Lingue e Linguaggi
Lingue Linguaggi 29 (2019), 291-314
ISSN 2239-0367, e-ISSN 2239-0359
DOI 10.1285/i22390359v29p291

A COGNITIVE, SOCIO-SEMIOTIC, LINGUISTIC, AND DISCURSIVE APPROACH TO POPULARISATION STRATEGIES IN INFOGRAPHICS

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Abstract – Information graphics or infographics are multimodal discursive spaces created by the combination of data and information visualisation, typography and colour. As effective forms of information communication and popularisation, infographics are frequently used by international organisations and government bodies as a means of popularising complex topics linked to health, food safety, politics, business and the environment. In this paper, Ciuccarelli's 2012 concept of the visual macroscope is adopted as an interpretative lens on a small corpus of infographics from the World Health Organisation, together with the tools of socio-semiotic, linguistic and discursive analysis, applied in a bottom-up approach. From a socio-semiotic perspective, it is seen that layout, pictorials, colour, typography and the order of information combine to make the *Ideal* and the *Real* (Kress, van Leeuwen 1996) stand out; from a linguistic and discursive point of view, thematic organisation interacts with pictorial organisation to make salient information emerge; lexical repetition, unmarked declaratives, and constant theme enact the strategy of explanation, frequently used in popularisation discourse.

Keywords: infographics; popularisation; interdiscursivity.

1. Introduction

To adopt a term coined by George Miller (1983), one of the founders of cognitive psychology, all higher organisms are *informavores,* wanting to be informed in order to make better decisions. In a society where the amount and complexity of information continues to grow, infographics are one of the most appropriate tools for dealing with and communicating that information.

[1] The paper was thought out, developed and written by both authors, who share the authorship equally. In particular, Sonia Piotti is responsible for Section 3, 5 and 6, and Amanda Clare Murphy for Section 1, 2 and 4.

Infographics are a popular genre used to produce and disseminate information across a variety of contexts from a real-world and socio-cognitive perspective. They are effective tools in business and professional teaching programmes (Toth 2013), in education and in academic contexts (IARE 2013). Businesses and news organisations including the *New York Times*, the *Washington Post* and *The Guardian* regularly incorporate graphics into their written stories. Politicians, activists and television reporters use graphics and visualisations as a backdrop for stories about socially relevant issues global health, economics and election results. Many national and international health associations also use infographics to engage what is often a heterogeneous audience. The trend can be found in science magazines and scientific journals such as *The British Medical Journal*, *Weird* and *Nature*, which use infographics to provide their expert audiences with accurate, research-based information. In the preparation of this paper, we have also found that many international institutions adopt this type of communication tool. These include the World Health Organisation, the European Parliament and Commission, the Directorates for General Food and Safety, Migration & Home Affairs, and the Canadian Centre for Policy Alternatives, all of which use infographics for fast knowledge transfer between evidence producers, particularly scientific communities, and policy makers.

In these contexts, infographics can be regarded as a class of texts or communicative events that fall under the broader category of popularisation, defined by Calsamiglia and Van Dijk (2004, p. 370) as

> the transformation of specialized knowledge into 'everyday' or 'lay' knowledge, as well as a recontextualization of scientific discourse, for instance, in the realm of the public discourses of the mass media or other institutions.

In this paper we concentrate on analysing how specialised knowledge in infographics is communicated also by means of socio-semiotic, linguistic and discursive resources, fields hitherto unexplored in the literature.

The paper is divided into five sections. Section 1 provides definitions of infographics and outlines some trends in infographics research, suggesting some distinguishing marks of infographics as opposed to other multimodal genres. Section 2 contextualises infographics from a historical perspective, while Section 3 describes infographics as a genre from the perspective of graphic design, the only perspective available in the literature thus far. Section 4 delves into the corpus analysis, focussing on the socio-semiotic level first and then moving to the linguistic and discursive. Section 5 summarises the findings and discusses future research.

We wish to make a methodological premise, regarding the language data which is the object of the analysis. We refer to the data as a small

specialised corpus. Use of this term derives from the conviction that there is no consensus among scholars about the optimal size of a corpus. In the preface to Ghadessy, Henry and Roseberry's (2001) book devoted to studies with small corpora, one of the fathers of Corpus Linguistics, John Sinclair states that

> a small corpus is seen as a body of relevant and reliable evidence, and is either small enough to be analysed manually, or is processed by the computer in a preliminary fashion […]; thereafter the evidence is interpreted by the scholar directly. (Sinclair 2001, p. xi)

It is important to note that the claims made about specialised corpora are different from those made about other corpora: as Ghadessy, Henry and Roseberry (2001, p. xx) point out, the investigation of genres or types of texts "is an area not well suited to the use of large corpora, in which a number of very different genres are typically mixed together".

As the purpose of this study is to investigate the distinguishing marks of infographics as new discursive spaces for popularisation of specialised knowledge, which we consider a genre, our conclusion from the above considerations is that there is justification for seeing the language data in the present study as a small specialised corpus.

2. Definitions of *infographic*

The term *Infographic* is a blend of *information graphic*, the graphic representation or visualisation of data and information (Rendgen 2012, p. 9). In this capacity, information graphics lie at the crossroads of disciplines as diverse as information science and architecture, information visualisation, data visualisation, graphic design, communication and media studies and history. Different approaches to infographics can be discerned across these disciplines. Information science and visualisation are mainly interested in the process of the visual conversion of data and information as a significant part of information architecture. In traditional research activities into information visualisation, in fact, the term *visualisations* is preferred to *infographics* to refer to tools that may incorporate a variety of media, including text, images and video (Segel, Heer 2010).

We will now consider some definitions of infographics, mainly coming from the field of graphic design and art history. Infographics are defined as multimodal: for Krum (2014, p. 6), a graphic designer, an *infographic* is specifically "a larger graphic design that combines data visualizations, illustrations, text, and images together […]". Rendgen (2012, p. 9), an art historian with an interest in visual culture and technology, defines them as

"hybrids and hence difficult to define", as they consist of "text, image and geometric shapes […]". A distinguishing mark highlighted by Smiciklas (2012), a graphic designer, is their property of being self-contained texts, the different modes being indissolubly linked together into a single entity, which "does not follow automatically from the data, but has to be developed [...]" (Rendgen 2012, p. 9).

A fourth characteristic pointed out by Krum (2014, p. 6) is that good infographic design is the result of the process of *storytelling*, i.e. an account of a series of events structured and presented in a tightly controlled progression, (*Oxford English Dictionary*, s.v. *storytelling*) and brought into a context that people can understand, remember, discuss and share. *Storytelling* was first identified as a key element of information design and visualisation by Gershon and Page (2001);[2] the idea was taken further by Segel and Heer (2010) with the coining of the term *narrative visualisation* (see also Lankow *et al*, 2012). These scholars developed a framework suggesting that use of visual narrative tactics and visual rhetorical devices guide the reader's attention and thus minimise cognitive cost, especially in journalistic storytelling. Drawing on news media data visualisation, they identified three visual *narrative* tactics: *highlighting* (through colour, motion, framing, size, audio, and more) *transition* and *guidance*. Three *narrative structure* tactics were also identified: *interactivity,* e.g. pop-ups, *ordering,* i.e. the ways of arranging the path viewers take through the visualisation, which can either be linear, random or user-directed,[3] and *messaging*. Messaging can include observations and commentaries to the viewer through short text fields such as labels, captions, headlines and annotations to add context, or more substantial descriptions such as articles, introductions, and summaries.

In our reading of the research into infographics, perhaps the most relevant work from an information architecture and cognitive slant is that of Ciuccarelli (2012), which calls for a stronger integration of narrative elements into visualisations in order to increase understanding. For this purpose, he defines narrative visualisations as *visual macroscopes*. Drawing on de Rosnay's (1975) idea of the macroscope as a metaphor symbolising a global approach to problems, systems and phenomena, the term *visual macroscope(s)* describes narrative visualisations as tools that draw the bigger context of the phenomena and "thus allow people to see not the infinitely

[2] The authors describe a cinematic scene represented through a visualisation to demonstrate how technology can provide new media and new genres with ways to present information in a story-like construct.

[3] The authors use ordering types to identify seven distinct genres of visual narratives, including magazine style, annotated charts, partitioned posters, flow charts, comic strips, slide shows, films/videos, animations, and then put them on a continuum of author-driven and reader-driven approaches.

small or the infinitely distant, as *microscopes* and *telescopes* do, but the infinitely complex" (Ciuccarelli 2012, p. 80). As the *macroscope* can help us enlarge our vision of the world, to better transmit knowledge, to free new values and act mindfully (de Rosnay 1975), similarly *visual macroscopes* offer opportunities to build a shared body of information, together with the possibility of sharing hypotheses and ideas (Ciuccarelli 2012); in this capacity, it is here argued that they represent discursive spaces for popularisation. Narrative visualisations use elements that go beyond the mere visualisation of data; thus, they work perfectly with socio-economic issues, "which are by nature complex, cannot be measured and can only be described in qualitative terms" (Ciuccarelli 2012, p. 79).

3. History of *infographics*

From a historical perspective, as mentioned above, infographics are not 'technically' new. As recounted by Rendgen (2012), history demonstrates that there is an ancient tradition of representing, producing and transmitting information, primarily scientific and technical, by means of visuals. Since the Middle Ages, in particular, visual representations have been used as teaching aids or important devices for conveying complex information. Examples include the cartographic tables and anatomical atlases of the Middle Ages, the cosmological theories and music annotations of the Renaissance, 17th century geography, and the statistical graphics used by 18th and 19th century officials and politicians, initially accessible only to small circles. In the 19th century, statistical patterns were also applied to historical subjects; examples include Florence Nightingale's diagram to display the mortality rate in British hospitals during the Crimean War and Minard's flow maps to visualise casualties and the narrowing flow of soldiers during Napoleon's catastrophic Russian campaign.

While these are good examples of pure visualisations and data visualisations, they are not all infographics in the current interpretation of the term, according to which illustrations, images and data visualisations – i.e. statistical graphics, tables and diagrams – are meant as a part of the elements used within the design of infographics (Rendgen 2012; Krum 2014). Notwithstanding these differences, *infographics* and (*data*) *visualisations* are often used interchangeably and to many, they continue to mean the same thing (Krum 2014).

The modern interpretation of the term *infographics* has evolved from its original application, according to which *infographics* were "ways of obtaining

diagrams and maps from a computer (infographics)" (de Grolier 1979, p. 38)[4] as succinct and effective types of information delivery in the internal organisation of public administration and governmental authorities. This definition became the common and accepted interpretation of the term: *infographic* was simply "any visual representation of data or information", generally through a computer. Charts, graphs, data visualisations, maps, diagrams, and tables were all considered infographics. For many years, infographics were mostly confined to newspaper designers; *infographic* became a behind-the-scene term used in the print production of art departments, especially in the USA.

This use has been changed by the Internet: since the turn of the new millennium, people are now using infographics every day as their primary source of news and information, and their importance in social and digital media is indisputable. By adding a visual element, photos, illustrations, and charts have always improved the readability of texts and stories in print publications, and that phenomenon is even stronger in public spaces, thanks to the many available online publishing tools and the increased professional nature of graphic design.

Figure 1 represents an infographic summarising the historical evolution of the modern concept of *infographics*.

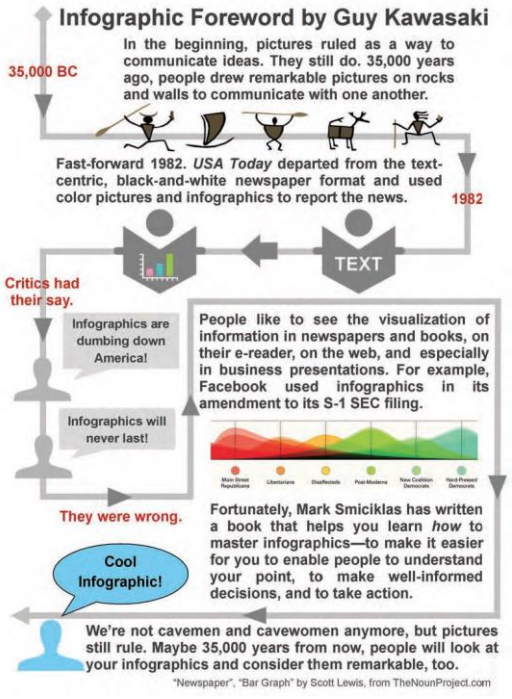

Figure 1
The historical evolution of the modern concept of infographic (Smiciklas 2012: xiii).

[4] "It matters little to decision-makers if it is a printed or stencilled document, a computer list, a diagram, map or photograph although, all things being equal, a decision-maker would prefer the most succinct" (de Grolier 1979, p. 38).

4. Infographics as a genre: layout, structure and communicative purposes

Segel and Heer (2010) and subsequent researchers in information visualisation have referred to narrative visualisations as genres, and have analysed them on the basis of varying strategies of visual narrative and layout, narrative structure and narrative rhetoric that emerge from visualisations across several media and different contexts. Other studies (e.g. Toth 2013) have analysed the pedagogical use and implications of infographics as a genre in professional communication.

According to the linguist Bhatia (1993, 1995), genres are instances of conventionalised or institutionalised textual artefacts in the context of specific institutional and disciplinary practices, procedures and cultures, and are identified on the basis of conventionalised features, typical textualisation patterns and socially recognised communicative purposes. Genre analysis has always been a multi-disciplinary activity, attracting attention not only from linguists, discourse analysts, communication experts and rhetoricians, but also scholars and professionals from other disciplines, all aiming to understand how members of specific discourse communities construct, interpret and use these genres to achieve their community goals. From an examination of the literature in various fields, we realise that genre analysis of visualisations and infographics has been terrain explored only by information scientists, communication scholars and professionals, artists and designers, and not by linguists, whether theoretical, applied or computational.

In the following sections we consider the three characteristics of infographics as a genre, namely visual layout, narrative structure and communicative functions from the perspective of graphic design. Krum's (2014) study is adopted, which, to our knowledge, represents the only systematic and comprehensive description available. As a data visualisation and infographics designer, however, Krum's study mainly reflects the concerns and practices in graphic design, and does not represent a linguistic genre analysis.

4.1. Layout

The first feature linked to genre is visual layout. In graphic design, the layout or format is referred to in various ways, such as a *tall*, *long* or *tower* and *horizontal* design (Krum 2014). According to Krum, the format chosen depends on one's publication strategy. From this perspective, the tall format (Figure 2) has some distinct advantages in online distribution, as most websites are designed to allow easy vertical but not horizontal scrolling; most infographics online follow this same format.

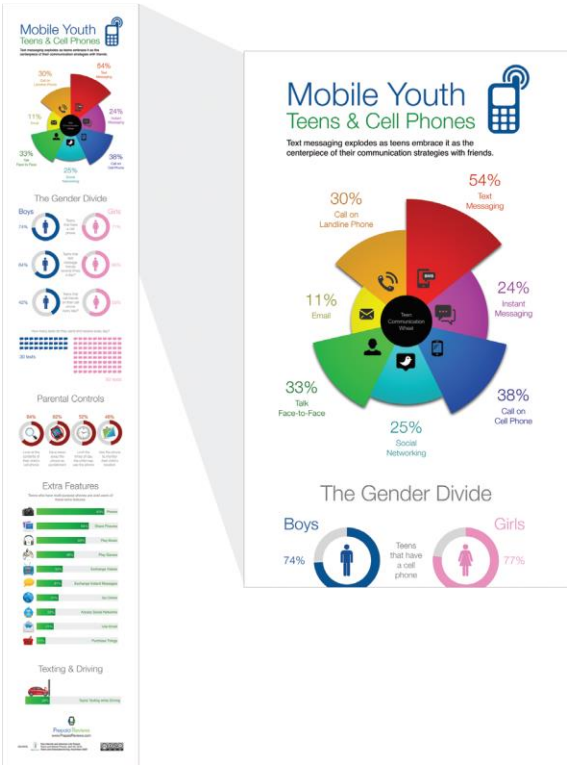

Figure 2
Tall format infographic (Krum 2014, p. 59).

In presentation slides and in printing, the tall format has some disadvantages, as it has to be scaled down to make its height fit the size of the page and this creates images that are usually too small to read or understand.
By contrast, the horizontal format (Figure 3) requires viewers either to scroll side to side to see all the content or to reduce the design to a very small size. As a result, tall format designs are much easier for the reader to view.

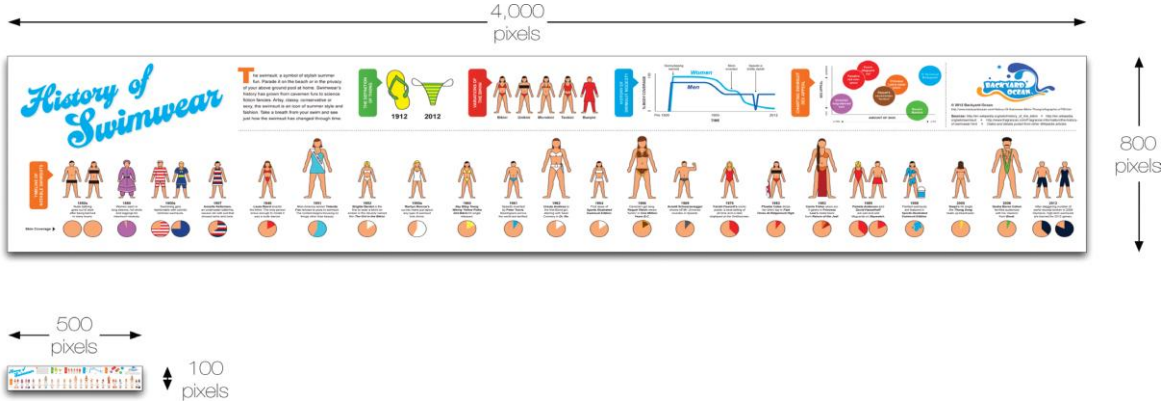

Figure 3
Horizontal format infographic (Krum 2014, pp. 62-63).

A very important aspect influencing choice of format in graphic design is information processing, which is not discussed by Krum.

4.2. Structure

The second feature linked to infographics as a genre is structure. In their capacity as narrative visualisations, many infographics have a narrative structure which follows a three-part sequential order, namely introduction, key message, and conclusion, each part having a proper function: appeal to the reader, comprehension and retention of information, respectively (Krum 2014).

The introduction presents the topic of the infographic, which is usually identified through some combination of the title and a brief paragraph of text, which has to be reduced to a minimum. This section also lays the foundation for the information before the reader moves to the key message. The key message represents the main event which is usually the dominant visual portion of the infographic through a large illustration or data visualisation.

Infographics also end with some closure, where the message is wrapped up for the reader, like the ending of a good speech or article. If appropriate, this is where a call-to-action should be included, if there is some type of follow-up that the readers are invited to take after reading the key message.

4.3. Communicative purposes

The third feature linked to infographics as a genre is communicative purpose. According to Krum (2014), the purpose of infographics can be assimilated to the same objectives as public speaking or writing: to inform, entertain, or persuade. In this sense, the taxonomy he proposes includes five distinct categories: *informative* infographics, *persuasive* infographics, infographic *advertisements, PR* infographics and *visual explanations*. The five categories will be briefly described.

4.3.1. Informative Infographics

Informative infographics are the dominant type of design, particularly online. After publishing infographics online for a number of years, Krum is convinced that if the goal of the design project is to maximise the number of views, visitors, and backlinks to the hosting site, informative infographics are more successful than all other types of designs. His theoretical stance is that online audiences are better disposed to read valuable information rather than advertisements.

An example of what Krum identifies as a good informative infographic is in Figure 4: the design has been published by an online backup company and focuses on the lifespan of storage media. Krum (2014, p. 71) observes that even though the company wants to sell its services to new customers, "the infographic isn't a sales pitch": the infographic uses data visualisations to convey the overall message that all storage devices are at risk of failure over time, but an online storage solution offers a backup that has some additional benefits. Then he concludes that "the message is meant to be independent and objective, [and that] the objective of informative infographics is to tie the value of the information presented to the value of the brand [which] creates a positive perception of the brand", that is self-promotion. Krum does not support his claims with any linguistic insight.

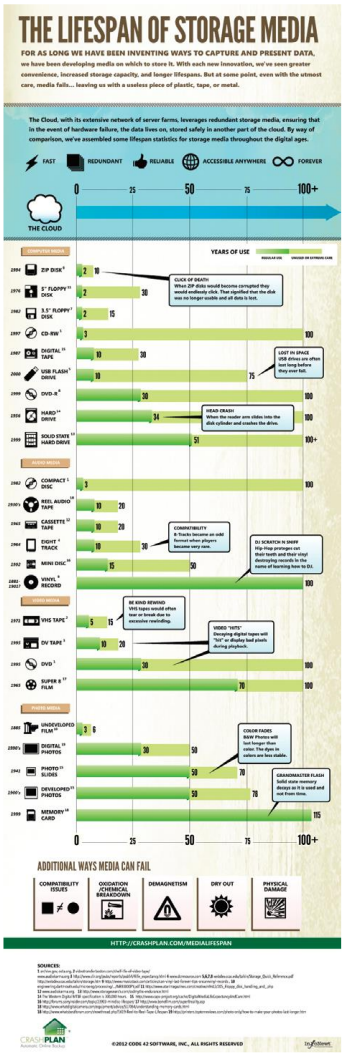

Figure 4
Informative Infographic (Krum 2014, p. 72).

4.3.2. Persuasive infographics and infographic advertisements

Persuasive designs are intended as a clear call to action and they attempt to convince readers to do something after seeing the infographic, such as performing good deeds or taking actions to help themselves, the local community, or the world at large. The actions might be to vote for a candidate/party/referendum, raise awareness of a health-related or environmental issue, visit a website, donate to a charitable organization, join a community, sign a petition, buy a product, to mention just a few.

Behind successful persuasive infographics is a narrative structure that leads the reader through the sequence of information: the technique Krum identifies is Monroe's *Motivated Sequence,* which motivates an audience to respond affirmatively to the speaker's purpose. The sequence contains five distinct steps. First, *Attention*: this step consists in getting the attention of the audience using a detailed story, shocking example, dramatic statistic or quotation, etc. Second, *Need*: this step describes the problem and explains how it applies to the psychological need(s) of the audience using statistics, examples, etc. and thus demonstrates a need for change. The premise here is that the audience's needs are what motivates action. Third, *Satisfaction*: the audience needs to solve the issue, so specific and viable solutions are offered that individuals or communities can implement to solve the problem. Fourth, *Visualisation*: this step tells the audience what will happen if the solution is implemented or does not take place. Monroe recommends being visual and detailed. Fifth, *Action*: the step tells the audience what action they can take personally to solve the problem.

Figure 5 shows an example of what Krum identifies as a good persuasive infographic from this perspective.

Persuasion is most visible in the form of advertising: a subcategory of persuasive infographics is therefore represented by infographic advertisements, which attempt to motivate the audience to take action such as purchase specific products or services. Persuasive infographics and infographic advertisements share the same communicative purpose: from a linguistic and socio-cognitive perspective, they belong to the same colony of promotional genre; what is not clear, therefore, is why Krum puts advertising infographics into a separate category.

Figure 5
Persuasive infographic (Krum 2014, p. 79).

4.3.3. PR Infographics

These are infographic designs particularly used by companies for public relations with press releases to build awareness of products and brands, provide information to shareholders, or increase the value of the brand.

4.4.4. Visual explanations

The final category is represented by visual explanations, which try to explain an idea or a process, such as how laws are made, relationships, or a complex concept.

5. Analysis and discussion

In the following sections we focus on the socio-semiotic, linguistic and discursive strategies adopted in a corpus of infographics from the World Health Organisation. The approach to infographics adopted for this analysis is Ciuccarelli's (2012) interpretation of narrative visualisations, hence infographics, as *visual macroscopes*.[5]

Two layers of analysis are adopted: firstly the social semiotic, i.e. the use of different modes and their interrelations in their capacity to create all three of Halliday's meaning functions (Kress, van Leeuwen 2001; Kress 2010); secondly, the linguistic and discursive, i.e. the interrelations between the cognitive dimensions arising from the corpus data and the linguistic and discursive strategies that realise them (Moirand 2003). The linguistic and discursive structures that specifically interest us include the set of metalinguistic expressions that introduce specialised terms and information, along with instances of explanation through paraphrase and exemplification.

5.1 The corpus

The data for the present analysis are taken from a corpus of six infographics produced by the Department of Nutrition for Health and Development of the World Health Organisation[6] and addressed to WHO Member States. These infographics are part of a comprehensive implementation plan which aims to achieve six global nutrition targets in maternal, infant and young child nutrition through direct nutrition interventions and multi-sectorial actions in the food system, education and social protection by 2025. These global nutrition targets include: reducing anaemia and improving breastfeeding in maternal nutrition, as well as reducing low birth weight, stunting, wasting and excessive weight gain in infant and young child nutrition.

5.2. Socio-semiotic analysis

This section analyses the ways in which meaning is socially and culturally constructed and interwoven in the multimodal discourse of WHO infographics through various semiotic resources. One of the key premises of multimodal social semiotics is in fact that meaning-makers, including authors and graphic designers, always draw on a multiplicity of modes – i.e. a set of socially shaped and culturally given resources for meaning-making (Kress, van Leeuwen, 2001; Kress 2010) – to make meanings. These modes are arranged in a multimodal

[5] See Section 2.

[6] The infographics are available at https://www.who.int/nutrition/global-target-2025/infographics/en/.

design. Selections are made in each mode and each mode offers ways to highlight that to which the audience's attention is to be drawn. This is how text makers can create reading paths and shape how the audience navigates the text and process information. In this sense, mode is "an organizing principle of presentation and communication and therefore treated as a central unit of analysis" (Bezemer, Jewitt 2010, p. 183).

The WHO uses layout and pictorials, but also typography – i.e. choice and size of fonts, margins, hierarchy between headings, subtitles and background text –, data visualisations and writing as modes of representation: they regularly combine and represent well-acknowledged regularities through which the storytelling is carried forward, and thus help the audiences locate the information and identify the important information.

In the following subsections, we will analyse how these resources are used to fulfil a variety of text functions.

5.2.1. Layout and structure

All the WHO infographics in the present corpus display the same vertical format and layout and the same structure: information processing and reading path progress from top left to bottom right, according to the Z-reading pattern typical of the western world (Kress, van Leeuwen 1996). This pattern is the most immediate and natural and helps define the *zones* where the different visual elements, and corresponding information, are set and thus identify the narrative pattern. The infographic on *stunting* (Figure 6) is used as a paradigm.

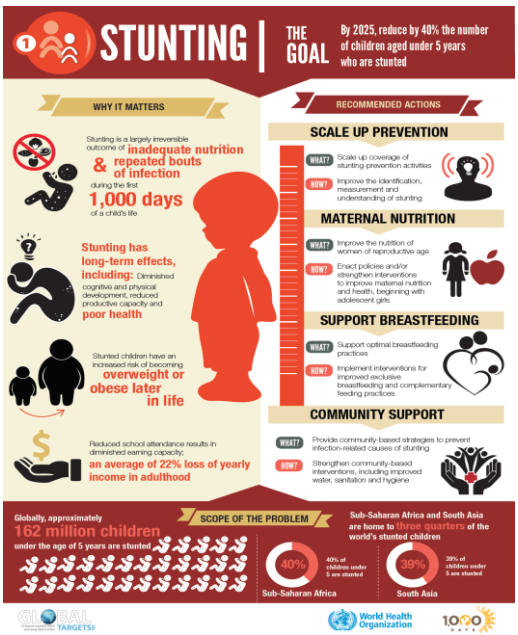

Figure 6
Stunting.

The elements of all WHO infographics are located according to an *Ideal* (top)/*Real* (bottom), *Given* (left)*/New (right)*, *Centre/Margins* triptych, even though all the infographics do not conform to a traditional Z-shape layout, as the number of Z-angles along the reading path varies. The information positioned on the top is *The Goal* and represents the *Ideal* part, i.e. representation of what the world should be like (Kress, van Leeuwen 1996): in this corpus, it corresponds to reducing anaemia in maternal nutrition, as well as reducing low birth weight, stunting, wasting and excessive weight gain in infant and young child nutrition. The white headline draws the attention first against the dark background. From the left, where the topic is given, the path leads across to the new information on the right and this is the first horizontal line. The top horizontal line includes the main components the Organisation wants viewers to focus on first.

From here the path continues diagonally over to the left of the following part. This part occupies the *Centre* and features any information that builds up the discourse: this is the first Z-angle. From the *Why it matters* section on the left, the path continues horizontally over the right side to the *Recommended actions*, and this is the second horizontal line. Following the path, attention is then directed to the left of bottom part: this section is the *Scope of the Problem* and represents the *Real*, i.e. shows what the world is really like. This is the second Z-angle. From here, the reading path moves horizontally to the right and this represents the second and final horizontal line.

The two central sections are visually organised through subsequent sub-sections, separated and introduced by pictorials and text in the left section – i.e. *Why it matters* – and by headings in the section on the right – i.e. *Recommended actions* –: this section displays an arrangement dominated by writing and its structure resembles the textual organisation of a book in chapters – represented here by sub-sections –, and paragraphs – here represented by "What?" and "How?" sub-sub-sections –, with pictorials playing a marginal role. Pictorials and text thus function as text organisers, but occupy different roles across the two sections, as will be explained in the following sections.

The narrative pattern develops along the reading path and moves from the Ideal part at the top through the two sections in the centre to the Real part at the bottom. This pattern appears as a slightly modified version of Monroe's *Motivated Sequence* in persuasive infographics, with the step *Action* preceding *Attention* and the step *Visualisation* implicitly implied from *Attention*.

In the next sections we will focus on ways in which colour, typography, pictorials and writing or text support the narrative structure and realise the persuasive function of the WHO infographics.

5.2.2. Colour, typography, images and data visualisations

In this section we analyse how colour, typography, pictorials, data visualisations are used to articulate the content matter and help the reader locate the important information.

For the purposes of this section, the infographics on stunting (Figure 6) and anaemia (Figure 7) have been chosen as a paradigm.

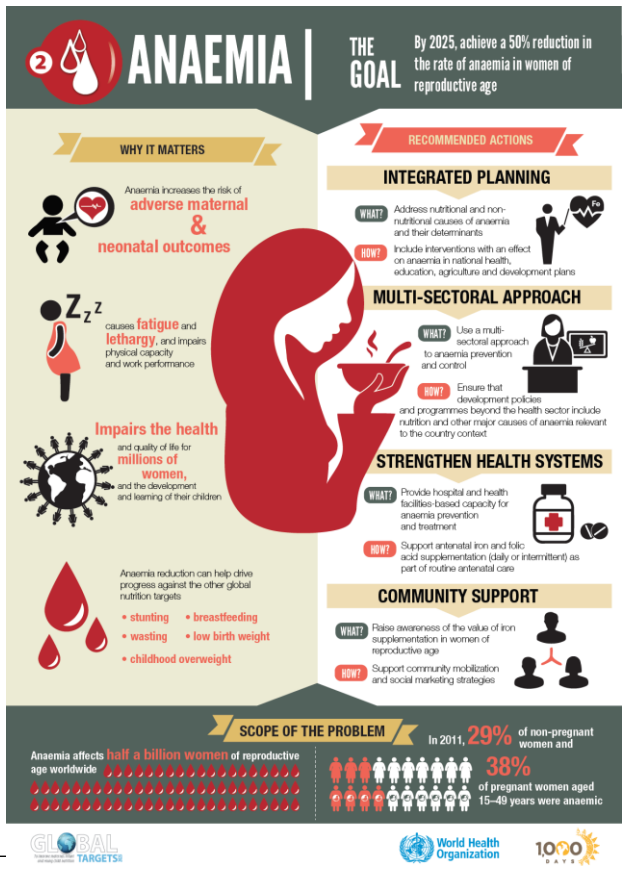

Figure 7
Infographic on anaemia.

The different modes often combine and contribute to the information organisation and narrative structure in different ways and according to different patterns: while modes such as colour, choice and size of font are exploited throughout the whole text, others such as pictorials, data visualisations, numbers headings and subtitles are predominant only in specific parts.

In *The Goal* part, the headline is highlighted through the use of white against the dark background; font size is also used to highlight the words referencing the topic of the whole design on the left and its *Goal* on the right. The section is therefore a call to action.

In the *Why it matters* section, colour, choice and size of font draw attention to the words that indicate the different topic-oriented discourses and how they are linked to each other, like the physical outcomes of stunting (Figure 6) in infants (e.g. "repeated bouts of infection, 1,000 days") and children ("long-term effects, poor health"), but also in adult life (e.g. "a higher risk of becoming overweight or obese later in life"), in addition to its social and economic outcomes in adulthood (e.g. "an average of 22% loss of yearly income in adulthood"). Similarly, in the same section of *Anaemia* (Figure 7), these modes draw attention to the words referencing the physical outcomes of anaemia, both neonatal and maternal (e.g. "maternal & neonatal outcomes; fatigue, lethargy"), in addition to the size of the problem (e.g. "impairs the health [of] millions of women") and how its reduction helps drive progress against other global nutrition targets (e.g. "stunting, breastfeeding, wasting, low-birth weight and childhood overweight"). In addition, pictorials introduce and visualise the different topic-related discourses − medical, social and economic, to mention a few: the selection and interpretation of their meanings, both literal and symbolic, is directed by the following verbal text. The relation between pictorials and text is thus of an anchorage type (Barthes 1977), as they both trigger the bigger context behind the topic and its infinite complexity. Each discourse within this context, then, represents how the topic applies to the psychological needs of the audiences, thus offering motivations for change.

In the right section on *Recommended actions*, choice and size of font draw attention to the headings referencing viable solutions to the problem, in response to the motivations highlighted in the previous section: the headings include "Scale-up prevention", "Community Support", and Support Breastfeeding (Figure 6); "Integrated planning", "Multi-sectorial approach", "Strengthen health-systems", and "Community support" (Figure 7). Each section is further subdivided in subsections introduced by the colour-coded headings "What?" and "How?", which detail what the viable solutions are and how they can be implemented. Compared to the left section, here the pictorials play a marginal role and mainly summarise the topic. In this section, pictorials, visual graphic, typography and text combine to simplify the complexity of the topic.

In the *Scope of the problem*, colour, choice and size of font combine with text and data visualisations like numbers, percentages and icons to indicate the extent of the problem either globally or in specific areas: here, the text provides a description of the process and the entities involved in the

problem, while numbers, percentages and icons visualise them. Without the use of either the one or the other, the information provided by the written account or the visualisations alone would be severely limited. In addition, since this part presents the current state of the problem, there is an interest in grounding the information scientifically in a quantitative approach, bringing 'scientific evidence' from various disciplines and with 'scientific discourse' as a framing.

It can be concluded that layout, visual graphic, typography and writing are semiotic resources which realise all three of Halliday's meaning functions, which is one of the premises of multimodal social semiotics. In the WHO infographics analysed, layout, structure – i.e. sections and sub-sections –, writing, headings, subtitles and pictorials combine to articulate content matter; colour, choice and size of fonts and data visualisations in the form of numbers, percentages and icons highlight the salience of each piece of information; all together, these elements help to lead the interpretation of the text from one element to another in order of decreasing impact; in short, they assist in concept development. Pictorials, in particular, are used in several of the following capacities, generally acknowledged in the visual communication of science (Trumbo 1999, 2000): they illustrate concepts, assist in concept development and summarise a topic.

5.3. Linguistic and discursive analysis

In the following sections, we analyse how the linguistic and discursive strategies support the narrative structure of the WHO infographics, as well as how they assist in concept development and trigger the Visual Macroscope: the approach adopted is bottom-up, from the lexical to the grammatical, textual, and then discursive level. In this section, examples from infographics other than stunting and anaemia are also included.

The "Goal" section (e.g. in Figure 7 "By 2025, achieve a 50% reduction in the rate of anaemia in women of reproductive age") deals with the lexico-semantic field of reduction (e.g. "achieve a […] reduction in the rate of […]" or "reduce (by + percentage) the number of") and is realised by non-finite verb phrases or elliptical noun phrases, as in "no increase in childhood overweight", seen in the infographic on overweight children All these clauses are marked and start with the time adjunct "by 2025", which represents the textual theme. The local lexico-grammar, therefore, indicates that the section is a call-to-action.

The lexico-grammatical patterns in *Why it matters* (e.g. "Anaemia increases the risk of adverse maternal and neonatal outcomes", Figure 7; "Stunting is a largely irreversible outcome of inadequate nutrition and repeated bouts of infection during the first 1,000 days of a child's life", Figure 6) correspond to unmarked declaratives, where the nutrition issue

discussed is the subject occupying the thematic position, and the rhemes consist in finite verb phrases with modification, telling how the problem applies to the psychological needs of the audience(s), according to the following patterns: X (i.e. the problem) + VP + NP [+PP]/PP. Sometimes elliptical subjectless declaratives also occur and exemplify instantiations of textual ellipsis as a cohesive device (e.g. "causes fatigue and lethargy, and impairs physical capacity and work performance", in the infographic on anaemia, Figure 7): the omitted subject is the problem discussed and can be recovered from the previous co-text. All these patterns exemplify that information structure is mainly realised through thematic progression with a constant theme (e.g. "Stunting is a largely irreversible outcome of inadequate nutrition and repeated bouts of infection during the first 1,000 days of a child's life"; "Stunting has long-term effects including: […]", Figure 6; "Anaemia increases the risk of adverse maternal and neonatal outcomes", "[Anaemia] causes fatigue and lethargy, and impairs physical capacity and work performance", "[Anaemia] impairs the health and quality of life of millions of women […]", Figure 7). This foregrounds the fact and idea that the problem discussed is a priority to the WHO Member States. These lexico-grammatical patterns also realise the discursive strategy of explanation, which is the most frequently used strategy in popularisation discourse (Moirand 2003).

How the problem applies to the needs of the audience(s) is explained through different topic-oriented discourses, which correspond to the fundamental underlying categories that structure the properties of the issue discussed, such as Cause (e.g. "stunting is a largely irreversible outcome of inadequate nutrition and repeated bouts of infection", Figure 6), Consequence (e.g. "stunting has long-term effects", Figure 6; "childhood overweight increases the risk of obesity […]", seen in the infographic on overweight children; "low birth-weight is a major predictor of perinatal mortality", in the infographic on low birth weight; etc.), Quantity (e.g. "anaemia impairs the health and quality of life of millions of women […]", Figure 7) and Localisation, either geographic (e.g. "low-birth weight is a global concern", in the infographic on low birth weight; "childhood overweight is increasing in all regions of the world", in the infographic on overweight) or socio-demographic (e.g. "Majority of low birth weight births occur in low-income countries", in the infographic on low birth weight).

In addition, the causal relation, which includes both cause and consequence, is more extensively represented and structured from a discursive perspective than the other two categories: its lexical units reveal that, while the cause is generally identified with inadequate nutrition or another disease/physical problem, the consequences can be multifaceted: physical (e.g. "children who are overweight or obese are at a higher risk of

developing serious health problems; wasting increases risk of stunted growth […]", in the infographic on overweight; "low birth weight increases the risk for non-communicable diseases such as diabetes and heart disease", in the infographic on low birth weight, etc.), cognitive (e.g. "stunting has long-term effects including: […] diminished cognitive development", Figure 6; "breastfeeding provides babies everything they need […] for brain development", infographic on breastfeeding), and social, particularly at the level of work performance and earning capacity in adulthood ("stunting has long-term effects, including: […] reduced productive capacity"; "anaemia impairs […] and work performance, Figure 7). In addition, when the health-related consequence is represented either through a general term, as in "Stunting has long-term effects" (Figure 6), or a specialised one, as in "Long-term effects including: […] non-communicable diseases" (Figure 6), exemplification is used, and it is introduced by metalinguistic expressions like *such as* or by means of punctuation, normally a colon (:).

These global targets are also linked to each other and interdependent: a reduction in anaemia, for instance, "can help drive progress against the other global nutrition targets: stunting, breastfeeding, wasting, low birth weight, childhood overweight" (Figure 7).

The overarching discourses – medical, scientific, social and economic and a mixture of these – regulate the infographic design and reflect the interests and concerns of the WHO and its epistemological positions. In the examples discussed, the discourses are realised through repetitions of some contextual lexico-grammatical patterns, especially in the discussion of the health-related consequences. Examples include the repetition of the verb pattern "X – i.e. the problem or person affected by it – has a high risk of developing […]" or the noun phrase "non-communicable diseases […]" as in the infographics on stunting and overweight. The design foregrounds an interest in the multifaceted nature of the problems discussed (primarily nutrition and medical issues) which, in addition to being closely related to each other, can also cause other health-related and cognitive problems, in turn likely to develop into social and economic issues later in life.

These global targets also need a multifaceted approach, which is organised into several sections within *Recommended actions* on the right side of the infographic. The lexical patterns of these section headings reference a variety of approaches: health, education and development planning (e.g. "Integrated Planning", Figure 7), disease prevention (e.g. "Scale-up Prevention", Figure 6), health systems (e.g. "Strengthen health systems", Figure 7), research (e.g. "Build up evidence"), social protection (e.g. "Community Support", Figure 6 and 7), legal and economic protection (e.g. "Support paid leave", in breastfeeding), education ("Dietary guidelines", in overweight), marketing of food substitutes (e.g. "Limit formula marketing of

breastfeeding substitutes"), etc. Within each section are two sub-sections, "What?" and "How?", which explain the viable solutions and how they can be implemented. They also showcase the interrelationship among overarching discourses – medical, legal, policy, social, education, scientific research, etc.: e.g. "Include interventions with an effect on anaemia in national health, education, agriculture and development plans to address causes of diseases" (Figure 7); "Enact policies to enhance food systems to support dietary practices" and "Develop public and social marketing campaigns to support regulations of food marketing" in the infographic on overweight; "Rapidly develop evidence to reduce the burden of wasting, which can then be translated into policy actions", in the infographic on wasting.

The lexico-grammatical patterns in the Recommended actions include non-finite VPs and NPs with complex modification and indicate that thematic progression is realised through subsequent themes derived from the hyper-theme. The hypertheme is the heading; "What?" and "How?" are the subsequent themes and the rhemes are the non-finite VPs or NPs that follow. The examples discussed indicate that the explanations in this section involve complex discourses, which are realised through different subsequent themes, with higher lexical diversity and density than any other section of the design.

Some considerations emerge from our analysis of WHO infographics. From a socio-semiotic perspective, the different modes used in the corpus correspond to those exploited in many other multimodal genres. At a linguistic and discursive level, however, the lexico-grammatical patterns trigger a variety of overarching and interrelated discourses or interdiscourses, which exemplify the infinite complexity of socio-economic issues such as health and nutrition. Their interrelationship turns these infographics into "visual macroscopes" (Ciuccarelli 2012) of the complex relation between science, nature and society. Within the WHO's implementation plan for the six global target issues – i.e. stunting, anaemia, low birth weight, overweight, breastfeeding and wasting –, these interdiscourses serve a variety of functions: they occur as "reminders" (Moirand 2003) of prior discourse moments within the global target issues by creating an *interdiscursive memory bank* (Moirand 2003) which enables the audiences to move backwards and forwards within these issues; they also act as constant "reminders" of the meaning-maker's – i.e. the WHO – position and interests.

6. Conclusions

Infographics are pliable discursive spaces which serve the process through which scientific and specialised knowledge is spread across a variety of contexts (e.g. medicine and health, business, environment, etc.) and socio-linguistic levels of communication (e.g. among experts in science magazines,

between expert professionals and lay audiences in journalism and business, for example). From the survey of the literature on infographics, we conclude that as a genre of popularisation it invites interest also from a socio-semiotic and linguistic point of view.

The examples discussed in the purposely constructed corpus illustrate how infographics are used in the context of important and global socio-economic issues to facilitate information transfer to government bodies, which can then implement informed policy actions: infographics gather specialised information produced by different discourse communities, and integrate their discourses –i.e. medical, legal, social, educative, etc. – into a complete and complex whole. The integration of narrative visualisation (the concept of "visual macroscopes") and semiotic resources into an infographic enables the interrelationship between discourses to be seen and made sense of. It is our view that infographics thus have considerable educational potential as a genre, and, given the visual age we live in, could be exploited more in different fields, including, for example, that of linguistics.

The present experimental analysis was deliberately conducted on a small corpus, which revealed specific socio-semiotic, lexico-grammatical and discursive patterns. While valid in their own terms, the results invite further investigation in larger and more diversified corpora.

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