

**Larissa D'Angelo / Stefania Consonni (eds.)**

# **New Explorations in Digital Metadiscourse**

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Larissa D'Angelo / Stefania Consonni  
(eds.)

New Explorations in Digital Metadiscourse

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## Contents

LARISSA D'ANGELO / STEFANIA CONSONNI

Dissemination, interaction and negotiation: Exploring digital  
metadiscourse (*cont'd*) 11

### PART 1

DIGITAL METADISOURSE AND THE DISSEMINATION OF  
SCIENTIFIC KNOWLEDGE 23

MICHELA GIORDANO / MARIA ANTONIETTA MARONGIU

Metadiscourse, rhetoric and the pandemic: A verbal-visual  
analysis of public information posters 25

STEFANIA CONSONNI

Cross-semiotic metadiscourse in science: Visual and verbal  
epistemicity in digital vs. analogue media 57

CARMEN SANCHO-GUINDA

From free rhetoric to the tripartite model: Metadiscourse  
trends in graphical abstracts 83

PART 2

DIGITAL METADISOURSE AND THE PATTERNING OF SOCIAL INTERACTION 113

ELENA MANCA

Australian and US wineries on Facebook: Analyzing interactive and interactional resources 115

GIROLAMO TESSUTO

Medicine and biology science communication blogs: Investigating stance patterns for gender identity construction 143

MICHELE SALA

First things first: Engaging readers through Google hyperlink titles 167

PART 3

DIGITAL METADISOURSE AND THE CULTURAL NEGOTIATION OF EXPERIENCE 195

WILLIAM BROMWICH

Metadiscourse and the gamification of ride-hailing in the platform economy 197

CINZIA SPINZI

Voicing otherness: A metadiscoursal analysis of digital campaigns across English and Italian 219

LARISSA D'ANGELO

Teaching effective poster design to medical students using eye-tracking technology 241

NOTES ON CONTRIBUTORS 263



LARISSA D'ANGELO

## Teaching effective poster design to medical students using eye-tracking technology

### 1. Introduction

Already in the early years of a medical student's curriculum, the importance of presenting at conferences and publishing quality research is often stressed by program directors and academic supervisors. Medical students soon learn that they will eventually enter the ever-demanding race to publish and that they need to acquire the art of presenting one's research results successfully by synthesizing and visually organizing preliminary data, most probably, through a poster presentation (Druetz/Robert 2012).

This task is often met with mixed feelings because what the genre entails is not always clear to the novice author (Hay/Thomas 1999). Conference participants and viewers often have a love/hate relationship with the poster session itself because of the several physical and time-related limitations posters entail and the amount of hard work that goes into poster writing that is seldom recognised by the academic system (Swales/Feak 2000; Swales 2004; Druetz/Robert, 2012). De Simone et al. (2001), for example, have noted that the traditional poster presentation can at times be frustrating for authors and can leave them, as well as the audience, with a sense of incompleteness. This negative evaluation of the genre leads De Simone et al. (*ibid.*) to consider the academic poster as a communication tool that is frequently inadequate for the message it carries because each poster generally attracts a limited number of viewers and sometimes not enough attention is given to the poster session by conference organizers. Another difficult aspect to manage is the competitiveness that a poster session entails: a poster presenter does not have the advantage of having a committed audience

and has to compete with other presenters for space, visibility and attention (Morin 1996a, 1996b), and if poster presenters do manage to attract someone's attention, they have to accept the fact that in most cases, the interaction will be brief and superficial, leading at times, to a frustrating experience.

However, if the content is interesting and the poster is well-designed, the presentation might attract a number of interested colleagues and the interaction might carry on longer than expected, which is at the same time rewarding and challenging. The possibility to interact personally with an author, with no time limitations, means that viewers are given the chance to pose numerous questions and comments which, if particularly challenging, might put the poster presenter into difficulty. If at conferences, paper presenters have to endure five or ten minutes of question time, poster presenters are asked to remain available and interact with viewers for one or two hours at a time, sometimes even longer. Staying alert and attentive for such a long time can be tiresome and stressful. Fortunately, as mentioned before, this smaller arena is also traditionally more informal than other sessions. This colloquial, almost intimate aspect of the poster presentation is what makes the genre so unique and challenging at the same time and it is one of the reasons why it is recommended by senior academic staff members across academic fields as diverse as medicine (Masters et al. 2018), nursing (Boullata/Mancuso 2007; Briggs 2009; Campbell 2004; Halligan 2008; Price 2010), marketing (Brownlie 2007), law (Heller 1999), psychology (Beins/Beins 2011; Marek et al. 2002), psychiatry (Singh 2014) statistics (Moreno/Schollenberger 1998) and geography (Vujakovic 1995). A poster presentation represents a 'safe' yet challenging initiation to the demanding life of a researcher but it is still an academic genre that needs plenty of preparation and quite a bit of know-how.

Thanks to the Internet there is a considerable amount of material searchable online ranging from how-to tips and techniques (Alley 2003; Block 1996; Briscoe 1996; Miller 2007) to a vast kaleidoscope of downloadable templates. Block (1996), for instance, lists basic dos and don'ts that are still useful today, regarding the layout and format of posters, their content and their presentation. Briscoe's (1996) work is another landmark when it comes to preparing good

scientific posters and presentations, and is particularly interesting because it focuses mainly on how to correctly handle images, tables and graphs. In Miller (2007) we find useful, hands-on annotated examples of ineffective writing and weaknesses in poster productions, followed by an explanation of how to improve the content and format of presentations. Finally, Purrington (2022) provides an example of easy and direct tips to design a good poster, together with an array of first-hand experiences, meant primarily for students, but not exclusively. All of these are valuable resources that introduce university students to the correct use of the poster genre. But what makes a poster presentation ‘good’? What are the elements that can turn this academic experience into a success or failure? Preparation and knowledge of the genre, once again, seem to be the key here. Understanding early on not only the basic rules of poster presentation (i.e. the dos and don’ts that can be easily found with a quick web search) but also comprehending how this multimodal genre will be received and cognitively processed by an audience becomes pivotal.

With this in mind, the present exploratory analysis saw a group of 32 1<sup>st</sup>-year medical students enrolled in the International School of Medicine and Surgery of the University of Milan Bicocca, trained in poster writing and design using eye-tracking technology. The students were exposed to current guidelines in academic poster production within the medical field and were asked to produce a poster following a short field research of their choice. With their data at hand, they each designed a poster whose readability and salience was ‘tested’ using a mobile eye-tracking lab. By observing eye movements and heatmaps obtained thanks to the eye tracker, and how these involved specific visual and textual metadiscourse elements (D’Angelo 2016, 2018), each student obtained information regarding the readability and the careful positioning of salient elements and redesigned their posters accordingly. The theoretical assumptions regarding multimodality and visual metadiscourse that led to the pilot study will be hereafter discussed, followed by two examples of poster analyses, drawn from the activity carried out in class. The chapter will then provide some educational insights and a brief discussion on poster formats.

## 2. The academic poster: Elements of a multimodal genre

Given the fact that the academic poster comprises a textual, visual and oral component, it can be defined as a multimodal genre (D'Angelo 2011) that, compared with genres with more rigid structures such as the research article, lacks precise prescriptive guidelines but, at the same time, allows presenters not only to inform but also to be creative and persuasive. Already in the early 1990s, researchers realized that the poster genre requires numerous artistic and stylistic skills and should not be taken lightly:

Integrating text and graphics within a limited space to convey a visual message requires detailed organization. Without professional assistance, the poster presenter must function as a writer, editor, designer, and artist. In displaying scientific information, a poster functions “to give visual access to the subtle and the difficult – that is, the revelation of the complex” (Tufte, 1983); it achieves this function through the pure form of a condensed, high-impact message integrating text and graphics (Matthews 1990: 231)

In poster presentations, visuals therefore become pivotal, because, like PowerPoints, posters display text and visuals and are organized in such a way that viewers can ‘glimpse’ the research work of a colleague, having, in this case, the freedom of ‘reading’ the poster at their own speed, of lingering on a specific aspect of the work, a table, graph or picture displayed.

What complicates this apparently simple procedure is that poster presentations usually take place in crowded, noisy places, where poster presenters should stand by their posters while conference participants walkabout, glimpsing from poster to poster, looking for one that catches their attention for a sufficient amount of time and allows them to quickly read and understand its content (MacIntosh-Murray 2007). In such an environment, where many presenters compete for attention, a well-designed poster, informative yet salient, utilizing specific visual interactive and interactional metadiscourse elements, will have a higher chance to be noticed, fully read and appreciated.

Thus, following current guidelines, what are the textual and visual features of an attractive, well-designed poster that also adheres to the norms and conventions of the discipline? First of all, a poster needs to reach a balance between visual and textual components (i.e. incorporating the right number of visuals and the right amount of text so that the poster presentation is clear and at the same time, harmonious). Avoiding crowding the poster with text and images results in better readability and consequently attracts a higher number of interested readers. In the academic poster genre, information is presented on a single large panel, a fact that semiotically distinguishes this type of genre from other academic genres, such as the research article. What in a research article can be described, explained and debated in several pages, in a poster must be condensed in few words and a very limited amount of space. Brevity and conciseness become fundamental when writing the text of posters (Matthews 1990). The most recurring advice is that the number of words in a poster should be limited (Erren/Bourne 2007; Masek 2003; Purrington 2022; Wood/Morrison 2011); also, a balance between text and images should be obtained to reach a sufficient amount of blank space which renders the poster more legible and less ‘crowded’ (Zerwic et al. 2010).

Like research articles and other academic genres, posters should also follow a clear structure and content organisation to achieve both coverage and intelligibility (Pho 2008; Samraj 2005). This is the reason why, in most posters, a title, an abstract as well as an introduction, a methodology, results and conclusions section are found (Alley 2003; Nicol/Pexman 2003), providing readers and authors with a clear ‘map’ of the content displayed. Cianflone (2011), Driskill et al. (1998), Matthews (1990) and Tardy (2005) have noted that the structure of posters displaying results of experimental studies usually follows the scientific ‘IMRD’ format (i.e. a standardized structure displaying an Introduction, a Methodology section, a Research section, and a Discussion section).

Also, MacIntosh-Murray (2007: 358), drawing on several observations by Swales and Feak (2000) suggests that poster authors should use a ‘compressed’ type of language and consider attentively the amount of white space on the poster panel. To achieve this, guidelines seem to frequently advise presenters to use bullet points instead of full

sentences (MacIntosh-Murray, 2007). The poster may also be considered as a sort of 'illustrated abstract' (Brown 1987, cited in Matthews 1990: 227), where we find not only a short text summarizing a research project but also images. When we create a text that will be inserted in a poster, we are often advised to divide information into units (or 'chunks' of information), something that we do, for example, when we organize information into paragraphs. These bits of information should be carefully organized and edited so that the final textual product is coherent and of immediate effect, thanks also to the correct use of white space. In this way, we avoid long and dense columns of text that are extremely tiresome for readers to assimilate. The act of 'chunking' texts (Matthews 1990: 226) therefore provides readability and a clearer organization of information but does not come easily for the novice writer, because discourse must be carefully organized conceptually and each unit of information must be coherent so that discourse flows correctly. Units of texts should be linked one to another through cued headings, which also help readers locate immediately the part of the text that interests them most (Matthews 1990).

If visuals play a primary role in poster presentations, also the way textual and visual elements are displayed is important to render content easily accessible and comprehensible. The flow of information, for example, might either be aligned vertically or horizontally as well as divided into sections by columns helping the viewer read and understand the information displayed (Purrington 2022). Within each column, the text can also be divided into blocks of text, which are often numbered, inviting the reader to follow the stream of information going from top to bottom as suggested by the vertical columns and the sequential numbering (*ibid*).

### 3. Visual metadiscourse elements in academic posters

Aside from the general 'best practice' advice described above, which widely circulates among writing centres and departments across a

variety of academic fields, many applied linguists have directed their attention to the elements in language that writers consciously (or unconsciously) utilize when they construct their arguments and present their statements. Hyland's (2000, 2004) theoretical approach to metadiscourse interpretation for example has long been used to research the way writers, with different amounts of experience and authority, use different communicative styles and relate with their audience. It is a well-known approach that represents a milestone in understanding how writers express their interpersonal standing and orientations towards their text and their readers. Using Hyland's (2000) theoretical approach and Thompson's (2001) terminology, textual metadiscourse can, for example, be distinguished between interactive resources (transitions, frame markers, endophoric markers, evidentials, code glosses) and interactional resources (hedges, boosters, attitude markers, engagement markers, self-mentions).

If written text can be analysed in terms of interactive and interactional forms, the same can be done for the visual components found in poster presentations (D'Angelo 2018). A new approach to reading visual images came with the publication of Kress and van Leeuwen's work (1998). Taking as their starting point the idea that visual images can be read as 'text', the metaphor of 'grammar' can be applied to the study of visuals. In this sense, 'grammar' is not a set of rules for the correct use of language but rather a set of socially constructed resources for the construction of meaning. Kress and van Leeuwen's work is revolutionary in the sense that it provides a key to reading images as if they were a text. In particular, they raise the status of the visual component in multimodal texts by considering it as "an independently organized and structured message – connected with the verbal text, but in no way dependent on it: and similarly, the other way around" (1998: 17). Consequently, they take the view that language and visual communication both realize the same fundamental and far-reaching systems of meaning that constitute our cultures, but that each does so by employing its own specific forms, and independently, although not everything that can be realized in language can also be realized utilizing images, or vice versa. This approach becomes then fundamental for those seeking a descriptive framework of analysis to be applied to multimodal texts.

Drawing from Kress and van Leeuwen's (1998; 2001) semiotic work, a number of visual elements can thus be categorized as *interactive* or *interactional* depending on their communicative function. As Table 1 shows, the interactive elements that organize information and guide the viewer in the comprehension of a multimodal text consist of the following interrelated systems: Layout, Framing Devices, Connective Elements and Graphic Elements.

*Layout* means the division of the poster into various 'zones' that guide the reading flow from left to right, from top to bottom, and from centre to margin. The presence or absence of *Framing Devices* (realised by elements that create dividing lines, or by actual frame lines) instead disconnects or connects elements of the image, signifying that they belong or do not belong together in some sense. Other interactive devices could be *Connective Elements* such as vectors (used in different sizes, shapes, colours or used in an attenuated or amplified way, denoting density or frequency), the repetition of shapes and colours and the alignment of elements within the poster. Information could be quickly visualized through *Graphic Elements* such as conversion processes, taxonomies, flowcharts, networks and tables. Because these elements allow writers to summarize information and help readers quickly understand the data presented, they are extremely important elements to include in poster presentations. Finally, the *Repetition of Colour and Shapes* as well as the use of *Section Titles* and the *IMRD* format can help viewers quickly understand the organization of the text in the poster. For example, by inserting short and explicative titles for each section or by using the IMRD format it is assumed that a reader will be able to easily map the organization of data on the display. Likewise, by utilizing the same colour or font type to signal specific sections in the poster the viewer should quickly navigate the information displayed.

<i>INTERACTIVE RESOURCES</i>	<i>Achieved through</i>
LAYOUT	Left- Right Top-Bottom Centre-Margin Triptych

FRAMING DEVICES	Frame lines Discontinuities of colour Discontinuity of shape Empty space between elements
CONNECTIVE ELEMENTS	Vectors Repetition of shapes Repetition of colour Alignment
GRAPHIC ELEMENTS	Conversion processes Taxonomies Flowcharts Networks Tables
REPETITION OF COLOUR AND SHAPES	Organized repetition of colours, shapes and font types in the text
SECTION TITLES	Use of short and explicative titles for each subsection
IMRD	Use of the standard IMRD format (Introduction, Methodology, Research and Discussion)

Table 1. Visual interactive elements in academic posters.

Interactional elements, listed in Table 2, are used to attract, involve and engage viewers and evolve around the concept of salience. Specific elements in posters are inserted to attract the viewer's attention to different degrees, such as the use of *Images* of real people and/or objects and *Unusual Graphic Elements* such as two- and three-dimensional graphs. The use of an *Unconventional Font Type* (e.g. Apple Chancery, **Chalkduster** and **Bradley Hand**) and bright or contrasting colour in the title of the poster, will likely raise its level of salience so that at a poster session it will be spotted among the numerous competing poster presentations.

<i>INTERACTIONAL RESOURCES</i>	<i>Achieved through</i>
IMAGES	Use of pictures representing people

	Use of pictures representing objects
UNUSUAL GRAPHIC ELEMENTS	Two- and three-dimensional graphs
UNCONVENTIONAL FONT TYPE	Use of a non-academic font type

Table 2. Visual interactional elements in academic posters.

#### 4. Methodology

The pilot project involved 32 students, enrolled in the 1<sup>st</sup> year of the School of Medicine and Surgery of the University of Milan Bicocca for the academic year 2021/22. These medical students, of different nationalities, followed a 30h course on scientific and academic writing and were trained in poster design using eye-tracking technology. During the course they were exposed to current guidelines in academic poster production within the medical field and were asked to produce a poster displaying a small-scale research carried out by them, during the second semester, using an available template found online on websites such as <[www.posterpresentations.com](http://www.posterpresentations.com)> and <[www.makesigns.com](http://www.makesigns.com)>. They each designed a poster whose readability and salience was then 'tested' using a mobile eye-tracking lab. By observing eye movements and heat maps obtained through the eye tracker, and by analysing how these eye-movement maps and heatmaps involved the visual and textual metadiscourse elements described above, students obtained important information regarding readability and the careful positioning of salient elements and reorganized their posters accordingly.

For the present chapter, two posters have been selected to exemplify differences in readability and comprehension and the subsequent difficulties experienced by the viewer. For each poster, a scan path and heat map were obtained after a 30-seconds reading of the first poster draft. Heat maps, in eye-tracking research, show the relative attention paid to different areas of the display and provide a colour-coded map to interpret fixations: if the eye lingers on one area, it signals a longer fixation which appears in red; vice versa, if an area is observed

for a very short time, it signals a shorter fixation, which will appear in yellow and green (yellow signalling a fixation duration between red and green) (Conklin et al. 2018). Heat maps, in this study, reveal the areas of the poster that are most significant for a reader, especially when exposed to a poster presentation. In other words, they reveal what the reader initially looks at to make sense of the poster display and the level of cognitive effort necessary. A scan path instead, provides a way to visualise the pattern of fixations and saccades during the 30 seconds of poster viewing. The size of the circle shows the duration of the fixation (bigger circles mean longer fixations, smaller circles indicate shorter fixations) whereas arrows indicate saccades and regressions, i.e. the forward and backward ‘jumps’ we make while reading a text (*ibid*).

#### 4. Results from the eye-tracking study

Eye-tracking is a tool that is capable of providing valuable moment-to-moment data sources. This exploratory study reveals what happens when we look at a poster for the first time and the cognitive efforts we make to locate and organize the data provided. When we look at a poster display, our eyes stop to process the information at a location (entry point) and then move to another location where further information is available. When we fixate on a textual or visual element, our cognitive system perceives and processes the textual/visual input and at the same time, it plans where and how far to move the eyes next (Conklin et al. 2018). Our reading pattern, therefore, especially when we initially skim a text for information, displays long and short fixations, saccades and regressions. All of them are automatic, physiological responses that are not controlled consciously.

The way a poster is organized and the amount of text, visuals and graphs displayed becomes crucial during the initial skimming stage, an inevitable reading phase during poster sessions, where one roams the room looking for a poster that triggers one’s interests and then copes with the volume of available information. It seems in fact, that in

complex processing tasks, eye location provides an index of attention (Rayner 2009) meaning that if what the eye looks at is complex or unclear, the number and duration of fixations and saccades will vary because the amount of cognitive expenditure also varies (Castelhanov/Rayner 2008).

Complex texts have generally been found to elicit more and longer fixations and regressions. If the text is crowded, cluttered or dense, fixations get longer and saccades get shorter (Conklin et al. 2018). During a poster session, a viewer seldomly has the time to process the text from start to finish as he would with a textbook. He focuses on the most important sections of the text first, but to do so, the reader must be able to make inferences about the content of the different poster sections before they are read to know what he can skip and what he has to read carefully.

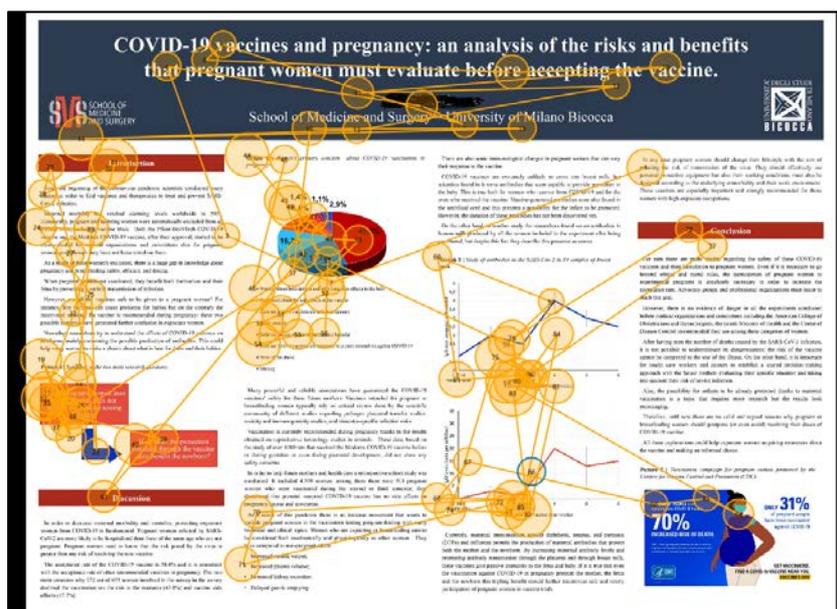


Fig. 1. Scan path of poster A.

Fig. 1 shows a poster following an IMRD format and displaying well organized and balanced content made of text, images and graphs. The

scan path shows that the entry point is not the poster title but the upper right part of the display. The gaze then fixates on the title which is clearly visible because of its placement (*layout*), the *font size* and the contrasting background colour (*discontinuity of colour*). Subsequently, longer fixations and shorter saccades can be seen clustered around *graphic elements* (a pie chart and two-line charts) and the *connective elements* present (repetition of shapes and a vector). With longer saccades and regressions, the gaze then shifts towards the *section titles* (headings) that are again clearly visible thanks to a contrasting background colour, signalling the content of each section (in this case, Introduction, Discussion, Conclusion). The scan path reveals that information is not processed all at once. Viewers select specific interactive and interactional visual elements and then, after skimming and scanning the layout of the poster, they proceed to fixate on the chunked paragraphs, with a preference for *graphic elements* and bullet-point lists.

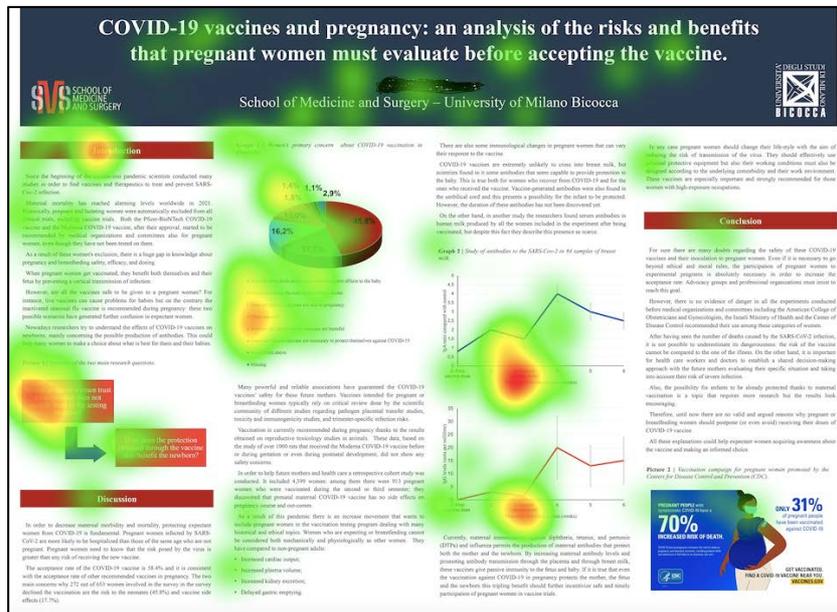


Fig. 2. Heat map of poster A.

Additional information can be gathered by considering the relative heat map, calculated considering the accumulated time spent looking at each part of the display over the course of the trial. In Fig. 2 (previous page), we see that the areas that received more attention overall were respectively *graphic elements*, *connective elements*, a bullet point list and *section titles*. These are the ‘warmest’ areas of the display where the reader shows a higher relative attention level.

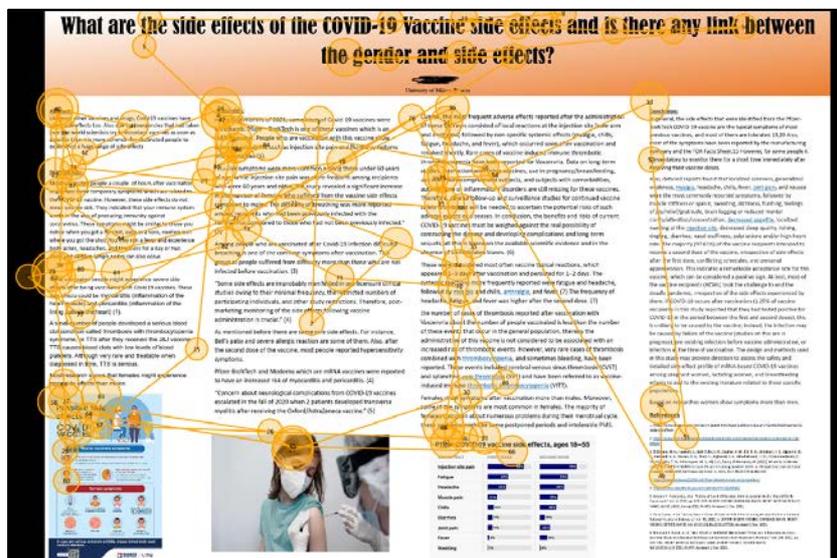


Fig. 3. Scan path of poster B.

Fig. 3 shows the first draft of a poster done by a medical student. Several problems regarding the readability of the poster emerged during the class discussion, especially after viewing the scan path and heatmap generated through the eye-tracking lab. Unlike in Fig. 1, we see that the scan path is more erratic and a higher number of brief fixations have been produced overall, all lasting approximately the same amount of time. We also see more and longer saccades and regressions occupying primarily the left side of the text columns, a scan path that is often in studies focused on the skim reading of websites (Duggan / Payne 2011; Katsanos et al. 2010). Like for websites, student viewers have been

found here to scan the poster searching for a fast comprehension of the subject matter and the layout organization by focusing on the first sentences of each paragraph. Because interactive visual elements that would guide the reader are not present, and the text is laid out in columns of compact text, the viewer doesn't continue reading word-by-word and starts scanning the rest of the content for clues. Viewers, in this case, gradually move down the page, fixing their eyes mostly on the left side of the content. They do so because after reading some of the words at the beginning of each line they stop abruptly around the middle of the line and continue elsewhere.

*Section titles* are present but the font size is too small to notice, therefore there are no clear sections that subdivide the content of the poster. There is one *graphic element* (a line graph) and a picture containing images and text. However, the size in both cases is too small to read the information displayed and almost no fixations can be seen on these elements. An *image* representing a child is the only instance of a visual interactional metadiscourse device utilized and its usefulness in attracting the viewer's attention is proved by the fact that the eye fixated on the child's face more than once and saccades and regression paths make this an Interest Area. Eye-tracking studies have long found that people generally prefer looking at other people if they are present in the picture, with a clear preference for the eyes and mouth of the person depicted (Rayner 2007; Vo et al. 2012; Yarbus 1967). Including such interactional elements in posters does not help the viewer understand and navigate the content of the poster but it significantly raises the salience of the presentation.

The entry point in this poster viewing is, again, not the title of the poster, as is commonly believed, but the centre of the display, between columns two and three. The gaze then moves and fixates on the title but because there are numerous syntactical mistakes and unnecessary repetitions in the title of the student's poster, there are numerous saccades, fixations and regressions (see Fig. 4, next page), signalling that the title has been processed with difficulty by the reader.

Finally, it is interesting to consider the heat map of poster B (Fig. 5, next page) as it confirms that the few salient areas of the poster are the *images* present, the line graph (*graphic element*) and the first three section titles. However, because the image on the left and the line graph

are too small to decipher, the 'warm' areas are limited, unlike in poster A (see Fig. 2, above). More attention was given instead to the small *section titles* inserted and the first few lines of each paragraph. Here we see more clearly how the reader tends to concentrate on the left part of the text columns, skimming through the overwhelming block of information provided.

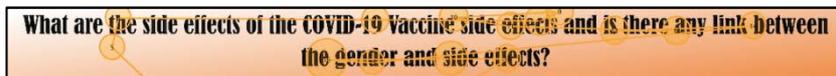


Fig. 4. Scan path of the incorrect title in poster B.

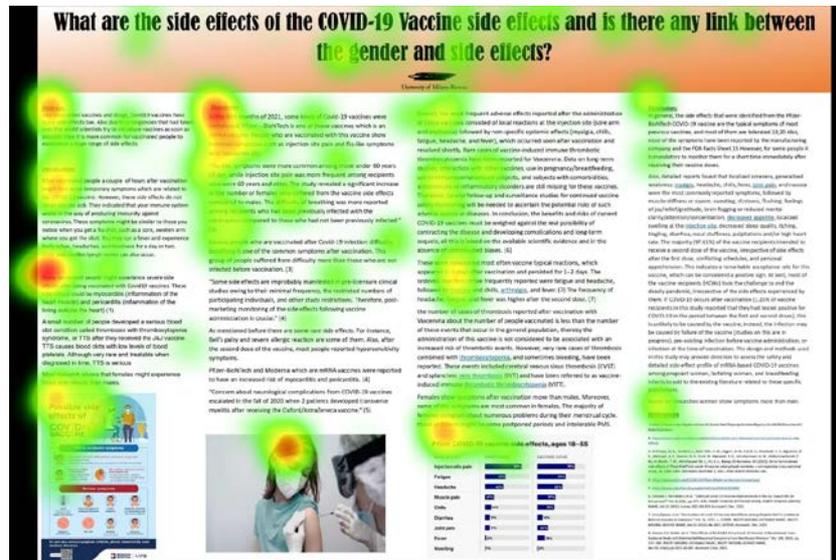


Fig 5. Heat map of poster B.

## 5. Conclusions

The present analysis has explored an alternative way to comprehend and evaluate academic poster writing within a class environment. What is commonly provided to university students that need to learn how to design and write an academic poster is usually a long list of do's and don't's, a few examples to follow and perhaps a university template to utilize, uniformizing every poster presentation. An alternative way to explore how the genre works cognitively is to utilize an eye-tracking lab to reveal to students what the consequences are for puzzled viewers because of a poorly designed poster.

Poster A provided an example of a poster that follows most of the instructions provided during the writing course and the scan path and heat map derived from the eye-tracking trial confirmed the effectiveness of the visual interactive and interactional elements utilized by the student. This exploratory study, although limited, confirms that academic posters are complex texts and consequently they tend to elicit more and longer fixations and regressions. These fixations cluster around visual interactive and interactional elements that respectively help guide the reader through the initial skimming phase, and provide salient material that makes the poster stand out in a poster session, where presenters inevitably compete for attention.

Poster B provided an example of poor design and bad choices made by the student writer, who did not fully comprehend how to utilize correctly visual metadiscourse elements and most of all, did not reach a balance between the amount of text inserted and the use of images and graphic elements. The scan path and heat map confirmed an overwhelmed reading experience, where the viewer tries unsuccessfully to map the organization of information. The high amount of average-length fixations and long and short saccades and regressions, especially where the novice writer inserted syntactically incorrect textual elements, has shown the student the cognitive load experienced by the viewer when trying to decipher the meaning of the text. In a poster session, such errors would lead viewers to stop reading the poster because, in such a context, where time is short and competition is high, one looks for interesting, yet easily readable academic material.

Finally, this exploratory study hints at the fact that utilizing ready-available poster templates is not sufficient. The visual and textual

mechanisms of poster presentations need to be fully understood by novice (and expert) academic writers to balance every element they choose to display, always keeping in mind the effect it has on viewers and the readability of the poster as a whole. Hopefully, more studies, with a wider corpus, will focus on this pedagogical aspect in the future, with the help of eye-tracking tools.

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