Lingue e Linguaggi
Lingue Linguaggi 40 (2020), 23-43
ISSN 2239-0367, e-ISSN 2239-0359
DOI 10.1285/i22390359v40p23
http://siba-ese.unisalento.it, © 2020 Università del Salento

"TINY NEW INGREDIENTS ARE A BIG CONCERN" The popularization of nanotechonologies in environmental organizations' and institutions' publications

FRANCA POPPI, ANNALISA SEZZI
UNIVERSITÀ DI MODENA E REGGIO EMILIA

Abstract – The chapter sets out to explore how nanotechnology is popularised in online reports and brochures in English issued by European and American institutions[1] and environmental organizations. Nanotechnologies, by manipulating matter at a nanoscale, have a great impact on several disciplines and find applications in sectors such as medicine, engineering, electronics, food, and renewable resources. Given the repercussions on humans' daily life, many information campaigns have been launched in order to disseminate nanotechnological knowledge to lay people. Different forms and media have been exploited as in other knowledge dissemination processes, with the new media and Web 2.0 playing an important role (Garzone 2007). If knowledge dissemination has been often seen in terms of a "recontextualization" (Calsamiglia, Van Dijk 2004) and a "translation" (Gotti 2013) of specialized information from experts to non-experts as opposed to specialized discourse (Ciapuscio 2003; Calsamiglia, van Dijk 2004; Minelli de Oliveira, Pagano 2006; Kermas, Christiansen 2013; Bongo, Caliendo 2014; Garzone 2014; Gotti 2014; Bathia *et al*. 2015; Salvi, Bowker 2015), it is nonetheless true that this transfer of information often goes beyond the aim of making exclusive knowledge more comprehensible to the generic public. As a matter of fact, popularized discourse frequently aims "to inform, raise awareness and cause the reader to take action" (Gotti 2014, p. 29). A striking example is for instance health discourse (Cummings 2004, 2005, 2009; Hall 2006). Therefore, this chapter intends to analyse how specialized concepts pertaining to the domain of nanotechnology are popularized in online institutions' and environmental organizations' reports and brochures in English and in Italian. With the former emphasizing the advantages and the latter the risks of nanoscience, a common point they share is, however, their concern with the diffusion of nano knowledge and its related vocabulary. More specifically, the analysis, based on Calsamiglia and van Dijk's classification of five "types of explanation" (2004, p. 372), will identify the discursive strategies adopted.

Keywords: nanotechnologies; popularisation; discourse analysis.

[1] The term here refers to formal and official institutions.

1. Communicating Nanotechnologies

The website of the National Nanotechnology Initiative (NNI 2020) defines nanotechnologies as

> the understanding and control of matter at dimensions between approximately 1 and 100 nanometers, where unique phenomena enable novel applications. Encompassing nanoscale science, engineering, and technology, nanotechnology involves imaging, measuring, modelling, and manipulating matter at this length scale.

Then, nanotechnologies, by manipulating matter at a nanoscale, exert great influence on several disciplines and have applications in varied sectors such as medicine, engineering, electronics, food, cosmetics, and renewable resources, ranging from computer microchips to sunscreens. They have thereby strong repercussions on humans' daily life.

This impact on society and the rapid developments of nanoscience have ignited the need for an international public involvement "in discussion, decisions and policy associated with nano" (Schönborn *et al*. 2015, p. 346) since its very inception, in order not to repeat the same mistakes made with biotechnology. The antecedent errors linked to GMOs and cloning have arisen from an "incapacity in adequately controlling the media exposure of scientists and experts, and, above all, in a limited consideration by members of the scientific community and policy makers of public perception mechanisms and social impacts of research" (Lorenzet 2012, p. 2). The consequence was a wide-reaching backlash against genetically modified food.

The call for tackling ethical and social issues interrelated with nanotechnologies and their applications is associated with their societal effects, the most impelling one being nanotoxicity, and the consequent necessity to ward off the threat of a "grey goo" scenario around the communication of nanotechnology (Lorenzet 2012). Indeed, the first utopian visions, according to which nanoscience is able to solve significant global problems such as world hunger (see Gordijin 2006; Lorenzet 2012; Fries 2018), have now their counterpart in a more dystopian and catastrophic view, based on Drexler's *Engines of Creation* (1986). Herein, the author, by foreseeing self-replicating nanomachines (nanobots) devouring the biosphere, evokes the so-called "grey goo" apocalyptic scenario (Drexler 1986). Drexler intends it as a demand for assessing both the advantages and the risks of molecular assembly, offering also action plans for a responsible development.

Within this context, professionals, scholars, and policy makers underline the necessity of promoting people's "nano-literacy" so that they can "navigate some of the important science-based issues related to their everyday lives and society" (Laherto 2010, p. 161). However, as Boholm and Larsson (2019)

explain, many studies emphasize how the general public has a very scarce knowledge of nanotechnology (among others, Castellini *et al.* 2007; Vandermoere *et al.* 2010; Delgado *et al.* 2011; Lin, *et al.* 2013). Independently from geographical provenance (yet, a survey comparing European and American public perceptions shows that people in the US are more optimistic due to pro-technology cultural values – Gaskell *et al.* 2005), this unfamiliarity makes people oscillate from enthusiasm, indifference, and general unstable and heterogeneous positive or negative attitudes (for example, Kim *et al.* 2014), based on personal values, approaches, and perspectives (Duncan 2011; Cormick, Hunter 2014). Obviously, a key role is played by the ways in which nanotechnology, its benefits and risks, are framed by the media (Satterfield *et al.* 2009; Satterfield *et al.* 2012). As a whole, "[d]uring the period of 2000 to 2010, surveys conducted on nanotechnology actually showed that the public, both in Europe and the United States, has not been very aware of nanotechnology, that for the majority of the public, the benefits outweigh the risks and that nanotechnologies are generally considered useful, good, and positive" (Lorenzet 2012, p. 3; see also Fisk *et al.* 2014). Similarly, nine years later, Boholm and Larsson (2019) specify that "[n]anotechnology is generally not an issue that spurs public engagement. Only a minority of citizens takes an active interest in nanotechnology and how it should be governed in society" (2019, p. 4).

This minority is primarily worried about environmental issues. Hazards and possibilities of nanotechnologies are assessed in a different way according to their area of application (Boholm, Larsson 2019, p. 5). For example, a study carried out in the US highlights that when nanotechnologies are employed for "important" applications such as improving water quality, for medicine, or for "alleviating distress in developing countries" (Macoubrie 2006, p. 236), people are usually supportive. At the same time, when they are employed for "trivial" applications (Macoubrie 2006, p. 236) such as cosmetics or in the food sector (see, for example, Siegrist *et al.* 2007), people tend not to justify or approve of their use. Especially, non-experts are concentrated on a transparent labeling of nanoproducts (Siegrist 2010). Brown and Kuzma's research (2013) shows how the consumers believe they have the right to be informed of possible risks, so as to choose the food accordingly: "A label is viewed as effective when the information on the label is understandable and leads to abilities for consumers to make an informed decision concerning consumption or purchasing" (Brown, Kuzma 2013, p. 534).

By reviewing the literature on the dissemination of knowledge about nanotechnologies in the fields of science communication, risk communication, and in the studies on societal responses, Boholm and Larsson (2019) identify three main problems to which scholars have sought to find solutions.

The first one is the public: as laypeople lack knowledge and are limitedly engaged in the public discussion and policy process, the solutions suggested are

education and a multiparty dialogue between all the stakeholders involved in order to favour participation. Moreover, different ethnicities, races, languages, religions, and also cognitive styles characterize the public, thus communication should be tailored to various audiences. It should also become more transparent in order to develop people's trust.

The second problem concerns societal organizations. The great influence of mass media on the public, the fragmentation and ambiguity of the representations they provide, as well as of the policy and regulations on nanotechnologies, can be faced with an appropriate media management, with a strengthening action of guidelines and regulations, and with more clarity and consistency in the communication, even in terminological terms. In general, "there is a striking disagreement on how messages should be formulated and what should be emphasized" (Boholm, Larsson 2019, p. 12).

The third problem is nanotechnology itself. Because of its intrinsic characteristics, nanotechnologies are not seen as entailing dreadful risks, differently from nuclear power. Thus, they do not attract public attention. By the same token, nanomaterials are invisible to the human eye, and nanoscience is consequently perceived as an obscure and distant issue. Furthermore, the applications of nanotechnologies are so varied that attitudes change depending on the application at stake. Not to mention the epistemic uncertainty surrounding nanotechnology, regarding, for example, the definition and size of nanomaterial itself. The solution put forward is to improve knowledge of nanotechnology, and especially risk assessment and life cycle analysis.

As it can be drawn from this brief introduction, popularisation of nanotechnology is the heart of the matter. Many information campaigns have been launched with the purpose of disseminating nanotechnological knowledge to lay people. Different forms and media have been used as in other knowledge dissemination processes, with the new media and Web 2.0 playing a key role (Garzone 2007). However, if there is a substantial body of research into communication of nanotechnology in different fields, there are few studies on their popularisation among non-experts from the point of view of discourse analysis, particularly from the perspective of the disseminating strategies adopted (see Lazzeretti, Poppi 2020).

Knowledge dissemination is frequently referred to as a "recontextualization" (Calsamiglia, Van Dijk 2004) or a "translation" (Gotti 2013) of scientific information from experts to non-experts. Thus, it is important to look at the way nanotechnological knowledge is recontextualized or translated for laypeople. It is nonetheless true that this transfer of information often goes beyond the purpose of making specialist knowledge more understandable to the general public. As a matter of fact, some popularising texts aim "to inform, raise awareness and cause the reader to take action" (Gotti 2014, p. 29), like, for example, some of the materials published on nanotechnologies.

Against this background, the present paper has the objective of investigating the discursive practices aimed at disseminating nanotechnological knowledge to the public in a selection of online materials published by the EU and other British and American institutions and NGOs. Specifically, the investigation is focussed on the introductory sections of their brochures and reports seen as a sort of springboard for supporting the institutions and NGOs' different views on the risks and benefits of nanotechnologies. The next sections describe the corpus and the methodology used. Then, the results of the analysis are presented, followed by some concluding remarks.

2. The NanoCorp

The corpus (*NanoCorp*) consists of online European and American brochures and reports published between 2004 and 2017, thus also covering the period from 2006 to 2008 when the debate was "on the request of more research on potential risks related to the development of nanotechnology and on regulation of nanotechnology products" (Lorenzet 2012, p. 4).

As it can be seen from Table 1, the first sub-corpus consists of four brochures and a report issued by three different institutions - the *European Commission*, the *American Chamber of Commerce to the European Union*, and the *UK Royal Academy of Science and Royal Academy of Engineering*. While the Report of the *UK Royal Academy and Royal Academy of Engineering* makes recommendations about regulations to minimise possible risks, the brochures by the *European Commission* and by the *American Chamber of Commerce to the European Union* aim at illustrating what nanotechnology is and what it can offer to European citizens.

The second sub-corpus includes four reports of NGOs: *The Friends of the Earth*, an international organization that "strives for a more healthy and just world, pushing for "the reforms that are needed, not merely the ones that are politically easy" (https://foe.org/about-us/), and *ETC* - an Action Group on Erosion, Technology and Concentration, addressing "the socioeconomic and ecological issues surrounding new technologies that could have an impact on the world's poorest and most vulnerable people" (https://www.etcgroup.org/content/mission-etc-group).

Both NGOs want to make the general public aware of the fact that governments, especially the US, have to develop clear mandatory regulations and safety assessments for nanomaterials used in some of their applications, such as food or other consumer products. Despite their different goals and positions, all these publications contribute to the diffusion of nanotechnological knowledge. The present analysis centres on their introductory sections, which are normally the most informative parts of the texts, preluding to the different positions –

beneficial, moderated or unfavourable – which will be more explicitly supported in the other sections. Captions accompanying pictures have been excluded, as the multimodal analysis of image-text relations and their contribution to popularisation of nanotechnologies in the genres under scrutiny is beyond the scope of this paper.

1. INSTITUTIONS SUBCORPUS				2. NGOs SUBCORPUS		
	Date of publication	No. of tokens			Date of publication	No. of tokens
"NanotechnologyInnovation for tomorrow's world" *European Commission*	2004	2,473		"A Tiny Primer on Nar scale Technologies ...a The Little Bang Theory" *ETC Group Erosion, Technology and Concentration*	2005	666
"Nanoscience and nanotechnologies: opportunities and uncertainties" *UK Royal Academy of Science and Royal Academy of Engineering*	2004	1,289		"Out of the laboratory and onto our plates: Nanotechnology in food & agriculture" *Friends of the Earth*	2008	2,371
"Nanotechnologies: Principles, Applications, Implications and Hands-on Activities" *European Commission*	2013	1,504		"Tiny Ingredients, Big Risks" *Friends of the Earth*	2014	2,344
"Tiny particles with big benefits" *Am Cham EU*	2017	1,181		"Nanoparticles in baby formula: Tiny new ingredients are a big concern" *Friends of the Earth*	2016	910
	TOT.	6,447			TOT.	6,291

Table 1.
Composition of *NanoCorp*.

The corpus is quite small (12,738 tokens), literally a nano-corpus. Given its specialized nature, its size does not pose any particular problem (see, for example, Flowerdew 2002). Then, within each subcorpus, the number of tokens of each text varies, as can be seen from Table 1. This imbalance will be considered when analysing the distribution of the popularising strategies.

3. Popularising Strategies

The *NanoCorp* was annotated for the discourse features of popularisation described hereinafter. As science communication is a complex phenomenon, different approaches have been combined (see Sezzi, Bondi 2019). Calsamiglia and van Dijk's classification of six "types of explanation" (2004, p. 372) is the starting point:

1. *Denomination* or *Designation* is the strategy thanks to which new terms or objects are introduced indicating their specialized denominations (Calsamiglia, van Dijk 2004, p. 381); as Garzone (2006, pp. 91-92) details, "[T]his strategy is often integrated into a sentence dealing with something else, often making recourse to expressions like "called", "known as", "meaning…", etc. or also "so called", "technically called", "in other words" etc.";
2. *Definition* cannot be separated from denomination. It implies the explanation of unknown words through the description of the characteristics or components of the object referred to (Calsamiglia, van Dijk 2004, p. 375); Garzone (2006, p. 92) adds that it is the "conceptual delimitation of a term by a brief description of some general and specific properties of the thing the term is referring to";
3. *Reformulation* or *paraphrase* is often introduced by appositions, parentheses, dashes, quotes and metalinguistic expressions. Garzone (2006, p. 94) describes it as "a discourse fragment that is easier to understand than the original discourse fragment, and that has more or less the same meaning";
4. *Exemplification* relates to specific examples used to explain general phenomena, "such as mentioning Alzheimer's as one of the diseases that might be better understood now that the human genome has been sequenced" (Calsamiglia, van Dijk 2004, p. 383);
5. G*eneralization* is the opposite process of exemplification, that is, general conclusions are drawn from specific examples (Calsamiglia, van Dijk 2004, p. 383). It is a "proposition that extends the validity of a proposition to all or most members of a set" (Garzone 2006, pp. 96-97);
6. *Analogy* or *association* (Calsamiglia, van Dijk 2004, p. 376) deals with a comparison with objects cognitively familiar to or easier to understand for non-specialists, by means of similes or metaphors.

Other strategies of popularisation are questions (Hyland 2002, 2004, p. 21; 2005). Through questions, relevant information is presented in the form of their respective answers (Gotti 2014, p. 29). Not only do these engagement markers position the readers as learners of a unilateral transmission of knowledge (Hyland 2002, p. 535) but they also anticipate possible questions and objections in order to forestall readers' criticism while leading them through an argument (Hyland

2004, p. 17). Consequently, the analysis takes *wh*-questions and *yes/no* questions into consideration too.

Lastly, citations, and generally reported discourse, are here considered as popularising strategies. They are used to guide the audience into their understanding process, underlining the credibility and the authoritativeness of the information delivered (Gotti 2014). In particular, the present study adopts the classification of citation styles by Calsamiglia and Ferrero (2003, p. 155):

1. Direct citation: where the words of writer 2 (D2) are separated from the discourse of writer 1 (D1).[2] There are two different enunciations with two deictic centers, "connected through juxtaposition and they are signalled by graphic markers such as (:)". This fracture between D1 and D2 influences tense, space, time adverbs, and person reference words;
2. Indirect citation: there is only the main discourse of W1, D1. As a consequence, there is only one deictic centre, which consists of "a subordinate clause introduced by a conjunction, and the correspondent agreement of tenses";
3. Integrated citation: "it has the form of indirect citation but with segments – of greater or lesser extension – signalled as being cited directly/literally with clear graphic or typographic marking, mainly with quotation marks and marked fonts (boldface or italics)";
4. Inserted citation: D2 is inserted in the main discourse (D1) through markers such as "according to X". In particular, they "have the function of assigning explicit words to a particular agent (literal or non-literal, depending on the use of graphic signs of quotation) without any communicative verb".

These categories are extended with Semino and Short's notion of Narrator's Representation of Speech Act –NRSA(p) (Semino, Short 2004, p. 52), which designates the summary or report of the speech act without a separate reported clause (either when the topic is not indicated or when it is presented– as the letter p in brackets signals).

[2] "D1 refers to main discourse by writer 1 (W1); D2, to quoted discourse by writer 2 (W2)" (Calsamiglia, Ferrero 2003, p. 171).

4. Methodology

The annotation of *NanoCorp* was carried out with the UAM corpus tool (O'Donnell 2008a, 2008b). It is a free software for manual and semi-automatic annotation of corpora that allows two types of annotation: users can assign features to entire texts and they can assign features to segments within every single text, referring to their own coding scheme. Then, the annotators set up their annotation "project" (as can be seen in Figure 1).

The first step in the definition of our *NanoCorp* was the uploading of the text files. Afterwards, the corpus was annotated at a document-level by dividing the individual texts according to the categories of "Institutions" and "NGOs".

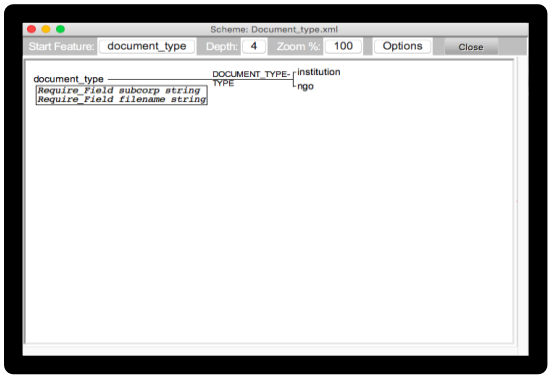

Figure 1
Document-level annotation scheme.

The second step consisted in the creation of a segment-level annotation scheme with all of Calsamiglia and van Dijk's popularising strategies, Hyland's types of questions, and different forms of speech and thought representation, so as to compare their use and frequency (Fig. 2), and identify the preferred strategies in each subcorpus.

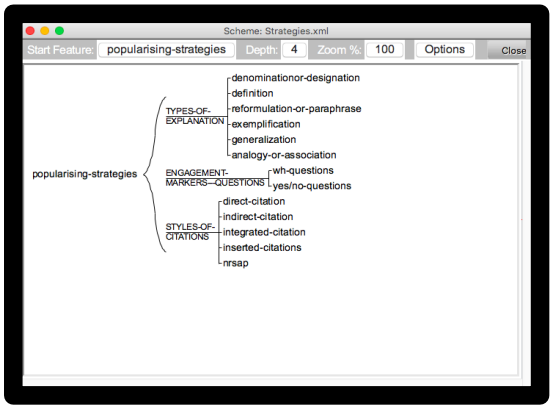

Figure 2.
Segment-level annotation scheme.

Finally, the texts of the *NanoCorp* were manually annotated thanks to a project window that enables users to underline the text segments and to assign them tags. Users can assign multiple tags to each segment.

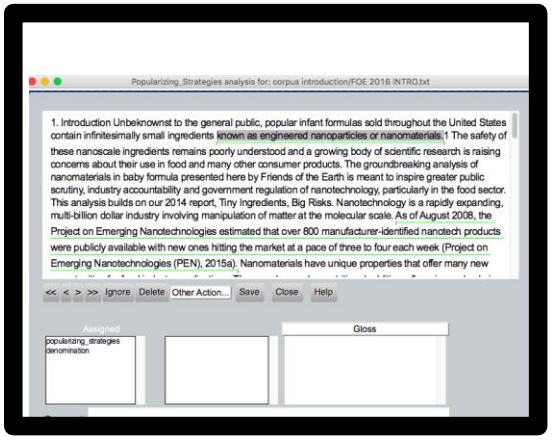

Figure 3
Tags assignment.

The corpus tool automatically performs a chi-square test. Thus, it highlights the statistical significance of the popularising strategies when comparing the two subcorpora. The strategies that are statistically noteworthy are marked with one or multiple "+" plus signs: only one plus sign ("+") indicates a weak significance, two plus signs ("++") indicate medium significance, and three plus signs ("+++") signal a high significance.

5. Results

As far as results are concerned, the system shows a description for each file of the popularising strategies adopted with their frequency (Table 2 and Table 3).

As can be seen from Table 2, about half of the total number of strategies are accounted for by the *Friends of the Earth*'s 2008 report,[3] whose introduction is the most verbose of the entire corpus. This long introductory part, characterized by an abundant use of definitions, might be explained by the fact that in 2008 the debate on nanotechnologies was particularly focused on the necessity to take the risks into consideration and to outline clear regulations (Lorenzet 2012), which had to be grounded on agreed and shared definitions. Moreover, in that period "[a]mong other initiatives, a call from the U.S. Food and Drug Administration for more regulation and safety in the nanotech production sectors followed the

[3] This variation in the composition of the NGOs subcorpus- with the *Friends of the Earth*'s 2008 report playing a major role – will be considered in the analysis.

involvement of think tanks and NGOs such as the Canadian ETC group, that called for a moratorium on nanotech products" (Lorenzet 2012, p. 5). Indeed, as clarified by Gotti, since "scientific or technological innovations also have political implications, their presentation in popular forms may pose a challenge to traditional views and established behavior. Rather than 'explaining' science, this new type of popularisation sets out to explain the social meaning of such events […]" (Gotti 2014, p. 27), thus trying to raise laypeople's awareness.

Features Total Units	ETC Group 2005		FOE 2008		FOE 2014		FOE 2016		Total	
POPULARISING STRATEGIES	N=16		N=61		N=34		N=13		N=124	100%
denomination	2	12.50%	8	13.11%	4	11.76 %	2	15.38%	16	12.90 %
definition	3	18.75%	15	24.59%	14	41.18 %	0	0.00%	32	25.81 %
reformulation	4	25.00%	1	1.64%	0	0.00%	0	0.00%	5	4.03%
analogy	0	0.00%	0	0.00%	0	0.00%	1	7.69%	1	0.81%
generalization	0	0.00%	0	0.00%	0	0.00%	0	0.00%	0	0.00%
exemplification	4	25.00%	7	11.48%	7	20.59 %	1	7.69%	19	15.32 %
wh/how questions	1	6.25%	1	1.64%	2	5.88%	0	0.00%	4	3.23%
yes/no questions	0	0.00%	0	0.00%	0	0.00%	0	0.00%	0	0.00%
direct citation	1	6.25%	1	1.64%	1	2.94	0	0.00%	3	2.42%
indirect citation	1	6.25%	8	13.11%	5	14.71 %	5	38.46%	19	15.32 %
integrated citation	0	0.00%	0	0.00%	0	0.00%	0	0.00%	0	0.00%
NRSA(p)	0	0.00%	20	32.79%	0	0.00%	3	23.08%	23	18.55
inserted citation	0	0.00%	0	0.00%	1	2.94%	1	7.69%	2	1.61%

Table 2.
Distribution of the popularising strategies in the NGO subcorpus

However, these requests were not considered extremely urgent by the public opinion. Indeed, a progressive decrease in the public interest from 2004 to 2012 is registered as people's attention was mainly catalyzed by climate change. For example, "while the media tried to push the interest in nanotechnology, especially during the years between 2006 and 2008, both at a global level and in Italy, the public demonstrated being progressively detached from preoccupations regarding potential risks related to nanotechnology development" (Lorenzet 2012, p. 5).

The texts issued by the institutions are more levelled, as can be seen in Table 3.

Features Total Units	Royal Academy 2004		EC 2004		EC 2013		AmCham 2017		Total	
Popularising strategies	N=22		N=27		N=31		N=19		N=99	99.99 %
denomination	5	22.73 %	9	33.33%	2	6.45%	3	15.79 %	19	19.19 %
definition	6	27.27 %	2	7.41%	8	25.81 %	5	26.32 %	21	21.21 %
reformulation	2	9.09%	1	3.70%	1	3.23%	0	0.00%	4	4.04%
analogy	0	0.00%	4	14.81%	0	0.00%	1	5.26%	5	5.05%
generalization	0	0.00%	0	0.00%	0	0.00%	0	0.00%	0	0.00%
exemplification	4	18.18 %	4	14.81%	13	41.94 %	5	26.32 %	26	26.26 %
wh/how questions	1	4.55%	2	7.41%	4	12.90 %	2	10.53 %	9	9.09%
yes/no questions	0	0.00%	2	7.41%	1	3.23%	0	0.00%	3	3.03%
direct citation	0	0.00%	1	3.70%	2	6.45%	0	0.00%	3	3.03%
indirect citation	1	4.55%	2	7.41%	0	0.00%	3	15.79 %	6	6.06%
integrated citation	0	0.00%	0	0.00%	0	0.00%	0	0.00%	0	0.00%
NRSA(p)	3	13.64 %	0	0.00%	0	0.00%	0	0.00%	3	3.03%
inserted citation	0	0.00%	0	0.00%	0	0.00%	0	0.00%	0	0.00%

Table 3
Distribution of the popularising strategies in the ONG sub-corpus.

As summarised in Table 4, the types of popularising strategies used in each text range from 6 to 9. In the texts by *Friends of the Earth* (2016) and by the *American Chamber of Commerce to the European Union* (2017), six typologies of strategies are used. These texts are the more recent ones. Probably some of the concepts and notions are taken for granted so that there is no need to exploit the potential of all the strategies. On the other hand, the texts by the *European Commission* issued in 2004 and the one by *Friends of the Earth* issued in 2008 show the use of many strategies, respectively 9 and 8 out of 13. These two reports date back to the period indicated by Lorenzet (2012) as the one in which non-experts, and people in general, lacked interest in the issue.

More specifically, the EC brochure emphasizes the potentialities of nanotechnology. It states in the foreword that its aim "is to illustrate what nanotechnology is and what it can offer to the European citizens." Conversely, the report by FOE stresses the importance of laws for regulating nanotechnologies especially in food, as previously indicated·

	Den.	Def.	Ref.	Anla.	Gen.	Exem.	Wh	Yes / no	Dir. cit	Ind. cit	Int.cit	NRSA (p)	Ins. Cit.	TOT. Out of 13
AmCham 2017	X	X	0	X	0	X	X	0	0	X	0	0	0	6/13
FOE 2016	X	0	0	X	0	X	0	0	0	X	0	X	X	6/13
Royal Academy 2004	X	X	X	0	0	X	X	0	0	X	0	X	0	7/13
EC 2013	X	X	X	0	0	X	X	X	X	0	0	0	0	7/13
FOE 2014	X	X	0	0	0	X	X	0	X	X	0	0	X	7/13
ETC 2005	X	X	X	0	0	X	X	0	X	X	0	0	0	7/13
FOE 2008	X	X	X	0	0	X	X	0	X	X	0	X	0	8/13
EC 2004	X	X	X	X	0	X	X	X	X	X	0	0	0	9/13

Table 4
Types of strategies used in each text.

However, the most interesting data emerge from the comparison of the two sub-corpora, whose statistical significance is emphasized by the output provided by the software (Table 5).

	Institutions subcorpus		NGOs subcorpus			
Feature Total Unit	N	%	N	Percentage	ChiSquare value	Significance
	99		124			
POPULARISING STRATEGIES	N=99		N=124			
- denomination	19	19.19	16	12.90%	1.645	
- definition	21	21.21	32	25.81%	0.641	
- reformulation	4	4.04	5	4.03%	0.000	
- analogy	5	5.05	1	0.81%	3.787	+
- generalization	0	0.00	0	0.00%	0.000	
-exemplification	26	26.26%	19	15.32%	4.090	++
-wh/how questions	9	9.09%	4	3.23%	3.449	+
-yes/no questions	3	3.03%	0	0.00%	3.809	+
-direct citation	3	3.03%	3	2.42%	0.078	
-indirect citation	6	6.06%	19	15.32%	4.744	++
-integrated citation	0	0.00%	0	0.00%	0.000	
-NRSA(p)	3	3.03%	23	18.55%	12.871	+++
- inserted citation	0	0.00%	2	1.61	1.611	
Total	99	99.99	124	100%		

Table 5
Distribution of the popularising strategies in the two subcorpora.

As Table 5 shows, both institutions and NGOs make extensive use of *denominations* and *definitions*. As a matter of fact, the concepts and processes related to nanotechnologies are introduced in both subcorpora with their respective specific terminology, like in example (1) in which nanotechnology is

defined, or in example (2) in which the technical name of the phenomena connected to nanomaterial is given. Example (3) is even more detailed when dealing with scientific terminology, specifying also the acronym that identifies the nano-compounds. Example (4) and (5) demonstrate the close interrelation between the strategies of *denomination* and *definition*. In the two cases the explanation of the term "nano" is offered, immediately followed by its definition.

(1) Nano-scale technology is a suite of techniques used to manipulate matter at the scale of atoms and molecules. (*ECT* 2005)

(2) Nanoscience is not just the science of the small, but the science in which materials with small dimension show new physical phenomena, collectively called quantum effects, which are size-dependent and dramatically different from the properties of macroscale materials. (*EC* 2013)

(3) In other monitoring applications, nano-structured compounds known as metal-organic frameworks (MOFs) not only enable advanced chemical detection, but can also purify the air of harmful organic compounds that may contribute to the so-called "Sick Building Syndrome" found in poorly ventilated buildings. (*AmCham* 2007)

(4) "Nano" is derived from the Greek word for dwarf. One nanometre is one billionth of a metre. (*AmCham* 2007)

(5) The prefix "nano" is derived from the Greek word for dwarf. One nanometre (nm) is equal to one-billionth of a metre, 10–9 m. (*Royal Academy* 2004)

If the concern for precision and technicality can be observed in all the documents of the corpus, slight differences emerge in the use of *analogy*, highlighted with one plus sign as one of the statistically significant strategies. Five instances are in fact found in the subcorpus of the institutions, while only one in the NGOs' subcorpus. This is particularly true for the brochure entitled "Nanotechnology Innovation for tomorrow's world" published by the European Commission in 2004, where the potentiality of these new technologies is accentuated. Examples (6), (7), and (8) establish similes between the structure of different organisms or materials and the organization of objects or situations that non-experts know very well, like, for example, chairs (see example (6)). Through these comparisons, the infinitesimal small and unintelligible world of nanotechnologies becomes more familiar and closer to a layman's everyday life.

(6) The sponge owes its name to the structure of the inner skeleton of its mantle. This consists of a tissue of fine silica needles, perforated like the wickerwork of a wooden chair. (*EC* 2004)

(7) [..] the crystal had to consist of a t o m s, arranged in an ordered structure, like the yarn in umbrella material, or a pile of oranges in a market. (*EC* 2004)

(8) It gathers the xray radiation from distant objects with 58 wastepaper basket-sized reflectors nestling inside each other like the layers of an onion and coated with gold vapour. (*EC* 2004)

Another popularising strategy characterizing institutions is the use of questions, both wh/how questions and yes/no questions, as shown in Table 4. However, their frequency is comparable to the one of the NGO's subcorpus.

(9) 'Nano' means small, very small; But why is this special? (*EC* 2013)
(10) So what are nanotechnology, nanomaterials and the nanoscale? (*AmCham* 2007)
(11) How do these sometimes very visually-attractive diatoms come into existence? (*EC* 2004)

Questions are normally the preambles for definitions and explanations and characterize "public-good popularising texts" and "well-written" documents (Gotti 2014, p. 29), They engage and position the readers as learners by anticipating their possible questions in a sort of fictional classroom dialogue while also hampering criticism or objections.

The texts issued by institutions also diverge slightly from those of NGOs because they rely more on *exemplification*. Particularly, as demonstrated by examples (12), (13), and (14), this strategy is mainly used when it comes to the applications of nanotechnology (from cosmetics to ceramics) with the double aim of rendering certain notions more comprehensible and simultaneously emphasizing their usefulness in people's ordinary life.

(12) Some applications are well known, such as sunscreen, but nano is so much more than that. (*AmCham* 2007)
(13) The use of these tools is not restricted to engineering, but has been adopted across a range of disciplines. AFM, for example, is routinely used to study biological molecules such as proteins.
(14) Nanotechnology is based upon pure nature: yet the capabilities of living nature are restricted, it cannot work at either high temperatures, such as those needed for ceramics, or with metallic conductors.

However, the most important dissimilarity between the two sub-corpora is the use of *citations* referring to the scientific literature on nanotechnologies in the texts published by NGOs. Thus, popularisation is herein supported by the "authoritativeness and seriousness" (Gotti 2014, p. 29) of the studies cited and by the research of other NGOs. The difference mainly concerns indirect citations and NRSA(p), as table 5 shows, which are marked with two and three plus signs. Yet, all the citation formulae are adopted, except for integrated citations:

(15) In 2004, the ETC Group reported that researchers at Chiang Mai University in Thailand had been able to alter rice colour from purple to green. They reported that ultimately the Thai researchers hoped to use their technique to develop Jasmine rice varieties that can be grown all year long, with shorter stems and improved grain colour (ETC Group 2004). (*FOE* 2008)

(16) […] In vitro studies show a significant percentage of the nanosilicon remains undissolved and that "the presence of undissolved nanosilicon particles in the gut in vivo is considered likely" (Dekker *et al*., 2013; SRU, 2011). (*FOE* 2016)
(17) Nanoparticles have a very large surface area which typically results in greater chemical reactivity, biological activity and catalytic behaviour compared to larger particles of the same chemical composition (Garnett, Kallinteri 2006; Limbach *et al.* 2007; Nel *et al.* 2006). (*FOE* 2016)
(18) In the words of the forum delegates, "food sovereignty puts those who produce, distribute and need wholesome, local food at the heart of food, agricultural, livestock and fisheries systems and policies, rather than the demands of markets and corporations..." (Nyéléni 2007 – Forum for Food Sovereignty 2007). (*FOE* 2014)
(19) "Our thirty-year goal is to have such exquisite control over the genetics of living systems that instead of growing a tree, cutting it down, and building a table out of it, we will ultimately be able to grow the table." – Rodney Brooks, director of Artificial Intelligence Laboratory, MIT (*ETC* 2005)

This interrelation of voices subsumed by these citations is "symphonic" (Bondi, Yu 2018) rather than "polyphonic" (see, for example, Dahl, Fløttum 2014 on climate change) as they are aligned, embracing the same stance and reinforcing the NGOs' opinions.

With regard to the NRSA(p) found in example 17, it is typical of the FOE's 2008 report: 20 out of the 23 instances are to be found in this text. As a matter of fact, the introduction of this text is built on the succession of explanations based on the scientific literature that support the opinion of nanotechnologies as extremely risky, like in the example (20):

(20) To put it simply: small particle size equates to new particle properties, which can also introduce new risks. Nanoparticles have a very large surface area which typically results in greater chemical reactivity, biological activity and catalytic behaviour compared to larger particles of the same chemical composition (Garnett and Kallinteri 2006; Limbach et al. 2007; Nel et al. 2006). Nanomaterials also have far greater access to our body (known as bioavailability) than larger particles, resulting in greater uptake into individual cells, tissues and organs. Materials which measure less than 300nm can be taken up by individual cells (Garnett and Kallinteri 2006). (*FOE* 2008)

6. Concluding Remarks

Most laypeople have a limited knowledge on nanotechnologies, as the literature in the fields of science communication, risk communication, and societal responses highlights. Institutions and NGOs have tried to partly fill this gap through the publication of online reports and brochures, made available to the general public at large. While disseminating nanoknowledge, they are also bringing the applications or the risks of nanotechnologies to the fore, supporting their own points of view on these problematic issues. However, despite the crucial role of popularisation in this process of knowledge dissemination, there are few

studies on the popularising strategies adopted. The present paper analysed the strategies of popularisation in eight brochures and reports published by European and American institutions and NGOs during a decade, focusing in particular on the introductory sections.

The preliminary results confirm the research conducted by Lazzeretti and Poppi (2020) who observe that these types of texts are very precise with regard to the terminology used. As a matter of fact, our study shows how *definitions* and *denominations* prevail in both the subcorpora of institutions and NGOs. Lazzeretti and Poppi (2020) also underline how the EU documents use a more plain and informal language. This is corroborated by our results. The recourse to *exemplifications*, *analogies*, but also *questions* does not only attempt to overcome the complexity of the topic by making it look more familiar, but also to directly engage and position the readers as learners in a more educational perspective.

On the other hand, the introductory sections of the documents by NGOs heavily rely on citations for disseminating nanoknowledge. Similarly to what occurs in journal articles on climate change, they are instances of "argumentation par autorité ('argumentation by authority'), i.e. quotes by authoritative sources used to support one's own argument" (Dahl, Fløttum 2014, p. 415). They pervade also the more informative parts of the texts, all built upon a symphony of scientific voices. One limit of the study is the length of one specific text, the FOE's 2008 report, with respect to all the other texts of the NGOs' subcorpus. Nonetheless, the analysis tries to see it in the context of the particular period in which it was published and in relation to the other texts.

In conclusion, it can be affirmed that, despite the different goals, knowledge dissemination appears to be the main objective of the publications by institutions and NGOs. Many popularising strategies are employed in order to both increase people's knowledge and raise their consciousness, which turn the documents into multifaceted texts.

Bionotes: Franca Poppi is Full Professor of English Linguistics and Translation at the University of Modena and Reggio Emilia and director of the University Language Centre. She has published on various aspects of teacher-learner interaction, learner autonomy and advising in self-instruction. Her research has focused on the interactional features of discourse, with particular reference to English for Specific Purposes. Her current research interests are focused on English as an international lingua franca, as it is used in intercultural business communication, written corporate communication and corporate web-site communication. She is on the Advisory Board for the *Profile Journal, Issues in Teachers' Professional Development*. She is also a member of the review team for the *Asian ESP Journal*, *the Bulletin of the South Ural State University. Series: Linguistics*, the *Journal of Linguistics and Literature Studies and Folia Linguistica*..

Annalisa Sezzi graduated *cum laude* from the Catholic University of Milan (Italy), where she also earned a Master's Degree in Literary Translation (EN>IT). She completed her PhD in

Comparative Language and Cultural Studies at the University of Modena and Reggio Emilia (Italy). She teaches English mediation and translation at the same department and English language and didactics (University of Modena and Reggio Emilia). Her research interests include translation, translation of children's literature, and knowledge dissemination in different genres.

Author's address: franca.poppi@unimore.it; annalisa.sezzi@unimore.it

Acknowledgements: This study is part of a broader interdisciplinary project developed by the Department of Science and Method of Engineering and the Department of Studies on Language and Culture of the University of Modena and Reggio Emilia (Italy). The project, financed by the Italian Ministry of Education, is focussed on the communication and transmission of nanoknowledge (FAR 2017 "Nanostrutture di silicio e germanio per il fotovoltaico di terza generazione. Come comunicare i risultati della ricerca scientifica avanzata ai vari portatori di interesse in un'ottica di inclusività e trasmissione delle informazioni a livello globale" - CUP: E81B17000570005) - FAR 2017 "Nanostructures of silicon and germanium for third generation photovoltaics. How to communicate the results of advanced scientific research to the various stakeholders in a perspective of inclusiveness and transmission of information at a global level".

References

Anthony L. 2009, *Issues in the design and development of software tools for corpus studies: The case for collaboration*, in Baker P. (ed.), *Contemporary Corpus Linguistics*, Continuum Press, London UK, pp. 87-104.

Bohom Å. and Larsson S. 2019, *What is the problem? A literature review on challenges facing the communication of nanotechnology to the public*, in "Journal of Nanoparticle Research" 21 [86], pp. 1-21.

Bondi M. and Yu D. 2018, *Textual Voices in Corporate Reporting: A Cross-Cultural Analysis of Chinese, Italian, and American CSR Reports*, in "International Journal of Business Communication" 56 [2], pp. 173-197.

Brown J. and Kuzma J. 2013, *Hungry for information: public attitudes toward food nanotechnology and labeling*, in "Review of Policy Research" 30 [5], pp. 512-548.

Calsamiglia H. and Ferrero C.L. 2003, *Role and position of scientific voices: Reported speech in the media*, in "Discourse Studies" 5 [2], pp. 147-173.

Calsamiglia H. and Van Dijk T.A. 2004, *Popularization discourse and knowledge about the genome*, in "Discourse Society" 15, pp. 369-389.

Castellini O. *et al*. 2007, *Nanotechnology and the public: effectively communicating nanoscale science and engineering concepts*, in "Journal of Nanoparticle Research" 9 [2], pp. 183-189.

Cormick C. and Hunter S. 2014, *Valuing values: better public engagement on nanotechnology demands a better understanding of the diversity of publics*, in "NanoEthics" 8 [1], pp. 57-71.

Dahl T. and Fløttum K. 2014, *A linguistic framework for studying voices and positions in the climate debate*, in "Text & Talk" 34 [4], pp. 401-420.

Delgado A., Lein-Kjølberg K. and Wickson F. 2011, *Public engagement coming of age: from theory to practice in STS encounters with nanotechnology*, in "Public Understanding of Science" 20 [6], pp. 826-845.

Duncan T.V. 2011, *The communication challenges presented by nanofoods*, in "Nature Nanotechnoly" 6 [11], pp. 683-688.

Drexler E. 1986, *Engines of Creation: The Coming Era of Nanotechnology*, Anchor Books, New York.

Fisk K., Fitzgerald R. and Cokley J. 2014, *Controversial New Sciences in the Media: Content Analysis of Global Reporting of Nanotechnology during the Last Decade*, in "Media International Australia" 150 [1], pp. 156-166.

Flowerdew L. 2002, *Corpus-based Analyses in EAP*, in Flowerdew J. (ed.), *Academic Discourse*, Pearson, London, pp. 95-114.

Fries M-H. 2018, *Nanotechnology and the Gray Goo Scenario: Narratives of Doom?*, in "ILCEA" 31, pp. 1-18. http://journals.openedition.org/ilcea/4687 (18.01.2019).

Garzone G. 2006, *Perspectives on ESP and popularization*, CUEM, Milano.

Garzone G. 2007, *Genres, Multimodality and the World Wide Web: Theoretical Issues*, in Garzone G., Catenaccio P. and Poncini G. (eds.), *Multimodality in Corporate Communication. Web Genres and Discursive Identity*, Franco Angeli, Milano, pp. 15-10.

Gaskell G., Eyck T., Jackson T. and Veltri G. 2005, *Imagining nanotechnology: cultural support for technological innovation in Europe and the United States*, in "Public Understanding of Science" 14, pp. 81-90.

Gordjin B. 2005, *Nanoethics: From Utopian Dreams and Apocalyptic Nightmares towards a more Balanced View*, in "Science and Engineering Ethics" 11, pp. 521-533.

Gotti M. 2013, *The Analysis of Popularization Discourse: Conceptual Changes and Methodological Evolutions*, in Kermas S. and Christiansen T. (Eds.), *The Popularization of Specialized Discourse and Knowledge across Communities and Cultures*, Edipuglia, Bari, pp. 9-32.

Gotti M. 2014, *Reformulation and recontextualization in popularization discourse*, in "Ibérica*"* 27, pp. 15-34.

Jiyoun K. *et al*. 2014, *Disentangling the influence of value predispositions and risk/benefit perceptions on support for nanotechnology among the American public*, in "Risk Analysis*"* 34 [5], pp. 965-980.

Hyland K. 2002, *What do they Mean? Questions in Academic Writing*, in "Text & Talk" 22 [4], pp. 529-557.

Hyland K. 2004, *Engagement and Disciplinarity: The Other Side of Evaluation*, in Del Lungo G. and Tognini Bonelli E. (Eds.), *Academic Discourse: Linguistic Insights into Evaluation*, Peter Lang, Bern, pp. 13-30.

Hyland K. 2005, *Metadiscourse. Exploring Interaction in Writing*, Continuum, London.

Laherto A. 2010, *An analysis of the educational significance of nanoscience and nanotechnology in scientific and technological literacy*, in "Science Education International*"* 21 [3], pp. 160-175.

Lazzeretti C. and Poppi F. 2020, *Nanotechnologies. Where should they take us?*, in "Lingue e Linguaggi" 34, pp. 31-49.

Shu-Fen L., Huan S. and Wu Y. 2013, *Validation and exploration of instruments for assessing public knowledge of and attitudes toward nanotechnology*, in "Journal of Science Education and Technology" 22 [4], pp. 548-559.

Lorenzet A. 2012, *Fear of being irrelevant? Science communication and nanotechnology as an 'internal'controversy*, in "Journal of Communication" 11 [4], pp. 1-7.

Macoubrie J. 2006, *Nanotechnology: public concerns, reasoning and trust in government*, in "Public Understanding of Science" 15 [2], pp. 221-241.

NNI 2010, *Nanotechnology 101. What It Is and How It Works*, Nano.gov, online. https://www.nano.gov/nanotech-101/what (18.01.2019).

O'Donnell M. 2008a, *The UAM CorpusTool: Software for corpus annotation and exploration*, in *Proceedings of the XXVI Congreso de AESLA, Almeria*, Spain. 3-5 April 2008. http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.159.7393&rep=rep1&type=pdf (18.01.2019).

O'Donnell M. 2008b, *Demonstration of the UAM CorpusTool for text and image annotation*, in *Proceedings of the 46th Annual Meeting of the Association for Computational Linguistics on Human Language Technologies: Demo Session*, pp. 13-16. https://dl.acm.org/citation.cfm?doid=1564144.1564148 (18.01.2019).

Satterfield T *et al*. 2009, *Anticipating the perceived risk of nanotechnologies*, in "Nature Nanotechnoly" 4 [11], pp. 752-759.

Satterfield T. *et al*. 2012, *Understanding shifting perceptions of nanotechnologies and their implications for policy dialogues about emerging technologies*, in "Science and Public Policy" 40 [2], pp. 247-260.

Schönborn K., Höst G. and Lundin Palmerius K.J. 2015, *Measuring understanding of nanoscience and nanotechnology: development and validation of the nano-knowledge instrument (NanoKI)*, in "Chemistry Education Research and Practice" 16, pp. 346-356.

Semino E. and Short M. 2004, *Corpus Stylistics. Speech, writing and thought presentation in a corpus of English writing*, Routledge, London.

Siegrist M., Cousin M. E., Kastenholz H. and Wiek A. 2007, *Public acceptance of nanotechnology foods and food packaging: the influence of affect and trust*, in "Appetite" 49 [2], pp. 459-466.

Siegrist M. 2010, *Predicting the future: review of public perception studies of nanotechnology*, in "Human and Ecological Risk Assessment" 16 [4], pp. 837-846.

Vandermoere F. *et al*. 2010, *The morality of attitudes toward nanotechnology: about God, techno-scientific progress, and interfering with nature*, in "Journal of Nanoparticle Research" 12 [2], pp. 373-381.

Sezzi A. and Bondi M. 2019, *"I am going on a ketogenic diet". Communicating dietary requirements for pediatric patients,* in "Token: A Journal of English Linguistics" 9, pp. 59-85.