Science and scientists in stories narrated by children: an experiment of illustrated and narrative focus groups*

Bárbara Magalhães de Aguiar Oliveira
Universidade Federal de Minas Gerais
moca.barbara@gmail.com

Yurij Castelfranchi
Universidade Federal de Minas Gerais
ycastelfranchi@gmail.com

Thereza Nardelli e Silva
Universidade Federal de Minas Gerais
therezanardelli@gmail.com

* We would like to thank the students Vanessa Sander, Meghie Rodrigues, and Sofia Rodrigues for their precious help in some of the narrative groups and with part of the transcriptions.

Abstract

Utilizing a new method of illustrated and narrative focus groups (Castelfranchi, 2013), associated with techniques from semiotic analysis and storytelling, the researchers interviewed and documented speeches and collective drawings made by groups of 6-10 children, aged around 7-12 yo, in 5 city schools of Diamantina, Vespasiano and Belo Horizonte (Minas Gerais, Brazil). In the context of collective invention of illustrated stories, the children talked about science, the scientists and their practices.

Relevant results were found: 1. Our subjects are equipped, in general, with less

instruments than their Italian peers to represent or describe the figure, activity and practices of science and scientists, and need to resort almost exclusively on the stereotyped images provided by media on the subject; 2. A marked difference between children from affluent social classes, enrolled in private schools, and children from schools in the state, or groups belonging to lower classes, concerning the access to scientific and technological information and its appropriation and elaboration; 3. In both cases, however, the picture narrated by children about science and scientists' activity is seen as predominantly positive (mostly, the scientists doing "good" and "useful" things, instead of being "mad" or "bad", for instance) - the positive view about science being prior, and partly decoupled, from access to information and knowledge.

Introduction

Studies on public perception and attitudes about science and technology are growing in the world such as in Latin America, both in the area of Social Studies of Science and Technology and educational and communicational fields (Polino and Castelfranchi, 2011 and 2012). However, there are relatively few studies that seek to understand the infant and juvenile imagery, attitudes and representations of science and scientists. As we see it, the choice in doing this research considering such generational crop is quite relevant because, firstly, several studies (Mead and Metraux 1957; Jarvis, 1996) demonstrated that the representations of science, scientist and the technology are formed already in childhood, generating a marked influence over the motivations, enthusiasm and distrust that children may have about the scientific disciplines, as well as on their future choices on studies and careers. Secondly, the study on perceptions about science in children and adolescents is important to improve policies and educational campaigns, as it is fundamental to form tools for public communication of science that might be able to engage concretely, emotionally, cognitively and politically such public.

In our research, we present a new technique which we call "narrative and illustrated focus groups", that has already been empirically tested in Italy (Castelfranchi et al, 2006, 2008) and in Brazil. These special kinds of focus groups allow a dynamically mapping of the perceptions of children from collecting data from stories invented with and by them and the drawings they create to illustrate these stories.

Most of the research conducted with children and adolescents approaches the perception and knowledge about science and technology in subtractive terms, in a "deficit" model (what does the children do not know, do not understand or realize in an "inappropriate" way) less than in positive terms (such as: how do children construct their representations, what they know about science and scientists). The classical technique called "Draw A Scientist Test" (Chambers, 1983) is an example: it helps to identify stereotypes in the scientific imagery of children at an early age. In this methodology, children are encouraged to draw a scientist or his lab. Then a checklist is used to identify which stereotypes are more frequent in the drawings which, in turn, are interpreted and associated with some classical *leit-motifs* such as: the “crazy scientist”, the “evil scientist", the “inattentive scientist”, the "lamp" symbolizing a genius idea, the "eureka", etc.

Although DAST results are important, it has, in our opinion, serious limitations. Firstly, it assumes a deficit perspective (Hilgartner, 1990; Castelfranchi, 2008): trying to identify faults or alleged "distortions" in the imagination of children, it ultimately reinforces stereotypes, since they are precisely what are demanded from the beginning. Moreover, it provides only a static image of the scientist, leaving aside the understanding of science as processes, in its methods and social aspects. It also hampers the possibility of investigating the constitution of the representations and opinions, ie, connections and references and sources children use to form their ideas.

Considering these insufficiencies, we decided to perform a more depth semiotic analysis of children's drawings, and cross it with a discourse and content analysis of children’s own words during the activity. Furthermore, we chose to modify the contexts of the activity: instead of a fixed task (draw a scientist, only), we created a collective narrative game based on *Role Playing Games* techniques in which children themselves told us the development and outcome of a story previously contextualized for them.

Methodology: Narrative and illustrated focus groups with children

For our research, five focus groups[1] were conducted in the state of Minas Gerais (Brazil) lasting from 45 to 60 minutes, each with 6-8 children aged 7-12 years old, from the following socio-cultural contexts: a)1 focus group at an educational project in the city of Vespasiano, which attend children and adolescents at risk situation from outskirts; b)1 focus group in a private school in Belo Horizonte, mainly frequented by children from wealthy or middle classes; c)3 focus groups in Diamantina, with children coming from three public schools in the city and its countryside, mainly from lower classes. Each focus group had the presence a moderator and one or two observers. They were all recorded in audio and/or video, and the words of children were literally transcribed for textual and discursive analysis[2]. Children's drawings were collected, scanned and analyzed in their visual content and by semiotic analysis (Flick, 1998). The results were compared to earlier narrative focus groups made in Italy a few years ago.

What differ our methodological technique from the others is, firstly, the discussion guide. It is not based on thematic points, but in a narrative draft: a story, outlined at the beginning of the meeting by the moderator, whose main characters are scientists. From this point, children themselves imagine the characters (scientists, their friends, humans or non humans, animals or fantastic beings, etc.), draw them and develop the story in joint participation with the moderator, that comes up with a problem to be solved in the narrative scenario: a puzzle to be unraveled or an obstacle to be faced in teamwork (like to cure a disease, find a missing object, find a secret or passage, etc.). Children are free to comment and invent the unfolding of the narrative, and they illustrate it until its final outcome, discussing it among themselves and with the moderator. This technique allows to enable a ludic, playful dynamic, similar to those in a psychodrama or in a *Role Playing Game*, turning visible and awakening, in our opinion, the juvenile imagination in its many dimensions and complexity - minimizing the model "school task driven by an adult", typical of DAST, and tending to provide less stereotyped and more

[1] The *setting* and operational structure are similar to those of traditional focus groups (Kitzinger and Barbour, 1999;. Bloor et al, 2001), but adapted to the juvenile universe and a group discussion with 6-8 participants.

[2] The qualitative and quantitative textual analysis, as well as the drawings, was supported by QDA-Miner software. The semiotic analysis was based on the categories already described in Castelfranchi et al, 2006 and 2008).

complex responses.

The *narrative illustrated focus group* allows, in an attempt to be less caricatural, to show the complexity of children's imaginary, its nuances, and its dimensions of sociability, power, knowledge, practices - making visible complex and sophisticated knowledges of science, and identifying unspoken beliefs, metaphors and connotations. The immersion in a narrative game of collective improvisation allows children to imagine and externalize: What's in the pockets of his white coat? How do scientists solve problems, unravel puzzles, face challenges? What instruments do they use? Do they work alone or in teams? Are they lonely? Do they have family and friends?

Results

Socio-economic nuances

First, we should emphasize the differences we found in children's representations depending on the socio-cultural context in which they belong. Children from rural or urban periphery demonstrated, in general, not only difficulty in describing the figure of a scientist, but also to imagine his/her work routine, the equipment they use, and even small confusions regarding his/her role or mission in the world - in some cases, children even explicitly verbalized that they did not know what a scientist is[3]. Evidence of this lack of familiarity with science or unequal access to information were mixed with lack of information and unknowns of a more generic nature: for instance, unknowns about the human body itself [4].

Thus, it became clear in our results that low-income children, from rural or peri-urban areas, resort more often to the classic narrative elements and imagery when representing scientists (the white coat, the glasses, the "crazy hair", the bench lab full of tubes,"potions", microscopes…) so well detected by the DAST test.[5]. It is also clear to us

---

[3] Some examples of such difficulty: The moderator asks: "*Now let's draw a scientist*"/ Child: "*What is that?*". The moderator encourages the design details: "*... I see some objects... which objects does the scientist take there?*"/ Child: "*... I don't know...*".

[4] A 11 year old reported not knowing the pathways in the body for the air we breathe, and where it goes. He showed that air came only from his mouth. When asked about what happens if we close my mouth, if we could still breathe, he said "no." Similarly, some children believed that there was only one lung in the body, or did not know what was in the digestive system besides the stomach.

[5] In our experiments, for instance, many times when a child asked "Scientist? But how do I draw it? ", another child answered: "Easy, just put a lab coat on it, so everyone understands".

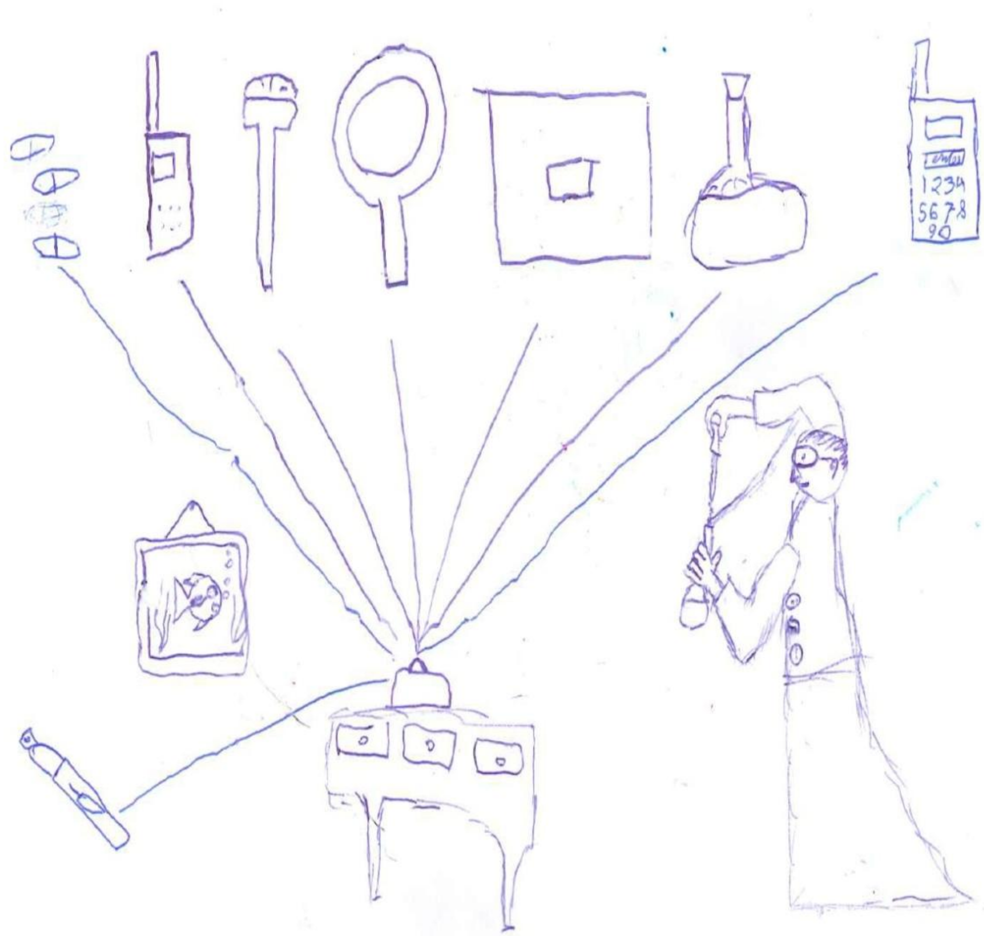
that children with such socioeconomic profile build their repertoires of speech and image primarily based on information from television[6], specifically from broadcast television: cartoons and soap operas. In turn, the children from upper classes have school and family as important instruction references, and when they mentioned television there also appeared paid channels such as NatGeo, Discovery Channel, Animal Planet.

In focus groups conducted in Italy, 8 years olds, from both public and private schools, both in urban centers and outskirts, could in many cases describe with complexity and sophistication the scientific activity, making use, even if with infant words and metaphors, of concepts such as "hypothesis," "experiment, "trial and error " and "analysis" (Castelfranchi et al. 2006). All groups in Brazil found it more difficult to imagine or describe a scientist's activities, showing greater difficulty of expression in relation to vocabularies.

Scientific method: practices and stereotypes

Concerning the scientists' practices, the main ideas mentioned by the children were generally linked to the idea of *search*, *investigation*, *observation* and *study*. Connotations for more specific concepts such as *hypothesis* or *deduction*, *measurement* or *calculation*, of *trial and error*, are absent. Thus, to make science means, primarily, to study, to collect information or, on the other hand, to invent machines. The idea of research is mostly located, for these children, typically in the semantic field of scholarly research: it is made "with notebook laboratory and books", "studying the issue", "building things" - in 33 % of the drawings, we have the figure of the scientist allied to suitcases or backpacks, often loaded with various tools such as books, magnifying glasses and syringes. The imagery of the scientists' workplace appears generically among them: a conventional desk appears in 38 % of the drawings, often with various instruments on top, similar to those found in the suitcases (Picture 1) .

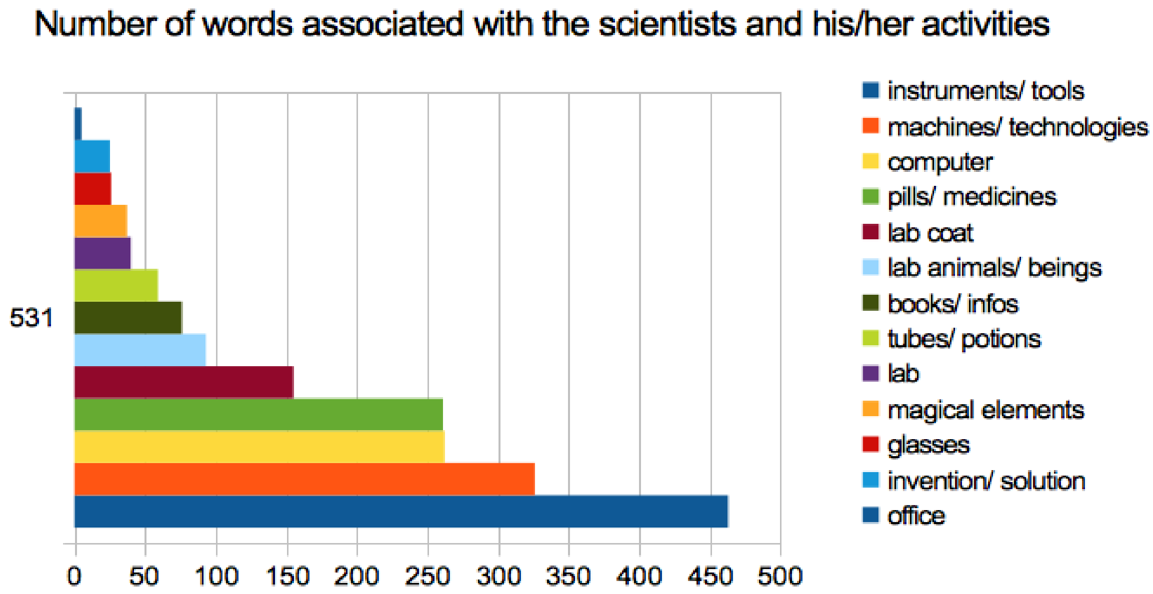
[6] Moderator: "Do you know what a scientist is?"/ Child: "I know they have glasses ... like in the soap opera on TV ...".



Picture 1

In relation to the characteristics of a scientist, terms like "smart", "study too much", "know a lot", and "research" are often triggered (see also table 1).

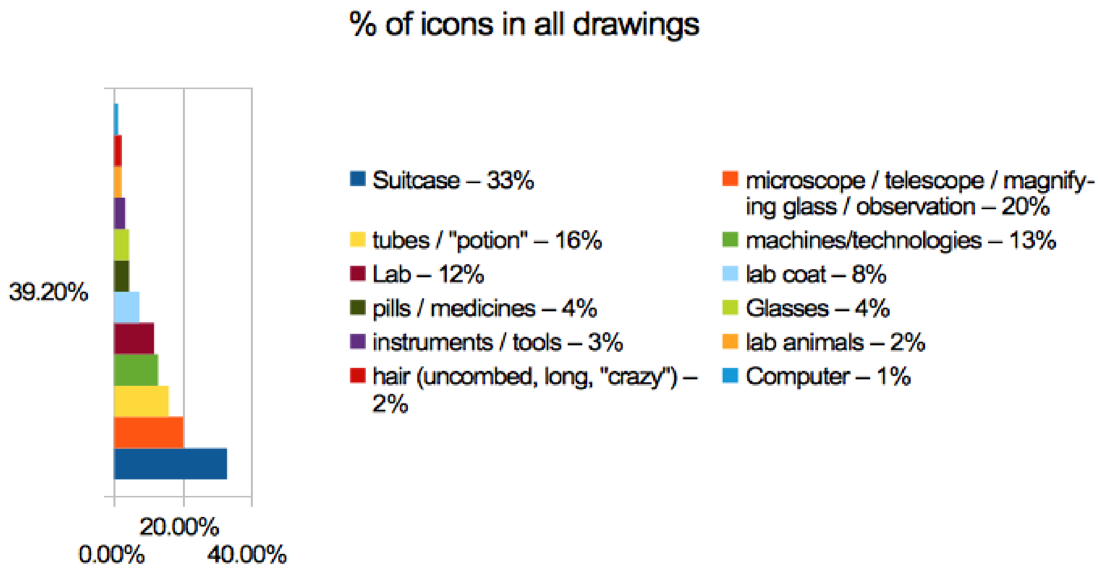
Table 1



The scientific activity is almost always associated, in the drawings and speech, to the use of tools and technologies[7] whose main functions, for children, is to leverage the observation, or store and provide information (as we can see by the most recurrent objects drawn: see table 2 - drawing).

Table 2

[7] In almost 13% of the drawings there are representations of technology or machinery.



Rarely, the scientist tools are used, for example, to measure or identify causality factors. Similarly, computers are more often viewed as analogous to books, or as a repository of information. It is also rare for children to express articulated notions about how the scientist does research, or "invent their machines". What the scientist can do is not clearly explained. It is described primarily in terms of technology, sometimes with magical connotations ("potions"). The power of the scientist would not be, mainly, to formulate problems, or solve them, but to produce or find objects that make things happen ("robots", "herbs that heal", etc.). Thus, the idea of hypothesis *stricto sensu* does not appear. However, other aspects of the research process arise, albeit in embryonic form: scientists know, thanks to their machines or books, discover the causes of certain phenomena[8].

Some children, either using or not the term "analysis”, conceptualized as an important part of the research process the idea of splitting into parts, to isolate fractions of a system to understand what is happening: a scientist, for example, when looking for a cure for a disease, observes "the plants with a magnifying glass to see what's in them". When studying the human body, she/he will "study each part of the system. You see an arm, another arm...Will you take off an arm... [laughs] No, don’t take an arm!... No, it's in

[8] As a child said, for example: the scientist "can take a stone that's being broken very easily, and that is not normally easily broken, and see because of what she's breaking this way."

the book". To formulate hypotheses about the origin of a disease, some children discussed:

> Child 1: *He may have been shot in the leg. And his leg was blistered. Then the bubbles rose and he was Aaaahhh!* Child 2: *He may have been stung by bees!* Child 3: *He may be allergic...* Child 2: *Let's analyze it, ué!* Child 3: *Then the guy invented a microbe that enter into the guy to analyze it...* Child 1: *Then after he removes the microbe with a syringe, and analyzes all virus that has within it.* Child 2: *Look, the microbe has a mouth like, and they entered a blood, a globular cell, actually. Then he pulls with a syringe and...*Child 3: *Maybe we can get a syringe to draw the blood and analyze.*

Connotations of scientific activity: power, promises, danger

We consider of equal relevance the bipolarity of Western representations of science (Castelfranchi, 2004), which also appears in the imagination of the studied children: in many cases, they make use of icons and symbols of danger on scientists' objects. Several of them used in their designs standardized danger signs, such as the skull, the icon of radioactivity, etc...They argued: "It is to sign that the bag may have dangerous things…". The coat itself, in some cases, was in the semantic field of risk: "Moderator: *Why is he wearing scrubs in the office*? Child: "*Because [...] a substance could drop on it...*". Or even: "Child: *We have to use gloves because there are substances that hurt us ... like ...Uranium!*"

Knowledge and concepts of science

In the narrative drawings made by children from public schools and belonging to lower classes, mentions to specific concepts or specific informations on science were very rare: most of the specific vocabulary was related to medical or police-investigative contexts, probably related to the context of the story we offered them[9]. Regarding the

[9] There appeared names and technical jargon such as: *depression*, drugs such as *dipyrone* and *paracetamol*, diagnostic techniques such as *measuring blood pressure*. It was also mentioned by several children the use

socio-economic differences and their influence on the perception of the children's scientific imaginary, we observed that, in the middle class school, it was evident the references to topics of current researches and to names of real scientists. On the other hand, children from lower classes appeared to have little knowledge about specific topics related to the scientific world, although they frequently mentioned the use of specific instruments for scientific research (however, in most cases, they did not know how to name them - a microscope, for example, has been named as a "more powerful magnifying glass").

Access to information and the strong presence of television media

Media stories represent the main source of symbolic and iconic resources used by children to narrate the scientists, which is predictable. Far more interesting is to see how well the concrete information and notions about science tend to relate to the media more than the school in general. Both television fiction and science communication are sources of information and forming agents of science representations for children - especially when it comes to middle-class children, with varying informational habits and living in an context of family with elevated cultural capital[10].

Conclusions: the *narrative focus group* in science education and science communication

As already shown in previous studies, children construct their images of scientists and science mainly from classic stereotypes (Casltefranchi, 2003, 2004) and media stories. However, these stereotypes function as a narrative skeleton, which does not say everything about the children's view: to study only the stereotype, as it is done in the DAST test, is largely insufficient. The narrative focus groups, in trying to situate scientists and science in a dynamic context, can better handle the complexity of children's

---

of powder to identify fingerprints ("A beauty product that can show digitals ...").

[10] When imagining how a scientist identifies an animal species, for example, a child said "*But they [scientists] have experience with snakes. Like that biologist on RedeTV, he looks at it and says a which snake it is.*" About stem cells: "*I've seen on TV, they are so [...] I do not remember [where I saw the stem cells], I think it was the Discovery, or Animal Planet*." When questioned if they had watched any TV program about science or scientists, the children from the urban private school replied, "*A lot!*" And mentioned: "*NatGeo, Discovery Channel, Animal Planet, let me see what else. I like .. Discovery Civilization, Discovery Science, Discovery*…".

representations.

In our opinion, the narrative groups can be successfully applied, especially with children over 7 years old, as non-formal educational activities involving the formulation of hypotheses about a phenomenon being experienced collectively, or the reconstruction of stories about science and scientists - both contributing to the awakening of curiosities, concerns, motivations and questions as well as to initiate various empirical activities and experiments. These experiments, besides being a research tool, thanks to its dynamic and immersive characteristics, may be useful to drive narrative, immersive and ludic experiences for science teaching experiences both in non-formal contexts (experiences in museums, workshops, "scientific camps", etc.) and in the classroom as complementary activities in science teaching, contributing , for example, for *inquiry based learning*.

Preliminary results show what kind of information (complementary and additional to the DAST methodology, questionnaires and interviews) can be obtained via illustrated narrative groups: it was detected evidence that stereotypical images of scientists are only a superficial visual layer beneath which lurk cognitive constructions and more complex imaginary made by children. Such layers - visible only when children imagine what a scientist does, with whom, how he solves problems - allow to access epistemological, sociological and ethical aspects of representations of science and scientists. They also can show to which extent the social and cultural capital of children is an important factor not so much to detect if children achieve to know the stereotypical image of a scientist in a white coat and glasses, but as a variable that make rise other rich, dense and complex dimensions of representation.

Bibliography

Barbour, R.S. and Kitzinger, J. (eds) (1999). Developing Focus Group Research. London: Sage.

Bloor, M., Frankland, J., Thomas M. and Robson, K. (2001) Focus Groups in Social Research. London: Sage.

Castelfranchi, Y. (2003). Imaginando uma paleontologia da cultura científica.

Comciência, Julho. Disponível em: http://www.comciencia.br/reportagens/cultura/cultura17.shtml.

Castelfranchi, Y. (2008). Para além da tradução: o jornalismo científico crítico na teoria e na prática. Los desafíos y la evaluación del periodismo científico en Iberoamérica. Jornadas Iberoamericanas sobre la ciencia en los medios masivos. Santa Cruz de la Sierra: Aeci, Ricyt, Cyted, SciDevNet e Oea,1, 10-20.

Castelfranchi, Y. (2004). Toward a ‘palaeontology’ of public representation of science. Paper presented at PCST-8 Congress. Barcelona: PCST-8 (Public Communication of Science and Technology).

Castelfranchi, Y.; Manzoli, F.; Gouthier, D.; Cannata, I. (2008). O cientista é um bruxo? Talvez não: ciência e cientistas no olhar das crianças. In: massarani, luisa. (org.). Ciência e criança: a divulgação científica para o público infanto-juvenil. Rio de janeiro: Museu da Vida - Fiocruz, p. 13-18.

Castelfranchi, Y.; Manzoli, F.; Gouthier, D.; Cannata, I. (2006). Children's perceptions of science and scientists. In: 09th International Conference on Public Communication of Science & Technology (pcst-9), 2006, Seoul.

Chambers, D.W. (1983), “Stereotypic images of the scientist: The Draw-a-Scientist Test”.Science Education, 67(2), pp.255-265.

Flick, U. (1998), An Introduction to Qualitative Research. Londres. SAGE.

Greig, A. and Taylor, J. (1999) Doing Research with Children. London: Sage.

Hilgartner, S. (1990). The Dominant View of Popularization: Conceptual Problems, Political Uses. Social Studies of Science, 20(3), pp.519-539.

Jarvis, T. (1996), "Examining and Extending Young Children's Views of Science and Scientists", em Parker, L.H., Gender, Science and Mathematics, Kluwer Academic Publishers, pp.29-40.

Mead, M. et al. (1957). Image of the Scientist among High-School Students. Science, vol. 126,nº 3270, 30 de agosto, pp.384-390.

Morgan, M.; Gibbs, S.; Maxwell, K.; Britten, N. (2002). Hearing children's voices: methodological issues in conducting focus groups with children aged 7-11 years. Qualitative Research, 1 Abr. v. 2, n. 1, p. 5–20.

Polino, C., & Castelfranchi, Y. (2012). The "Communicative Turn" in Contemporary Techno-science: Latin American Approaches and Global Tendencies. In B. Schiele, M. Claessens, & S. Shi (Eds.), Science Communication in the World (pp. 3–17). Springer Netherlands.

Polino, C.; Castelfranchi, Y. (2011). Knowledge of and Attitudes towards Science and Technology in Iberoamerica. In: Bauer, M.; Shukla, R.; Allum, N.. (Org.). The Culture of Science: How Does the Public Relate to Science Across the Globe. New York: Routledge, p. 155-175.