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Reductionism and Multiple Realizability. With a Special Emphasis on the Social Sciences

(*Rezumat*)

Prezentul text analizează teza *reducţionismului* stărilor, faptelor şi proprietăţilor studiate de ştiinţele speciale la stări, fapte şi proprietăţi ale nivelului ontologic postulat a fi fundamental, fie acesta fizic, fie ideal. Literatura de filozofie socială discută ardent posibilitatea reducţiei entităţilor şi stărilor sociale la cel al individului, în vreme ce reducţia stărilor mentale la stări neuro-fiziologice este o chestiune centrală a filozofiei minţii. Dacă reducţia este realizabilă, atunci stările şi proprietăţile de nivel ontologic superior nu pot avea un statut de autonomie ontologică faţă de nivelul fundamental, ci vor fi simple redescrieri ale stărilor şi proprietăţilor de nivel fundamental. Pentru tabăra anti-reducţionistă, argumentul cel mai puternic şi mai întrebuinţat este cel al *realizabilităţii multiple* al stărilor de nivel superior la nivel fundamental, adică al diferitelor moduri în care un tip de stare de nivel superior poate fi *implementat* sau *instanţiat* la nivel fundamental. Articolul discută şi respinge diferite obiecţii ridicate împotriva argumentului realizabilităţii multiple, oferind ilustrări din filozofia mentalului şi, în subsecţiuni separate, din filozofia socialului. Secţiunea finală oferă un argument suplimentar, simetric din punct de vedere formal cu realizabilitatea multiplă: stările de nivel fundamental pot fi *descrise multiplu* la nivel superior, ilustrat cu exemple din filosofia socialului.

1. Introduction

Ontological *nonreductionism* is the doctrine that combines the naturalistic view of the fundamental character of the some ontological realm – be it physical or ideal – with the idea of autonomy of the special, higher-level sciences. The main argument for nonreductionism relies on the assumption that the special science predicates are *multiply realized* (or *instantiated*, or *implemented*) in the lower-level predicates. As we shall see, the *multiple realizability argument* (henceforth MR) is a point of consensus among adversaries of type-identity theories, functionalists, emergentists, and holists. However, in spite of its appeal, MR came under intense scrutiny. Jaegwon Kim (1989, 1992), for example, contends that multiple realizability is compatible with *local reductionism*, i.e. with species-specific reductionism. But the strongest and most convincing criticism of MR is delivered by Lawrence Shapiro (2000), who, after undertaking a needed conceptual clarification of the notion of multiple realizability, shows not only that that MR is compatible with reductionism, but that the latter ought

to be a methodological desideratum in science.

My aim in this paper is, first, to assess Kim's criticism of nonreductionism. After distinguishing between different versions of reductionism (section 2), I argue in section 3 that MR is indeed *the* nonreductionist argument, though some of its advocates were sometimes imprecise in defending it. Section 4 shows that the irreducibility of the social to the individual level is also supported by the *multiple describability* of individual-level phenomena in social terms, depending on the social context.

2. Reductionism

2.1 Historical background

Reductionism was the credo of the Unity of Science movement, a positivist project exemplarily expressed in the paper by Oppenheim and Putnam, "Unity of Science as A Working Hypothesis" (1958). Oppenheim and Putnam classified the object of science into levels, starting at the bottom with elementary particles and building up to molecules, cells, individual, and societies. In this "layered model" the special sciences are ordered top to bottom: the social sciences, individual psychology, biology, chemistry, and physics. A neat ontological picture underlies this classification: society is composed of individuals; individuals have minds; every individual with a mind is alive; every individual who is alive is an individual in which chemical processes occur; and every system in which chemical processes occur is one in which physical processes occur.

The pillar of this hierarchy is the idea of *inter-theoretic reduction*. In his classical account, Ernst Nagel construed reduction as consisting in "the explanation of a theory or a set of experimental laws established in one area of inquiry by a theory usually though not invariably formulated for some other experimental domain." (Nagel 1961: 338) Explanation was to be understood as deduction of the laws of the reduced theory from the laws of the reducing science. But since the latter typically does not contain predicates of the former, valid deductions also require "bridge laws". Each bridge law relates a predicate of the reduced theory to the appropriate predicate of the reducing theory (e.g., "temperature" to "mean kinetic energy of the molecules"). Under the assumption that the domain of the reducing theory's domain is ontologically more fundamental, the bridge laws must be interpreted as identity claims: instances of type *H* ("high") of the reduced theory are identical with instances of type *L* ("low") of the reducing one.

This naïve picture was abandoned by the mid-1960s, when a nonreductionist turn was brought forward. Its initiators, Hilary Putnam (1967) – in the guise of his own critic! – and Jerry Fodor (1975), were mainly concerned about the possibility that mental states and properties can be *multiply realized* in the lower-level theory. Putnam used the idea of multiple realizability to argue against early versions of the mind-brain identity theory and to defend a functionalist account of mind. Using "pain" as an example of a type of mental state, Putnam states:

> Consider what the brain-state [identity] theorist has to do to make good his claims. He has to specify a physical-chemical state such that *any* organism (not just a mammal) is in pain if and only if (a) it possesses a brain of suitable physical-chemical structure; and (b) its brain is in that physical-chemical state. This means that the physical-chemical state is question must be a possible state of a mammalian brain, a reptilian brain, a mollusk's brain

(octopuses are mollusks, and certainly feel pain), etc. (Putnam 1967)

So, "if we can find even one psychological predicate which can clearly be applied to both a mammal and an octopus, but whose physical-chemical correlate is different in the two cases, the brain-state theory has collapsed." (idib.) According to Putnam, it is "overwhelmingly likely" that at least one such predicate can be found. Consequently, the identities stipulated by bridge laws require the lower-level predicates to be disjunctive, perhaps "wildly" and infinitely so. The mental state M (e.g. "pain") will be identical to the disjunction P_1 (in humans) or P_2 (in octopuses) or…. Yet, as we shall see, it is very unlikely that such a disjunct occurs in any scientific law. As Fodor (1974) puts it, it would be an "accident on a cosmic scale" if this requirement of a physicalist reduction turned out to be true.

Largely due to the multiple realizability argument, nonreductionism turned into a new orthodoxy. Kim's and Shapir's discussions of MR and the criticism raised against them occupy an important part of this paper (section 3). But let us first draw some distinctions between different varieties of reductionism.

2.2. Varieties of reductionism

We have seen that the original interest in reductionism concerned explanation. This *epistemic* motivation has remained prevalent in recent literature. For example, Elliott Sober (1999) characterizes reductionism through the following two propositions: (1) Every singular occurrence that a higher-level science can *explain* also can be explained by a lower-level science. (2) Every law in a higher-level science can be *explained* by laws in a lower-level science.

Reductionism is also a *semantic* thesis, according to which the predicates in the higher-level theories are *definable* in terms of lower-level predicates. But if it is to make claims to objectivity, reductionism must also be an *ontological* thesis. Let us illustrate this with the case of *physicalism*. Semantically, physicalism claims the explicit definability of higher-level predicates in physical terms. Yet, there is no direct relation between the reduction of ontology and the reduction of terminology. Semantic reductionism is separable from a purely ontological thesis of physicalism, which regards the sort of entities and processes of which the world is constituted. According to Hellman and Thompson (1975), physicalism is defined by two principles: First, an ontological principle of *exhaustion*, according to which everything concrete is exhausted by basic physical objects – i.e., higher-order entities belong to an iterative set-theoretic hierarchy built from concrete physical entities; and second, a principle of *determination*, according to which every higher-order difference is accountable in terms of a physical difference.[1] While semantic reductionism is essentially tied to a theory, ontological determination is not: "Determination, in contrast to [semantic] reducibility, has nothing directly to do with the existence of a theory or permitting the proof of certain kinds of sentences." (Hellman and Thompson 1975: 564)

[1] In more recent philosophical literature, the notion of determination has evolved into the vast notion of *supervenience*. More specifically, Hellman and Thomson's relation of determination is closely related to what is known as "global supervenience": once the physical character of the world is fixed, its entire character is thereby fixed. Within a given system, the supervenience of one set of properties H on another set of properties L is the requirement that the system cannot differ in respect of its H-properties without differing in its L-properties. This can also be put as the requirement that indiscernability with respect to L-properties entail indiscernability with respect to H-properties.

3. The multiple realizability argument

3.1 The projectibility of higher-level predicates

That psychological states are "multiply realizable" is deemed by Kim to be part of today's conventional wisdom: "We are constantly reminded that any mental state, say pain, is capable of "realization" in widely diverse neuro-biological structures in humans, reptiles, mollusks, and perhaps other organisms further removed from us (Kim 1999: 1). The multiple realizability thesis is indeed the main support for non-reductionists of all sorts. In particular, it is due to MR that nonreductionist physicalism has become so popular in contemporary metaphysics. Though I argue that MR is *the* non-reductionist argument, we should be careful to expose some inconclusive applications of MR.

Let us start by taking a look at a much-discussed example by Putnam (1967), to the effect that higher-level facts are explanatory irreducible to lower-level facts. Consider a wooden board that has two holes in it. One whole is circular and has a 1-inch diameter; the other is square and is 1 inch on a side. A cubical peg that is 15/16ths of an inch on each side will fit through a square hole, but not the circular one. What is the explanation? According to Putnam, the explanation is provided by the *macro*-properties of the peg and the holes, in terms of solidity, rigidity and geometry. He denies that the *micro*-properties of molecules or atoms or particles in the peg and the piece of wood are of any explanatory avail. The micro-description, in terms of the properties of the molecular arrangements in the peg and board, is too long, too complicated and largely irrelevant for the raised question. Therefore, as the argument goes, reductionism to microphysics is explanatorily ineffective.

But Sober rightly points out, that "there is a difference between explaining too much and not explaining at all." Putnam's concept of explanatory relevance seems to be too narrow, given the frequent cases in which scientific explanations are in micro-physical terms. Very likely, it is the microphysical structure of cigarette smoke that accounts for the carcinogenic effects of smoking:

> If there turn out to be several carcinogenic ingredients and different cigarettes contain different ones, this does not make the molecular inquiry explanatorily irrelevant to the question of why people get cancer. The fact that *P* is multiply realizable does not mean that *P*'s realizations fail to explain the singular occurrences that *P* explains. A smoker may not want to hear the gory details, but that does not mean that the details are not explanatory. (Sober 1999: 548-549)

This rebuttal shows that we cannot plausibly admit that causal explanations are in place only at the higher-level: "Macro-generalizations may be laws, but there also may be laws that relate micro-realizations to each other, and laws that relate micro- to macro as well." (1999: 549).

Fodor (1974) uses MR to argue that laws in any special science are not explained by laws in a lower-level science. The picture is the following: consider the higher level properties P and Q and their respective lower-level realizations, A_1, …, A_n and B_1, …, B_n. Suppose that "If P then Q" is a higher-level law. Then this law will have n lower-level instantiations. Can we derive the higher-level law from our knowledge of the many lower-level laws? In other words, is the following argument valid (Sober 1999: 552)?

If A_i then B_i (for each i = 1, …, n)
If A_1 or A_2 or … or An, then B_1 or B_2 or … or B_n
P iff A_1 or A_2 or … or A_n
Q iff B_1 or B_2 or … or B_n

If P then Q

The higher-level properties are connected to the lower-level ones through the bridge principles stated in the third and fourth premises. Assuming that all premises are true, does this reasoning prove the reduction of the higher-level law $P \rightarrow Q$?[2]

Fodor's answer is that laws cannot be disjunctive. Accordingly, he denies that the second, third and fourth disjunctive premises are laws. He actually adds a condition to Nagel's conception of reduction, namely that the bridge principles connect *kinds* to *kinds*, assuming that a heterogeneous disjunction is not a kind. He concludes that MR precludes the deduction of higher-level laws from lower-level necessary disjunctive regularities, which means that reductionism cannot be achieved.

A related point of view if presented by LePore and Loewer (1989), in their account of how higher-level properties realize lower level ones:

> Exactly what it is for one of an event's properties to *realize* another? The usual conception is that *e*'s being *P* realizes *e*'s being *F* iff *e* is *P* and *e* is *F* and there is a strong connection of some sort between *P* and *F*. We propose to understand this connection as a necessary connection which is *explanatory*. The existence of an explanatory connection between two properties is stronger than the claim that $P \rightarrow M$ is physically necessary since not every physically necessary connection is explanatory. (LePore and Loewer 1987: 179)

LePore and Loewer's relation between *P* and *M* is an epistemic relation, but how does the subjectivity of our explanatory interests comport with the objective metaphysical relation of realization? Along with Kim (1993), I take *realization* to be a causal relation, which must specify a causal mechanism by which *M* is instantiated in the set of properties *P*. Now, as Pereboom and Kornblith (1991) show, explanatory interests are compatible with objectivity as long as they rely on scientific methodology. They offer an argument based on scientific realism as to why the kinds – and the relations between them – figuring in our explanation are the right ones:

> …when it is these [subjective] interests which give rise to and define successful scientific research programs, the claim that these interests are merely parochial loses its plausibility. The success of a scientific research program in prediction and technological application is evidence of the truth of the theories which are instrumental in gaining that success, and of the legitimacy of the interests which give rise to and define the program. (Pereboom and Kornblith 1991: 127)

I think this is a correct argument, provided that we keep our explanations within the discourse of our best currently accepted scientific theories. And, in the end of the day, the reason why our subjective explanatory motivations "give rise and define successful scientific research" is that

[2] The objection can be made here that explanation is not the same thing as logical implication in the sense that logical implication is neither necessary nor sufficient for explanation. Nonetheless, concerning the explanation of laws, I agree with Sober that "Laws are usually explained by deriving them from "deeper" laws and initial condition statements; the explained laws and the explaining laws are true at the same time…" (Sober 1999: 552)

they properly identify and describe the causal relations between kinds.

Now, as the usual story goes, the realization of *P* can be a *wildly disjunctive* property, meaning that the lower-level disjuncts have nothing relevant in common. Moreover, the disjunction can be open-ended or infinite, so it is hard to see how wildly disjunctive open-ended properties could be projectible. This, of course, is a problem for reductionism, for there is no lower-level property with which *P* can be identified. But, surprisingly enough, this can also turn into a difficulty for nonreductivism: If a higher-level property is as projectible as the disjunction that realizes it, generalizations in which lower-level disjunctive properties occur are just as lawlike as the higher-level generalizations they are meant to reduce. Thus, MR seems to be turned on its head against nonreductionism, leading to the following dilemma, formulated by Lawrence Shapiro:

> Take what appears to be a legitimate case of multiple realization… Either the realizing kinds truly differ in their relevant causal properties, or they do not. If they do not, then we do not have a legitimate case of multiple realizability… If the realizing kinds do genuinely differ in their causally relevant properties, then they are different kinds… and so we do not have a case where a single kind has multiple realizations. (Shapiro 2000: 647)

Thus, if heterogeneous disjunctions are not kinds, higher-level entities, being nomically equivalent to such disjunctions, are also not kinds. Consequently, there cannot be any autonomous higher-order scientific theories, for they are not able to cover all the heterogeneous realizations of their own level's properties. Indeed, several philosophers[3] appreciate that this understanding of multiple realizability supports reductionism. The idea they embrace is that if the realizers of a higher-order property have some significant structural commonality in virtue of which they make the same causal contribution at the higher-level, then the realization of that property is not multiple.

I think that the nonreductionist can have a solid response to this challenge. Specifically, I believe answer must be two-pronged: (a) The heterogeneity of the realizations of a higher-level property may not be wild; that is, it may be compatible with the disjuncts' having significant structural features in common. Therefore, higher-level properties would be kinds nomically supported by this structural sameness. And (b) what is common to all disjuncts is not part of the realization base.

Let us first see how (a) is motivated. Regarding the idea that disjuncts in the realization base have structural commonalities, Ned Block (1997) gives an argument grounded on what he calls the *Disney Principle*:

> In Walt Disney movies, teacups think and talk, but in the real world, anything that can do those things needs more structure than a teacup. We might call this the Disney Principle: that laws of nature impose constraints on ways of making something that satisfies a certain description. …even when there are many realizations, laws of nature may impose impressive constraints. (Block 1997: 15)

An eye, for instance, is a system whose properties have evolved under the constraints of natural selection. Some mental or social states are differently produced through *learning* – e.g., "the under-

[3] For example, see Bechtel and Mundale (1999) and Shragrir (1998).

standing of fractions is inculcated anew, in different ways, in each generation of elementary school students." Further, *conscious design* exerts conspicuous constraints upon various social products. Artifacts, such as pens, "tend to have similar properties despite a great deal of difference in materials and principles of operation, e.g. they don't dissolve in ink" (1997: 15-16). Forces like natural selection and conscious design do not impose much similarity at the physical level. Notoriously, natural selection "doesn't care" about genotypic features as long as the phenotype meets the environmental challenges. And outcomes of conscious design, such as computers, are not fully determined by low-level constraints. There is latitude in choosing the design, material, and basic physical principle. But the realization of complex biological systems, such as the *eye*, will be causally constrained (*channeled*) at several levels:

> There are constraints on how one can make an eye at the "design" level, but there are also constraints imposed by the fact that only some materials are transparent enough to transmit light without destroying much information. An eye requires some such material at least in the part that points at the world. So there are reasons to expect less than total heterogeneity at both the design and realization levels. Since evolution enforces similarity only at the design level, we should expect more variation at the levels of realization than at the design level. And this is why we expect multiple realization. …If evolution wants an eye that has the same function as ours, why should it also make it scientifically like ours? But the Disney Principle tells us that there are channels in which evolution must move, for there are constraints on how one can make an eye given certain materials in conditions of a certain range of temperatures, gravitational forces, etc. (Block 1997: 17-18)

Thus, higher-level properties that are multiply realizable can, nonetheless, be projectible with respect to "properties of channeled selection, learning, and design." Because there are typically only a few ways in which entities of a particular higher-level type can be designed and produced, we can expect relatively broad similarities among these things that would render the corresponding higher-level properties significantly projectible. These structural similarities among the realizers maintain the projectibility of the higher-level property.

We can now turn to (b), the second part of the answer to Shapiro's dilemma. Assuming that a mental state can be realized both by neural and by silicon structures, the common features in virtue of which these realizations have the same causal effects at the mental level are neither essentially neural nor essentially silicon-structural. There is no lower-level type with which the higher-level type (e.g., "pain") should be identified. One lesson to be drawn from the multiple realizability of a higher-order property H by the distinct lower-level properties L_1, …, L_n is that H cannot be characterized either as L_1, or as L_2, or as … L_n, but rather as the common structure that the L_i's share so as to be aptly grouped as H at the higher level. Importantly, the commonality does not belong to the L-level.

3.2 Local reductionism

Let us consider again the predicate *pain*. If *pain* can be realized in both neurological and silicon-structural systems shouldn't we restrict our search for type-type identities to each specific domain? This move certainly renders reductionism compatible with multiple realizability and it has, as a matter of fact, been embraced by numerous philosophers, such as David Lewis (1969), Paul and Patricia Churchland

(1998), and in several articles, Jaegwon Kim.

Here is how the Churchlands put it:

…visual experience may count as one thing in a mammal, and a slightly different thing in an octopus, and a substantially different thing in some possible metal-and-semiconductor android. But they will all count as visual experiences because they share some set of abstract features and at a higher level of description. That neurobiology should prove capable of explaining all psychological phenomena in humans is not threatened by the possibility that some *other* theory, say, semiconductor electronics, should serve to explain psychological phenomena in robots. The two reductions would not conflict. They would complement each other. (1998: 78)

The same point has been made by Kim (1992), the most sagacious defender of the idea of local reductionism. Kim sees the situation of many higher-level predicates, such as *pain*, as similar to the one of *jade*, a predicate that is physically realized in two different microstructures: *jadeite*, the less frequent and more valuable sort of jade, which is a Na-Al-silicate – $NaAl(SiO_3)_2$; and nephrite, which is a Ca-Mg-silicate. Science, Kim contends, has no law about jade, but only laws about jadeite or nephrite. One can then take jade either as a disjunctive kind, which is methodologically useless; or as a nonkind, which doesn't question the existence and the utility of the concept of "jade". Kim deems the predicate *pain* to be in a similar condition: if *pain* is neurologically realized in different species, then *pain* is nomically coextensive with a disjunction of lower-level combinations of properties ($N_h \vee N_r \vee N_m$) – "h" for humans, "r" for reptiles, "m" for mollusks. Assuming that this disjunction is wildly heterogeneous,[4] and assuming that a certain psychological law has been established for humans, should we expect that law to hold for the rest of the sentient species in the disjunction? Kim answers in the negative: the physical realization of mental states by physical states along with the assumption of a radical difference among the species-specific mechanisms at the physical level of implementation entail indeed the lack of theoretical unity at the higher-level.

However, it is an empirical matter whether sentient species really are wildly different. As pointed out earlier, they may present an important degree of structural similarity among the mechanisms that instantiate the causal functioning of pain, case in which the nonreductionist stance is vindicated. The extent to which the issue is of empirical nature needs to be emphasized, since the way nonreductionists sometimes support their cause makes it difficult to notice. For instance, in responding to Kim's "fragmentation strategy" that led to local reductionism, Block (2003: 147) chooses *rigidity* as an example of physical kind that is multiply realized in solid bodies. Certainly, rigidity is multiply realized and figures in causal laws of motion, but, contrary to Block's claim, rigidity does not constitute "an affront to the fragmentation strategy." Unlike "pain", "rigidity" is a predicate fully characterized at the superficial level of observation and can be predictably implemented in any body whose microscopic structure complies with certain specifications. On the other hand, the existence of pain can only be inferred from a creature's manifest behavior, together with assumptions about the typical conditions that cause pain. But

[4] If the above disjuncts do not seem different enough, add some alien species with the head filled with green slime, as John Bickle (2003) suggests.

such inferences get less and less safe the further we distance ourselves from the familiar territory of human psychology. Even if a green slime alien displayed a behavior similar to some typical human pain reaction, we wouldn't know what the quale of that particular alien experience was. Mere functional identification would not do, since what we need in this case is an intrinsic characterization of the experience; i.e., a way to individuate "pain" *qua* pain. If we are not clear about the higher-level nature of the predicate we are analyzing, we cannot establish any structural similarity among its many low-level realizations. While we know that *rigidity* is a natural kind functionally defined, it may well be that *pain* is a kind of narrower scope than presumed. The issue of local reductionism hinges on empirical results. If, after sufficient scientific investigation, we are entitled to conclude that the alien experience is qualitatively similar to human pain, then psychology gains important new territory; if not – and we cannot a priori exclude this possibility – then psychology must be restricted to more congener species. This reasoning can be extended to all mental states and processes. Consequently, the autonomy of psychology as a science of all sentient species is less firmly established than the state of mechanics or thermodynamics, most of whose predicates are straightforwardly reducible to lower-level physics.

There is one important objection against local reductionism: it seems to be the case that no domain of reduction is specific enough to preclude MR. With respect to psychology, species may still be domains too wide to yield determinate realization bases for psychological states. Would then reductionism become so specific as to demand a special science for studying the properties of individual *X*? And couldn't individual *X* have been differently realized at different moments in time? Kim (1992) answers the first part of the question: the special sciences go on due to the well-motivated belief that there are salient commonalties among the objects of their study, and that these objects share the lower-level realization bases to a sufficient extent to make their research worthwhile. There must be enough similarity among the members of a species, and enough evidence about common substrates of the neural realizations of mental states to motivate a species-specific psychology. Concerning the possibility of cross-world token identification, I subscribe to Block's position: "If we non-reductivists are to countenance cross-world identification of token events, we should not say that token events have microphysical individuation conditions." (2003: 137) Any particular entity at a given moment in time could have been realized differently, in the sense that similar, but distinct micro-components could have composed it. But this is not the sort of multiple realization that needs preoccupy us here. The existence of higher-level event tokens is an ineliminable assumption of any talk about higher levels, and identity over time of such tokens assume their resilience when some changes in their constitution occur or, for that matter, could have occurred.

3.3 Multiple realizability in the social sciences

There are some facts that speak directly against individualism. Social predicates-types such as "bureaucracy" or "vote" are multiply realized by various types of mental states. Indeed, such predicate-types are instantiated in social groups whose members manifest different preferences, beliefs, and values. Besides, there are macro-sociological processes that seem to

ignore individual-level detail. The work of Hannan and Freeman (1989) on *organizational ecology* is relevant in this respect. They offer a categorization of economic organizations and inquire into their dynamics using models borrowed from population biology. The picture likens natural selection: In competing for resources, organizations adopt different strategies that enable them to survive. The basic strategies are either generalist – by which an organization focuses on a wide range of resources – or specialist – by which it focuses on a narrow range of resources. In any event, there are many different ways in which a strategy-type qualifies as generalist or specialist. Additionally, inside each organization, each particular strategy can be instantiated by various possible combinations of individual attitudes, beliefs and behaviors. This is equivalent to multiple realizations at different levels.

Similar considerations apply to the economic theories of the firm. Eugene Fama (1980) gives a neoclassical account according to which firms, defined as sets of contracts among factors of production – with each factor motivated by self-interest – are profit-maximizers. On the one hand, the contractual relationships between the self-interested parties result in different internal structures; on the other hand, externally, firms adopt various strategies to maximize their profits: different market strategies, different mixes of short-term versus long-term investment, etc. As Kincaid emphasizes, "the diversity of organizational forms alone suggests that profit maximizing behavior will be realized in quite different sets of individual behaviors and attitudes." (1997: 20) Consequently, MR is a strong argument against the prospect of reducing corporate behavior to any single optimal set of inter-individual relationships.

4. The multiple describability of lower-level events

As a conceptual point, note that the reductionist bridge laws $H_i \leftrightarrow L_i$ can be attacked either in its $H_i \rightarrow L_i$ relation, which was accomplished through MR; or in its $L_i \rightarrow H_i$ relation, which is equivalent to the denial of local supervenience. A ground to attack the second implication is given by the fact that individual actions are *multiply describable* at the social level, depending on the social context, which comes to a sort of reversed MR.

A good illustration of the multiple describability of individual behavior is George Homans' (1974) individualist account on small groups. He defends the thesis that groups control their members by offering them rewards that can be withdrawn. He denies that this process essentially involves commitment to social entities, because 'group rewarding' can be explained in terms on individual actions. However, not just any rewarding activity brings about 'group rewarding.' Whether a reward counts as a group reward or not depends on the social context. In some social circumstances, some rewarding personal interactions have nothing to do with the group, or would even be inhibited by it.

There is a problem specific to the interface between the individual and the social in the hierarchy of levels. While the physical level is constituted of physical objects and properties and, as such, it is neatly distinguishable from any other higher level, the individual level in the social sciences is constituted of individual mental states that are also *about* social entities and properties. Certainly, one could try to restrict the individual level to non-intentional mental states, but that would bring with it the difficult problem of accounting for individual action in non-

intentional terms. Behaviorism is a failed attempt to achieve this, but more recent attempts in the neuro-sciences are still empirically open questions. In any event, a concept of "individual" deplete of reference to social facts is not what most social scientists have in mind, so the former understanding of the individual level seems to be preferred. For example, in his work on rational-choice theory in economics, Gary Becker (1981) gives an account of how marriage patterns result from the rational choices made by individuals. Families are seen as the outcome of a marriage market in which individuals maximize their preferences for a kind of spouse, number and "quality" of children, economic level, etc. Among the assumptions of this account are the individual preferences for number of children and their "quality", individual preferences for traits of spouses, etc. But the objects of these preferences are certainly dependent on social structures such as family, media, peer, work, and ethnic groups, religious affiliation, etc. Sure, it would be unfair to Becker to presume that he hasn't realized the importance of social factors upon individual decision making. He explicitly includes in the expression of utility function the variable of *social capital* as a part of a person's total human capital: "Social capital *S* incorporates the influence of past actions by peers and others in an individual's social network and control system." (Becker 1996: 4) He also admits that an individual utility function at any moment depends not only on different "ordinary" goods consumed, like apples or clothing, but "also on advertisement, education, and other determinants of preferences not ordinarily considered as 'goods'." (1996: 5) But for all their increased strength, Becker's explanations cannot preclude them impression that they "presuppose social explanations rather than reduce them." (Kincaid 1997: 21)

However, in particular cases, the dependence of explaining individual behavior on social facts and processes might well turn out to be eliminable just as the dependence of certain bio-molecular explanations on facts and processes at the cellular level may be reduced to an explanation in purely molecular terms. This, again, is largely a matter for case-by-case empirical investigation.

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