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JOURNALISM, DATA VISUALIZATION, AND PERCEPTION ABOUT READERS

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DOI: 10.25200/BJR.V16N3.2020.1309

Received on: April 30th, 2020
Desk Reviewed: May 21th, 2020
Desk Review Editors: David Domingo and Laura Storch
Revised on: October 16th, 2020
Approved on: November 3rd, 2020

ABSTRACT – In recent years, digital journalism has flirted with the production of new narratives. Among them is the use of data visualization to explain complex information better. There is still a shortage of works that focus on visualization and its narrative potential, especially when it involves the reader. In this article, we investigate how professionals in the graphic departments perceive the reader when producing visualization. We applied a Likert scale questionnaire and obtained 57 responses. We used the Kruskal-Wallis and Mann-Whitney tests to analyze the results to prove our two main hypotheses: (1) that each professional profile has different views on readers and (2) that the innovative character is related to the professionals' perception of the reader. As a result, we proved the first hypothesis partially: journalists and designers have a more favorable view on the role of data visualization than programmers. It was not possible to obtain valid confirmation for the second hypothesis.
Key words: Digital Journalism. Data Journalism. Data Visualization.

JORNALISMO, VISUALIZAÇÃO DE DADOS E PERCEPÇÃO SOBRE OS LEITORES

RESUMO – Nos últimos anos, o jornalismo digital tem flertado com a produção de novas narrativas. Entre elas está o uso da visualização de dados como forma de explicitar melhor as informações complexas. Ainda há escassez de trabalhos que foquem a visualização e seu potencial narrativo, principalmente quando envolve o leitor. Neste artigo, investigamos

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como profissionais dos departamentos gráficos percebem o leitor ao produzir visualização. Aplicamos um questionário de escala Likert e obtivemos 57 respostas. Utilizamos os testes de Kruskal-Wallis e Mann-Whitney para analisar os resultados de forma a comprovar nossas duas principais hipóteses: (1) de que cada perfil profissional possui visões diferentes sobre os leitores e (2) de que o caráter inovador está relacionado com a percepção dos profissionais sobre o leitor. Como resultado, conseguimos comprovar parcialmente a primeira hipótese, na qual jornalistas e designers têm uma visão mais favorável sobre o papel da visualização de dados do que programadores. Não foi possível obter uma confirmação razoável para a segunda hipótese.
Palavras-chave: Jornalismo Digital. Jornalismo de Dados. Visualização de Dados.

PERIODISMO, VISUALIZACIÓN DE DATOS Y PERCEPCIÓN SOBRE LECTORES

RESUMEN – En los últimos años, el periodismo digital ha acercado con la producción de nuevas narrativas. Entre ellas se encuentra el uso de la visualización de datos como una forma de explicar mejor las informaciones complejas. Todavía hay una escasez de trabajos que se centren en la visualización y su potencial narrativo, especialmente cuando involucra al lector. En este artículo, investigamos cómo los profesionales en los departamentos gráficos perciben al lector al producir la visualización. Aplicamos un cuestionario de escala Likert y obtuvimos 57 respuestas. Utilizamos las pruebas de Kruskal-Wallis y Mann-Whitney para analizar los resultados con el fin de demostrar nuestras dos hipótesis principales: (1) que cada perfil profesional tiene diferentes puntos de vista sobre los lectores y (2) que el carácter innovador está relacionado con La percepción profesional del lector. Como resultado, pudimos probar parcialmente la primera hipótesis, en la cual los periodistas y diseñadores tienen una visión más favorable sobre el papel de la visualización de datos que los programadores. No fue posible obtener una confirmación razonable de la segunda hipótesis.
Palabras clave: Periodismo Digital. Periodismo de Datos. Visualización de Datos.

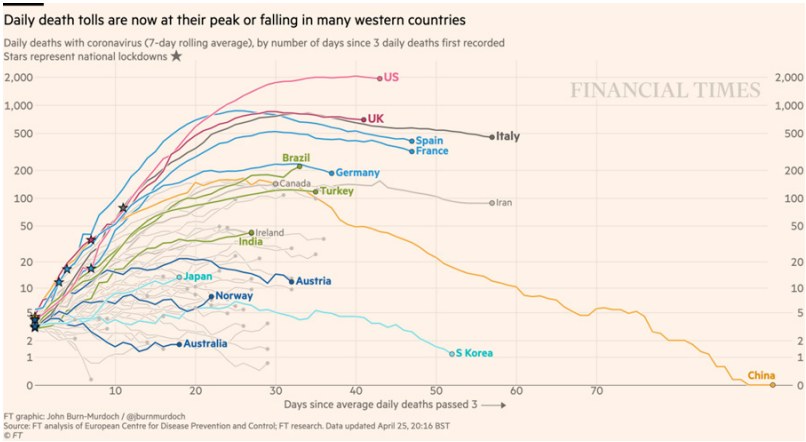
1 Introduction

In recent years, digital journalism has flirted with the production of new narratives to attract and bring the audience closer. Like *The New York Times*, large news corporations have established complete and autonomous data analysis and visualization teams (Bailerson, 2018). These teams are made up of professionals from different backgrounds and positions. They include journalists, designers and programmers, and other unusual profiles in newsrooms such as cartographers, sociologists, mathematicians, economists, urban planners, belletrists, among others. Professional practices range from developing codes to automate collecting information (scraping), filtering, standardizing, and mining data, applying statistical models, editing videos and animations, and designing data visualizations.

There is still a shortage of works that focus on visualization and its narrative potential. According to Ausserhofer et al. (2017), the first wave of research on data journalism has addressed organizational culture questions, with in-depth interviews and content analysis of the teams' visual reports. The most recent research on data visualization in journalism is a consequence of the first studies in the area carried out since the 1960s, with the works of Jacques Bertin (*Semiology of Graphics*, 1967), John Tukey (*Exploratory Data Analysis*, 1977), William S Cleveland (*The Elements of Graphics Data*, 1983) and Edward Tufte (*The Visual Display of Quantitative Information*, 1983). For Cairo (2016), we are talking about exploratory data analysis that, based on visual representations, allows the reader to explore and interpret information.

The relationship is evident in the visualizations produced by various digital media on the cases of confirmation and death by the new coronavirus (SARS-CoV-2). An example is a graph produced by the *Financial Times*, which compares the number of daily deaths reported by Organs official agencies of each country. In addition to revealing the peaks in nations that overcame the disease crisis, it is also possible to establish that there are problems of underreporting cases like Brazil, which perceive an increase in the curve that seemed to slow down (Figure 1).

Figure 1 – *Financial Times* line graph compares the number of daily deaths from coronavirus in different countries (updated April 25, 2020)



Source: Financial Times, John Burn-Murdoch. Retrieved from https://on.ft.com/2VVbPKI

One of the crucial questions about the production of data visualization in digital journalism directly involves the reader: what is

DOI: 10.25200/BJR.v16n3.2020.1309

the perception of professionals about the receivers when producing a visualization? Alberto Cairo (2016) treats all visualization as a grammar, which has its rules and limitations and needs to be learned and taught to the reader. Mainly when producing impressive graphics: bars, lines, and pie. This article presents the result of a questionnaire with a Likert scale, applied to journalists, designers, programmers, and other professionals in the graphic departments of companies to understand how readers think when creating a specific visualization.

We work with two hypotheses:

H1. That journalists, designers, and programmers have different views on readers. Even though it is challenging to establish groups because we have multifaceted backgrounds in this field, it is worth understanding how the professional sees himself within the newsroom, regardless of his background. It is possible to find significant differences related to (a) the person's work and (b) academic training. Programmers may be more inclined to experiment with innovative graphics and explain to the reader how to read. Journalists are more inclined to use more basic graphics. It is what we want to test;

H2. That the innovative character is directly related to the professionals' perception of the reader. The more they think their readers can understand grammar, the more they bet on innovative visualizations. We intend to consult both large newsrooms, with an innovative character and a history with awards that attest to their innovative potentials, such as *The New York Times*, *The Washington Post*, *The Guardian*, *Financial Post*, and small newsrooms.

The questionnaire was applied to professionals in these newsrooms. The Likert scale results were analyzed using statistical models, which will be detailed in the methodology.

2 Literature review

2.1 Data journalism

Research on data journalism is quite recent. Some divergences are evident. Starting with the nomenclature for the phenomenon: computational journalism (Cohen et al., 2011; Flew et al., 2012; Kalsen & Stavelin, 2014; Primo & Zago, 2015); programmer journalist (Parasie & Dagiral, 2013); open-source journalism (Lewis & Usher,

2013); data or data-driven journalism (Gray et al., 2012; Appelgren & Nygren, 2014; Gynnild, 2014; Träsel, 2014; Borges-Rey, 2016) and digital database journalism (Barbosa, 2004; Quadros, 2005).

Despite this, many scholars recognize the tradition of computer-assisted reporting as one of the precursors to the current phenomenon. Also known as RAC, this type of reporting emerged in the 1970s from social science methodologies with investigative journalism (Meyer, 1973; Cox, 2000; Lima Júnior, 2006). For Coddington (2015), current terminologies, such as data journalism and computational journalism, are far from RAC, especially after the spread of open-source culture in the 1990s.

The current research wave has focused on some concerns related to the introduction of data in the journalistic routine, causing changes and requiring specific skills (Gray et al., 2012; Flew et al., 2012; Parasie & Dagiral, 2013; Appelgren & Nygren, 2014). There is also an emphasis on the role of visualization for data analysis, using interactive maps and diagrams (Hullman et al., 2015). However, bibliographic production presents an understanding of the phenomenon of data journalism both as a production process and as a product (Cohen et al., 2011; Tabary et al., 2015; Coddington, 2015).

Brazilian studies are rarely found in research on data journalism. We highlight the seminal work of Suzana Barbosa (2004), which deals with the paradigm of digital journalism in databases. Likewise, there are studies by Quadros (2005), Lima Júnior (2006), and Träsel (2014). More recently, there is the work of Primo and Zago (2015), which deals with the identification of the actors involved in the computational journalism process, combined with Bruno Latour's actor-network theory; and also Longhi's research (2014), which studies visualization as an element in which the author fits into the phenomenon of multimedia reporting.

When "datifying" research on data journalism, Ausserhofer et al. (2017, p.17) identified some gaps in the focus of previous research, among them, the scarcity of international studies that compare the phenomenon between different countries, the need for studies with a longer *corpus* term and, according to the suggestion of Segel and Heer (2010), investigations that are focused on the reader's experience to understand whether he is involved with visual elements and, consequently, how data visualization can improve in the journalistic production process.

 DOI: 10.25200/BJR.v16n3.2020.1309

2.2 Data visualization

Data visualization has been present as part of print and television news for some time. With digital journalism, today's difference is the interactive graphics that use a database from the beginning until its presentation. The media needed other professionals to adapt to the new product form, such as designers, cartographers, data scientists, and programmers. The visualization of data not only gave the interdisciplinary character in the research but also in the newsrooms.

Kirk (2019, p.15) conceptualizes data visualization as "the visual representation and presentation of data to facilitate understanding". The basis of all visualization is the power of synthesis of communication and understanding on a given subject. A graph, with its patterns and visual objects, can communicate faster than a table of numbers. Both ways are not mutually exclusive but offer different ways to observe the data. The analyst/producer must be able to choose the best way to represent the information.

Unlike infographics, which are used to communicate a (or more) specific message from a graphic representation, data visualization, in turn, allows the reader to analyze, explore, and discover information. Because there are no predetermined messages, the reader can interact with the graph and obtain the information he is looking for or even discover other hidden data under the layers of information (Cairo, 2016).

This improvement, in turn, generates new forms of communication. Representing multidimensional information requires an analytical and visual/spatial method of reasoning. "Graphic design, in particular, depends on cognitive processes and visual perception for its creation (coding) and its use (decoding). If the decoding process fails, the visualization will fail" (Meirelles, 2011).

Therefore, the concern with detecting and analyzing how much the user can interpret interactive graphics is justified. There is a distance between the producing instances and the people who receive the information. The daily journalism environment allows for little dialogue between the two actors. Often, a well-crafted visualization can lead to communication failure.

3 Methodology

The method design consisted of applying an online form, with twelve statements, based on a 5-point Likert scale (with the options completely disagree = 1, disagree = 2, neutral = 3, agree = 4, and completely agree = 5). We chose this psychometric response scale to quantify the levels of posture and opinions about certain statements worked on in the main hypotheses. The form was applied between August 2018 to April 2019 for several professionals who work with data journalism and in the newspaper companies' graphic departments. The author's questionnaire statements were constructed experimentally and previously tested to detect the perception that the professionals had of the readers about the reading of the visualization. Some points overlap with others to test the best language and increase the tool's reliability criteria. In the pilot study, the following questions were adopted:

1. Data visualization has essential role in digital journalism
2. Data visualization is just one element of digital journalism among many others
3. Graphics are able to explain any information in an easy way to the reader
4. Graphics are just one element of information among many others
5. My reader has limited ability to interpret graphics/charts
6. My reader is able to understanding any graphic
7. My reader is able to understand any complex graph, provided there is an explanation about it
8. My reader is able to interact with any visualization
9. My reader is able to interact with any complex visualization provided there is an explanation about it
10. My reader is afraid to interact with some visualizations
11. My reader gives up reading when there is a complex chart/visualization
12. My reader is attracted to innovative visualizations

In total, the questionnaire was applied to 153 people, reaching a return rate of 39.6%, with 61 responses. Four were excluded due to three duplicates in the responses and one person who did not want to identify himself, even though it was confidential information. In the end, we worked with 57 responses. In addition to statements and identity, we also asked about age, function, company for which you worked, and educational background. The items on function and training will be used to analyze the results to test the hypotheses. The average age of those who participated in the questionnaire is 34.76 years (SD = 7.92), 43 men and 14 women.

Under the main criterion of frequently working with data visualization, the selected vehicles were taken from awards such as

  doi: 10.25200/bjr.v16n3.2020.1309

Malofiej (focused exclusively on infographics and data visualization), SND Best of Digital Design, Online Journalism Awards, and GEN Data Journalism Awards. Also, we launched the form for data journalism professionals in the NICAR-L Mailing List group, which also includes professionals from independent journalism companies. In all, respondents identified themselves as belonging to the following vehicles: *The Washington Post* (USA, 11 people); *The New York Times* (USA, 7); *FiveThirtyEight* (USA, 5); *The Wall Street Journal* (USA, 4); Vox (USA, 2); *ProPublica* (USA, 2); *The Guardian* (United Kingdom, 2); *A24.com* (Argentina, 1); *Agência Pública* (Brazil, 1); *Austin American-Statesman* (USA, 1); *Axios* (USA 1); *Bayerischer Rundfunk* (Germany, 1); *CBC* (Canada, 1); *CBS Interactive* (USA, 1); *Datasketch* (USA, 1); *Der Spiegel* (Germany, 1); *Folha de S.Paulo* (Brazil, 1); *KUNM Radio* (USA, 1); *McKinsey* (USA, 1), *Nexo Jornal* (Brazil, 1); NPR (USA, 1); *Folha de S.Paulo* (Brazil, 1); *RADAR AI* (United Kingdom, 1); *RTV Slovenija* (Slovenia, 1); *South China Morning Post* (Hong Kong, 1); *Sun Sentinel* (USA, 1); *The Chronicle* (USA, 1); *Tiso Blackstar* (South Africa, 1); and *Univisión* (USA, 1). Two people identified themselves as a freelancer.

In this study, we made an effort to include a more balanced sample, with professionals from Latin America and other continents. However, we obtained little or no response from these professionals, with the predominance of American journalists.

Participants were also able to identify their position and their academic background, which are important issues for establishing groups for the study. Table 1 summarizes the identification of people in the questionnaire.

Table 1 – Identification of the questionnaire participants

ID	Gender	Age	Background education	Position held	Media
1	Male	28	Art (F3)	Visuals Editor (C2)	Axios (M2)
2	Male	37	Journalism (F1)	Graphics Editor (C2)	The Washington Post (M1)
3	Male	36	Design (F3)	Visual Editor (C2)	The New York Times (M1)
4	Male	34	Engineering (F2)	Visual Journalist (C1)	FiveThirtyEight (M1)
5	Male	37	Journalism (F1)	Infographer (C2)	Univision (M1)
6	Female	36	Journalism (F1)	Graphics Assignment Editor (C1)	The Washington Post (M1)
7	Male	28	Mathematics (F2)	Graphics Editor (C2)	The New York Times (M1)

8	Male	52	Journalism (F1)	Graphics Editor (C2)	Vox (M2)
9	Female	27	Advertising (F1)	Interactive Designer (C2)	Sun Sentinel (M2)
10	Male	29	Journalism (F1)	Graphics Editor (C2)	The New York Times (M1)
11	Female	29	Communication (F1)	Graphics Editor (C2)	The Wall Street Journal (M1)
12	Female	-	Journalism (F1)	Assistant Managing Editor (C4)	ProPublica (M1)
13	Male	29	Environmental Studies (F4)	Assignment Editor (C1)	The Washington Post (M1)
14	Female	30	Informatic Engineering (F2)	Graphics Editor (C2)	The New York Times (M1)
15	Male	38	Computer Science (F2)	Graphics Reporter (C1)	The Washington Post (M1)
16	Male	26	Journalism (F1)	Graphics Reporter (C1)	The Washington Post (M1)
17	Male	26	Journalism (F1)	Graphics Editor (C2)	The Washington Post (M1)
18	Male	35	Mathematics (F2)	Editorial Developer (C3)	The Washington Post (M1)
19	Female	30	Economics (F4)	Graphics Reporter (C1)	The Washington Post (M1)
20	Male	35	Arts (F3)	Deputy Director of Graphics (C4)	The Washington Post (M1)
21	Male	29	Journalism (F1)	Graphics Reporter (C1)	The Washington Post (M1)
22	Male	35	Journalism (F1)	Staff Writer (C4)	The Washington Post (M1)
23	Male	35	Political Science (F4)	Senior Editor (C4)	The New York Times (M1)
24	Female	26	English (F4)	Visual Journalist (C1)	FiveThirtyEight (M1)
25	Male	39	Computer Engineering (F2)	Computational Journalist (C1)	FiveThirtyEight (M1)
26	Female	25	Urban Studies (F4)	Associate Visual Journalist (C1)	FiveThirtyEight (M1)
27	Male	45	Journalism (F1)	Assistant Managing Editor (C4)	The Chronicle (M2)
28	Female	31	Mediterranean Studies (F4)	Journalist (C1)	Freelancer (M2)
29	Female	33	Liberal Arts (F3)	Data Editor (C3)	CBS Interactive (M2)
30	Male	39	English	Data Journalist (C1)	CBC (M2)
31	Male	38	International Relations (F4)	Project Coordinator (C4)	KUNM Radio (M2)
32	Male	47	Journalism (F1)	News App Developer (C3)	ProPublica (M1)

DOI: 10.25200/BJR.v16n3.2020.1309

33	Male	27	Journalism (F1)	News App Developer (C3)	Austin American-Statesman (M2)
34	Male	39	Computer Science (F2)	Director (C4)	FiveThirtyEight (M1)
35	Male	42	Journalism (F1)	Graphics Editor (C2)	The New York Times (M1)
36	Male	37	Computer Science (F2)	Data Editor (C3)	Vox (M2)
37	Male	37	Journalism (F1)	News App Developer (C3)	NPR (M2)
38	Male	25	Software Engineering (F2)	Interactive Journalist (C1)	The Guardian (M1)
39	Male	27	Business Management (F4)	Interactive Journalist (C1)	The Guardian (M1)
40	Male	47	Photography (F1)	UX Lead (C4)	McKinsey (M2)
41	Male	24	Journalism (F1)	Data Journalist (C1)	O Estado de S.Paulo (M2)
42	Female	29	Fine Arts (F3)	Graphics Editor (C2)	The Wall Street Journal (M1)
43	Female	28	English (F4)	Graphics Editor (C2)	The Wall Street Journal (M1)
44	Female	36	Meteorology (F4)	Cartographer (C2)	The Wall Street Journal (M1)
45	Male	60	Geography (F4)	Graphics Editor (C2)	The New York Times (M1)
46	Male	45	Mathematics (F2)	Developer (C3)	Agência Pública (M2)
47	Male	25	Journalism (F1)	Visual Journalist (C1)	Nexo (M1)
48	Male	36	Urban Planner (F4)	Data Journalist (C1)	Der Spiegel (M1)
49	Male	36	Biological Sciences (F4)	Data Journalist (C1)	Folha de S.Paulo (M1)
50	Male	30	Journalism (F1)	Technical Lead (C4)	Bayerischer Rundfunk (M2)
51	Male	52	Economics (F4)	Director (C4)	RADAR AI (M2)
52	Male	42	Design (F3)	Graphic Designer (C2)	Tiso Blackstar (M2)
53	Male	36	Business (F4)	Freelancer (C4)	Freelancer (M2)
54	Male	25	Anthropology (F4)	Data Journalism (C1)	A24.com (M2)
55	Male	35	Electrical Engineering (F2)	CEO (C4)	Datasketch (M2)
56	Female	34	Social Sciences (F4)	Researcher (C4)	RTV Slovenija (M2)
57	Male	49	Design (F3)	Graphic Designer (C2)	South China Morning Post (M1)

Source: self elaboration.

For analysis, we separated the participants into groups, according to their academic background and their position. In the analysis design, we did not consider crossing other factors such as writing time, which was not defined in our initial hypotheses. However, it is something that we will be able to contemplate in more studies. Regarding training, we established four groups: F1/with 31.5% of the total (trained in Journalism, Advertising and Communication); F2/19.3% (graduated in Computer Science, Mathematics, Engineering); F3/14% (graduated in Arts, Design and Photography); F4/31.6% (other areas of Social Sciences, such as Environment, Urban Planning, Geography, Literature, Economics, International Relations, Political Science, Sociology and a person trained in Biological Sciences). This last group reflects the diversity of academic backgrounds of professionals involved in data journalism. The groups are identified in the table above.

Regarding the position, we also identified and classified in the following groups: C1/with 33.3% of the total (professionals who identified themselves as journalists and reporters, such as data journalist, visual journalist, interactive journalist, computer journalist, agenda editor, and graphic reporter); C2/31.6% (designers, visual editors, graphic editors, infographic designers); C3/12.3% (developers, data editors); and C4/22.8% (management positions with a broad vision of functioning, such as coordinators, researchers, CEO, senior editors, as well as freelancers). Job groups are also identified above.

Finally, we also classify the media to which the professionals belong in groups. We separated into two groups to detect a difference in perception between professionals from the most awarded media (M1) and those who have less protagonism (M2). The media that are part of the first group received awards for journalistic design and data visualization, such as Malofiej and SND Best of Digital Design. They include *The New York Times*, *The Washington Post*, *The Guardian*, *The Wall Street Journal*, *South China Morning Post*, *Folha de S.Paulo*, *Der Spiegel*, *FiveThirtyEight*, *Nexo Jornal*, *ProPublica,* and *Univisión*.

We consider using non-parametric test methods to perform the analyses. In the pre-test, we identified that the results were not identified with the normal distribution. We adopted the Kruskal-Wallis H test to compare each of the four groups of formation and position (or analysis of variance of a factor in positions). Regarding the means, we opted for the Mann-Whitney U test for the analysis of two independent samples (Hollander, Wolfe & Chicken, 1999).

In the results obtained both in the pre-test and in this study, we present the results only for the statistically significant questions ($p < .05$).

doi: 10.25200/bjr.v16n3.2020.1309

4 Results and discussion

In the first analysis, the Kruskal-Wallis test showed that there is an effect of the groups on Formation (F1, F2, F3, and F4) on question 3 "Graphs are able to explain any information in an easy way for the reader" [x^2 (3) = 9,800; p <.05]; question 5 "My reader has limited ability to interpret graphs" [x^2 (3) = 6.534; p <.05]; and question 7 "My reader is able to understand a complex graph, as long as there is an explanation about it" [x^2 (3) = 10,140; p <.05].

Table 3 – Descriptive statistics

	N	Mean	Standard derivation	Minimum	Maximum
Data visualization has essential role in digital journalism	57	4,3509	,87610	1,00	5,00
Data visualization is just one element of digital journalism among many others	57	4,4211	,77799	1,00	5,00
Graphics are able to explain any information in an easy way to the reader	57	2,9649	1,37536	1,00	5,00
Graphics are just one element of information among many others	57	4,0526	,83283	1,00	5,00
My reader has limited ability to interpret graphics/charts	57	3,0877	1,07372	1,00	5,00
My reader is able to understanding any graphic	57	2,2105	,99529	1,00	5,00
My reader is able to understand any complex graph, provided there is an explanation about it	57	3,1404	1,23112	1,00	5,00
My reader is able to interact with any visualization	57	2,5614	,90667	1,00	5,00
My reader is able to interact with any complex visualization provided there is an explanation about it	57	3,0000	1,16496	1,00	5,00
My reader is afraid to interact with some visualizations	57	3,2105	,99529	1,00	5,00
My reader gives up reading when there is a complex chart/visualization	57	2,8246	1,01985	1,00	5,00
My reader is attracted to innovative visualizations	57	3,7719	1,03540	1,00	5,00
TOTAL	57	2,6842	1,07168	1,00	4,00

Source: author´s elaboration

Table 4 – Kruskal-Wallis test

		N	Mean rank
Data visualization has essential role in digital journalism?	Art, Design	8	34.56
	Journalist	20	28.05
	Programmer, Mathematics	11	32.36
	Others	18	25.53
	Total	57	
Data visualization is just one element of digital journalism among many others	Art, Design	8	30.38
	Journalist	20	28.38
	Programmer, Mathematics	11	32.64
	Others	18	26.86
	Total	57	
Graphics are able to explain any information in an easy way to the reader	Art, Design	8	38.13
	Journalist	20	34.68
	Programmer, Mathematics	11	23.23
	Others	18	22.17
	Total	57	
Graphics are just one element of information among many others	Art, Design	8	25.56
	Journalist	20	32.95
	Programmer, Mathematics	11	32.95
	Others	18	23.72
	Total	57	
My reader has limited ability to interpret graphics/charts	Art, Design	8	23.94
	Journalist	20	26.63
	Programmer, Mathematics	11	21.45
	Others	18	38.50
	Total	57	
My reader is able to understanding any graphic	Art, Design	8	33.75
	Journalist	20	34.08
	Programmer, Mathematics	11	22.23
	Others	18	25.39
	Total	57	

DOI: 10.25200/BJR.v16n3.2020.1309

My reader is able to understand any complex graph, provided there is an explanation about it	Art, Design	8	34.06
	Journalist	20	36.38
	Programmer, Mathematics	11	20.05
	Others	18	24.03
	Total	57	
My reader is able to interact with any visualization	Art, Design	8	30.94
	Journalist	20	31.90
	Programmer, Mathematics	11	27.59
	Others	18	25.78
	Total	57	
My reader is able to interact with any complex visualization provided there is an explanation about it	Art, Design	8	32.63
	Journalist	20	35.08
	Programmer, Mathematics	11	21.86
	Others	18	25.00
	Total	57	
My reader is afraid to interact with some visualizations	Art, Design	8	28.75
	Journalist	20	31.20
	Programmer, Mathematics	11	27.59
	Others	18	27.53
	Total	57	
My reader gives up reading when there is a complex chart/visualization	Art, Design	8	34.25
	Journalist	20	25.60
	Programmer, Mathematics	11	29.27
	Others	18	30.28
	Total	57	
My reader is attracted to innovative visualizations	Art, Design	8	32.88
	Journalist	20	30.28
	Programmer, Mathematics	11	29.32
	Others	18	25.67
	Total	57	

Source: author´s elaboration

Figure 2 – Result of the Kruskal-Wallis test of Independent Samples: the question "Graphics are able to explain any information in an easy way to the reader" for the samples grouped by background education [x^2 (3) = 9,800; p <.05]

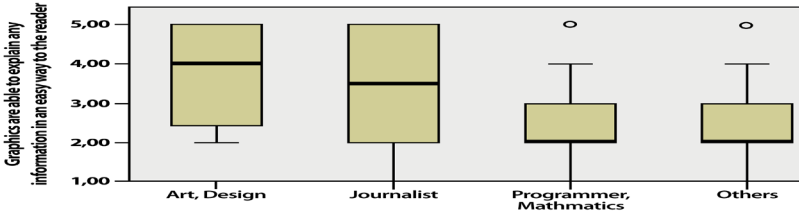


Figure 3 – Result of the Kruskal-Wallis test of Independent Samples: the question "My reader has limited ability to interpret graphics/charts" for the samples grouped by background education [x^2 (3) = 6.534; p <.05]

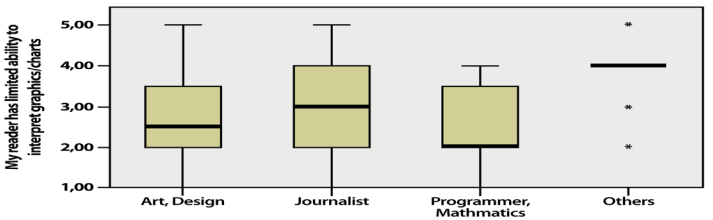
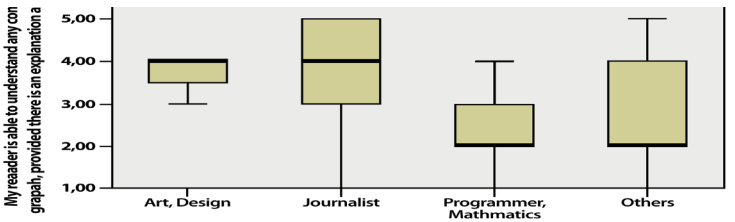


Figure 4 – Result of the Kruskal-Wallis test of Independent Samples: the question "My reader is able to understand any complex graph, provided there is an explanation about it" for the samples grouped by background education [x^2(3) = 10,140; p < .05]



Source: author´s elaboration

In the three questions, we understand a distinction between the four groups from the training. In distributions, the Art/Design

DOI: 10.25200/BJR.v16n3.2020.1309

(F3) and Journalism (F1) groups tend to agree more on each issue than Programmers/Mathematicians (F2) and other backgrounds (F4), who are more conservative. This contradicts our initial hypothesis that journalists could be more conservative and opt for more basic graphics. For them, in addition to understanding the potential of graphics to facilitate the understanding of any information, the reader would also be able to interpret more complex graphics, as long as they are didactic as to their interpretation. On question 5, the limitation of the reader, they have a more neutral opinion.

In the second analysis, the Kruskal-Wallis test showed that there is an effect on the Cargo groups (C1, C2, C3, and C4) on question 3 "Graphics are able to explain any information in an easy way to the reader" [x^2 (3) = 11,937; p <.05]. In this case, we are classifying the groups by the position they identify, regardless of each person's background education. It is possible for a person trained in journalism to identify himself as a designer and vice versa.

Table 5 – Descriptive statistics

	N	Mean	Standard derivation	Minimum	Maximum
Data visualization has essential role in digital journalism?	57	4,3509	,87610	1,00	5,00
Data visualization is just one element of digital journalism among many others	57	4,4211	,77799	1,00	5,00
Graphics are able to explain any information in an easy way to the reader	57	2,9649	1,37536	1,00	5,00
Graphics are just one element of information among many others	57	4,0526	,83283	1,00	5,00
My reader has limited ability to interpret graphics/charts	57	3,0877	1,07372	1,00	5,00
My reader is able to understanding any graphic	57	2,2105	,99529	1,00	5,00
My reader is able to understand any complex graph, provided there is an explanation about it	57	3,1404	1,23112	1,00	5,00
My reader is able to interact with any visualization	57	2,5614	,90667	1,00	5,00
My reader is able to interact with any complex visualization provided there is an explanation about it	57	3,0000	1,16496	1,00	5,00

My reader is afraid to interact with some visualizations	57	3,2105	,99529	1,00	5,00
My reader gives up reading when there is a complex chart/visualization	57	2,8246	1,01985	1,00	5,00
My reader is attracted to innovative visualizations	57	3,7719	1,03540	1,00	5,00
TOTAL	57	2,2456	1,15389	1,00	4,00

Source: author´s elaboration

Table 6 – Kruskal-Wallis test

		N	Mean Rank
Data visualization has essential role in digital journalism?	Journalist	19	27.95
	Visuals	18	29.86
	Programmers	7	31.86
	Staff	13	27.81
	Total	57	
Data visualization is just one element of digital journalism among many others	Journalist	19	29.03
	Visuals	18	32.50
	Programmers	7	27.14
	Staff	13	25.12
	Total	57	
Graphics are able to explain any information in an easy way to the reader	Journalist	19	18.63
	Visuals	18	33.92
	Programmers	7	34.36
	Staff	13	34.46
	Total	57	
Graphics are just one element of information among many others	Journalist	19	29.82
	Visuals	18	28.47
	Programmers	7	26.21
	Staff	13	30.04
	Total	57	
My reader has limited ability to interpret graphics/charts	Journalist	19	30.34
	Visuals	18	28.39
	Programmers	7	25.21
	Staff	13	29.92
	Total	57	
My reader is able to understanding any graphic	Journalist	19	26.87
	Visuals	18	31.89
	Programmers	7	25.21
	Staff	13	30.15
	Total	57	

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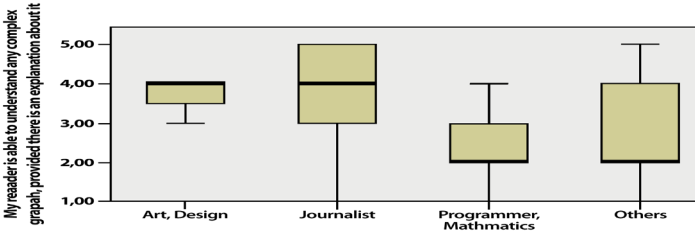
My reader is able to understand any complex graph, provided there is an explanation about it	Journalist	19	28.55
	Visuals	18	31.53
	Programmers	7	23.43
	Staff	13	29.15
	Total	57	
My reader is able to interact with any visualization	Journalist	19	25.71
	Visuals	18	32.00
	Programmers	7	35.21
	Staff	13	26.31
	Total	57	
My reader is able to interact with any complex visualization provided there is an explanation about it	Journalist	19	26.79
	Visuals	18	35.36
	Programmers	7	23.00
	Staff	13	26.65
	Total	57	
My reader is afraid to interact with some visualizations	Journalist	19	29.03
	Visuals	18	27.14
	Programmers	7	32.50
	Staff	13	29.65
	Total	57	
My reader gives up reading when there is a complex chart/ visualization	Journalist	19	26.55
	Visuals	18	30.94
	Programmers	7	32.57
	Staff	13	27.96
	Total	57	
My reader is attracted to innovative visualizations	Journalist	19	28.55
	Visuals	18	30.31
	Programmers	7	29.93
	Staff	13	27.35
	Total	57	

Source: author´s elaboration

Figure 5 – Result of the Kruskal-Wallis test of Independent Samples: the question "Graphics are able to explain any information in an easy way to the reader" for the samples grouped by position held [$x^2(3) = 11,937$; $p < .05$]



Source: author´s elaboration

In this case, without considering the training point of view, we have the opposite effect. The people who identified themselves as journalists are more conservative and tended to disagree on the third question. Professionals with design and managerial positions tended to agree more. While programmers are more neutral than others.

Finally, in the third analysis, we separated the samples into two groups: those who work in the media outlets (large media outlets, which have awards in visual reporting) and the small vehicles we call local/ regional media. The Mann-Whitney test showed that question 12, "My reader is attracted to innovative visualizations" affects the samples of the leading innovative vehicles and regional media ($U = 260,500$; $p <.05$).

Table 7 – Descriptive statistics

	N	Mean	Standard derivation	Minimum	Maximum
Data visualization has essential role in digital journalism?	57	4,3509	,87610	1,00	5,00
Data visualization is just one element of digital journalism among many others	57	4,4211	,77799	1,00	5,00
Graphics are able to explain any information in an easy way to the reader	57	2,9649	1,37536	1,00	5,00
Graphics are just one element of information among many others	57	4,0526	,83283	1,00	5,00
My reader has limited ability to interpret graphics/charts	57	3,0877	1,07372	1,00	5,00
My reader is able to understanding any graphic	57	2,2105	,99529	1,00	5,00
My reader is able to understand any complex graph, provided there is an explanation about it	57	3,1404	1,23112	1,00	5,00

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My reader is able to interact with any visualization	57	2,5614	,90667	1,00	5,00
My reader is able to interact with any complex visualization provided there is an explanation about it	57	3,0000	1,16496	1,00	5,00
My reader is afraid to interact with some visualizations	57	3,2105	,99529	1,00	5,00
My reader gives up reading when there is a complex chart/visualization	57	2,8246	1,01985	1,00	5,00
My reader is attracted to innovative visualizations	57	3,7719	1,03540	1,00	5,00
TOTAL	57	1,3684	,48666	1,00	2,00

Source: author´s elaboration

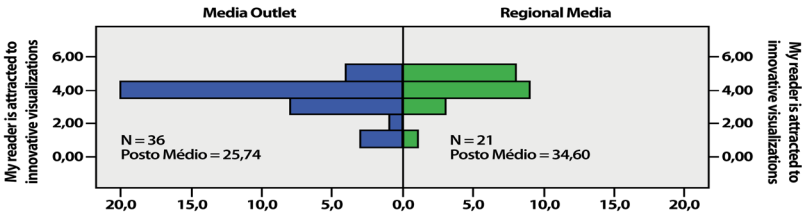
Table 8 – Mann-Whitney test

		N	Mean Rank	Sum of Ranks
Data visualization has essential role in digital journalism?	Media Outlet	36	27.76	999.50
	Regional Media	21	31.12	653.50
	Total	57		
Data visualization is just one element of digital journalism among many others	Media Outlet	36	30.47	1097.00
	Regional Media	21	26.48	556.00
	Total	57		
Graphics are able to explain any information in an easy way to the reader	Media Outlet	36	27.24	980.50
	Regional Media	21	32.02	672.50
	Total	57		
Graphics are just one element of information among many others	Media Outlet	36	30.08	1083.00
	Regional Media	21	27.14	570.00
	Total	57		
My reader has limited ability to interpret graphics/charts	Media Outlet	36	26.40	950.50
	Regional Media	21	33.45	702.50
	Total	57		
My reader is able to understanding any graphic	Media Outlet	36	29.46	1060.50
	Regional Media	21	28.21	592.50
	Total	57		
My reader is able to understand any complex graph, provided there is an explanation about it	Media Outlet	36	30.10	1083.50
	Regional Media	21	27.12	569.50
	Total	57		
My reader is able to interact with any visualization	Media Outlet	36	28.78	1036.00
	Regional Media	21	29.38	617.00
	Total	57		
My reader is able to interact with any complex visualization provided there is an explanation about it	Media Outlet	36	29.21	1051.50
	Regional Media	21	28.64	601.50
	Total	57		

My reader is afraid to interact with some visualizations	Media Outlet	36	27.32	983.50
	Regional Media	21	31.88	669.50
	Total	57		
My reader gives up reading when there is a complex chart/ visualization	Media Outlet	36	28.44	1024.00
	Regional Media	21	29.95	629.00
	Total	57		
My reader is attracted to innovative visualizations	Media Outlet	36	25.74	926.50
	Regional Media	21	34.60	726.50
	Total	57		

Source: author´s elaboration

Figure 6 – Result of the Mann-Whitney U test of Independent Samples: the question "My reader is attracted to innovative visualizations" for the samples grouped by position held (U = 260,500; p <.05)



Source: author´s elaboration

Regarding the analysis, the average rank of media outlets (25.74) is lower than that of regional media (34.60). However, according to the distribution, both tend to agree that the reader is attracted to innovative visualizations. However, regional vehicles tend to agree more strongly, given the greater frequency of people who choose the answer "totally agree = 5".

5 Conclusion

Returning to the hypotheses worked out at the beginning of the research, we believe that the first hypothesis is partially supported. Even though journalists, designers, and programmers have different views, this also tends to differentiate due to each professional's work and educational background. On the training aspect, journalists and designers agreed more than the programmers that graphics represent an easier way to explain any information to readers. Nevertheless,

DOI: 10.25200/BJR.v16n3.2020.1309

when it comes to the role, how they identify within the newsroom, journalists were more conservative. The image of the professional position he holds weighed in the respondents' opinions.

Regarding the second hypothesis, in which the innovative character is directly related to the reader's professionals' perception, we could not prove it, as there was no statistically significant issue. As for the company to which it belongs, the only possibility that we can attest is that both professionals from large companies and small newsrooms also think that readers are attracted by innovative views, tending to have more weight in small newsrooms.

The research presents itself as the first development of a tool for the opinion of professionals about readers. Indeed, there are flaws that we can improve in the next applications, mainly regarding the reproducibility of the results for other researchers and a more balanced sample, with the diversification of the view of professionals from other continents. As for the applied methodology, we can rely on the choice of tests that presented satisfactory results. That will continue to be applied in future studies on the relationship between professionals and readers in digital journalism.

*Acknowledgment: We thank Professor Alberto Cairo, Knight Chair in Visual Journalism at the School of Communication at the University of Miami, for his support in spreading the questionnaire; and Professor Getúlio Amorim, from the Statistics Department of the Federal University of Pernambuco, for his support on statistical analysis.

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