1 SCIENCE AND THE MEDIA
Alternative routes in scientific communication
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INTRODUCTION

The 'canonical account' of public communication of science

It is maintained that one of the most salient features of modern science is its greater autonomy from the general public compared with the past. This autonomy rests primarily on the widening 'knowledge gap' between researchers and the generally educated that has marked the last three centuries of the history of science and which has resulted in the stable codification and institutionalization of the scientist's professional role. Today, researchers place considerable importance on their autonomy and distance from the general public and to the existence of a general agreement, within society, concerning who can be deemed a specialist and what really counts as scientific knowledge. This process of professionalization, autonomization and disentanglement from both the public and from general culture has been accompanied by the creation of new channels of communication between specialists and non-specialists. The diffuse relationship which used to link scientists with the public has been replaced on the one hand by formal education (which is also the traditional and most widespread means of recruitment of new members to the scientific community) and on the other by a series of media spaces where scientific knowledge can be presented to wider audiences. According to Shapin, 'The differentiation and specialization of science meant that scientific knowledge no longer enjoyed a matter-of-course place in general culture. Yet that same differentiation created an opportunity for the explicit "popularization" of science, and thus, for literary forms designed to convey otherwise inaccessible or impenetrable scientific knowledge to sectors of the public'.

This presentation of science to the public has taken several different forms (books, magazines, educational films, radio and television programmes), although often labelled with the same term 'popularization'.

Already in 1686, in his Entretiens sur la pluralité des mondes, Fontenelle recognized the need to satisfy both 'la gens du monde' and 'les savants'. During the following decades, this double narrative tended to split more
and more into two different orders of discourse: one for the scientist’s
colleagues, the other one for the educated public. By the end of the following
century, this second language had already focused on specific and para
digmatic audiences: women (as ‘symbols of ignorance, goodwill, curiosity’)
for instance, through periodicals like The Ladies’ Diary and books like Il
Newtonianoismo per le dame by Francesco Algarotti (1752) or L’Astronomie
des dames by Joseph Jérôme Lefrançois de Lalande (1785).

It is only since the second half of the nineteenth century, however, that
one can really talk of ‘large scale’ communication of science, explicitly
addressed by its authors not just to specific audiences but to the general
(public ‘grand public’). According to Raichvarg and Jacques, scientific and
 technological stories were increasingly ‘given’ to the public without the
public overtly looking for them. The authors provide in particular three
elements:

1. The daily press, which created a real ‘feuillet scientifique’ (along with
the traditional ‘feuilles littéraires’) by documenting salient events in
science and technology (ranging from announcements of new discov-
deries, to earthquakes, to explosions in laboratories).
2. General interest magazines devoting considerable space to scientific
information.
3. Fairs and exhibitions where the major advances in science were presented
(photography, models of the body, later x-rays).

This addition to a model of communication of science ‘à la carte’, i.e. one
addressed to a select, motivated audience, of a model of ‘science du chef’
with its fixed menu whose delights the general public was urged to sample,
was a crucial step in securing a conception of public communication of
science as benevolent alms-giving by scientists to a large and poorly informed
audience.

As the written communication of science to the public consolidated itself
as a specific media genre (with its appropriate rules of access and formats),
the nature of its performers also became clear. The existence of a category
of writers responsible for the ‘dissemination’ of scientific knowledge was
soon acknowledged, and indeed deemed essential, given the sensational
advancement and specialization of the natural sciences. Journalists and
journalism became increasingly prominent within this category: even
those writers with different backgrounds (mostly teachers of sciences and
researchers) regularly published either articles or previews of their forth-
coming books in newspapers.

This briefly and imperfectly sketched account of the historical transfor-
mations shaping public communication of science has been greatly
overemphasized and absolutized over time by researchers and, consequently,
by the other actors involved in the process, such as journalists or research

managers. This progressive shedding over and disciplining of the public
has been in fact presented as essential for the consolidation of the sci-
entific enterprise as we know it today and depicted as an ‘inevitable’ process,
necessary for the effective pursuit of scientific truth. Recent works in the
history of science have instead shown the extent to which the present rela-
tions between scientists and non-scientists are the result of ‘massive historical
achievements’ by the scientific profession and have therefore questioned
teleological explanations such as the one mentioned above.

Nevertheless, general opinions on such themes as ‘science and the media’
or ‘communication of science to the public’ revolve around those same
truisms that are part of the so-called ‘canonical account’ of the communi-
nicative relationships between science and society. The basic arguments of
this account can be summarized as follows:

1. The scientific enterprise has become too much specialized and compli-
cated to be understood by the general public. For example, in December
1919, when two solar eclipses had finally confirmed Einstein’s general
theory of relativity, The New York Times gave great emphasis to a
comment allegedly made by Einstein himself: ‘In the world there are
no more than a dozen of persons who could understand my theory.

2. Therefore, a form of mediation is needed in order to make scientific
achievements more suitable and accessible for the public. This media-
tion requires the intervention of a new professional figure: a ‘third
person’ (in general, the science journalist) who can manage to bridge
the gap between scientists and the non-scientific audience, by under-
standing the former and communicating their ideas to the latter.

The introduction of this ‘third person’ is essential for researchers as they
can claim to be completely indifferent and extraneous to the process.
It is the journalist, after all, who takes their theories and sentences and
rearranges them for the public where ‘rearranging’, according to the
scientists, usually means ‘distorting’. For example, ‘Natural knowledge
. . . is perceived as watered down and then trickled down for popular
consumption, along the way losing theoretical content.’

3. This mediation is most often described through the metaphor of
linguistic translation. As a sort of interpreter, the ‘third person’ should
simply accomplish the task of reformulating scientific discourse in more
simple words. From this point of view, the problem of communicating
science to the public, then, is reduced to a mere matter of linguistic
competence.

This series of arguments involves some deeper assumptions about the
nature of scientific discourse and about the nature of scientific work at
large. According to such views, in fact, the public discourse of science starts
where scientific discourse ends. Once the task of producing ‘pure’, reliable
knowledge has been accomplished, knowledge can be offered in a simplified form to non-experts. The use of terms like 'popularization' or 'dissemination' is itself symptomatic of this idealized and largely unproblematic vision of public communication of science. Such a vision has its roots in the professional ideologies of scientists and journalists. Through the canonical account, scientists dismiss any involvement in the process and are thus free to depreciate its faults and excesses, namely inaccuracy and spectacularization. Journalists, on the other hand, need it in order to justify their role and to give sharper focus to the nature of their task.

What is more striking, however, is that the canonical account of public communication of science is not to be found solely in the opinions and judgements of scientists and journalists. In fact, a 'positivist' and diffusionist model of science communication has by-and-large dominated literature in this area. Until the 1970s, contributions were almost exclusively of a prescriptive tenor; books were written by scientists and leading scientific writers which documented the inaccurate coverage of science by the media and offered advice to journalists to help them improve their writing and understanding.

The position of scientists in the definition of the issue 'communicating science to the public' has also been powerful enough to influence research work. Not surprisingly, therefore, of the three main groups of actors involved in the process (scientists, journalists, and the public), research has focused pre-eminently on the latter two. Media studies have analysed the rules and constraints of scientific journalism and identified the 'structural difficulties in reconciling the demands of science with the exigencies of newswriting'.

A 'blame the messenger' perspective has therefore emerged, in which limits inherent to journalistic practice (limits of time, education, etc.) have been indicated as responsible for misrepresentations of scientific ideas to the public and, consequently, for the insufficient appreciation of scientific achievement by the public itself. A typical contribution to this perspective draws a comparison between scientific 'original' ideas and their media representation; or a group of scientists is asked to judge the accuracy of journalistic coverage about a specific issue in their field.

Very similar reflections are inspired by studies focusing on the side of the public. Until very recently, the 'public understanding of science' approach was to be easily identified with measurements of the degree of awareness and understanding about scientific issues reported by the media in a given sample of the population. Again, these measurements have been ostensibly science-centred, with scientists as the only observers authorized to assess accuracy and reception levels. In the next section, however, I will try to show that it is exactly in this area that the canonical account was first called into question.

It is clear that such a 'science-centred, paternalistic and pedagogic' orientation entails not only an idealized vision of scientific activity, but also a normative approach to the processes of communicating science to the public. Terms like distortion, sensationalization and inaccurate translation only make sense by reference to the most outdated models of communication. As a unidirectional, linear communication transfer from one sender (the scientific community) to a completely passive receiver (the broad, uninformed public), the process should in no way affect the nature and content of original information. Therefore, efforts should be devoted to the minimizing of all those 'noises' which impede proper reception and understanding (and are, it goes without saying, nothing but a byproduct of journalistic mediation). A graphic representation of the canonical account is given in Figure 1.1.

The social representation of scientific theories

As we have seen, one of the key assumptions of the canonical account is that lay audiences simply absorb, in an impoverished and lessened form, ideas which stem from scientific activity. Given the proper transmission of information, people will be led along the 'royal avenue' to scientific awareness.

Studies in cognitive and social psychology, together with important advances in fields such as risk-communication have instead shown the extent to which scientific knowledge is elaborated and manipulated at the popular level. Scientific knowledge has therefore been recognized to be an essential component in the formation of 'social representations', i.e. sets of values, notions and practices regarding social objects that constitute a mean of orientation and perception of responses. According to Moscovici, the diffusion of scientific theories among non-specialists creates a 'second-hand common sense' derived from science. 'Science was before based on common sense and has made common sense less common; now common sense is science become common.'

Figure 1.1 The canonical account

Note: Keywords are 'mediation'; 'distortion'; 'sensationalization'; 'science as "too difficult" for the lay public' ('specialization'); the media as a 'dirty messenger' for science; 'blame the messenger'
Thus, studying the social representation of a scientific theory means analysing the transformations which this theory encounters when it is transferred to a consensual universe, circumscribed and represented.\textsuperscript{21}

These transformations may occur in the construction of the representation (external transformative processes) or within the representation itself, as it becomes more and more consolidated (internal transformative processes). In the former case, there are two main mechanisms at work: 1) objectification; and 2) anchoring.\textsuperscript{22}

1 By means of objectification selection is made among items and at the same time the selected items are given greater concreteness and relevance. Different and even contradictory elements embedded in the theory are coagulated in a schematic and coherent unit. For example, a ‘personification’ of theories takes place: Einstein becomes the image of relativity and all psychoanalysts have (for Moscovici’s interviewees) the face of Freud. At this stage, concepts are visualized in metaphorical images like ‘wave’ or ‘corpuscle’ and purely logical/formal relations are given ontological status. What eventually remains of psychoanalysis is merely the dualism between conscious/unconscious that leads to the complex through repression. The neurological theory which posits a functional specialization between the two hemispheres of the brain becomes a clear-cut contraposition between ‘right brain’ and ‘left brain’, art and mathematics, ‘right persons’ and ‘left persons’.\textsuperscript{23} Similarly, to take a more recent example, popular images of AIDS tend to collapse the disease into the HIV virus.\textsuperscript{24}

2 It is at this point that the mechanism of anchoring comes into operation: the previously selected elements of the theory become relatively autonomous from the overall picture and can therefore be inserted into pre-existing (cognitive and social) relations. Scientific theory gets incarnated in the texture of everyday life, thus enlarging, narrow-focusing and rendering instrumental a number of common sense theories.\textsuperscript{25} Analogies play in this sense a fundamental role as instruments of identification and classification, as they integrate new information into a familiar universe. Some elements of the theory are decontextualized and then recontextualized in other areas.

None of these processes can occur without an accompanying linguistic arrangement. The keywords of a theory are decontextualized, get ‘automatized’ and then become stereotypes able to explain a wide range of phenomena (theoretical meanings are enriched with ‘common sense’ ones). The outcome of the process is a ‘thematic language’, a linguistic space which surrounds the social representation, its centre is a ‘zero degree symbol’ (complex for psychoanalysis, HIV for AIDS) which constitutes at once a synthesis and a mode of identification.

Internal processes complete the formation of the social representation, fashioning it into a real instrument for the mapping of reality. What in theory is simple description, becomes explanation: people behave in a certain way because they have complexes or because they are ‘left’ people.

The role of scientific imagination

I have briefly presented the contribution made by the social representation approach to the topic ‘science and the public’ because it marks an important step beyond the canonical account without essentially departing from it. The important advance is achieved by questioning the idea that science is simply ‘disseminated’ and transferred from scientific communities to the public context. Popular knowledge about science is not just a ‘diminished simulacrum’, simpler, weaker or distorted in proportion to the distance between the learned and the lay communities.\textsuperscript{26} Rather, it is a complicated tangle of processes and transformations through which science is appropriated, used or simply neglected by different audiences. ‘Popular science may diverge from learned science not because the latter is poorly understood but because it is elaborated by its recipients for different purposes’.\textsuperscript{27}

There are, however, at least two senses in which the social representation approach keeps itself within the confines of the canonical account.

In the first place, it retains a unidirectional vision of the communicative process: scientific formulation remains the sole original point of departure. Second, it locates transformation processes only in stages subsequent to scientific construction. Yet one should bear in mind that most of the transformation processes identified by such an approach are to be found in the works of scientists themselves. Metaphors, visual images and ‘prototheories’\textsuperscript{28} are not just embellishments with which to dress up a theory when presenting it to the public (in place of esoteric calculations and formal expressions).\textsuperscript{29} Instead, they are constitutive elements of the theory itself.\textsuperscript{30} This is not to imply that a scientific theory cannot be enriched or transformed by its subsequent public presentations. However, these possible ‘enrichments’ or transformations often stem from those same representation processes employed by scientists. ‘It is the researchers themselves who propose reinterpretations susceptible of constituting representations.’\textsuperscript{31} Therefore, the problem is not just one of describing what happens to scientific theories as soon as they cross the borders of the scientific enclave. It is also that of understanding ‘how scientists, after elaborating theories, or simply concepts characteristic of their discipline, do transform them in order to make them suitable for propagation within differentiated publics’.\textsuperscript{32}

In Chapter 2, I shall exemplify the foregoing discussions by examining two elements – metaphors and paradoxes – which play a key role both in
core scientific activity and in public communication of science.

**A communication continuum**

It should by now be clear that the contributions of the history and sociology of science to our topic have for long been of little relevance compared with those of other disciplines (like social psychology, cognitive sciences, linguistics). This lack of interest in the public side of science may be explained by the fact that the historical tradition has in the past been largely committed to a rationalist and elitist reconstruction of scientific work. It may be more surprising, though, to note that sociologists of science, even those accustomed to the most radical of theoretical frameworks, have paid even less attention than historians to the relationships between scientists and their audiences in society.

An interpretation of this is offered by Cooter and Pumfrey:

> if all science was to be regarded as socially permeable there was no particular need to study the popularisation of science to access this sociability... Thus, from a sociology of science perspective, the best that could be said for the popularisation of science was that it served to maintain the authority of science by legitimating the fiction of its autonomy and the asocial production of its 'truths'.

It is also not unlikely that sociologists of science have been merely more sophisticated victims of the 'canonical account': public communication of science, as a practice completely detached from science and entrusted to other social actors, bore little interest for those concerned only with the influence of social factors on core scientific activity.

More recently, however, contributions from both fields have increased in number and significance. They address the canonical account critically and plausibly, by recasting the public communication of science within the general context of the 'scientific field'. Since it is strictly linked to other stages of scientific practice, and since it often involves scientists themselves either as sources or as authors, communication of science to the public cannot be the sole province of media or journalism studies, which regard it just as another genre of media communication. Instead, recent accomplishments in the study of scientific discourse (for example, concerning scientific rhetoric or the role of metaphors and visual images) can be fruitfully applied to science communication studies.

In place of the clear-cut distinction between science and its dissemination, a 'continuity' model of communicating science has therefore been suggested. A *continuum* in the exposition of scientific ideas can be mapped in which differences inevitably occur due to different contexts and styles of communication/reception, but only as a matter of degree. Barriers between genuine knowledge/audiences and popular discourse cannot be sharply drawn, even if they are often used by scientists to define and preserve their authority over knowledge. One of the most detailed models of this *continuum* has been described by Cloitre and Shinn, who identify four main stages within the process of scientific communication:

1. **Intraspecialist** This is the more distinctly esoteric stage, the prototype for which is an article in a scientific journal. Empirical data, references to experimental activities and graphs prevail.

2. **Interspecialist** To this stage belong several kinds of text, from the truly interdisciplinary articles published in 'bridge journals' like *Nature* and *Science* to the papers presented at meetings among researchers in the same discipline, but working on different topics. Compared to the previous stage, texts here are more likely to represent theoretical concepts in concrete form.

3. **Pedagogical** What Fleck calls 'textbook science' is the stage where the theoretical body is already developed and consolidated and where the current paradigm is most completely presented. The emphasis here is on the historical perspective and on the cumulative nature of the scientific enterprise.

4. **Popular** Cloitre and Shinn unite under this label both articles about science in the daily press and the 'amateur science' of TV science documentaries and magazines like *Scientific American* or the French *Science et Vie*. They identify in such texts a greater quantity of metaphorical images and marked attention to issues relating to health, technology and the economy.

**Cognitive trajectories and their obstacles**

A typology of this kind invites us to imagine a sort of 'cognitive trajectory' for scientific ideas which carries them from the intraspecialist expository context to the popular one, passing through intermediate stages. This conceptualization can be usefully employed provided one introduces the following specifications:

1. A synchronous approach should accompany this sequential perspective. The same researchers can simultaneously communicate their work at different levels, by publishing specialist and popular articles.

2. The trajectory is by no means immune to 'obstacles'. It may happen that some ideas fail to find an adequate exposition at one of the levels. Cloitre and Shinn use the term *crystallization* to describe the process which prevents some concepts from passing from an expository style to another. It is not difficult to accept, for instance, that not every
scientific theory or discovery is well suited to the general media, or that they may suit one medium but not another (e.g. magazines rather than TV). This is less a matter of complexity of some theories, however, than of the specific constraints of each format. Announcements of scientific discoveries or advances may fit more or less well with media practices (e.g. newsmaking) or into general thematic areas that already attract public attention.\textsuperscript{45}

One should not think of crystallization as being limited to the step towards popular exposition. A specialist contribution may be of no interest to the contiguous fields and therefore will fail to reach the interspecialist stage. Balmer provides an interesting example of ‘temporary crystallization’ at the pedagogical level.\textsuperscript{46}

Sickle-cell anaemia is caused by a genetic deficiency of haemoglobin which causes the affected cells to assume an irregular shape. It affects only black people (in the United States one black child out of fifty suffers from it) and is transmitted hereditarily. The disease was first diagnosed by the physician James Herrick in Chicago. In 1949 Pauling proved that sickle haemoglobin has a different molecular structure from the normal one; in 1957 the differences between the two molecules were defined and in 1966 Marayama was able to draw a complete model of the disease. In textbooks and university books, however, no reference was made to this anaemia until the mid-1970s, when it gradually gained public attention. After some TV documentaries on the disease, subscriptions were organized for the people affected and the disease was even mentioned by President Nixon in a speech on health problems (February 1971). In 1972 research funds to study this kind of anaemia grew from one million to ten million dollars and the black population was massively screened.

According to Balmer, it is because of this public resonance of the disease that since the late 1970s textbooks have begun to devote increasing space to it. The case is also interesting because it illustrates (at least partially) another variant of the trajectory depicted above, which Cloître and Shinn call ‘deviation’. An idea does not necessarily have to pass through all the four stages in sequence: it can simply skip some of them by jumping to those that follow.

In deviation, cognition is intentionally shifted from one expository genre to another with the idea in mind that the expository standards and criteria of the alternative category are more felicitous for the growth of the idea at hand.\textsuperscript{47}

This process, which Cloître and Shinn do not elaborate, is the main focus of this work. In comparison to their general formulation, the present analysis is limited to those cases where the target expository genre (i.e. that to which

knowledge is intentionally shifted) is located at the popular level,\textsuperscript{50} and the source expository genre is at the intraspecialist or interspecialist level. I would also argue that the shift is not always made in order to improve theory elaboration. This can be one of the consequences (furthermore, mostly one not clearly intended by those who actually foster the shift), but different aims and effects can be pursued. I refer not only to the search for political and material support from the public. For example, the importance of public appeal in particular cases of controversy or paradigm shift has been variously hypothesized and studied.\textsuperscript{51} It seems that there may be conflicts (crisis situations) which cannot be resolved within the scientific community, and which therefore require the intervention of the public to determine the success of one party over another.

The popular stage and its implications

As I have already pointed out, studies of science have, under the influence of the canonical account, paid little attention to public communication of science as an integral part of scientific discourse. They have instead assumed the existence, at a certain moment, of a ‘completed’ and ‘definite’ scientific fact which can be taken and brought to external audiences. The role of the public has at best been that of providing a passive environment (‘climate of opinion’) in which knowledge can be spread. However, here I consider the activity of communicating knowledge at any level to constitute a fundamental element of that complex mosaic which is a scientific fact.\textsuperscript{52} The concepts of syphilis and AIDS that pathologists share today are not untouched by the transformations they have undergone in passing from the esoteric to the exoteric sphere.\textsuperscript{53} Scientists themselves can make use of the information and of the images which circulate at this level. Cloître and Shinn document the appropriation by specialists of a metaphor (‘the ant in the labyrinth’) originally designed to explain the brownian motion of particles in popularization texts.\textsuperscript{54} A research study conducted by Phillips shows that articles appearing in The New England Journal of Medicine are cited twice as much by specialists if they are also mentioned in a daily paper like the New York Times.\textsuperscript{55} Approximately one-third of the scholars involved in the debate on the mass extinction of dinosaurs as resulting from the collision of the earth with a meteor reported that they had first heard about the Alvarez hypothesis from the general media.\textsuperscript{56}

One of the cases of ‘deviation’ thoroughly explored in Chapter 3 – the cold fusion case – illustrates this point quite well: especially in the first phase of the controversy, scientists had to rely heavily on journalistic sources in order to obtain information, and they used the general media to exchange experimental results and comments.\textsuperscript{57} A similar pattern can also be observed in the days immediately after the announcement of the COBE satellite
discovery of ripples in cosmic background radiation, when 'astronomers had to respond to journalists off the cuff, without knowing the details of the COBE announcement'.

In such cases one could even argue that, just as it happens for a certain form of political discourse, scientific discourse at the public level is only apparently 'public': communication at this level is not actually meant to address the general public, but to reach a vast number of colleagues rapidly by sending them 'coded messages' without having to conform to the times and constraints of specialist communication. Pons and Fleischmann's initial press conference is a clear example of this, since it was designed mainly to secure them priority in the discovery.

These active influences of the popular discourse of science cannot be reduced to feedback mechanisms of public support and legitimation as even some innovative studies seem to envisage. By often emphasizing a unilateral interpretation of Fleck's theory, they regard the popular stage as the final (and often, decisive) stage in that process of stylization, 'distancing from the research front', and production of factuality and apodicticity which is the construction of scientific evidence. According to Whitley:

The more removed the context of research is from the context of reception in terms of language, intellectual prestige and skill levels, the easier it is for scientists to present their work as certain, decontextualised from the conditions of its production, and authoritative.

In this view, it is not difficult to devise a 'social itinerary of recognition' for a scientific fact, flowing parallel to the cognitive trajectory. The intraspecialist level is the minimum threshold for knowledge to be presented; by reaching the interspecialist level the sectorial recognition is transformed into a more general one which involves the wider scientific community (this does not necessarily mean 'every physicist' but possibly, for example in the cold fusion case, 'every nuclear physicist'). Through citations by other researchers and its mention in textbooks a theory becomes part of a certain knowledge heritage and through the mass media it gains public recognition.

This model, which is sketched in Figure 1.2 as funnel-shaped, to indicate its emphasis on the growing solidity and simplification that a scientific fact acquires stage by stage, should probably not be questioned as such. It can undoubtedly be a useful reference tool since it describes a sort of ideal communication flow in routine conditions. Especially in the aforementioned 'deviation cases', however, the picture of the process should be slightly more complicated. In such cases, public discourse of science does not simply receive what filters through preceding stages: it may be at the very core of the dynamics of scientific production. That there might be more than one type of communicative practice hidden under the general

Figure 1.2 A continuity model

Source: After Shinn and Whitley (1985) and Hilgartner (1990)
Note: Keywords are 'expository continuum'; 'distancing from the research front'; 'consolidation'; 'production of certainty'

label of 'public communication of science' is also suggested by Peters, who introduces a similar distinction between 'routine' ('scientific-oriented') and 'problem-oriented' communication of science in the media, to be in turn subdivided into 'consensus-oriented' and 'conflict-oriented' communication of science (framed in the media as 'scandal' or as 'controversy'). For my purposes here, it is sufficient to distinguish between two main modalities of the public communication of science:

1 A 'routine', consensual, unproblematic trajectory that is adequately described by the continuity model. In spite of its ideological connotations, popularization is on the whole not an inappropriate term for this process.

2 An alternative trajectory, i.e. the one represented by deviation processes, which could reasonably be made to coincide with what Peters means by 'problem-oriented' public communication of science.

Some relevant formal and substantial differences seem to be respectively associated with these two modalities. At a formal level, when the popularization modality is activated, scientific issues are likely to be framed in spaces explicitly devoted to the communication of science: e.g. amateur scientific magazines ('Scientific American, Science et Vie'), the science sections
of newspapers. On the other hand, in deviation processes, scientific issues more frequently appear in general media contexts as well: e.g. the general interest sections of newspapers, television news broadcasts.

At a more substantial level, with popularization, the outcome of communication at the public level is relatively straightforward: as a chiefly 'celebratory', discourse it further strengthens the certainty and solidity of theories and results. This is what the ‘funnel’, continuity model is about. On the other hand, when deviation processes take place it is not possible to determine a priori what the outcome of communicating at the public level will be or which interests will be best served. For example, scientists make increasingly frequent use of press conferences and articles in the daily press to announce their discoveries. It takes a fair amount of time for an article to be published in a scientific journal (and therefore the chances of being anticipated increase) and the risk of plagiarism arises from the anonymous examination of manuscripts by colleagues before publication. In such cases, 'deviation' to the public stage can actually enhance the peer-review process, but it is also likely to be sanctioned as an attempt to bypass this process and to gain 'improper recognition' outside the scientific community.86

Possible effects in terms of legitimation (or, in some cases, even delegitimation) are not separable from those concerning the definition of cognitive boundaries and of roles related to the processes of knowledge production. At this level, scientific facts (together with their networks of professional figures and institutions) can be consolidated as the routine model predicts, but they can also be dissolved, decontextualized (by the scrutiny which they are subjected to, and by the recontextualizing of some of their elements), or simply black-boxed for different uses. 88 Given that the approach adopted here means that it is not only important to study how science enters the public domain but also how the public enters the scientific arena, it is worth noting that the same perspective can be applied to the use of common sense by scientists. 69

The study of public discourse of science in cases of deviation should be seen, therefore, as an opportunity to recapture 'the plurality of sites for the making and reproduction of scientific knowledge'. 70

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2

WHEN SCIENTISTS TURN TO THE PUBLIC

So far, I have tried to outline two main points:

1 That certain communicative situations (‘deviations’ in Cloitre and Shinn terminology) can be accounted for neither within the canonical model nor within the continuity model of public communication of science.

2 That it is in these situations that the contribution of the public discourse to scientific communication can become most evident and therefore amenable to investigation.

I shall now try to build an explanatory hypothesis on this rather descriptively thickened dimension by addressing the problem of the conditions under which scientists might be stimulated and/or allowed to deviate their normal expository practice towards the public level.

Deviation to the public seems related to peculiar crisis situations which cannot be managed within the scientific community. These situations may often involve the definition and negotiation of scientific boundaries. The concept of 'boundary work' is applied here in a very general sense to encompass three broad types of demarcation strategies. It refers in the first place to the boundaries between science and non-science. Boundaries can be restricted to exclude competing professional practices (as in the case of the Scottish anatomists against the phrenologists described by Gieryn), or in turn they can be made more flexible in order to incorporate such practices within the dominant framework (as in the case of acupuncture which has been studied by Webster). Such boundary definitions are not only defensive. For instance, public speeches and popular writings by Tyndall in late nineteenth-century England can be easily interpreted as efforts to extend the boundaries of science to the detriment of religious tradition and engineering practice.

However, public support is particularly necessary when what is at stake is not just the negotiation (however massive) of the boundaries but rather their very constitution. As long as a discipline has not yet been recognized as such (and therefore until it is granted authority and prestige), it is