

International Encyclopedia of the Social & Behavioral Sciences

Editors-in-Chief

Neil J. Smelser

Center for Advanced Study in the Behavioral Sciences, Stanford, CA, USA

Paul B. Baltes

Max Planck Institute for Human Development, Berlin, Germany

Volume 16

darin: Karl-Dieter Opp,

"Norms", S. 10.714 - 10.720.



2001

ELSEVIER

AMSTERDAM—PARIS—NEW YORK—OXFORD—SHANNON—SINGAPORE—TOKYO

Grunwald A, Saupe S (eds.) 1999 *Ethik in der Technikgestaltung. Praktische Relevanz und Legitimation*. Springer, Berlin
 Kambartel F, Mittelstrass J (eds.) *Zum normativen Fundament der Wissenschaft*. Athenäum, Frankfurt
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C. Thiel

Norms

Norms are a major focus of attention of all social sciences, particularly sociology, political science, economics, anthropology, and social psychology. Whereas these social sciences are interested in the empirical study of norms, jurisprudence and philosophy (moral philosophy and deontic logic) address the question of what 'good' norms are and how normative reasoning can be formalized. The literature on norms is so vast that a short article on this subject has to be restrictive. The following sections address the most important questions of the study of norms. These are, first of all, how norms are (or should be) defined and measured. Second, the central theoretical questions are how norms originate and, if they exist, what effects they have.

1. The Definition of Norms

The literature abounds with definitions of norms. An overview and discussion of many norm definitions is provided by Gibbs (1965), Biddle and Thomas (1966), Rommetveit (1953), and Williams (1968). Crawford and Ostrom (1995) give a detailed analysis of the 'grammar' of norms. In this section, the dimensions of the norms concept that most definitions include are described, and which definition of norms is preferable is discussed.

George C. Homans' definition of norms includes most of the dimensions that are ingredients of other definitions as well:

A norm is a statement specifying how a person is, or persons of a particular sort are, expected to behave in given circumstances—expected, in the first instance, by the person

that utters the norm. What I expect of you is what you ought to do (1974, p. 96).

Homans refers to four dimensions. One is *oughtness*; a norm is an expectation that some behavior ought to be (or ought not to be) performed. This is a basic characteristic that almost all norms definitions have in common. Definitions that include this criterion may be called *oughtness definitions*. This kind of definition is mostly used by sociologists.

A second dimension is that people are expected to behave in a certain way 'in given circumstances.' Thus, norms may be *conditional*. A norm such as 'you shall not kill' holds only in certain circumstances or for certain kinds of actors (for example, soldiers are allowed to kill in times of war). Homans' definition further implies that norms refer to *behavior*, not to beliefs or attitudes. In contrast, Morris' definition (1956) also includes beliefs and attitudes. Thus, demands that one should believe in the existence of god (a belief) or should love his parents (an attitude) are norms. Fourth, the *actors* (i.e., the norm-senders) who hold (or utter) a norm are individuals. In other definitions, the actors are collectives such as parliaments.

Two other criteria are used in many definitions of norms. Morris (1956) defines norms as 'generally accepted, sanctioned prescriptions...' (p. 610). Thus, an expectation is, by definition, only a norm if the expectation is *shared* by the members of some group, and if conforming to or deviating from the expectation is *sanctioned* with some probability.

It is important to note that a normative expectation is not identical to a preference. For example, I may not *like* when you smoke in my company, but I may think that you are *allowed* to smoke; in a similar vein, smoking may be prohibited but I may like your smoking.

A second type of definition—which may be called a *behavioral definition* of norms—states that a norm exists if there is a *behavioral regularity* and if *sanctioning* occurs with some positive probability in the case of not performing the respective behavior. 'Sanctioning' means that others impose a cost on a person if a behavior is or is not performed. For example, a behavioral regularity may be that people keep promises. If someone does not keep a promise and if the person is sanctioned with some probability a norm exists. *Refraining* from a behavior may be a behavioral regularity as well. If people usually do not smoke (a 'behavioral' regularity) and if smoking triggers sanctions there is a nonsmoking norm. Thus, 'behavior' implies 'refraining from behavior.' This definition is typically used in economic analyses of institutions. The latter term often refers to single norms, as the following definition illustrates: 'an institution is a regularity of behaviour or a rule that is generally accepted by members of a social group, that specifies behaviour in specific situations, and that is either self-

policed or policed by external authority' (Rutherford 1996, p. 182). 'Institution' often also denotes sets of norms as well as organizations (for a discussion see Calvert 1995, pp. 216-18).

If a norm exists according to the behavioral definition, there need not be any element of oughtness. Assume that smoking is allowed (i.e., there be no nonsmoking norm in the sense of the oughtness definition) and let nonsmoking be a behavioral regularity. Some nonsmokers do not like to be exposed to smokers. If nonsmokers get into contact with smokers it happens that smokers are sanctioned: nonsmokers move to other tables in restaurants or they express their anger about being disturbed; furthermore, nonsmokers may reduce private contacts with smokers. These actions may be costly to smokers, but they have nothing to do with a norm. Thus, although there is a behavioral regularity (most people don't smoke) and although there is some probability that deviations are 'sanctioned' no norm is involved. Only if 'sanction' is defined as a reaction to the violation of a norm (in the sense of the oughtness definition) the behavioral definition includes oughtness. But most proponents of the behavioral definition do not like the oughtness definition because they prefer a pure 'behavioral' definition that allegedly allows easier measurement of norms (see below).

There are other definitions of norms in the literature. For example, Ensminger and Knight (1997, p. 2) define norms as 'informal rules that structure behavior.' Thus, only if a rule causes behavior can it be called a norm. If this definition is applied it is no longer possible to explain when norms emerge because a norm exists by definition only if it causes behavior. Since such definitions are relatively rare they will not be discussed here.

Laws (that will not be addressed in this article) are a subset of norms: they are norms that are promulgated by a public institution. There is a growing literature that explores differences between norms and laws (see, e.g., Posner and Rasmusen 1999).

What definition is to be preferred? It is striking that despite the multitude of definitions in the literature, authors usually don't give reasons for preferring a certain definition over others. One important criterion for choosing a definition is the extent to which a definition refers to the explanatory problems social scientists want to solve. With regard to norms, social scientists are interested in explaining, among other things, when people accept normative expectations and under what conditions what kinds of sanctions are attached to normative expectations. Answering these questions is not possible if several dimensions of norms are included in a single complex definition. In those definitions, certain combinations of values are contained (such as existence of a behavioral regularity and a positive probability of sanctioning). Thus, only this combination of values can be explained. It is further important to know how the dimensions are

I. Stipulating complex definitions



II. Explaining the dimensions of norms

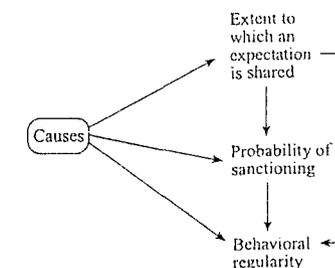


Figure 1
Different procedures for explaining norms

causally related. For example, if norms are accepted and if strong sanctions go with the norm, it is likely that the behavior that the norm prescribes is performed. These complex interdependencies cannot be addressed if several dimensions are incorporated into a single definition. The upper part of Fig. 1 shows that specifying complex definitions implies looking at certain values of the dimensions simultaneously. Treating the dimensions separately allows us to explain them and look at their interdependencies, as the lower part of Fig. 1 indicates (for a similar argument see Hechter and Opp in press).

It is further assumed that the definition used has theoretical import: it must permit the formulation of true and informative theories. The extent to which this criterion is fulfilled can only be judged if a theory with the respective concepts exists and has been tested. As long as such a theory does not exist the definition is a preliminary working definition.

2. How Can Norms Be Measured?

If historians want to get information about norms they will look at *documents* such as books about manners (see, e.g., Elias 1994). To learn about the norms of a cohort of young people, sociologists may analyze their diaries. The norms of voluntary associations may be taken from their statutes. One problem with these sources is to what extent the written norms are actually

in effect. Diaries may only reflect the norms of a specific group of middle class youths. Books of manners may reflect rather the ideals of the author than the manners that are effective. A second problem is the extent to which written documents state the conditions under which a norm holds. Members of a group may often not be aware of those conditions so that it is questionable whether documents state a given norm in all its complexity.

It seems that the method of *observation* is especially suitable for ascertaining norms according to the behavioral definition: behavior, in contrast to expectations, can be observed. But the *principal* possibility of observing behavior does not mean that the respective behavior can also *practically* be observed easily. Is it easy, e.g., to measure the frequency of promise keeping (or of breaking promises), of certain sexual behavior, or of smoking? It is practically impossible to observe these behaviors for a large group: numerous observers and intrusion in the private sphere would be necessary. Even if these difficulties can be overcome, recording the behavior (even on a video-tape) is not sufficient. A given behavior may have quite different meanings. For example, making a promise is a verbal behavior and the observer must know the language of a group in order to ascertain the extent to which promises are made or kept. Many kinds of sanctioning are verbal behaviors as well, and a given behavior may have different meanings. Shaking of the head may express disapproval but may also be a sign of astonishment. Thus, although behavioral regularities and sanctioning are in principle more accessible than expectations, practical measurement by observational techniques is extremely difficult. The conclusion is that the measurement argument that is often invoked for a behavioral definition is very questionable.

Surveys are probably used most frequently to measure norms. There are different measurement procedures. For example, Jackson (1966) measures the extent of approval or disapproval of a behavioral dimension (such as the extent of approval of the number of times a person speaks in an hour's session of a discussion group). If 'frequency of behavior' is plotted on the x-axis and average approval/disapproval of the members of a group on the y-axis, a curve ensues that shows what behavior is more or less approved or disapproved. This procedure also yields various statistical measures. Another measurement procedure is to formulate various items that are designed to capture, among other things, the conditionality of a norm. For example, one of the items used to measure protest norms reads: 'nobody can be expected to take part in political actions that might send her or him to jail' (Opp and Gern 1993, p. 668). A third measurement device is the factorial survey that seems best suited to ascertain the conditionality of a norm. The first step is to specify the conditions under which a norm holds. For example, people may endorse

an obligation to protest if the expected repression by police action is low or if the expected success of the collective action is high. Thus, the dimensions 'expected repression' (with values no or yes) and group success (with values no or yes) may be important conditions for a felt obligation to protest. As a next step, descriptions of situations (the vignettes) are constructed from all possible combinations of the dimensions. Each of these situations is then judged by the respondents of the survey: they are asked to what extent a behavior (such as participating in a demonstration) is more or less obligatory in a given situation. The data enable the researcher to ascertain what effect each of the dimensions has on the overall normative judgment performing certain actions under a whole set of conditions (for details see Jasso and Opp (1997, Opp in press).

The well-known problems of surveys also hold for the measurement of norms. For example, people may not be able to report norms because they have never been faced with situations in which the norm holds. There may also be socially desirable answers when people hold deviant norms.

Qualitative researchers may in general object that norms are not given but are largely 'constructed' in specific situations (see, e.g., Fine in press). This implies that the measurement of norms is impossible because they do not exist. Survey research does not confirm this view. If norms do not exist the prediction is that factorial surveys yield a large number of missing values which did not turn out to be the case (Jasso and Opp 1997, Opp in press).

It is surprising that despite the centrality of norms in the social sciences, there is rather little effort to develop standardized measurement procedures of norms. A detailed comparative discussion of the different procedures is also missing.

3. The Origins of Norms

The major difficulty of reviewing theories about the emergence of norms seems to be the great variety of propositions, scattered in the literature, and the diversity of theoretical approaches. Recent reviews of the so-called new institutionalisms (see, e.g., Hall and Taylor 1996) testify this. Nonetheless, a review of various propositions and approaches indicates that there seems to be one basic idea that underlies all or at least most explanations of norms. This is the *instrumentality proposition* (Opp in press). The idea is that norms emerge if their emergence is in the interest of a collective of people. Norms are thus instrumental.

It is important to distinguish the instrumentality proposition from a *functionalist hypothesis* arguing that norms emerge if they contribute to the equilibrium or survival of a social system. This hypothesis is flawed because it is not possible to explain the existence of a cultural item by the effects that it would have if it

existed. Such functionalist arguments are still widely used in the literature (see the critique by Hardin (1980) of Ullmann-Margalit (1977)). In contrast, the instrumentality proposition holds that situations or events that jeopardize the realization of group goals of actors provide incentives to the actors to set up rules that are designed to make the group better off.

The instrumentality proposition is consistent with the widely held view that the emergence of norms is likely if there are *externalities*. These are actions which incur costs (negative externalities) or provide benefits (positive externalities) to other actors. Those who are affected by negative externalities have an interest in establishing norms that reduce the externalities. Those who cause positive externalities have an interest to establish a norm that compensates them. The basic reference for this theory is Demsetz (1967) (for a discussion see Eggertsson 1990). This theory underlies Coleman's explanation of norms (Coleman 1990, Chaps. 10 and 11).

Norms are public goods, i.e. goods that if they are provided are consumed (or enjoyed) by every member of a group even if the member has not contributed to their provision. For example, a non-smoking norm holds for everybody. Public goods theory which is consistent with the instrumentality proposition argues that 'groups exist in order to supply their members with some desired joint good. This good can be attained only if members comply with rules that are designed to assure its production' (Hechter 1987, p. 41; see also Oliver 1980, Heckathorn 1990, Coleman 1990). Thus, norms are instrumental to achieve group goals: norms are (second-order) public goods which are instrumental for providing (first-order) public goods. This theory suggests a certain mechanism of how norms emerge: they are created by *human design* such as laws.

Assuming that individuals may have biased knowledge about the effects of their actions on the emergence of a norm (a lawmaker may issue a law that is not accepted) or about the effects of a norm on the goals of a group (the norm has unintended negative effects), it may happen that norms are inefficient. Such norms may persist when the costs of changing a norm are high.

We find the instrumentality proposition also in the work of qualitative sociologists. Fine (in press) explains why there is a norm that restrains mushrooming. He notes that mushrooming is competitive: if someone picks a mushroom another one cannot. Mushroomers are thus exposed to a negative externality. In this instance, the norm 'first come, first serve' might apply. However, this solution would breed strain. Mushroomers were interested in good personal relations that were inconsistent with an untamed competition. Thus, the emergence of a norm about constraining the collection of mushrooms is, among other things, due to the goals of the group of mushroom collectors.

Norms are often not the result of human design but

the unintended and sometimes undesired result of human action. The emergence of such 'spontaneous' norms is consistent with the instrumentality proposition as well. Assume that all of a sudden being exposed to smokers becomes a strong externality for nonsmokers. They will increasingly punish smokers. Nonsmokers may be interested in the production of a 'private good' (being free of smoke) and not in establishing a general nonsmoking norm. Due to extensive sanctioning behavior smokers will increasingly stop smoking and will get a bad conscience when they smoke in the presence of nonsmokers. A general nonsmoking norm has emerged. Various other mechanisms of the spontaneous emergence of norms are described in the literature. See particularly the literature on conventions (Schelling 1960, Lewis 1969, Sugden 1995). Other examples of the spontaneous emergence of norms are explored by Mackie (1996), Opp (1982, in press), and Horne (in press).

The instrumentality proposition assumes 'instrumental rationality': individuals have goals and they perceive that a norm *x* generates outcomes that attain their goals. Boudon (1997, pp. 19-22) argues that 'many moral feelings are not the product of instrumental rationality' (p. 20). For example, the act of stealing cannot be shown to have negative consequences; stealing is bad because it contradicts basic moral principles. However, the instrumentality proposition does not rule out that the goal of a group may be to preserve general social principles (or values).

The claim that the instrumentality proposition (and the theory of rational action in general) assumes 'instrumental rationality' or is 'consequentialist' may have different meanings. A behavior (or a norm) may be instrumental in the sense that it is *related* to phenomena in a noncausal manner. Assume that a person P performs action A and knows that this is in accordance with a norm N. The fact that A *corresponds* to N certainly cannot be construed as a causal effect of A. But it is a behavioral situation that may be an incentive for an individual actor to perform the respective action. Therefore, rational choice theory can be applied. In general, terms such as 'outcomes,' 'behavioral consequences,' and 'instrumentality' are used in a wide sense that does not include only (actual or perceived) *causal* effects of actions (or norms). This is confused, e.g., by Elster (1989, Chap. 3). For a critique see Opp (1997).

Are there other propositions about the emergence of norms that are not based on a 'rationalistic' process? Sociologists usually explain norms by the *socialization proposition* claiming that norms are transmitted (see, e.g., Boyd and Richerson 1985). This may occur spontaneously (a norm is imitated) or in a planned way (parents socialize their children). One question that the socialization proposition does not address is *under what conditions people transmit norms*. Whatever these conditions are, sociologists seem to argue that it is not the overall instrumentality of a

norm for a group. This is suggested by the fact that norms may be dysfunctional (Merton 1968, Chap. III). However, one would expect that parents who socialize children (or members of a group who socialize new members) are driven by incentives, i.e. by their personal goals (Coleman 1990, Chap. 11): parents teach their children good manners because they think that this is in the interest of the child or because they do not want to get a reputation as bad parents who are not able to teach their children how to behave. Thus, parents aim at providing a private good that might lead to a norm on the macrolevel.

The socialization proposition further does not say under what conditions the targets of socialization subscribe to a norm and how norms emerge before they are transmitted.

It might be argued that the previous propositions are inconsistent with a cultural approach such as symbolic interactionism. Hall and Taylor (1996) argue that a cultural approach does not reject that individuals are purposive, goal oriented, or rational (p. 949). But, they argue, the goals of individuals are conceptualized much broader: not only material well-being is at issue but individuals or organizations are assumed 'seeking to define and express their identity in socially appropriate ways' (p. 949). This is correct for a narrow neoclassical version of rational actor theory but not for a wider version (Opp 1999) which includes goals that go beyond material well-being. For example, preserving his or her 'identity' may mean that members of a group subscribe to the goal of acting in accordance with important others. Furthermore, invoking 'world views' as conditions for norm emergence is also not against a rational choice approach because actors may realize that certain norms contradict values, and this may be a cost that discourages the acceptance of a norm.

4. The Effects of Norms

Assume that a norm has come into existence. What effects does the norm have on people's actions? Role theory posits that norms are organized in roles that individuals take over. The message of the *homo sociologicus* is that individuals behave according to their roles (see, e.g., Biddle and Thomas 1966). There are several problems with this proposition. One is that behavior that is not regulated cannot be explained. For example, there is no norm prescribing that I should not go to a cinema and instead watch television. A second problem is that the proposition is wrong—people often deviate from role expectations—and that such deviations cannot be explained. A third problem exists if there are conflicting role expectations: the theory does not tell us what expectation is heeded. The basic assumption of this theoretical orientation is that individuals are socialized into their roles and follow them blindly.

An alternative to this oversocialized conception of man (Wrong 1957) is to assume that in situations in which norms hold there is choice—as in any other situation. Individuals realize that they have at least two options: to follow or not to follow a norm. Each of these options has certain costs and benefits, depending on the situation. If norms are internalized this means that breaking a norm ensues in a bad conscience which is a cost. The severity and probability of external sanctions, including informal sanctions, are costly as well (see, e.g., Epstein 1968, Hechter 1984, Heckathorn 1990, Posner and Rasmusen 1999). But other non-normative costs and benefits may instigate an individual to break a norm. What exactly the costs and benefits are that govern behavior if norms are given depends on the explanatory problem and cannot be said in advance. For example, when people consider divorce, marriage norms play a more important role in Catholic countries than in Protestant countries. In committing murder norms may be more important than in tax evasions. In both situations, the kinds of non-normative costs are very different. This argument suggests that *homo sociologicus* does not contradict *homo oeconomicus*.

Is there always a choice situation if a norm holds in a given situation? For example, if a person decides to take a subway will she or he consider every time to pay or not to pay the fare? It often happens that at some time a person makes a decision to act in a certain way and then performs the same action again without deliberating. The action then becomes a habit. But it also happens that deviating from a norm is so costly that this action is never considered. This type of situation indeed resembles the situation that role theory seems to portray.

When the effects of norms are considered, it is useful to distinguish between two types of effects. One is conformity: the emergence of a norm (and the pertinent sanctions) has the effect that more people perform the behavior that is in accordance with the norm than before. If, e.g., a government prohibits civil servants to smoke at their workplaces, smoking will decrease.

This example may illustrate a second type of indirect effect of norms. If fewer civil servants smoke, this may instigate others to stop smoking as well. This will reduce the number of people who get cancer and, thus, expenditures of health insurance companies will decrease. Their membership will be reduced. If civil servants have special consumer preferences, the profits of certain industries may rise. Indirect effects are often subtle and difficult to discover. For example, if companies have to pay increasing benefits to employed women (such as time off before and after pregnancy that the employer has to pay), the costs of employing women increase. The effect may be that in the long run unemployment of women increases and salaries decrease. This would certainly not have been intended by those who made the law. Increasing punishment for

some crimes may amount to a higher benefit of committing other crimes and thus may lead to a displacement effect. In general, changing norms may change the costs or benefits of various types of actions and may thus have unanticipated and undesired indirect effects. What the indirect effects of norms are cannot be said in advance. A detailed analysis of the incentives that prevail in the situation for which the effects of norms are to be explained is necessary.

See also: Coleman, James Samuel (1926–95); Collective Beliefs: Sociological Explanation; Conformity: Sociological Aspects; Control: Social; Institutionalization; Institutions; Integration: Social; Law and Everyday Life; Law: Anthropological Aspects; Law: Economics of its Public Enforcement; Law, Sociology of; Parsons, Talcott (1902–79); Policing; Sanctions in Political Science; Status and Role: Structural Aspects; Structure: Social; Values, Sociology of

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K.-D. Opp

Norms in Science

It is generally recognized that communication among scientists and scholars is governed by a particular scientific ethos, i.e., by a set of rules that are supposed to establish trust in, and guarantee the reliability of, the knowledge created in the process. This ethos, although rarely made explicit in science, was given its most succinct and influential formulation by the American sociologist of science Robert K. Merton (1957 (1942)), who defined it in terms of four basic norms, and with that laid the groundwork for the *Sociology of Science*. This article presents the norms, their significance in scientific and scholarly communication, and some criticisms challenging their actual existence.

1. The Norms of Scientific Communication

The scientific ethos refers to those patterns of behavior and implicit norms among scientists that can be traced back in history to the establishment of the academies in England and France in the seventeenth century. Regardless of many changes in detail there is a remarkable continuity in this ethos over a period of more than three centuries. Merton's formulation of the norms of science can be understood as an analytical condensation of the behavioral patterns that evolved over the duration of this period into a set of institutional imperatives or norms. The ethos, in his words, is that effectively toned complex of values and norms which is held to be binding on the man of science' and which, although not codified, can be inferred from, above all, the 'moral indignation directed toward contravention of the ethos' (Merton 1957, pp. 551-2). The four key norms, according to Merton, were the following.

(a) Universalism is the principle that truth claims are 'subjected to pre-established impersonal criteria' (Merton 1957, p. 553) irrespective of the social attributes of their protagonists, e.g., nationality, race, class, or religion.

(b) Communism (later, and preferably termed 'communality') refers to the norm that the findings of science 'are a product of social collaboration and are

assigned to the community' (Merton 1957, p. 556). Property rights are kept to a minimum, and the scientist's claim to intellectual property may only be exchanged for recognition and esteem by the members of his community.

(c) Disinterestedness demands from the scientists to resist the temptation of using improper means (such as fraudulent manipulation of data) in the search for and communication of 'true' knowledge to their own advantage. It is a fundamental institutional element that has its basis in the public and testable nature of science, and it contributes to the integrity of scientists by the accountability to their peers.

(d) Organized skepticism is 'both a methodological and an institutional mandate.' It refers to the scrutiny of claims and beliefs by scientists' peers on the basis of empirical and logical criteria (Merton 1957, p. 560).

These norms or values are inter-related and together shape a system of communication that is uniquely geared to produce knowledge that may be considered 'true,' in the sense of being reliable, but by no means final. Universalism guarantees, at least formally, general social accessibility and at the same time prevents the intrusion of any other criteria (political, religious, ethnic) in the communication of knowledge other than those accepted as belonging to science itself. Communality subjects all knowledge to general and open communication, thereby subordinating the proprietary interests of the scientist to the less tangible rewards of gaining recognition by obtaining priority of discovery. It contributes to the social cohesion of the scientific community. Disinterestedness constitutes the self-reference of scientific communication. This means that science differs from the professions in that it has no clientele. The clients of science are scientists themselves; since all are engaged in a communally beneficial search for truth, fraud or quackery may lead to temporary advantages at best. Organized skepticism is the reverse side of the norm of disinterestedness, as it stipulates the impersonal scrutiny of any claim to truth as a general principle of scientific communication. It is institutionalized in the peer review system of journals and funding agencies.

Merton's list of the norms of science was one of several descriptions of the 'scientific ethos' formulated during the late 1930s and early 1940s in reaction to the threats against science and democracy by fascist states in Europe (Hollinger 1983). Merton's own account was written under the immediate stimulus of direct political interventions in science in National Socialist Germany (Mendelsohn 1989). Later treatments of the scientific ethos have largely ignored this peculiar historical (and ideological) context of its formulation and have focused on its sociological relevance. Bernard Barber, working in the structural-functionalist tradition of Talcott Parsons and Robert Merton, added three values to the list of norms: faith in the virtue of rationality, 'emotional neutrality as an instrumental condition for the achievement of ration-

ality,' and 'individualism' (Barber 1953, pp. 86, 88). However, partly because of their overlap with the Mertonian norms and partly because of their different theoretical status, they never attracted the same attention.

1.1 The Theoretical Status and Significance of the Norms in a Sociology of Science

In order to appreciate the significance of the norms one has first to realize that science in its modern form, as an institution which has the goal of the 'extension of certified knowledge' (Merton 1957, p. 552), is an unlikely social invention. The improbability lies in the fact that science emerged from a historical situation in which the production of knowledge was immediately linked to the glorification of God or to the pursuit of economic utility. The unprecedented progress of science began when it became a 'self-validating enterprise' (Merton 1957, p. 551), i.e., a separate functional subsystem of society (Luhmann 1990). On the institutional level, the remarkable social innovation was the separation of social status, religious affiliation, and, above all, prestige from the communication of truth claims. The rules and principles which have been poignantly dubbed 'technologies of distance' (Porter 1992) were instrumental in creating trust in scientific communication. They were gradually extended from individuals to institutions, allowing for a communication network that reached beyond generational limits in time, as well as beyond the social and geographical limits of personal acquaintances. Historically the process of the formation of modern science spans from the seventeenth to the early nineteenth century when the university emerged as the core institution and disciplines formed marking the establishment of self-validation and autonomy (Stichweh 1984). Merton's list of norms condensing the institutional patterns have emerged over this period into an analytical scheme which serves to explain the unique status of science—as a set of methods to produce certified knowledge and to accumulate the knowledge that accrues from their application, as well as a set of cultural values and customs that govern these activities. Thus, with the articulation of the norms, Merton also defined the aim for sociology of science to be concerned primarily with the moral compulsion of methods and their impact on behavior, not with their technical expediency. Merton in effect conceived of the sociology of science as an analysis of the social prerequisites and institutional configurations of science. It would in no way be concerned with the substantive findings of science or their methodological underpinnings. Consequently his sociology never challenged the philosophical assumptions that shaped the concept of science at a particular historical moment and which have changed since then, a limitation for which his views have subsequently

been criticized. Under the influence of Thomas Kuhn (1967) sociologists began to look into the normative nature of scientific paradigms and thereby crossed the line into a fully fledged 'sociology of scientific knowledge.'

The theoretical status of the scientific ethos has been a persistent issue. It has often been argued that scientists do not behave in accordance with these norms and that they are subject to historical change (Barnes and Dolby 1970). However, the existence of norms is not necessarily reflected in actual behavior. Merton's theoretical construction of the norms is a complex combination of different elements: (a) social-psychological patterns of attitudes that are expressed in internalized (but not necessarily explicit) reactions to violations of the norms, in the awareness that one's own actions or those of others are breaching a code; and (b) social-structural patterns of sanctions, i.e., mechanisms institutionalized in science that sanction, positively or negatively, certain behaviors like plagiarism (negatively) or the open exchange of information (positively). Thus, to demonstrate whether the norms are operating or not, requires a more sophisticated approach than mere observation of behavior.

Merton himself responded to the challenges to the validity of the norms by pursuing two research strategies: (a) the analysis of apparent paradoxes in scientists' behavior and the resulting psychological and social conflicts (Merton 1973, (1968)); and (b) the study of typical reasons for attacks against science or for conflicts between science and its societal environment (Merton 1957 (1937)).

On the one hand Merton observed a peculiar ambivalence among scientists toward priority disputes and their own interest in priority of discovery. (His empirical evidence consists of biographical materials and correspondence of scientists dealing with priority disputes.) He attributed this ambivalence to the institutional mandate of disinterestedness and the primacy of the expansion of knowledge. Here again, sociological elements are coupled with social-psychological ones. The need for recognition felt by the individual scientist is not an expression of idiosyncratic vanity but is initiated by the institution. 'Continued appraisal of work and recognition of work well done constitute one mechanism that unites the world of science' (Merton 1973, p. 401). Merton reacted to the changes in social-psychological patterns effected by institutional changes. Observing the increasing number of multi-authored journal articles that indicate the rising importance of cooperative forms of research, he concluded that the 'interest in priority'—by no means historically invariant—may give way to an interest in the recognizability of one's work in a research team (Merton 1973, p. 409).

Merton's second approach to documenting the validity of the scientific ethos was to analyze conflicts between science and its societal environment. He observed two sources of hostility toward science: the