effort to submit our theories and conceptions to rigorous logical and empirical tests. In Popper's view, the goal of the scientist is not to discover absolute certainty but to create increasingly better theories, which have more and more content (as a consequence of their growing degree of falsifiability) and are capable of being submitted to more and more rigorous tests. It is only through the establishment of the falsity of our conjectures that we can, in fact, learn about reality (cf. Popper 1972). We can see, thus, how Popper is committed to the idea of an atemporal and universal criterion to evaluate the relative merits of theories, i.e., that Popper is a rationalist. In these terms, it is assumed that, when choosing between two or more theories, a scientist would act in an entirely rational manner, using universal and ahistorical criteria, a set of clear and unambiguous rules to determine theory choice.

It is also common that a rationalist takes theories that are in accordance with the universal criteria for theory choice as increasingly true, or approximately true, or

probably true, despite the problematic nature of the notion of "truth." Truth, rationality, and science are closely related in a rationalist stance, and, on the side of values, they are also seen as intrinsically good.

It is quite clear that such a rationalist stance cannot fit together with the conceptual profile theory. The alternative is a relativist account of knowledge appraisal, or so it seems. This is not the space to discuss all aspects involved in the idea of a relativist philosophical position with regard to knowledge. This is indeed an intensely debated theme.[1] We are only interested in emphasizing some consequences of the relativist denial of the existence of universal and ahistorical rationalist criteria that might guide our judgments and decisions about what theory to choose among a diversity of rival theories. In the absence of such criteria, it seems, at first, that what is better or worse with regard to scientific theories varies from individual to individual and/or from community to community. Indeed, we find in many relativists the idea that the goal of knowledge construction will depend on what is regarded as important or valued by the individual or community at stake (Chalmers 1993). In these terms, accounts of progress in knowledge and the choice of criteria to judge the merits of theories will be always relative to individuals or communities. Most importantly, the "relativism" which interests us here amounts to the thesis that the criticism against universal criteria of demarcation or theory appraisal has, as a necessary consequence, the conclusion that *for this reason we cannot evaluate our beliefs* (cf. Swoyer 2003; Heise 2004).

This is the problem of "equal validity," which follows from a claim such as the following: "There are many radically different, yet 'equally valid' ways of knowing the world, with science being just one of them" (as discussed by Boghossian 2002, p. 2). This position is not a straw man. Rather, it became particularly strong in the work of some contemporary philosophers and social scientists (e.g., Unger 1979; Margolis 1991; Bloor 1992; Lynch 1998; Winch 2007), who directed a fierce criticism against the pretense of truthfulness and universal validity of science, as a way of defending the diversity of ways of knowing, produced in different cultures.

This view is also strong in science education. Many advocates of multicultural science education assume this brand of relativism, arguing that Western modern science is just one example of a number of equally valid sciences built by mankind throughout its history (e.g., Pomeroy 1992; Ogawa 1995; Kawagley et al. 1998). Ogawa (1995, p. 588), for instance, claims that any "rational perceiving of reality" can be called science. But if we assume that rationality is plural and that there are many styles of reason, produced in different sociocultural circumstances, i.e., that all humans should be recognized as rational beings, then all cognitive human activities will count as science, according to Ogawa's rendering of the term. Or take the argument that "science is a way of knowing and generating reliable knowledge about natural phenomena. Other cultures have generated reliable knowledge about natural phenomena, therefore reason invites exploration of the possibility that other cultures may have different sciences" (Pomeroy 1992, p. 257). In this

[1] For a general treatment of the debates about relativism, see Kirk (1999) and Boghossian (2002).

manner, each and every reliable knowledge about natural phenomena counts as scientific.[2]

If we do not take the epistemic criteria used in science into account—as well as the epistemic criteria found in other forms of knowledge—we will not be able to comprehend and stimulate our students to comprehend the differences between diverse ways of knowing. And, as the conceptual profile theory intends to make it clear, it is important to be aware of the distinctions between the different modes of thinking that populate our social experience. Precisely because thinking is heterogeneous, we should strive for building a more systematic and organized view of this heterogeneity, in such a manner that polysemy does not degenerate into unbridled ambiguities and conceptual confusions. Moreover, as El-Hani and Bandeira (2008) argue, we gain nothing by conflating the meaning of the term "science" with the meaning of another word we already have to speak about the diversity of human ways of knowing, namely, "knowledge." If we do so, we will only lose a term whose meaning we are striving to clarify, "science," in order to obtain just one more synonym.

Some could advocate, however, that since science is highly esteemed in our modern societies, and so many times regarded as hierarchically superior to any other form of knowledge (from a scientistic perspective), to call other ways of knowing "science" can be justified as a way of stressing their value. But it is worth considering arguments to the effect that to include other ways of knowing into a broad concept of science may contribute to their devaluation rather than to their legitimacy (Cobern and Loving 2001; El-Hani and Bandeira 2008). In this manner, they lose their distinctiveness and, also, their epistemic value in terms of their own validation criteria. By calling them "science," we can inadvertently set the stage for them to be submitted to the criteria of modern science, instead of being valued by their own merits. This is a game they are bound to lose, since they would have "to compete where [modern science] is strongest —technical precision control, creative genius, and explanatory power" (Cobern and Loving 2001, p. 62).

The "equal validity" approach has tended to a *naturalization* of truth and reason, and, often, it came to mean the end of general criteria that might establish a reasonable distinction between *belief*, on the one hand, and *true belief*, on the other, as much as between *acting* and *rationally acting*. Validity could be taken, in this case, to mean merely the agreement with cultural and social conventions established in the process of organization of a human community.

This was supposed to oblige us to accept the criticism of any form of realism or belief based on rational reasons and justifications.[3] Rather, our knowledge would

[2] For a broader discussion of the (robust) multiculturalist arguments for broadening the concept of science and their relationship with the conceptual profile theory and a related conception of the goals of science teaching, see El-Hani and Mortimer (2007). El-Hani and Bandeira (2008) discuss the multiculturalist account of science in relation to Indigenous knowledge.

[3] This movement suggests that we should accept the incommensurability of beliefs, since all symbolic regimes define in their own domain different criteria of truthfulness and fulfillingness, imposing their own forms of rationality and acceptability. All these regimes would deserve the same dignity, with no judgment stemming from a Tribunal of General Reason. It became evident to those

amount to the construction of "narratives" and "interpretations" which are, in turn, symbolic systems that organize and categorize experience. These narratives and interpretations are, moreover, plural; they depend on diverse modes of construction and exhaust themselves to the same extent that they correct and renew themselves. With this linguistic-pragmatist-hermeneutic turn, the place of epistemology and metaphysics was occupied by "a world without substances or essences," "a truth with no correspondence to reality," and "an ethics without principles" (Rorty 1999).

Now speaking of science, in particular, the kind of relativist position sketched above entails that all we can do in order to comprehend scientists' theory choices is to investigate their values and how these values guide their choices. Thus, theory choice would no more be an epistemological issue, but a topic for psychological investigations and, given that no choice is really individual, but depends on the social circumstances in which one is embedded, also of sociological investigations. The relevance of epistemology is thus denied, and, not surprisingly, this has paved the way to science studies, in which epistemological, sociological, and historical issues are all treated together, and any normative intention in epistemology is under suspicion. We see no problem with this merging of fields, since to understand science we do need to account for the interdependence of the epistemological, historical, and sociological dimensions. But there is no need to bring relativism together as unchecked luggage. Or else, there is no need to devalue epistemology. In this scenario, we need some via media between relativism and rationalism.

2.3 Pragmatism

As a philosophical doctrine, pragmatism traces back to the academic skeptics in classical antiquity and developed in the history of Western thinking under the influence of a variety of philosophical doctrines, ranging from Kant's idea of pragmatic belief to moral agency (Margolis 2009). Despite the many varieties of pragmatist philosophy, a basic common theme in the tradition of pragmatism is a strong emphasis on the practice- and discourse-embeddedness of any human cognitive

that inherited the "language games" (Winch 2007), "ontological relativism" (Quine 1969), and "world-versions" (Goodman 1978) that our knowledge does not consist in an unmediated mirroring of external things. This does not mean, however, that rampant relativism is to be accepted. Quine's naturalism, for instance, advocates that we cannot think or speak of an object (such as a number, a natural being) outside a conceptual scheme or language, since there is no absolute object, absolute position, and absolute value. Ontology is relative to the natural process of belief formation. However, Quine does not claim that any conceptual scheme can be accepted or that all of them can be equally valid. As belief formation is a natural process, taking place, thus, in our own immersion in nature, certain beliefs can be better than others, to the extent that they guarantee more explanatory success (Quine 1969). This position points to a via media, such as that one offered by objective pragmatism.

construction (Pihlström 1996; El-Hani and Pihlström 2002).[4] It is due to this emphasis that we think that pragmatism—in some of its forms—can be integrated with the conceptual profile theory, providing the necessary epistemological basis to this research program on teaching and learning.

If we focus on the epistemic concern for meaning and truth, philosophical pragmatism is characterized, generally speaking, by the idea that efficacy in practical application provides a standard for the determination of the truth of statements (Rescher 1995). It is not that pragmatists simply reject the notion of truth as some relation of correspondence between belief and reality; rather, their intention is to clarify what we mean by such a relation by appealing to actions, even though there is substantial variation among pragmatists about how to carry out such practical clarification (Hare 1995). From a pragmatist standpoint, one advocates that the cognizable world and any explanation, description, and observation we build about it are necessarily conceptualized through our practices of predication and inquiry (El-Hani and Pihlström 2002). Since our knowledge about the world is necessarily shaped, in part, by concepts that we, humans, bring to the task of describing and explaining the world, no simple mirroring relationship between knowledge and world can ever obtain (Pihlström 1996; Mitchell 2003). Knowledge is simultaneously illuminating and limiting, since it cannot perfectly capture all the features of the world. This recognition of the double nature of knowledge as creating possibilities and, at the same time, posing limits to our understanding is taken by pragmatists as a ground for claiming that knowledge must be judged, at least in part, in terms of their usefulness. We need not restrict usefulness, however, to practical applicability, in some utilitarian sense. After all, knowledge can be extremely *useful* for many other things than practical applications, for instance, as a *thinking device* (Lotman 1988, quoted by Wertsch 1991, pp. 73–74), that is, an instrument for generating novel meanings.

Thus, for a pragmatist our ontological commitments, epistemological assumptions, and bodies of knowledge should be assessed entirely or partially in terms of their pragmatic efficacy. But if we consider that a limited number of ideas can be successful in dealing with a given problem, we can understand that it is never the case that anything goes when we strive for using knowledge to decide about how to act in specific circumstances. We can judge the pragmatic efficacy of different ideas and concepts for addressing concrete problems in specified circumstances. Moreover, they can also be challenged and critically assessed from the point of view of other frameworks. In these terms, we will have grounds for choosing what knowledge, what theory to accept, by critically considering and verifying its consequences for practice. This is what we mean when we refer to the pragmatic power of

[4] A thoroughgoing historical account of pragmatism with a comprehensive bibliography is Thayer (1980). Pihlström (1996) offers an extensive review of pragmatic realist positions. Regarding pragmatist works, one should consider both classical pragmatists such as Peirce, James, and Dewey and neopragmatists such as Margolis, Putnam, and Rorty. In this paper, we mainly focus on the contributions of two classical pragmatists, Peirce and Dewey. An interesting reflection upon the conflict among interpretations about the contribution of pragmatism to epistemology is found in Mounce (1997).

different zones of a profile. It is in this sense that the conceptual profile theory is not committed to relativism or, at least, to radical forms of "anything goes" relativism. Indeed, a first contribution of assuming pragmatism as a philosophical ground for the conceptual profile theory is that it moves us away from other philosophical positions that might be associated with it, such as some radical forms of "anything goes" or rampant relativism.

The work of C. S. Peirce, widely recognized as having turned pragmatism into a substantial philosophical doctrine, offers ideas that are helpful to our purposes, such as his pragmatic maxim, according to which the meaning of any concept that has application in the real-world amounts to the habits of action it produces:

> To develop its meaning [of a thought], we have, therefore, simply to determine what habits it produces, for what a thing means is simply what habits it involves. Now, the identity of a habit depends on how it might lead us to act, not merely under such circumstances as are likely to arise, but under such as might possibly occur, no matter how improbable they may be. (CP 5.400)[5]

The pragmatic maxim can be conceived as a rule for clarifying the meaning of concepts and hypotheses based on ascertaining the experiential consequences our actions would have were the hypotheses true (Hookway 1995). Every real distinction in thought or meaning should consist in a possible difference in practice.

This is closely related to the idea that distinct modes of thinking, as modeled in a conceptual profile, have different meanings and domains of validity, since this distinction is grounded on the pragmatic consequences that these modes of thinking have for both ways of speaking and ways of acting. The pragmatic maxim offers, thus, an adequate philosophical background for the conceptual profile theory.

However, as Rescher (1995) discusses, when Peirce referred to the practical consequences of accepting an idea or statement, he initially meant the consequences for experimental practice, but he also moved beyond this, treating pragmatic effectiveness as a means for the quality control of human cognition. Nevertheless, Peirce focused once again on the scientific praxis and a standard of efficacy based on predictive success. Truth was, for Peirce, the ultimate outcome of a self-correcting process of inquiry conducted by a community of researchers endowed with a number of settled habits of action (Peirce 1931–1935, CP 5.407). Nevertheless, this was an abstracted community of ideally rational agents. It is necessary, then, to come to grips with the reality of communities of human agents that are far from being entirely rational.

A possible movement toward this, so as to say, "down-to-Earth" pragmatism can be found in Jamesian pragmatism. William James was also highly influential in the history of pragmatism, since he was directly responsible for calling the attention of the scientific and philosophical community to the doctrine built by Peirce (e.g., James 1907). There are important differences, however, between Peircean and Jamesian pragmatism.

Peirce developed his pragmatism as a move toward impersonal and objective standards. James, in turn, treated pragmatism in a more subjective manner. Not that James' pragmatism is entirely subjectivist, as influential philosophers argued,

[5] We will follow here the scholarly practice of citing from the *Collected Papers of Charles Sanders Peirce* (Peirce 1931–1935) by volume number and paragraph number, preceded by "CP."

such as Bertrand Russell (1910) and George E. Moore (1922). Moore and Russell substantially contributed to the reading of James as entirely subjectivist and, more than that, as a second-rank thinker, when they associated James with the idea that everything goes provided that a belief brings some sort of satisfaction or is somehow useful to someone, despite any demand of objective verification or even the existence of the objects to which the belief refers. As Sprigge (1997) argues, these criticisms were devastating at James' own times, despite his attempts to clarify his ideas, particularly in *The Meaning of Truth* (1909). This author argues, also, that the interpretation of James as an entirely subjectivist philosopher does not hold with a careful reading of his works. Indeed, in several passages of his works, James considered the requirement of objective verification (e.g., James 1907, Lecture VI). There are, thus, both subjectivist and objectivist aspects in James' philosophy, as he himself argued (James 1909; a detailed discussion is offered by Pires 2013). It is also true, however, that James included much more subjective elements in his philosophy than Peirce. Indeed, these elements are the most controversial issue in James' philosophy, following from how he associates truth and satisfaction (including personal, individual satisfaction). Instead of considering the practical consequences of concepts or statements for abstracted and rational agents, as Peirce, James highlighted the use of pragmatic criteria by particular and plural flesh-and-blood people, emphasizing the role of personal ideas of efficacy and success, which can be idiosyncratic and highly subjective.

Even though James also took into account objective judgments in his philosophy, his version of pragmatism is not as objective as Peirce's, who treats pragmatism as a manner of validating objectively cogent standards, which he conceives as a consequence of habits of action followed by an abstract community of rational agents. James, in turn, ascribed an important role in his pragmatism to the judgment about what proves to be effective for the satisfaction of a particular person (or group). To our purposes here, we need something between Peirce's appeal to an abstract community of rational agents and James' more subjective account of a community of individuals assessing the efficacy of ideas in terms of their own satisfaction. It seems to us that pragmatic efficacy should be formulated as a criterion used in judgments made by communities of flesh-and-blood people, not by rational agents abstracted away from the fuzzy relationships of real life. Yet, it should be also treated in such a manner that these judgments can be, in some sense, objective. How could this be done?

Among the pragmatist philosophers, a helpful source in this attempt is John Dewey, who takes Peirce's logical theory as a starting point to develop an account of logic as an inquiry into inquiry which is particularly illuminating regarding our arguments. Accordingly, we will expand on Dewey's ideas in the following paragraphs.[6]

[6] As we use pragmatist ideas—particularly, Peirce's and Dewey's—to a great extent to formulate the epistemological grounds of the conceptual profile theory, and we are also strongly inspired by Vygotsky's and Bakhtin's theories, it is important to consider, even if briefly, the prospects and possible contradictions involved when we try to use both of these sources of ideas together.

In his *Logic: The Theory of Inquiry*, published in 1938, Dewey proposes that logic, as an inquiry into inquiry, should derive all logical forms from the operations of inquiry, and, in turn, these logical forms, once derived, make it possible that inquiry is controlled so that it yields warranted assertions. Or, to put it differently, the principles of inquiry are formulations of conditions established in the course of inquiry itself—and postulated in formal statements by inquiry into inquiry—which further investigations must satisfy if they are to yield warranted claims. These ideas are familiar to us in certain fields, such as art and law, where subject matters of everyday experience are transformed in historically developed logical forms that render certain product objects of fine art, just as certain aspects of transactions between human beings are transformed into legal rules. Nevertheless, they were, at the time Dewey wrote his *Logic* (1938), unfamiliar in logic and philosophy of science.

After the historicist turn of the 1960s, they became certainly more familiar, but, yet, Dewey's claims need to face a predictable criticism, related to the fact that logic, as conceived by him, becomes a circular process, not dependent upon anything extraneous to inquiry (Dewey 1938, p. 20): since inquiry can be better or worse and is criticized and evaluated by logical standards, how can inquiry, which has to be evaluated by a reference to a standard, be itself the source of the standard?[7] If we simply say that inquiry cannot be the source of standards to guide itself, it will immediately follow that the logical requirements that inquiry should meet in order to reach valid conclusions must be imposed from without. It is curious to see that

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The first thing that comes to our mind when we ponder about this issue is that Marxist and pragmatist tendencies have been involved in dialogue during the twentieth century, as discussed by Reisch (2005) and, thus, do not seem to be entirely at odds with each other. More importantly, it is not the case that we need to simply assimilate Vygotsky's, Bakhtin's, Peirce's, or Dewey's frameworks as a whole. Just to mention two examples, many of the statements made by Vygotsky about language in apes cannot be currently accepted, to our understanding, in view of the subsequent developments in research on the topic, and we also do not follow Dewey's way of distinguishing between scientific inquiry and common sense, based only on differences in their subject matters, problems of interest, and the objective consequences they are concerned to achieve. A further example concerns Dewey's attempt to equate the sign with the tool, treating the tongue as the tool of tools, which is explicitly rejected by Vygotsky (1978, p. 53). That we can proceed in building connections between these authors, but not assimilating their entire frameworks, is illustrated by the fact that the idea that sign and tool could be equated is of no consequence at all to the Deweyan theses we use to formulate epistemological grounds for the conceptual profile theory.

[7] Or, to put it differently, if we should derive from historical cases the standards that will control inquiry, what criteria shall we use to identify the exemplars of good inquiry from which to derive those canons? Obviously, we cannot use these very standards to select the cases, since this would commit our position to fatal circularity. Other criteria should be used to identify the cases of good inquiry that can lead to standards. In the main text, we will just follow Dewey's argument. Let us add, however, that we do not see reasons to doubt that such criteria can be available: we can use, for instance, criteria related to heuristic power, success in explanation and prediction, technological outcomes, and so forth to select the cases worth studying in order to derive norms or, at least, values, logical principles that good inquiry can tentatively obey. And we can in a safe position regarding our possible mistakes, since the very criteria to guide inquiry should be, as Dewey argues, open to revision, tentatively accepted, and self-correcting.

Dewey was facing two decades earlier a problem that would challenge the historicist turn in the philosophy of science, which claimed that norms for scientific research should be derived from historical studies about science. It is both interesting and informative about Dewey's position to verify how he meets this question:

> The problem reduced to its lowest terms is whether inquiry can develop in its own ongoing course the logical standards and forms to which *further* inquiry shall submit. One might reply by saying that it *can* because it has. One might even challenge the objector to produce a single instance of improvement in scientific methods not produced in and by the self-corrective process of inquiry. (Dewey 1938, p. 5, emphasis in the original)

His idea is, thus, that the very history of science and its methods—to take a well-developed example of inquiry—illustrates that the logical forms that control scientific investigations have been produced by the very self-corrective process of inquiry. Inquiry generates not only new knowledge but also new canons that control knowledge production. The logical forms of inquiry are themselves evolved; they change through time, as previous research establishes the criteria to which future research is to be submitted.

The methods have been not only tried but also *tried out* during the developing course of science or, generally speaking, of human's endeavor to produce knowledge. As methods are tested and eventually fail, the history of inquiry leads to modified methods that yield more dependable results. The improvement of methods follows from the fact that not only conclusions were found to be inadequate in previous investigations, but they have been often found to be so because of the methods employed. Thus, the methods themselves have been modified and even replaced by methods that produced results that stood the strain of further research better and, more than that, by methods that tended to be self-rectifying. Indeed, one of the central elements of Dewey's theory, inspired by Peirce, is the idea that a good method of inquiry should be self-correcting. Such a method does not appear out of logical canons imposed from without, but in the course of the history of inquiry, through the evolution of methods themselves.

It is clear, then, that Dewey is not talking about a rigid scientific method, as in what has become known as the myth of the scientific method (Bauer 1994). The method that Dewey is talking about is not a rigid construct, but changes throughout historical times, to the extent that it is not established a priori, based on logical operations only, but follows from actual practice. The logical forms considered by him are not fixed and eternal, but change with transformations in both the habitual ways in which inquiry proceeds and the consequences ensuing from it. There is a dialectical relationship between logical forms guiding inquiry and inquiry itself: those logical forms originate out of experiential material and, when established, introduce new ways of operating with prior materials, but, as these ways develop, they modify the materials out of which the logical forms arise (Dewey 1938, p. 103).

Another important conceptual elaboration made by Dewey, in relation to our articulation of the conceptual profile theory, regards his explanation of what he means by "situation." Problematic situations and ways of solving them appear to human beings in a manner which has, for Dewey, no precedent among organisms,

due to the nature of our social lives (Dewey 1938, p. 43). But what he means by "situation" and in what circumstances are situations rendered problematic? Dewey uses the word "situation" to refer to a contextual whole which makes it possible for us to experience and form judgments about objects and events (Dewey 1938, p. 66). A situation is "a qualitative existential whole which is unique" (Dewey 1938, p. 122). And a situation is problematic when it is indeterminate, i.e., when it is not clear what kinds of responses the organism shall give in its interactions with environing conditions (Dewey 1938, p. 107). Thus, problems that are chosen to be investigated should grow out of actual situations; otherwise, we will be engaged in nothing but dead work (Dewey 1938, p. 108). Moreover, we need to establish in the very course of inquiry what problems are presented by a problematic situation to be inquired into. Thus, a first step in investigating an indeterminate situation is to ascertain what are the problems that we need to deal with to turn it into a determinate situation, i.e., a situation in which we know, even if provisionally, how to answer to the environing conditions and how to act.

All our experiences, judgments, thoughts, etc., are pragmatically embedded into objective situations, and it is in connection with them that we can make decisions about what and how to think, say, and act. This pragmatic grounding of our modes of thinking and speaking underlies, in the conceptual profile theory, the learning goal of students' acquiring a conscious awareness of the diversity of ways of thinking and speaking about a given concept and their differential application to distinct problematic situations.

In the process of inquiry, we analyze the situations, since every situation is, in Dewey's terms, "extensive" (Dewey 1938, p. 122), in the sense that it contains diverse distinctions and relations which form, despite their diversity, a unified qualitative whole. Such an analysis is taken by Dewey as a crucial, critical stage of inquiry, since it leads us to identify singular objects and events, which should be always treated as occurring within a situation, and provides means of considering the situation in reference to the problem set to inquiry and how we act regarding it. When we speak of *this* or *that* organ, rock, atom, or whatever, we are always talking about a discrimination or selection made for a purpose, or for the sake of some objective consequence we need to deal with in our attempt to turn, through inquiry, an indeterminate into a determinate situation (Dewey 1938, p. 123).[8]

Although this is not the place to explore this putative relationship, Dewey's emphasis on the fact that we live and act in connection with a whole environmental situation, not in connection with isolated objects, leads him to a criticism of the way psychology interpreted at his time the act of perception, which takes him to a path

[8] All these ideas are quite consequential to authentic science experiences in the classroom (Roth 1995; Buxton 2006; Tytler et al. 2008; van Eijick and Roth 2009) or more to the point of this volume, to the way a teacher may work with situations in order to teach students about how modes of thinking and speaking—including scientific ones—can provide solutions to problematic situations: How can we analyze the situation? What are the objects and events we should consider? What is problematic about the situation? What concepts can we bring to bear on it?

that can come close to the situated cognition research program in current cognitive sciences (see Chap. 1, this volume):

> When the act and object of perception are isolated from their place and function in promoting and directing a successful course of activities in behalf of use-enjoyment, they are taken to be exclusively *cognitive*. The perceived object, orange, rock, piece of gold, or whatever, is taken to be an object of *knowledge per se.* (Dewey 1938, p. 67. Emphasis in the original)

No object can be, from this standpoint, an isolated object of knowledge in an ultimate and self-sufficient manner. It should be always interpreted in pragmatic terms, i.e., as part of a whole environmental situation in relation to which it can be known in order to provide guidance regarding the course of behavior, so that the situation can be dealt with in a manner conducive to some adaptive response.

It is in connection with the establishment of courses of behavior as a consequence of inquiry that Dewey introduces the concept of "warranted assertibility" as a substitute for "truth":

> If inquiry begins in doubt, it terminates in the institution of conditions which remove need for doubt. The latter state of affairs may be designated by the words *belief* and *knowledge*… I prefer the words "warranted assertibility." (Dewey 1938, p. 7, emphasis in the original)

Dewey saw inquiry (both scientific and—in his words—practical) as a self-corrective process that required evaluation of procedures and norms through the test of experience. He emphasized that knowledge is gained as a result of this ongoing, self-correcting process of inquiry. Inquiry begins with problematic situations and, when it is successful, terminates in reaching that which is settled, namely, a settled objective state of affairs, which eliminates hesitancy to act.

For Dewey, inquiry is, in its most highly generalized conception, "*the controlled or directed transformation of an indeterminate situation into one that is so determinate in its constituent distinctions and relations as to convert the elements of the original situation into a unified whole*" (Dewey 1938, pp. 104–105, emphasis in the original).[9] He also states that "inquiry is a progressive determination of a problem and its possible solution" (Dewey 1938, p. 110). The indeterminate situation which is investigated is open to inquiry because its constituents do not hang together. That is why a crucial outcome of inquiry is to allow us to see the situation, with the constituents we discerned by analysis, as a unified whole.

Despite the diverse subjects of inquiry, and the related diversity of its special techniques, Dewey proposes that there is a common structure or pattern of

[9] When Dewey uses the terms "controlled" and "directed," he is not referring to controlled experiments or something similar—which would render his arguments limited to scientific work. Rather, what he is considering is that inquiry can be regarded as "competent" to the extent that the operations involved in it do lead to the establishment of an "objectively unified existential situation." By using the words "controlled" and "directed," he is pointing to "… the methods of inquiry that are developed and perfected in the processes of continuous inquiry" (Dewey 1938, p. 11).

inquiry, to be found not only in science but also in what he calls "common sense"[10] (see Dewey 1938, ch. VI).

The first element of this common pattern of inquiry is the indeterminate situation, which constitutes the antecedent conditions of inquiry. This indeterminate situation should be, by its very nature, questionable, uncertain, and unsettled, since we inquire when we question, seeking for whatever may provide an answer to a question asked (Dewey 1938, p. 105). The indeterminate situation has, however, a peculiar and unique quality that exercises control over the special procedures or means that will be used in inquiry. That is, when we investigate a particular situation, it is not the case that everything goes. This would be, for Dewey, "a condition of complete panic," of "blind and wild overt activities" (Dewey 1938, p. 105). Rather, the character of the indeterminate situation is such that some procedures of inquiry can be more effective than others. That is, there are comparisons and contrasts to be made between modes of inquiry, by taking into account the pragmatic nature of the particular situation we are dealing with. We are far from any radical relativism in the framework put forward by Dewey.

Moreover, the pragmatic nature of problematic situations is not doubtful only in a subjective sense, but in an objective sense, related to the relationships between the inquiring organism and its environing conditions, which compose a situation which is indeterminate with respect to its issue. This indetermination can be of different natures: perhaps, we cannot anticipate the outcome of a situation, which is said, then, to be "confused"; or the course of a situation makes room for final consequences that cannot be clearly established, in which case the situation is said to be "obscure"; or the situation can evoke discordant responses, being then called "conflicting" (Dewey 1938, p. 106). In any of these cases, we have an objective, indeterminate, unsettled situation which can be fruitfully taken as a matter of inquiry. This way of dealing with situations makes it clear that Dewey is to be located, in the pragmatist scenario, closer to objective than to subjective pragmatism.

The situations in themselves are regarded by Dewey as "precognitive," becoming "cognitive" due to inquiry, which has, as its first result, an identification of why a situation is problematic. As Dewey (1938, p. 107) writes, "to see that a situation requires inquiry is the initial step in inquiry." But to characterize a situation as problematic is just an initial step in what Dewey calls the "institution of a problem." When we say that there is a problem for inquiry, we already have in hands a partial transformation of a problematic situation into a determinate situation. This is what is meant—Dewey states—by the familiar saying that a problem well put is half-solved. It is an important advance in inquiry to find out what problems a

[10] As we pointed out earlier, we do not follow Dewey in the way he interprets the similarities and differences between common sense and science (for more details, see Dewey 1938, ch. IV). However, this is not the place to pursue this matter, since it would take us away from our main subject here. What is most relevant here is to note that, in his discussion of inquiry, Dewey is not focused only on scientific inquiry. For him, inquiries "… enter into every area of life and into every aspect of every area" (Dewey 1938, p. 102). Nevertheless, we cannot deny that he was much affected by consideration of scientific investigation, which he regarded as a quite well-developed form of inquiry.

problematic situation presents to be investigated. After all, as it is well known by those who engage in scientific investigation, the way we conceive of a problem will affect which specific suggestions to its solution we consider and dismiss and what data we select and reject. Moreover, the conception of a problem provides criteria for our judgments about the relevance or irrelevance of hypotheses and conceptual structures (Dewey 1938, p. 108).

After establishing what are the problems in a problematic situation, we need to determine a problem solution, according to Dewey's common pattern of inquiry. Here, the very statement of the problematic situation should help, since a problem well instituted has reference to a possible solution in its very statement. This leads Dewey to put into question how is the formation of a genuine problem so controlled that further inquiries will move toward a solution (Dewey 1938, pp. 108–109). The first requirement is to ascertain what are the constituents of a given situation. This demands observation of the problematic situation, leading to the establishment of what he calls "the facts of the case," the observed conditions in a situation. The second requirement is to find out a possible relevant solution suggested by the determination of observed factual conditions. This possible solution presents itself as an *idea*.[11] At first, it is nothing but a vague idea, but, as inquiry progresses, it becomes more and more determinate with respect to its capacity as a means to solve the problematic situation at stake.

With regard to the conceptual profile theory, we can say that a key point when one is examining and comparing modes of thinking in relation to the prospects of dealing with an indeterminate situation is to anticipate the consequences of using that mode of thinking so as to make the situation determinate and eliminate our hesitancy to act. It is in this manner that the pragmatic maxim bears on the attempt to reach a conscious awareness about the ways we may think about a situation and how fruitfully they can be applied to deal with it.[12]

In Dewey's view, there is a dialectical relationship between ideas and observations: on the one hand, the more the facts of the case are established through observation, the clearer and more pertinent become the conceptions of how to deal with the problem constituted by the facts; on the other, the clearer the idea, the

[11] It is important to mention that Dewey opposes the theory of ideas that has been held since the time of Lockean empiricism, striving, instead, to formulate a pragmatic account which defines ideas functionally, i.e., in the reference they have to the solution of a problem (Dewey 1938, p. 109, n. 6). From this standpoint, "ideas are anticipated consequences (forecasts) of what will happen when certain operations are executed under and with respect to observed conditions" (Dewey 1938, p. 109). Not surprisingly, Dewey rejects both traditional empiristic theories that ignore the function of ideas in directing observation and ascertaining relevant factors, treating them as mental copies of physical things, and rationalistic theories that fail to attend to the operative and functional nature of ideas, treating them as being equivalent to the ultimate structure of reality. He assumes a Kantian position, recognizing the profound logical insight of Kant's statement that perception without conception is blind, while conception without perception is empty (Kant [1789]1955).

[12] We will come back below to the usage of the pragmatic maxim in the science classroom.

more definite become the operations of both observation and intervention to solve the situation[13]:

> In logical fact, perceptual and conceptual materials are instituted in functional correlativity with each other, in such a manner that the former locates and describes the problem while the latter represents a possible method of solution. (Dewey 1938, p. 111)

It should be clear, then, that the common pattern of inquiry described by Dewey is not atheoretical, or naïvely empiricist, despite the role ascribed to observation in ascertaining the facts of the case. Both the perceptual and conceptual materials are determined in and by inquiry of the problematic situation, which shows, in turn, qualities that control the institution and contents of those materials. Factual material has its significance established on the grounds of an existing conceptual system, while the quality of the problematic situation determines which conceptual materials are selected as having bearing on the particular inquiry being carried out (Dewey 1938, p. 121). This selection is possible because "conceptions have been organized in the past under definite rubrics which summarize the *kinds* of interpreting principles that past experience has shown to be applicable in the variety of special cases that normally arises" (Dewey 1938, p. 121, emphasis in the original). After all, there is a definite advantage in having conceptual frameworks ready in advance to be actually used when they are needed (Dewey 1938, p. 136). In connection with the conceptual profile theory, such frameworks can be interpreted as modes of thinking about a given concept, as they apply or not in a fruitful manner to problematic situations, constituting a conceptual profile available for use in a given sociocultural circumstance.

Moreover, following the pragmatic maxim, the perceptual and conceptual materials (which lead to anticipations with regard to the consequences of acting upon the situation in a given manner) are finally checked by their capacity to work together to lead to a resolved unified situation, which amounts to the end of (that) inquiry:

> The anticipation functions logically to instigate and direct an operation of experimental observation. When the consequences of the latter combine with facts already ascertained so as to constitute a unified total situation, inquiry comes to an end. (Dewey 1938, p. 131)

In our view, all these remarks put forward by Dewey show why we can see in objective pragmatism an apt middle road not only between rationalism and relativism but also between extreme forms of realism and anti-realism.

Reasoning, in the sense of ratiocination or rational discourse, also intervenes in Dewey's common pattern of inquiry, as a way of developing the meaning-content of ideas in their relations to each other, and in relation to the problematic situation. He admonishes against accepting a suggested meaning (or, else, idea) immediately,

[13] For more details on the functional and operative correspondence between factual and conceptual matters, which Dewey (1938, p. 125) called "the *copula,*" see his discussion in Chapter VII of his *Logic: The Theory of Inquiry*. The *copula* consists, in his account, of a "complex of operations by means of which (a) certain existences are restrictively-selected to delimit a problem and provide evidential testing material, and by which (b) certain conceptual meanings, ideas, hypotheses, are used as characterizing predicates" (Dewey 1938, pp. 132–133).

since this would cut inquiry short. Rather, we need to elaborate on the ideas and meanings, examining them in such a manner that they are properly grounded. In an important sense, this examination consists in addressing the implications of a given meaning in relation to other meanings in some system in which they are embedded. An outcome of this reasoning on the meaning-content of ideas is that the operations that can be used to test the applicability of the suggested idea become more clearly determined (Dewey 1938, pp. 111–112).

This leads us to recognize a key feature of observed facts and ideas in Dewey's framework: they have an *operational* character. Ideas are operational because they instigate and direct further operations of observation, which can bring new facts to light and organize the selected facts into a coherent whole, showing the way to the determinate situation which is the end of inquiry, and in relation to it we know (at least provisionally) how to act. Factual observations, in turn, are operational in the sense that "… they are not self-sufficient and complete in themselves" (Dewey 1938, p. 113). Rather, they are purposefully selected, described, and arranged with the intent of fulfilling their specific roles in inquiry, so that the very statement of the problem indicates a meaning relevant to the solution of the situation at stake and, also, serves to test its worth and validity. That is, the facts of the case are recognized by Dewey as having a dual function: they both bring the problem to light and provide evidential material regarding its solution. Furthermore, conceptual contents also have a dual function, both anticipating a possible solution and directing observational operations.

The operational character of factual observations is of central importance when we take facts to be not only results of operations of observation but, more than that, evidence relevant to the test of a suggested idea:

> Their function [of facts] is to serve as evidence and their evidential quality is judged on the basis of their capacity to form an ordered whole in response to operations prescribed by the ideas they occasion and support. (Dewey 1938, p. 113)

He also assumes a systematic view about the evidential power of facts:

> … no fact in isolation has evidential potency. Facts are evidential and are tests of an idea in so far as they are capable of being organized with one another. The organization can be achieved only as they *interact* with one another. (Dewey 1938, p. 113. Emphasis in the original)

It is clear, then, that for Dewey evidence is not only factual observation, but factual observation that has been purposefully selected, described, and arranged as a consequence of its dialectical relationship with ideas.

While it is true that reasoning allows us to appraise the ideas to solve a problem, putting us in a better position to judge the pertinence and weight of diverse ideas for dealing with a situation, it is only by effectively testing the ideas in the course of investigation that we will overcome the hesitancy to act. By putting ideas into operation so as to observe facts not previously observed, but anticipated, and organize them with other facts into a coherent whole, we can evaluate if the ideas actually function. This is a pragmatic test of the consequences of an idea, which can establish (or not) its pragmatic efficacy. And, even though we formulated this argument

using the concept of idea in order to follow Dewey's phrasing, "mutatis mutandis," the same can be said of modes of thinking.

As mentioned above, the outcome of inquiry is a settled situation, which amounts, for Dewey, to judgment (Dewey 1938, p. 120). That is, if we began inquiry with an unsettled situation, in the face of which we showed hesitancy to act, after we inquired into the situation so as to settle it, we reach a judgment about how to act, we are in position to make a decision about how to deal with the situation. As Dewey (1938, p. 120, emphasis in the original) writes, "… judgment, as finally made, has *direct* existential import." When judgment is reached, we perform some action which has consequences with regard to the situation we are involved with. Accordingly, the warranted assertions we reach as an outcome of inquiry are not to be judged only in terms of themselves but, rather, in terms of the consequences that ensue from them, i.e., from the existential determination or settlement of the previously uncertain situation. Peirce's pragmatic maxim is clearly involved in Dewey's account of inquiry:

> The final judgment arrived at is a settlement. The case is disposed of; the disposition takes effect in existential consequences. The sentence or proposition is not an end in itself but a decisive directive of future activities. The consequences of these activities bring about an existential determination of the prior situation which was indeterminate as to its issue. (Dewey 1938, pp. 155–121)

As evidential and conceptual materials are considered throughout inquiry, in their dialectical relationship with each other, we progressively move from an indeterminate to a determinate situation, culminating with a final settlement. This final settlement is a judgment that is reached through a series of intermediate judgments and partial settlements, with regard to the evidential and conceptual materials that bear on the situation and are progressively covered by inquiry.

In a subsequent work, *Democracy and Education*, Dewey (1950/2001) discusses basically the same elements composing his pattern of inquiry as "general features of a reflective experience," further showing that he is not talking about scientific method only but about a more general construct—in this book, "reflective experience"—of which scientific investigation is one manifestation (needless to say, a well-developed one). He presents the general features of reflective experience as follows:

> They are (i) perplexity, confusion, doubt, due to the fact that one is implicated in an incomplete situation whose full character is not yet determined; (ii) a conjectural anticipation—a tentative interpretation of the given elements, attributing to them a tendency to effect certain consequences; (iii) a careful survey (examination, inspection, exploration, analysis) of all attainable consideration which will define and clarify the problem in hand; (iv) a consequent elaboration of the tentative hypothesis to make it more precise and more consistent, because squaring with a wider range of facts; (v) taking one stand upon the projected hypothesis as a plan of action which is applied to the existing state of affairs: doing something overtly to bring about the anticipated result, and thereby testing the hypothesis. (Dewey 1950/2001, pp. 155–156)

These steps are certainly established on the grounds of what Dewey took to be the scientific method, conceived by him as a rather advanced form of inquiry.

However, we should not forget that, although taking science as a departure point (as a man of his time), Dewey was pondering about the more general nature of this approach to knowledge production, considering that it can take place in everyday circumstances.[14] This position [Dewey's] can surely lend itself to scientistic readings, but this can be avoided if we do not focus on scientific knowledge as a general model of knowledge, but, following reliabilism,[15] we take as knowledge a broader notion involving beliefs that are constructed by means of reliable processes, i.e., processes that recognizably tend to produce more true than false beliefs and in relation to which we have no better reasons to put knowledge into doubt.[16] This means that we will need to broaden Dewey's perspective on what are the canons that follow from inquiry into inquiry, including, for instance, inquiry into other fields of knowledge, such as philosophical or artistic domains. Anyway, if we think about the goals of science education, it is widely held that students are supposed to apply both scientific ideas and scientific ways of knowing in their everyday lives. This is, arguably, not so far from Dewey's intention.

The settled, objective state of affairs that is reached at the (provisional) end of inquiry can be said to have warranted assertibility, because it leads to a solution of a problem, so settled that we feel ready to act upon it in a given way, overtly or in

[14] We should also avoid losing from sight that the general features of reflective experience mentioned by Dewey are not taken by him to be fixed and rigid, but modifiable through the very course of inquiry, and—we can draw from his arguments—adaptable to different sorts of inquiry.

[15] Reliabilism comprises a broad variety of epistemological theories that conceive the notions of knowledge and justification in terms of the truth-conduciveness of the process by which an individual forms a true belief. The idea that knowledge involves a reliable process appeared for the first time in a brief essay by Frank Ramsey ([1929]1990) but only became a relevant theme in epistemology 40 years later with the works of Alvin Goldman (1967, [1976]2000, 1979[1993], 1986), Fred Dretske (1971, 1981), Robert Nozick (1981), and Tyler Burge (1993), among others who emphasize the social character of cognition. In contrast with internalist theories that claim that belief is knowledge if the individual has reasons that justify and guarantee (inside a broad framework of reasons) the truth of a belief, reliabilism is a kind of epistemological externalism (with a naturalistic bias) because it acknowledges that many factors that cause or determine knowledge are outside the cognizer's mind and are not necessarily accessible to that individual. The fact of possessing a perceptive apparatus that connects herself, as an individual, to the natural world, the ownership of a personal and social epistemic memory, and, also, the participation in a linguistic community that counts with the strength of the testimony of other people makes the human condition amply favorable to the formation of true beliefs about the world. This does not make the reliable process, to be sure, immune to errors and failures. Although we cannot develop this point further here, we think that Dewey's account can be conceived as an appeal to inquiry as a reliable process to settle states of affairs and knowledge claims.

[16] According to reliabilism, whether we know something or not does not depend on which justifications we can argumentatively present in favor of our belief, but whether our belief was produced by a reliable process, and we are capable of discriminating the true belief from opposed situations (or relevant alternatives). For Goldman (1976/2000, p. 86), "a cognitive mechanism or process is reliable if it not only produces true beliefs in actual situations, but would produce true beliefs, or at least inhibit false beliefs, in relevant counterfactual situations […] To be reliable, a cognitive mechanism must enable a person to discriminate or differentiate between incompatible states of affairs. It must operate in such a way that incompatible states of the world would generate different cognitive responses."

imagination. However, the fact that a given particular situation has been settled through inquiry is no guarantee that the settled conclusion will always remain settled, being such a fallibility of the conclusions of inquiry a key feature of any proper understanding of the concept of warranted assertibility. Warranted assertions are never the end of inquiry. Rather, inquiry is a continuing (and self-correcting) process, since the settlement of a particular state of affairs is by no means a guarantee that a specific settled conclusion will always remain settled. There is no assertion so settled that cannot be exposed to further inquiry. Warranted assertions are always, continuously refined through continuous testing in public experience (e.g., Dewey 1938, pp. 8–9). Thus, what we can say about a state of affairs reached through inquiry is that it has warranted assertibility, but never any sort of absolute truth known by rational insight with certainty. Knowledge is not a system of truths. Knowledge leads to action, and it is from action that we derive our confidence on it.

Dewey indeed accepts the word "knowledge" as a suitable term to designate the objective state of affairs resulting from inquiry. He accepts this designation to the extent that it is recognized that the claim that attainment of knowledge, or truth, is the end of inquiry is a truism. In his view, this statement is a truism because "that which satisfactorily terminates inquiry is, by definition, knowledge" (Dewey 1938, p. 8). "Knowledge" is, in his view, an abstract term for the product of competent inquiries. Knowledge is to be defined in terms of inquiry, not vice versa. However, he still prefers the expression "warranted assertibility" because "knowledge" suffers from an ambiguity that hampers its utility as a designation for the state of affairs that is the outcome of inquiry. This ambiguity enters the scene when one thinks that the term "knowledge" designates something beyond the outcome of inquiry, i.e., when knowledge is supposed to have a meaning of its own, apart from its connection with inquiry. The unfortunate result is, then, that the theory of inquiry is subordinated to this meaning of "knowledge" as a fixed external end. Endless controversy ensues, then, about what "knowledge" really is.

The expression "warranted assertibility" has, for Dewey, the advantage of being free from the ambiguities of the terms "belief" and "knowledge." We think that Dewey, in his move to "warranted assertibility," strictly defined as an objective state of affairs that results from inquiry and (temporarily) eliminates hesitation to act, gives a significant contribution to dissolve many problems surrounding epistemological discussions that revolve around the notions of "knowledge" and "truth." We cannot expand on this issue, however, in the confines of this chapter.

In his theory of inquiry, Dewey relies upon pragmatic criteria that are clearly related to Peirce's pragmatic maxim. The norms of inquiry are to be derived from cases in which we manage to fulfill through inquiry needs to be satisfied, consequences to be reached. As he writes, in an analogy between the improvement of inquiry methods and the advances in the art of metallurgy,

> … it was the result of their use [of new instrumentalities], their failure and success in accomplishing ends and effecting consequences, that provided the final criterion of the value of scientific principles for carrying on determinate technological operations. (Dewey 1938, p. 6)

The pragmatic maxim also appears in a clear manner when he claims that the validity of principles that guide the methods of inquiry is determined by the coherence of the consequences produced by the habits those principles articulate. A principle is valid if the habit of inference resulting from it generally produces conclusions that are sustained and developed in further inquiry. (Dewey 1938, p. 13)

That Dewey is closer to Peirce than some authors think (e.g., Hacking 1983) is clear in his own works. He explicitly grounds a great part of his theory of inquiry on what he calls a "free rendering of Peirce" (Dewey 1938, p. 14, n. 4). Furthermore, his account of inquiry is, to our understanding, clearly on the side of objective pragmatism. For instance, the reasons he offers to reject the term "belief" as a designation of the outcome of inquiry show his rejection of a subjectivist reading of pragmatism:

> … in popular usage, *belief* also means a personal matter; something that some human being entertains or holds; a position, which under the influence of psychology, is converted into the notion that belief is merely a mental or psychical state… when it is said that the end of inquiry is settled belief… The objective meaning of *subject-matter* as that is settled through inquiry is then dimmed or even shut out. (Dewey 1938, p. 7, emphasis in the original)

Here, we see Dewey coming closer to Peircean than to Jamesian pragmatism. The indebtedness to Peirce on the part of Dewey follows from the fact that the former was the first thinker—as stated by Dewey himself (1938, p. 9, n. 1)—who took inquiry and its methods as the primary and ultimate source of logical subject matter, just as Dewey did.

2.4 Objective Pragmatism

In order to reach a via media between Peirce's abstract community of rational agents and James' more subjectivist account of a community of individuals using personal standards to assess the efficacy of ideas, we can talk about communities of flesh-and-blood people who make decisions that are guided or, at least, can be guided, by specific criteria. Among these criteria, we can consider in the scientific case, say, accuracy, (theoretical and/or empirical) consistency, simplicity, intelligibility, coherence, fruitfulness or heuristic power, explanatory power, predictive power, etc. These criteria can be differently applied by different individuals (or even by the same individual in different circumstances) and can conflict with one another. However, they can still be discussed and justified. The criteria available for deciding, for example, for one theory rather than another do not give room to any neutral algorithm that might lead each and every individual to the same decision, if correctly applied. These criteria should be rather treated as *values* shared by a community that can *guide* an individual's choice, but do not *determine* that choice. That is, the use of the same set of values does not determine always the same choice, because different weights can be ascribed to these values by different individuals and/or in different circumstances.

These criteria, thus, mediate at least partially the process through which theories, ideas, approaches to solve problems, etc., come to be accepted by the community, but they do not establish by themselves which choice is to be made regarding their acceptance (*cf.* Kuhn 1977).

If one assumes, then, that the values guiding the choices of a relevant community with regard to knowledge are ultimately specified by sociological means, one might conclude, then, that this is closer to a subjectivist than to an objectivist position. This would seem to follow from the commitment to the ideas that such choices are the result of judgments made by appealing to criteria assumed by the relevant community, and that these criteria typically vary with the historical and cultural circumstances of the community. However, we intend to argue that this position can be interpreted differently: rather than being relativistic, it can be taken as an attempt to move in a space between relativism and rationalism, which is open by a pragmatist realignment. From this standpoint, the choices made by individuals and communities, and their commitments regarding knowledge and its usage to act in the world, are neither purely objective nor purely subjective. Rather, they depend on a mixture of objective and subjective factors, or shared and individual criteria, which are taken to be epistemic *values*, not *rules* or *algorithms* for choice.

What could be the alternative, after all, to the idea that our knowledge choices are guided by criteria that are historically, socially, culturally situated? There is an available alternative, namely, to assume that we can choose between different theories, ideas, and indications for action by some kind of entirely rational decision, guided by ahistorical and atemporal criteria. Despite the seduction that this alternative may represent to some, to our understanding it is an untenable avenue, since to assume that kind of decision-making is to suppose that we can assume a superhuman perspective, some kind of God's eye view. If we do not take this position, we will have no other alternative than recognizing that epistemic criteria are sociohistorically grounded. We can argue, however, that this recognition does not necessarily entail that we should deny, *in some absolute manner*, the objective nature of the decisions grounded on those criteria or values.

The problem here is that the terms "objectivity" and "subjectivity" pose a series of difficulties. They suggest at first a distinction between some knowledge that simply reflects the world as it is and some other knowledge which is nothing but an individual opinion. Since a naïve realist position is not available anymore in the philosophical scenario, and we tend to ascribe to knowledge a value transcending mere subjective opinion, this way of opposing objectivity and subjectivity makes the debate go astray. To our understanding, however, no matter how wary we are about using the concepts of objectivity and subjectivity, there is still a useful and, above all, important distinction to be made between attempts to settle a situation by mere opinion or by an outcome of inquiry, as proposed by Dewey. There is a distinction to be made between a judgment that is grounded, in the sense that it is a product of inquiry, and a belief entertained without examination.

Even though he is far from being a pragmatist, Kuhn's (1977) discussion of his discomfort with the terms "objectivity" and "subjectivity" can be helpful here.[17] He considers a conflation between two distinct uses of "subjective," one in which "subjective" opposes "objective" and another in which it opposes "judgmental." Kuhn argues that his critics appeal to this second sense when they describe the idiosyncratic features mentioned by him when addressing theory choice as "subjective," claiming, further, that theory choice would be, for him, just a matter of mob psychology. These critics also claim—he argues—that his view deprives science of "objectivity." Then, a conflation between the two senses of "subjective" takes place.

In our interpretation, Kuhn's argument is that, even though guided by values, and not algorithmically determined by rules, theory choice can still be objective. But this must certainly lead us to question what the word "objective" means in this context and, in particular, if this meaning might lead to some via media between an entirely subjective account and a completely objective account of theory choice.

Kuhn asks us to consider one of the usual applications of the term "subjective," namely, to refer to matters of taste. Consider, however, that one of the central features of matters of taste is that they are not open to discussion. But if we consider two scientists who disagree about a theory choice, it is certainly the case that they can discuss their decisions. Moreover, this discussion does not take place in terms of the fact that one likes the theory, the other does not. What can be and often is discussed about their decisions are the judgments they offer about the theories. If their judgments are guided by shared values, the scientists probably applied them differently in that specific situation, and this can also be discussed. Moreover, even when the decisions were not based on shared values, it is still the case that these values can be and often are discussed in the scientific community. As Kuhn (1977, p. 337) writes, "scientists may always be asked to explain their choices, to exhibit the bases of their judgments." After negotiation and all the rest, we still see a case in which there are criteria being applied and there is a judgment being done. We do not have a subjective situation in the sense that it is not judgmental, just a matter of taste (El-Hani and Bandeira 2008).

Thus, one cannot claim that the thesis that decisions about knowledge are not determined but rather guided by epistemic values—which should be themselves interpreted in a sociohistorical manner—necessarily entails that these decisions are "subjective," particularly if this term is somehow opposed to "judgmental," in the sense that the decision at stake would not be discussable, just a matter of taste, or that theory choice would be nothing but a kind of religious conversion. From the fact that those values can only guide, but not determine the decision, it does not follow that there is no judgment being done, which can be critically analyzed, properly justified, and so on.

[17] Our appeal to Kuhn here is deliberate in the sense that we do not agree with the way he has been often taken as a basis for radically relativist accounts, as well as for putting under siege the idea of objectivity and rationality in science, through which Hacking (1983, p. 13) calls "the popularized Kuhn of Structure." In our view, such a popular view about Kuhn's theory seriously misrepresents his ideas. We cannot expand on the issue here, but the way we will use Kuhn's ideas throughout our argument at least implies how we differ from this popularized interpretation.

We can, then, think about decisions about knowledge that are sociohistorically grounded and open to the vicissitudes of human endeavors, and yet can be, at least in the sense discussed here, "objective" and "rational." Certainly, this claim puts us in a position in which we need to clarify what we mean by these latter terms.

By appealing to the notion of "rationality," what we have in mind is that people can be asked to explain their choices, to exhibit the grounds of their judgments, and, by doing so, they can be called "rational," no matter if they are scientists or not. We can still talk about a rational and objective decision, even though it is made by flesh-and-blood people engaged in socially embedded ongoing negotiations. As we argued above, we can do so when there are criteria being applied and there are judgments being done. In these terms, a choice of a mode of thinking, speaking, and acting can be rationally guided by criteria that can be discussed and appraised. Notice, also, that this does not mean that we are requiring that all that takes place—or even that is relevant—in a decision should be judgmental. There is certainly much more in place, such as values, emotions, and attitudes. What we are claiming is that, everything else being equal, there are judgments being made, which can be discussed and appraised and, in this manner, regarded as rational. In this sense, when we choose an idea, a theory, a mode of thinking, a mode of speaking, a manner of acting, etc., there is a judgment being made which is neither entirely subjective nor made in the abstract.

We can fruitfully consider what is objective in such decisions by tying objectivity not to propositions, as it is typically done, but to human practices. We can find this movement in Shrader-Frechette and McCoy's (1994) "Wittgensteinian insight," derived from the following statement: "giving grounds […] is not a kind of *seeing* on our part; it is our *acting*" (Wittgenstein 1969, p. 204). Their argument can lead us to come to grips with a sound notion of objectivity after the Kantian turn showing that truth and objectivity cannot be formulated in terms of any correspondence between knowledge and some external, mind-independent reality. Yet, we can still say that there are objective and subjective actions, statements, beliefs, and so on, if we follow Shrader-Frechette and McCoy in their move from propositions to practices. In the domain of practices, to be objective is to search for impartiality in our actions and decisions, even though complete impartiality is obviously impossible for embodied and situated agents. It is, however, by attempting to reach this impossible goal that we can allow it to regulate our practices, in such a manner that they are critical and informed by procedures aiming at avoiding biases, at least to some extent. And, as biases are always present, this goal will also incite us to critically appraise them.

The criteria we will use to make judgments, including judgments about the pragmatic efficacy of distinct modes of thinking and speaking, will always be situated and influenced by the sociohistorical circumstances in which they are built and used, but we will—or at least can—be always engaged in discussing our reasons and decisions, and, in doing so, we will not reach any objectivity in the (untenable) sense of a mind-independent belief, but we may arrive at the objectivity that is possible to us, embodied, situated, human agents. We think, however, that there is no sense in asking for more, and this is enough to our responsible and critical actions as humans.

The mutual criticism of knowledge, actions, decisions, and criteria plays a central role in the self-correcting inquiry process that both Dewey and Peirce saw as the

source of human knowledge. Scientific knowledge, in particular, can reach a high degree of objectivity, due to its public nature and to the use of a series of (far from being perfect) procedures of mutual rational control by the scientific community, such as systematic criticism of theories and hypotheses, methods and evidence, through referee systems, project evaluations, and meeting presentations. It is important to make it clear, however, that it is not only science that can reach such objectivity. Critical thinking and action are found in many human practices of knowledge construction, such as philosophy, logic, theology, and traditional ecological knowledge (TEK). This is an important and interesting consequence of the view that objectivity is tied to human practices: it does not lend itself to a value distinction between science, as some superior knowledge, exclusively capable of being objective, and other ways of knowing, treated as inferior and incapable of being truly critical. In this manner, this view is not committed to scientism, a caricature of science that the conceptual profile theory also strives for avoiding.

We can also find arguments in favor of objective pragmatism in other philosophers, such as Hilary Putnam and Donald Davidson. For Putnam, if one understands the problem of truth and reality as a dispute about statements about the world (which reflect the structure of our language), it is possible to make a severe critique of epistemology and correspondence realism and, at the same time, avoid epistemological relativism. The idea of comparing our thoughts and beliefs, on the one hand, and things as they are in themselves, on the other, does not make sense. This does not mean, however, that we should conclude that this idea should be a necessary assumption of the common idea that there are animal, vegetal, and mineral objects, which are not part of thought or language, or of the equally common idea that what we say about these objects sometimes *captures facts correctly* (cf. Putnam 1990). Even if we are working on the horizon of pragmatist themes, a certain *minimal* epistemological and realist attitude seems indispensable. We can accept that reality is relative to the linguistic apparatus available to us to speak about the real world, but even if the concept of reality is *dependent* upon the conceptual schemes we use to describe it, this does not mean that we cannot distinguish between real and unreal facts or, else, between true and false statements about facts, *within a given conceptual scheme*. That's the reason why Putnam, Davidson, and originally also Peirce defended a "pragmatic realism." The concepts we use are *our* concepts, and they are relative to a culture or to public criteria, but from this we should not conclude that the truth or falsity of anything we say using those concepts is simply decided in an arbitrary manner by a culture or person.

Although Davidson never declared himself a pragmatist,[18] his positions about truth, language, and knowledge are in agreement with central intuitions of objective pragmatism. For him, philosophical problems could be expressed as follows:

[18] Richard Rorty (1991, pp. 113–125) appraised Davidson's work as the culmination of a school of thinking in North-American philosophy that attempted to be naturalist without being reductionist. He was clearly referring to pragmatism. Davidson himself did not accept that his philosophy was a brand of pragmatism (cf. Borradori 1991; Pereira 1998). We do not intend to discuss in this text whether or not Davidson's philosophy can be regarded as a variety of pragmatism. It is enough to

> In sharing a language, in whatever sense this is required for communication, we share a picture of the world that must, in its large features, be true. It follows that in making manifest the large features of our language, we make manifest the large features of reality. One way of pursuing metaphysics is therefore to study the general structure of our language. (Davidson 1984, p. 199)

We only master the idea of reality if we share a language by means of the objective practice of intersubjective communication. In these terms, the epistemological authority is shifted from the *first person* or a transcendental subject to the *point of view of the interpreter*, since it is not the speaker who confronts their beliefs (that which she conceives of reality) with reality (that which reality is) and with the beliefs of others in the act of conversation. It is the intersubjective dialogue which establishes this adjustment, looking for causal relationships and reasons. To put it differently, meaning and belief are interdependent, since we cannot infer the belief without knowing the meaning and, in turn, we cannot infer the meaning without the belief (Davidson 1984, p. 142). When we speak about the world, we are speaking about meaning and belief, since our world is not outside our descriptions and narratives about our world. But the world cannot be true or false; only our descriptions of it can be false or true. When we interpret someone's speech, we should consider that, in order to speak, she accepted beliefs that she somehow considered to be true—she ought to consider them to be true—since there should be countless true beliefs about the matter before something in the world can play a part in the subject matter of belief. Moreover, no simple theory can make speaker and interpreter reach a perfect agreement. The basic methodological principle is, then, that a good theory of interpretation should maximize the agreement. Davidson speaks of a "theory of interpretation" not in the sense of a "philosophical theory of interpretation" or a "hermeneutic theory of interpretation." For him, a theory of interpretation is a hypothesis made by a hearer concerning the meaning and truth of another person's speech. If someone says (the example is Davidson's) "The gun is loaded," the hearer should formulate a hypothesis about the meaning of each term involved, the context of the statement, and the speaker's intentions. The success of intersubjective communication depends on the success of the theories formulated by the hearer (see Davidson 1984; LePore and Ludwig 2007).

With Peirce, Dewey, Putnam, and Davison, we can conclude that the collapse of "the God's eye view" in philosophy does not have a unique and fair reaction either in relativism and conventionalism or in the complete abandonment and dissolution of epistemology. On the contrary, in pragmatism it is reasonable to accept that truth and reality, just as epistemological problems in general, should be understood in the *mirror of meaning*. In order to do so, a theory of knowledge is replaced by a theory of interpretation in language, in a dialogue in which language, interpreter, speaker, and context participate. The end of dialogue is not only the agreement—which is not necessarily achieved—but also understanding. Moreover, everything that can be said (about objective reality, our own sensations, and the minds of others) can

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our purposes to observe that, no matter if Davidson can be characterized as a pragmatist or not, his work is consistent with the pragmatic realist position we are striving to elaborate here.

be said truthfully and can be understood fallibilistically. Even if we cannot take the terms of the agreement to be true in any sense of simple correspondence to the world, we can go on with the interpretation and bet that we are following a *good* (the meaning, the truth).

2.5 Concluding Remarks

If we consider the ideas discussed in this chapter, we can conclude that we will have grounds for choosing what knowledge, what theory, and what mode of thinking and speaking to accept by critically considering and verifying its consequences to practice. Rival modes of thinking, say, can be chosen when facing concrete but problematic situations in an objective manner, in the sense that this choice can be rationally guided by criteria that do not determine it, but influence it, and can be intersubjectively discussed and appraised. We can reach in this manner a view about the choice of different perspectives to account for phenomena grounded on historically situated criteria and a pragmatic appraisal of the consequences of adopting one or another mode of thinking and speaking.

This is the position taken by the conceptual profile theory when it comes to critically comparing distinct modes of thinking, something that may be inevitable in the science classroom: distinct modes of thinking can be chosen when facing some concrete and problematic situation, by deciding whether that situation falls under the domain of application of a specific zone. This decision will be grounded by values to which a person is committed, and it is a key issue in science education, according to this approach, to promote the development of an awareness among students about the domains of application of distinct modes of thinking and about the values or criteria that can guide the choice of perspectives to address particular problems.

It is probably clear now that the philosophical basis of the conceptual profile theory cannot harbor a commitment to anything goes relativism. Rather, this approach assumes an objective pragmatist ground, in the sense explained above. In our account, we move away from subjectivism by demanding that choices of modes of thinking and acting be always rationally appraised and discussed. In the particular confines of the conceptual profile theory, we do so by introducing as a learning goal the construction of awareness about the domains of application of modes of thinking and speaking.

In the end, one might argue, however, that such pragmatism is not really that different from relativism. Maybe. But we think we drove home the central distinction we want to make here, namely, between anything goes relativism—particularly as it often appears in robust multicultural stances (El-Hani and Mortimer 2007)—and the pragmatist grounds of the conceptual profile theory. If one calls the latter also "relativism," we have no problem with that, provided that one does not conflate this "relativism" with that other, namely, anything goes relativism. Still, one of the easiest ways to be confused is to use the same word to say different things. Thus, it is

always better to use different words to say different things, and this is why we prefer to characterize our position as (objective) pragmatism.

Objective pragmatism has no problem with efforts to compare different modes of thinking, ideas, ways of knowing, etc., provided that these comparisons are not made *in abstract*, but *in a clear connection with concrete situations to be dealt with*. Here, we can come back to Dewey, in his elaboration of how different modes of inquiry can be contrasted on the grounds of their pragmatic consequences:

> …we are able to contrast various kinds of inquiry that are in use or that have been used in respect to their economy and efficiency in reaching warranted conclusions. We know that some methods are better than others in just the same way in which we know that some methods of surgery, farming, road-making, navigating or what-not are better than others. It does not follow in any of these cases that the "better" methods are ideally perfect, or that they are regulative or "normative" because of conformity to some absolute form. They are the methods which experience up to the present time shows to be the best methods available for achieving certain results…. (Dewey 1938, p. 104)

Moreover, it is not only the case that we can choose between different bodies of knowledge and ways of knowing, but we can also rationally appraise and understand why some are successful where others are not:

> … through comparison-contrast, we ascertain *how* and *why* certain means and agencies have provided warrantably assertible conclusions, while others have not and *cannot* do so…. (Dewey 1938, p. 104)

This leads us to briefly mention a pedagogical consequence of assuming objective pragmatism as a philosophical basis for the conceptual profile theory. It concerns a putative strategy to attain the learning goal of increasing the awareness of learners about the heterogeneity of human thinking, as represented in a conceptual profile model, and the domains of validity of distinct modes of thinking. How should we establish these domains, so that we can use them in pedagogical practice?

The pragmatic maxim suggests a heuristically powerful approach: examine the pragmatic consequences of the modes of thinking constituting the zones of a profile, i.e., their consequences to the ways people think and speak about relevant issues and to the ways people act in relevant circumstances, or, to put it differently, compare modes of thinking in relation to the prospects of dealing with a problematic situation by anticipating the consequences of using that mode of thinking to deal with it. This will provide the grounds to delimit the validity of the application, the pragmatic efficacy, and the warranted assertibility of the distinct zones of a profile. Needless to say, it will be a highly fruitful enterprise for teachers and students to consider what pragmatically follows from thinking about relevant issues in one way or another.

Examples such as the ones mentioned above in connection with the conceptual profile of heat can be helpful. If we consider the cases of a student asking for a coat in a shop or deciding which drinking vessel to use (see Chap. 1), we will be dealing with the pragmatic efficacy of everyday and scientific language in the context of students' daily experiences. These cases—and other similar ones—can be used by teachers to build teaching approaches grounded on conceptual profiles. It is important to remember, however, that to stimulate students to consider problematic situations and strive for

proposing solutions is much more worthwhile when we engage them in a methodical approach to the situation, which can follow, for instance, the common pattern of inquiry suggested by Dewey and discussed above. We still need, however, to develop and test, in future steps of the research program on conceptual profiles, teaching sequences addressing the pragmatic value of different modes of thinking.

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