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Abstract

There is little doubt that during the past few decades science communication efforts aimed at non-expert audiences have increased in quantity and intensity on a global scale. Public engagement and outreach activities have now become a routine – when not a prominent – feature for several research institutions in Europe. However, it would be difficult for both scholars and those involved in science communication to agree on the impact of these activities, on the long-term implications of the 'science communication movement' and on the indicators we should develop and employ in order to assess impact. The paper argues that quality is a relevant issue and challenge for contemporary science communication. Style is relevant to addressing that challenge, insofar as it relates to discussions about how to strengthen the quality of science communication, suggesting a different perspective other than the traditional normative/prescriptive framework. The notion of style also fruitfully connects the debate on science communication with a rich tradition of studies in the history and sociology of science.

Keywords

quality, science communication, science in culture, science in society, style

Le quali opere sí perfettamente finí Andrea, che piú desiderare non si potrebbe, se nate non che lavorate fossero; cosí sono elleno di nettezza, di bellezza e di grazia ben finite e ben condotte. In quelle si scorge la osservanzia e le misure dell'arte …

(Giorgio Vasari, *Le vite de' più eccellenti architetti, pittori architetti e scultori italiani, da Cimabue insino a' tempi nostri*, 1568)[1]

You've got the style it takes

(John Cale and Lou Reed, 1990)

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1. Introduction

There is hardly any doubt that during the past few decades, science communication efforts aimed at non-expert audiences have increased in quantity and intensity on a global scale. Public engagement and outreach activities have now become a routine, or even prominent, feature for several research institutions in Europe and elsewhere. Financial and human resources are devoted to these activities, and researchers themselves are increasingly and even institutionally encouraged to pursue this 'third mission' alongside more traditional research and teaching duties.[2] However, both scholars and those involved in science communication (including policy makers and institutions) would find it difficult to agree on the impact of these activities, on the long-term implications of the 'science communication movement' and on which indicators should be developed and employed in order to assess quality.[3] In other words, to tell the difference between 'good', 'bad' and 'average' public communication of science as we do for other activities. As recent studies clearly showed for the European context, while research and teaching functions of scientific institutions can count on established – albeit from time to time still discussed – indicators, public engagement functions are often still performed as a sort of 'goodwill exercise' (Bauer and Jensen, 2011; Bucchi and Neresini, 2011). Despite increasing general emphasis on public engagement and remarkable performances by some institutions, *a culture of public engagement* still seems to be lacking among most research institutions in Europe. By this I mean an organisational culture in which these activities are appropriately recognised, evaluated and rewarded as part and parcel of the organisation's routine activities and identity as well as a relevant element of the broader institutional landscape in which the organisation operates; a culture in which public engagement would become an element to be taken into account when relating to funders and policy makers or when assessing and benchmarking institutions' performances vis-à-vis other organisations in the same area. In this light, having access to indicators and standards of performance might provide substantial support for those institutions and policy actors that wish to take seriously the challenge of public engagement and societal dialogue. Public communication of science should now be mature enough to pass from a 'heroic phase', in which 'everything goes' for the sake of communicating science, to a phase in which quality is the central concern for all parties involved.

The 'quality challenge' becomes particularly relevant in relation to processes that could be summarised as 'the crisis of mediators'. This crisis is not specific to science communication, but is particularly relevant to this field. Owing to several factors, which include the increasingly central role of digital media and the ever stronger public relations push by research institutions, traditional mediators of science communication such as newspapers, magazines, television/radio shows and science museums and centres are undermined in their traditional centrality as filters and guarantors of the quality of information (see e.g. Goepfert, 2007; Brumfield, 2009).

To draw an analogy with what has become a commonplace definition of the evolution of the Internet, one can refer to this contemporary configuration as 'Science Communication 2.0', and thereby to the previous configuration of science communication as 'Science Communication 1.0' (Table 1). In Science Communication 1.0, the problem of quality was solved by the public by substantially resorting to information 'brands' and to the channel's reputation. By and large, readers, viewers and visitors could confidently assume that content printed in the science sections of the *New York Times* or *Il Corriere della Sera*, or broadcast by the BBC or displayed in a major science exhibition would be a high-quality extract of findings and ideas filtering from the scientific community. In Science Communication 2.0, end-users have access to an unprecedented amount and variety of materials, including 'direct to consumer' materials provided by research institutions – e.g. videos, interviews with scientists, selected news. But above all, it is the traditional sequence of the communicative process (specialist discussion/didactic exposition/public communication or

Table 1. Main analytical differences between Science Communication 1.0 and Science Communication 2.0.

	Science Communication 1.0	**Science Communication 2.0**
Dominant communication model	Mediated, filtered	Direct to consumer
Key actors	Mediators, sometimes scientists (journalists, professional communicators, popularisation channels, science museums)	Research institutions, scientists, digital media corporations
Relation between specialist and public communication levels	Vertical, sequential	Horizontal, simultaneous, overlapping
Quality assurance devices	Editorial brand, channel reputation	?

The two labels (Science Communication 1.0 and 2.0) should be clearly intended as ideal types for analytical purposes. In practice, one should obviously account for several nuances, exceptions and communicative situations that combine features of both types. See also note 4.

'popularisation') that has been disrupted.[4] The didactic and public exposition of science is no longer, as in Kuhn's theory, a mere static and petrified page, written by the winners in the struggle to establish a new scientific paradigm. Even science museums, the places *par excellence* of 'fossilised' science, increasingly hold exhibitions on current and controversial science issues.[5] More importantly, users increasingly have access to science in its making and to highly controversial debates among specialists. Some of the implications of this new scenario have been spectacularly highlighted by recent cases like Climategate in 2009, when email exchanges among climate change researchers became available on the web, exposing in public internal communication dynamics that traditionally were confined to the 'backstage' of knowledge production processes;[6] or in the discussion of the discovery of the so-called 'fast neutrinos' in 2012 – a controversy among specialists unfolding in real time before the eyes of the public.

2. What does quality mean in contemporary science communication?

If the factors outlined above help clarify the relevance of the quality challenge, it is much more complex to establish what quality means in science communication; or more pragmatically, how we tell the difference between good, bad and average science communication.

The field – and the topic of science communication in general – has long been dominated by a normative impulse. Guidelines and training courses have been made available in many countries to instruct science journalists (and later, scientists) on the 'dos and don'ts' of communicating science. These provide suggestions and sometimes even recipes either for better serving the aims of the research community or for exploiting media operational rules and routines. During the 1970s, Kantrowitz's suggestion of an institution of scientific judgment – a science court designed to filter and certify the quality of scientific expertise for the benefit of policy makers – received presidential support in the US as well as severe criticism from scholars and commentators (Kantrowitz, 1967; Jurs, 2010). Various other attempts and calls to regulate science communication have failed for several reasons, including democratic concerns.

Scholars studying the contemporary, broader dynamics of science in society are familiar with the two key – and often overlapping – arrangements that societies have used historically to deal with the results and products of science and technology and their implications.

The first is the regulatory framework; i.e. state legislation and authorities' defining 'what should be done and what should not be done'. The second is the moral dimension, sometimes (too) simplistically identified with the ethics of specific professions – the idea being that control of what should and should not be done is dictated by the conscience of scientists and journalists. Both arrangements face significant limits and difficulties in our era and in the context of Science Communication 2.0.

The regulatory arrangement is challenged by science and technology innovations that have been defined – particularly with regard to the life sciences – as 'mobile and private' (e.g. genetic tests), making the usual nation-based regulatory tools and controls increasingly permeable. Likewise, the achievement of a moral consensus also appears less and less viable in the context of increasingly pluralistic and fragmented societies (see e.g. Nowotny and Testa, 2011).

Moreover, one of the distinctive features of contemporary communication technologies and environments is to substantially displace traditional concepts of legal and moral responsibility. Who is responsible for the contents, collective discussion and shared material on the web? The authors, those who upload it, viewers and readers, or those who provide links to it?[7]

There is, however, at least one other dimension through which we can potentially solve, in some circumstances, the issue of what should be done and should not be done, namely the aesthetic dimension. To use a trivial example, in Italy there is no law, nor any other compelling moral arrangement forbidding cappuccino after lunch, but every Italian knows this should not be done. This relates, in a more general and conceptual sense, to *style*, that is the ability to perform this function of selection – thereby defining quality – in ways other than through policy obligation or moral duties.

3. Style and taste: The ethics and aesthetics of science communication

Nowadays, *style* is pre-eminently regarded as something that has to do with artistic expression, fashion, and personal taste. However, *style* has also been extensively studied in relation to the history and sociology of the sciences. The classic work of Alistair Crombie (1994) identified six dominant styles of scientific inquiry and demonstration throughout the history of science, seeing them in distinctive connection with the broader cultural context; different "national scientific styles" have also been identified by scholars studying the historical development of science policy and research organisation in different countries and cultures (Jamison, 1987; Pyenson, 2003).

In his seminal analysis of the historical and social transformations of science theories and their public communication which was a source of inspiration for Thomas Kuhn's concept of paradigm, Ludwik Fleck emphasised the central role of styles of thought (*Denkstil*) as a socially reinforced and compelling "mood", constraining perception and orienting action, through which a community ("thought collective", *Denkkollektiv* according to Fleck's terminology) identifies problems of interest and appropriate research methods, together with "a technical and literary style characteristic of the given system of knowledge" (Fleck, [1935] 1979: 99). Communication between different levels – specialist and popular – of the same thought collectives[8] leads to corroboration and enhancement of "thought currency". Since an individual quite often belongs to multiple thought collectives at the same time, this results in inter-collective communication across different domains and contributes to the shaping of scientific visions. The biography of Galileo offers beautiful examples in this respect, when he applied his competence in drawing and *chiaroscuro* to interpret his observations of the Moon's surface, or when he apparently solved the problem of dividing time into equal units for his experiments on the acceleration of falling bodies by resorting, as the son of a renowned musician, to musical rhythm (Bredekamp, 2007; Drake, 1975). For similar reasons,

Galileo was inclined to describe orbits in circular form, elliptical orbits being in profound contrast with his humanistic training and aesthetic taste (Panofsky, 1956).

In the field of art, studies have shown the normative and perceptually binding force of decorative styles and patterns characterising different historical and cultural contexts (Gombrich, 1979). During the Italian Renaissance, the term *virtuoso* (from the Latin *virtus*, meaning power or capability) identified the moral spur of both "rational artists" and early natural philosophers as "a program for relating man to the world as perceiver and knower and agent in the context of his integral moral, social, and cosmological existence […] a common style in the mastery of self, or nature, and of mankind alike by the rational anticipation of effects" (Crombie, [1986] 1996: 90). This style was perfectly embodied by Galileo and other key figures of the scientific revolution.

By focusing on the concept of style and its importance for science communication – and more generally, for the history of science and its interactions with social domains – I wish to suggest that we should look at the theme of quality not only as a technical problem (i.e. finding appropriate indicators of performance and impact). Rather, I suggest the need for a broader vision of science communication that reflects a vision of science as an integral part of contemporary culture. From this point of view, science communication is not meant to be just a 'technical fix' to impose social consensus, based on a narrow interpretation – albeit currently dominant in several policy contexts, including the EU's – of science as a mere driving force of technological innovation and economic development.[9]

One perhaps simplistic way to describe my proposal is as an invitation to integrate common discussions of the 'ethics of science communication' with no less crucial discussion of the 'aesthetics of science communication'. Another, perhaps more comprehensive way of presenting my argument would be as a call for a more *humanistic* – and indeed more *humane* – vision of science communication that moves away from the limits of its technocratic, functional definitions.[10] In his "Discours sur le style" read when he became a member of the Académie Française in 1753 – a lecture that became standard reading for French pupils for almost a century – the naturalist George-Louis Leclerc, Comte de Buffon argued that only style made scientific knowledge distinctively human and durable despite the quick obsolescence of its content. "Les choses [les connaissances, les faits et les découvertes] sont hors de l'homme, le style est l'homme même" (Buffon, [1753] 2007: 427). In Bruno Latour's terms, style could thus be described as bridging human and non-human actors in the weaving of knowledge production and communication (see e.g. Latour, 1987).

These perspectives suggest it is valuable to explore sources of analogy in other cultural domains and to reflect on the topic of style in science communication. One is the literary domain, to which Buffon also referred in his speech. The last, incomplete, writing by Italian writer and critic Italo Calvino is his series of Norton lectures that he was supposed to read at the University of Harvard. They deal with (again!) six different qualities of writing – it should be noted that Calvino also refers to them as values, capturing both their aesthetic and ethical role – and thus with style. The six qualities/values are: *lightness, quickness, exactitude, visibility, multiplicity, consistency*.[11] Although I clearly do not have the space here to analyse all of them in detail, such qualities appear, in principle at least, suitable for application to contemporary science communication scenarios. Calvino himself explicitly made the connection between some of the qualities/values and the role of science in contemporary society and culture.

> I look to science to nourish my visions in which all heaviness disappears. Today every branch of science seems intent on demonstrating that the world is supported by the most minute entities, such as the messages of DNA, the impulses of neurons, and quarks, and neutrinos wandering through space since the beginning of time … (Calvino, 1988: 8)

The then still emerging world of digital communication appears to Calvino the domain of light and dematerialised communication, of "weightless bits and electronic impulses" replacing "rolling mills and molten steels". Then he proceeds to draw examples of lightness from a classical masterpiece, an intersection of science and literature, Lucretius' *De Rerum Natura*, "the poem of physical matter", "the first great work of poetry in which knowledge of the world tends to dissolve the solidity of the world, leading to a perception of all that is matter is made up of invisible particles" (Calvino, 1988: 8).[12]

When dealing with the quality of quickness, Calvino cites Galileo in praise of the immediacy and power of communication enabled by the "stupendous invention" of alphabetical writing.

> But above all stupendous inventions, what eminence of mind was his who dreamed of finding means to communicate his deepest thoughts to any other person, no matter how far distant in place and time? Of speaking with those who are in India, of speaking with those who are not yet born and will not be born for a thousand or ten thousand years? And with what facility? All by the various arrangements of twenty little characters on a page! (Galileo, *Dialogo dei massimi sistemi*, cited in Calvino, 1988: 44)

This quality emphasises the relevance of communication as one of the revolutionary key values on which modern science was founded. By recognising knowledge as valuable only insofar as it was communicated, in sharp contrast with previous traditions cherishing knowledge as exoteric, science enabled and fostered communication across different nations and cultures at a time of great divisions and contrasts (Rossi, 1997; Bucchi, 2004b). This quality also highlights the importance and value of communicating knowledge across different levels and diverse forums, this process having been described by several studies as potentially significantly interacting – especially in certain circumstances – with core knowledge production processes themselves (Fleck, 1979; Bucchi, 1998, 2004a, 2008):

> the value I want to recommend is precisely this: in an age when other fantastically speedy, widespread media are triumphing, and running the risk of flattening all communication onto a single, homogeneous surface, the function of literature is communication between things that are different simply because they are different, not blunting but even sharpening the differences between them, following the true bent of written language. (Calvino, 1988: 45)

This recognition of communication as an interactive transformative process rather than as a pure transportation of content across communicative contexts invites us to explore the correspondent of style, i.e. *taste*. Taste has to do with the recognition and appreciation of style, the ability and competence to discern among different styles and in general to appreciate and recognise quality.

Particularly since the XVIIth and XVIIIth centuries, another Italian term, *buongusto* ('good taste') became a powerful guidance for European elites in gastronomy as well as in culture at large, incorporating and summarising new scientific knowledge, moral expectations and taste. In the entry "Goût" of the *Encyclopédie*, Voltaire makes an explicit parallel between gastronomic taste and aesthetic judgement, between *gourmet/homme du goût* and *connoisseur* (*Encyclopédie*, 1751–1765: 761).[13]

One of the founders of modern biology, Francesco Redi, after describing an experiment on fallow deer brain in his laboratory notebooks, decided to challenge the widespread conviction in the Medici court that:

> fallow-deer brain was a terrible meat, almost hard to eat, as well as noxious to the health of mankind; so that there was not a single gentleman in the court that, whether for civilisation or fear, dared bring a deer's brain on his table […] but they seeming to me beautiful and well made brains, and of good substance, I took the risk, despite my servant being ashamed of taking this Lutheran villainy in the kitchen […] to have a solemn pan of it cooked in virgin fat, that came to my table piping hot and well roasted and I frankly enjoyed it, and found, with reiterated, true and certain experience, that deer brain is a noble thing, very savoury and healthy and much better than the pig or veal brain, not to mention the dolphin brain, which to me is the finest of all brains, considering that one can eat them during Lent and other compulsory fasts. (Redi, [1689] 1809–1811: 194)

Taste for science and taste for food are here remarkably conjoined on both cognitive and aesthetic grounds. The deer brain appears to Redi beautiful, well made and of good substance; so it cannot be but good to eat, palatable and nourishing. Taste becomes an ethical and aesthetic guidance, a behavioural guide as well as a reasonable application of the new scientific knowledge. Reason and taste, experiment and 'essay' are intertwined here; the deer brain, object of scientific enquiry and gluttony, slides from the experimental table to the pan. Palate and taste become knowledge instruments no less sensitive and reliable than the experimental apparatus through which nature is usually interrogated.

4. "Good, clean and fair"

Nowadays, relevant analogies with the food domain can be inspired by another globally influential – although more recent – cultural movement, Slow Food, which heralded a new attitude to food, advocating eating "good, clean and fair" (Petrini, 2007).[14] Although this is of course not yet true in many parts of the world, one could argue that a reflection on the quality of science communication is just as mature as the reflection on food in a society which has increasingly satisfied its hunger for science communication and now has the possibility to focus on the quality and meaning of that food.

Thus, XXIst century public communication of science should – or at least could – be *good*, meaning having a special attention and care for quality. It should not praise and approve any science communication effort just for the sake of its aims or goodwill, but apply scrupulous scrutiny just as to any other performance and domain. It should reward best practice and openly and frankly criticise poor practice.

Public communication of science should be *fair.* 'Fairness' also has a strong historical and linguistic connection with quality, its root in many Northern European languages recalling aesthetic harmony as well as equity, beauty and capability to please, moral purity and lack of bias. Related verbs in Dutch and German (*vegen, fegen*) refer to adorning, decorating and cleaning (Scarry, 1999). Science communication should be fair not only to institutions and actors promoting communication efforts, but to all parties involved, particularly in an era in which the distinctions between users, suppliers, mediators and even producers of information are increasingly blurred. One lesson from the crisis of the deficit model and traditional approaches is that fairness in the process is no less important a criterion than content accuracy when discussing and evaluating the 'success' and implications of science communication. Finally, fairness may be interpreted as the openness to criticism and reflexivity. If science aims to become an integral part of contemporary culture, for example like art or sport, then it should eventually be amenable to criticism, selective incorporation and even misinterpretation just as those other areas are.

Public communication of science should be *clean* (again, as we have seen, cleanliness is etymologically connected with fairness), not necessarily meaning devoid of bias and subjective interests. New communicative scenarios have multiplied the number and variety of providers of science communication, who inevitably bring in their own aims and strategies. Yet, transparency and willingness to problematise one's own definition of science communication – as well as the rationale underlying it – are among the keys to avoiding increased generalised public distrust and sense of confusion in a time of proliferating, polyphonic and often controversial communication. Science Communication 2.0 requires, most of all, a more active and competent user, capable of discerning quality, although in her/his own terms.[15] This probably calls, even more so than in the past, on public institutions to provide stronger educational infrastructures rather than to invest in short-term, short-sighted communication efforts.

5. Concluding remarks and future research agenda

To summarise, I have argued that quality is a key issue and challenge for contemporary science communication; that style is relevant to addressing that challenge, also insofar as it relates to discussions about strengthening the quality of science communication, suggesting a different perspective other than the traditional normative or prescriptive framework. The notion of style also fruitfully connects the debate on science communication with a rich tradition of studies in the history and sociology of science.

Several questions remain, of course, open for further reflection, research and discussion, for example the question of diversity of styles. This theme can be analysed both in a diachronic perspective (how do science communication styles change across time? How do such changes interact with broader research, policy, cultural and social contexts?) as well as in a synchronic, intercultural perspective (do diverse styles or sub-styles of science communication respond to diverse tastes, in terms of local contexts or global 'taste subcultures'?) Also, how can differences in style respond to different communicative occasions and situations, particularly in the increasingly fragmented landscape of Science Communication 2.0?

Within this landscape, probably one of the most substantial challenges remains that of identifying *quality* in science communication in new ways. If traditional, Science Communication 1.0 patterns delegating quality recognition to trustworthy communicative brands appear insufficient, when not plainly displaced by new communicative contexts, it is nevertheless difficult to see how horizontal, user-based quality endorsements that have become commonplace in several digital contexts (e.g. travel or commerce) could be straightforwardly applied to the complex, multilayered dynamics of contemporary science communication.

It would probably be misleading to expect a single, straightforward response to that challenge. Regulatory and 'quality ensuring' arrangements traditionally invoked in the past for science communication largely sought uniformity and standardisation of practices, mostly by anchoring and flattening quality to a single or chief requisite or criterion, such as accuracy in 'transporting the message', adherence to scientific sources, independence of mediators. One of the advantages of the perspective explored here is precisely that the notion of style allows us to deal with the issue of quality in science communication without necessarily imposing uniformity. This resonates significantly with recent discussions challenging the expectation of eventually finding the 'best' and most appropriate, 'one size fits all' model of science/public interaction. Such discussions suggest we should resist the temptation to see different analytical models of interactions among experts and the public as a chronological sequence of stages in which the emerging forms obscure the previous ones (Bucchi, 2008; Irwin, 2008). Focusing on style(s)

helps us to account for the continuing coexistence of different patterns of science communication that may coalesce depending on specific conditions and on the issues at stake. This should lead us to reappraise, for example, national differences in terms other than being more or less distant from an abstractly defined golden standard.[16]

In this light, the perspective outlined here is also more sensitive to the interaction between communicative styles and their contexts and more broadly to a notion of science communication as an integral part of culture rather than just functionally serving economic or policy targets (such as innovation or development). In other words, style(s) may work, in science communication, as shared quality binding device(s) – with variable degrees of contingency and stability – while at the same time accounting for rich diversity in communication practices and formats.

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Notes

1. "These works were wrought so perfectly by Andrea that nothing more could be desired, since they were so well executed and finished, and with such purity, beauty, and grace, that they reveal the true consideration and proportion of art". Giorgio Vasari ([1568] 1912–1915), "Andrea Sansovino", in *Lives of the Most Eminent Painters, Sculptors & Architects*, translated by Gaston du C. de Vere, London: Macmillan and The Medici Society.
2. See for instance Miller et al. (2002) and the European Charter for Researchers (2005).
3. For some reflections on the state of the field, see Miller (2001), Bauer and Howard (2012) and the chapters in Bucchi and Trench (2008).
4. For an extended theoretical and empirical discussion of science communication processes, see Bucchi (1998, 2008) and Shinn and Whitley (1985). Fleck's (1979) classic work on communicative trajectories of scientific knowledge is also relevant here. Obviously, there were particular situations in the past in terms of specialist debate reaching out to the public – for example in the cases of particularly acute controversies or issues that involved crossing or questioning disciplinary boundaries – for examples see Clemens (1994) and Bucchi (1998).
5. An early reflection on controversial exhibitions involving science issues is in Gieryn (1998).
6. The concept of *backstage* was introduced by Goffman (1959); for an application with regard to science communication contexts, see Bucchi (1998) and Trench (2012). For a recent overview and analysis of the Climategate case, see Grundmann (2013).
7. For a general reflection in the context of digital science communication, see Trench (2008).
8. Fleck defines "thought collectives" (*Denkkollektiv*) as "the communal carrier of the thought style", describing the concept as "functional, rather than substantial, and may be compared to the concept of field of force in physics". Thought collectives can be "transient and accidental" or more stable, forming around particularly organised social groups; this latter being the case of contemporary science communities according to Fleck (1979: 102–103). For a philosophical analysis of "styles of scientific reasoning" see also Hacking (1992).
9. See for example the documents regarding the European Commission strategy "Horizon 2020", or those outlining the role of science communication in that context (European Commission, 2012).

10. Bruno Latour (2010) has introduced the concept of "scientific humanities" (*humanités scientifiques*) as an opportunity to consider "the whole performance, and not just one of its acts" (p. 24) – namely, to represent the multidimensional nature and heterogeneous networks characterising science and technology in contemporary societies.
11. Calvino only completed the first five lectures; of the sixth one, we know only the topic.
12. On Lucretius' influence on modern science, see for example Beretta and Citti (2008).
13. On 'buongusto' see for example Montanari (2009), Camporesi (1990), Sermain (1999) and Mangione (2003). For an extensive study of interactions and metaphorical exchanges between science and cooking, see Bucchi (2013).
14. Founded in 1986 in Italy, the Slow Food movement has become an international network with branches in several countries and an estimated 100,000 associate members.
15. It would be interesting to explore potential analogies between this triplet of science communication qualities ('good, fair, and clean') and the three key means of persuasions or proofs that classical rhetoric identifies within the faculty of invention, i.e. 'logos, ethos and pathos', with *logos* referring to arguments, *ethos* to qualities of the communicator (credibility, trustworthiness), *pathos* to emotions and expectations in the audience that can be mobilised. See Bauer and Glaveanu (2011), Barthes (1970). That relatively few systematic studies of rhetoric are available in the context of public communication of science is probably a further indication of how the field emphasised a focus on objectives and audiences, largely taking for granted the question of the most appropriate communicative means and strategies to reach such objectives and audiences; and thereby limitedly addressing the issue of the quality of such strategies. Relevant exceptions include Gross (1994), and Leach (2008). For a critique of the very concept of communication with regard to science see Bucchi (2004a).
16. It would be also worth further exploring science communication styles in the context of broader styles for handling science in society issues, e.g. "civic epistemologies" (Jasanoff, 2005).

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