

Interactive Infographics in German Online Newspapers

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Abstract

Interactive infographics are increasingly used in online journalism. Especially in data-driven journalism they provide a powerful tool to represent and communicate complex information. On the basis of a content analysis of five German-speaking online newspapers we show which kinds of interactive visualizations are preferred in German-speaking online media. However, users are still unfamiliar with interactive infographics. The results of a user survey demonstrate how readers of online newspapers use interactive infographics. These results point out how users interact with interactive infographics and how they assess the availability and findability of interactive infographics in online newspapers.

1. Introduction

Data-driven journalism (short: DDJ) collects, evaluates, interprets and presents large amounts of data. In an innovative and unique way data-driven journalism explains new insights and clarifies facts while telling complex stories on the basis of large amounts of retrieved data [Mat16] [GBC12]. Lorenz [Lor10] defines data-driven journalism as a workflow, where data is the basis for analysis, visualization and – most importantly – storytelling. The growth potential of data-driven journalism is vast and according to Weinacht und Spiller [WS14] it is one of the big issues in specialist publications on journalism and in education of journalists in Germany.

Data-driven journalism can help a journalist to tell a complex story through engaging information graphics [GBC12] [WR13]. In the reporting phase, visualizations can help journalists to identify themes and questions, to identify outliers or to find typical examples. In publishing, visualizations play multiple roles, e.g., to

illustrate a point made in a story in a more compelling way, to remove unnecessary technical information from prose and to provide transparency about the reporting process to readers (especially interactive visualizations that allow exploration) [GBC12].

Information visualization is the use of interactive visual representations of abstract data to amplify cognition [Che10] [War12]. Information visualization in online media like online newspapers or online magazines can be interactive, i.e., it provides users with at least one option to control which and how much information shall be shown. Shneiderman [Shn96] proposed key principles for the success of information visualization that are based on his *Visual Information-Seeking Mantra*: Overview first, zoom and filter, then details-on-demand. Since then several types of interactivity have emerged. Information visualization provides several types of information graphics, e.g., functional infographics, cartographical graphics or visualization of statistical data, that can be enhanced with interactive elements.

Journalists tell stories based on their investigations. Data visualization is an appropriate communication medium for storytelling, in particular when the story also contains a lot of data [KM13]. However, these data stories told by data journalists differ from traditional forms of storytelling [SH10]. An emerging number of stories is enhanced with narratives including complex graphics and especially interactive graphics. Like the pioneers of data-driven journalism using interactive visualizations from Anglo-Saxon countries (e.g., *The Guardian*, *The New York Times*) the increasing number of data-driven journalistic projects in German-speaking countries use various visualizations with different options of interaction.

In this paper, we investigate which kinds of interactive infographics are used in data-driven journalism in Germany, Austria and Switzerland to effectively present complex data and causal relationships. A content analysis is applied to five examples of German-speaking online newspapers. The interactive infographics that have been published in 2014 and 2015 are analyzed.

Although interactive infographics are increasingly used in online media, readers really have to view them and use the control tools. First, readers have to identify

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interactive infographics as such and the control tools have to be recognized intuitively. Thus, we investigate how readers of online newspapers assess the availability and findability of interactive infographics and which types of interaction they utilize.

2 Interactive Infographics

Information graphics (short: infographics) combine graphics, image and text to communicate information, data or knowledge effectively using graphic visual representations [Ale13] [Yau11] [Yau13]. Infographics aim at providing the percipient with new insights and a quick overview on complex facts on subjects like politics, science, technology, and nature that are hard to understand just using text-based information. They shall communicate complex issues efficiently and draw the attention of percipients to them. However, there is a continuous debate over visual embellishment, i.e., adding unnecessary visual embellishment – chart junk – versus a minimalistic approach using plain and simple charts [BMG+10]. Like the data-ink ratio for noninteractive infographics proposed by Tufte [Tuf01] to reduce chart junk, interactive infographics have to apply interactivity purposeful.

2.1 Types of Infographics

Infographics can be categorized in three basic types (Figure 1): [JS99] [Sta13]

- Principle representation
- Cartographic infographics
- Statistics chart



Figure 1: Three types of infographics (Source: [JS99])

The principle representation – also denoted as functional graphics – covers *What* and *How* questions and describes complex causal relationships in real or abstract form. Principle representations are subdivided in fact

graphics, structure graphics and process graphics (Figure 2). [JS99]

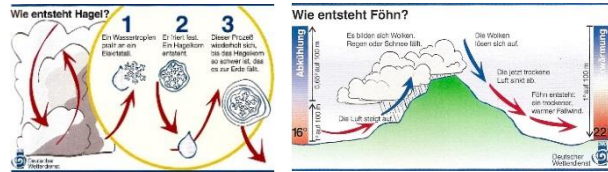


Figure 2: Fact graphics (left) und process graphics (right) (Source: [JS99])

The cartographic infographics (map) conveys space-oriented information in a clearly arranged, simple and understandable way that provides orientation. This type consists of event space map, topic map and weather map. [JS99]

Statistics charts help to illustrate quantities and compare them, especially large, complex sets of numbers and relations. This type consists of pie chart, bar chart, curve chart, area diagram, scatter plot, Sankey diagram and radar chart (Figure 3). [JS99] [Sta13]

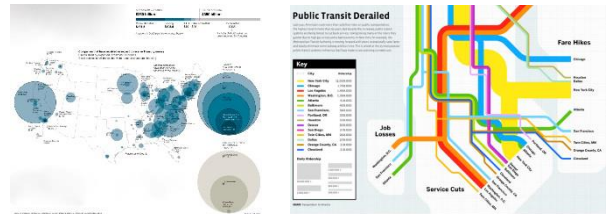


Figure 3: Bubble graph (scatter plot, left, Source: www.nytimes.com) and Sankey diagram (right, Source: www.ensbira.com)

2.2 Interactions in Infographics

Many technical systems offer interactive performance. However, the interactive elements have to be recognized and utilized by users. This level of action is made up of a control dimension and a transmission dimension that allows the system to react on user input. The control dimension is subdivided in options for selection (selection of existing content, e.g., click on a hyperlink) and options for modification (change of system range by input; e.g., input of text) [QS06].

There exist several methods of interaction to manipulate a visual representation, like scrolling,

overview plus detail, or focus plus context, filtering or data reordering [Maz09].

Weber and Wenzel [WW13] define interactive infographics as being a visual representation of information that integrates several modes (at least two), e.g., image/video, spoken or written text, audio, layout, etc. (image mode is constitutive), to a coherent ensemble that offers at least one option of control to the user. The provided option of control can be, e.g.,

- Start or Stop button
- Forward or backward button
- Menu item to select
- Timeline or time controller
- Filter, data request or input box

2.3 Classification of Interactive Infographics

While evaluating interactive infographics we analyze five features which cover interaction as well as narrative issues: degree of interactivity, course of action, communicative intent, “W-questions” and topic. We follow a typology introduced by Weber and Wenzel [WW13] and Weber [Web13]. Other features like *genre* or *visual narrative* as in [SH10] might be applied as well, but have not been included.

2.3.1 Degree of Interactivity

Weber and Wenzel [WW13] distinguish three degrees of interactivity:

- Low interactivity
- Medium interactivity
- High interactivity

A low level of interactivity allows users to navigate within the infographics and select content, e.g., by using internal links, zooming, mouseover effects for showing details, Next or Start buttons, but without changing the infographics. On a medium level of interactivity users can manipulate the infographics, e.g., by a timeline slider or menu items, thus showing changes and comparing information. A high level of interactivity enables users to explore the infographics and to interact with data and information, e.g., by inputs, filtering or data retrieval (Figure 4).

We analyze only the degree of interactivity, but do not identify the ways of manipulation as in [SH10], like hover highlighting and details, filtering and selection, search or navigation buttons.

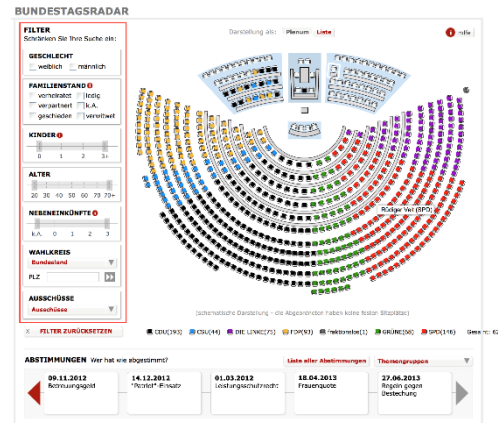


Figure 4: Infographics showing German House of Parliament with high interactivity (Source: www.spiegel.de, [WW13])

2.3.2 Course of Action

Weber and Wenzel [Web13] [WW13] distinguish three types of course of action:

- Linear
- Nonlinear
- Linear-nonlinear

Linear interactivity enables the user to move (forward or backward) through a predetermined linear sequence [Sim97]. The linear type is based on a step-by-step course defined by the author (i.e., author-driven [SH10]). The user follows a strict path and does not have to explore the visualization by himself. Navigation tools like *Start*, *Stop*, *Forward*, *Backward* or *Next* are used to navigate in a linear course. A navigation bar provides a better overview on the whole sequence. [Web13]

A nonlinear visualization does not provide a prescribed ordering and requires a high degree of interactivity by the user [Rya06] – its narrative being reader-driven [SH10]. Nonlinear-based interactive infographics provide the user with many ways to explore and query the visualization – including free exploration without predefined navigation paths. Navigation tools for nonlinear infographics include filter, input box, data query or brushing (various visual representations of same data). [Web13]

The linear-nonlinear type results from a hybridization of the linear and nonlinear course of action. This type is a hybrid of the author-driven and reader-driven approach [SH10] that enables the author to

communicate his message using a predefined path, but still allowing the user a certain amount of selection ability. Navigation tools for linear-nonlinear infographics include interactive timelines, time controller, and integrated navigation menu. [Web13]

2.3.3 Communicative Intent

Based on Nichani und Rajamanickam's taxonomy [NR03] we use the following categories to represent the communicative intent of interactive infographics:

- Narratives: Stories told from a distinct point of view (e.g., anecdotes, personal stories, business stories, case studies).
- Instructives: Step-by-step instructions explaining how things work or how events occur.
- Exploratives: Allow readers to discover the intent themselves by active exploring and sensemaking.
- Simulatives: Allow readers to experience the intent (usually a real world phenomena) themselves.

2.3.4 W-Questions

In addition to the communicative intent [NR03] the communicative function can be derived using an extended version of the journalistic W-questions [Web13] [Roa09]:

- What/Who
- When
- Where
- How
- Why
- How much

2.3.5 Topic

Following the news departments of a newspaper/magazine that classify a newspaper article we classify the topic of the interactive infographics:

- Politics/Economics
- Accidents/Natural disaster
- Consumption
- Sports
- Science/Society
- Crime
- Others

3 Analysis of Utilization of Interactive Infographics in German-speaking Online Newspapers

Interactive infographics have various occurrences and are used for multiple purposes. However, not all types of interactive infographics can be utilized in data-driven journalism. In this section we analyze which interactive infographics are used in data-driven journalism in Germany, Austria and Switzerland to efficiently present complex data and their causal relationships. [Zwi16a]

3.1 Method

The analysis of interactive infographics of selected online newspapers is based on evaluation research. The object of the evaluation – the interactive infographics – is assessed according to predefined goals and specified criteria. [GJ14] [SM14]

To represent the German-speaking online newspapers we selected five newspapers from Germany, Austria and Switzerland that are published in print and online: „Zeit Online“, „Berliner Morgenpost“, „Neue Zürcher Zeitung“, „Der Standard“ und „Kurier“. The objects to be evaluated are the interactive infographics that had been published between January 1, 2014 and December 31, 2015 in the newspapers' online portals.

A total of 276 interactive infographics have been identified and subsequently analyzed: Zeit Online 36, Berliner Morgenpost 54, Neue Zürcher Zeitung 89, Der Standard 60, and Kurier 37 infographics.

Based on the typology and classification introduced in section 2 a list of criteria is defined. The type of infographics is classified on a nominal scale (scale values A-M and A-E respectively) (Table 1). The classification criteria are assessed using an ordinal scale with varying degree (Table 2).

3.2 Results

3.2.1 Example: Zeit Online

As an example, we present the results of the evaluation of interactive infographics that have been published by „Zeit Online“ [Zwi16a]. The other newspapers, i.e., „Berliner Morgenpost“, „Neue Zürcher Zeitung“, „Der Standard“ und „Kurier“, have been evaluated in the same way.

Table 1: Scale values for type

Criterion	Value
Type of infographics	Definitely a single type of infographics: 0: no, 1: yes
	If type is 1 $\Rightarrow$ Single type: A: Fact graphics (view, magnifier, section) B: Structure graphics (building plan, text image) C: Process graphics (overall view, sequence) D: Event space map E: Topic map F: Weather map G: Pie chart H: Bar chart I: Curve chart, area diagram J: Scatter plot, bubble graph K: Sankey diagram L: Radar chart M: Other
	If type is 0 $\Rightarrow$ Hybrid type: A: Principle representation with cartographic IG B: Principle representation with statistics chart C: Cartographic infographics with statistics chart D: Mixed statistics chart E: Other

We identified 36 interactive infographics that have been published during the period of investigation by “Zeit Online”. 27 of them are single type infographics, and 9 are hybrid infographics. The single type infographics are made up of seven topic maps, four bar charts, four curve charts, three event space maps, two fact graphics and one process graphics; the remaining six infographics are of type *Other*. The nine hybrid infographics consist of three cartographic infographics with statistics chart, two principle representation with statistics chart, two mixed statistics charts and two infographics of type *Other*.

“Zeit Online” published 18 interactive infographics with a low degree of interactivity, 13 infographics with medium interactivity and 5 infographics with high interactivity. In category *Course of action* 6 infographics were linear, 25 infographics were nonlinear and 5 of the combined type linear-nonlinear. Analyzing the communicative intent shows 21 infographics of type *Exploratives*, 10 infographics of type *Instructives*, 3 of type *Simulatives* and 2 of type *Narratives*.

Most infographics have been published relating to topics in science and society: 19 infographics in total. 6 infographics cover politics and economics, 5 deal with sports, 5 deal with consumption and one infographic is on crime (Figure 5).

Table 2: Criteria for classification

Criterion	Value
Degree of interactivity	0: Low interactivity (internal links, zooming, mouseover, Next button) 1: Medium interactivity (menu items, timeline slider) 2: High interactivity (filter, input box, brushing)
Course of action	0: Linear (step-by-step; Forward, Backward or Next) 1: Nonlinear (filter, input box, data query, brushing) 2: Linear-nonlinear (interactive timeline, time controller, integrated navigation menu)
Communicative intent	0: Narratives 1: Instructives 2: Exploratives 3: Simulatives
W-Questions	0: What/Who 1: When 2: Where 3: How 4: Why 5: How much
Topic	0: Politics/Economics 1: Accidents/Natural disaster 2: Consumption 3: Sports 4: Science/Society 5: Crime 6: Others

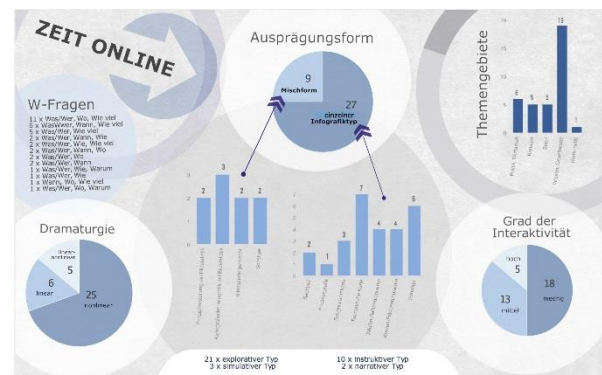


Figure 5: Results „Zeit Online“ (Source: [Zwi16a])

3.2.2 Using Interactive Infographics

The unrepresentative evaluation research analyzed 276 interactive infographics in five selected online newspapers (period: January 1, 2014 until December 31, 2015) showing that in German-speaking data-driven journalism typically interactive infographics are used that belong to single type infographics (77.54 % vs. 22.46 % of hybrid type). Most commonly used are bar charts (23.83 %) and curve charts/area diagrams (18.69 %). Topic maps are used at a percentage of 17.76 % and event space maps are used at a percentage of 12.15 %. Rarely used are structure graphics (2.34 %), pie charts (1.87 %), Sankey diagrams (1.87 %), process graphics (1.40 %) and fact graphics (1.40 %) (Figure 6).

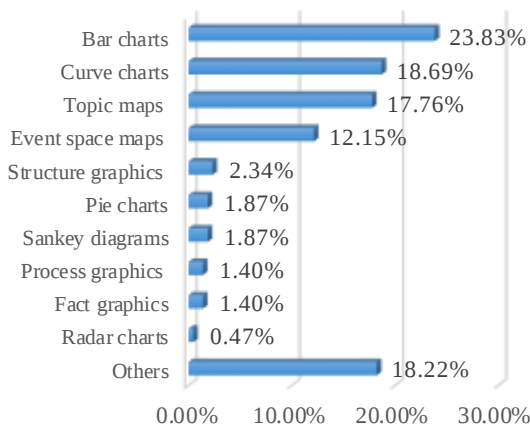


Figure 6: Use of single type infographics (Source: [Zwi16a])

The majority of interactive infographics, i.e., 43.11 %, shows a low degree of interactivity. 38.77 % of the analyzed infographics have a medium degree of interactivity, whereas only 18.12 % of the analyzed infographics offer a high degree of interactivity (Figure 7).

The vast majority of published interactive infographics exhibits a nonlinear course of action. 75.0 % are nonlinear infographics, whereas 13.77 % of the infographics are identified as belonging to the linear-nonlinear type. Only 11.23 % of the analyzed infographics have a linear course of action (Figure 8).

The evaluation of the communicative intent depicts that *Exploratives* are used most at a ratio of 70.65 %. We identified 21.02 % *Instructives*. *Narratives* (5.07 %) and *Simulatives* are seldom used (Figure 9).

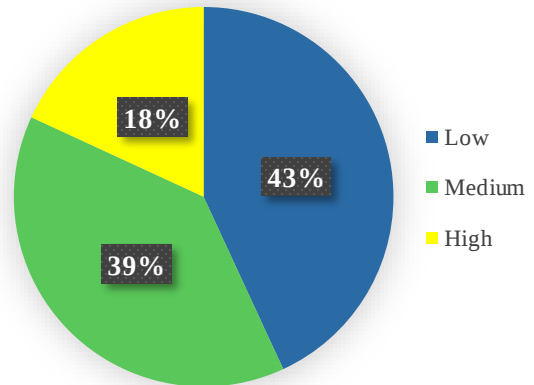


Figure 7: Degree of interactivity (Source: [Zwi16a])

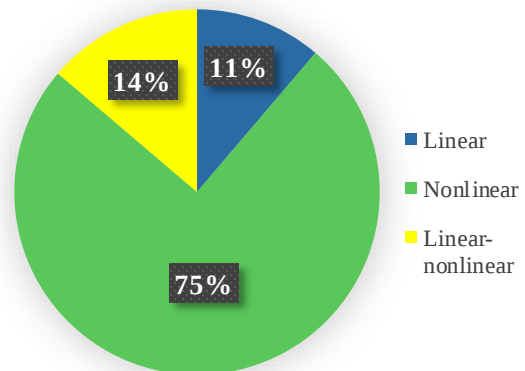


Figure 8: Course of action (Source: [Zwi16a])

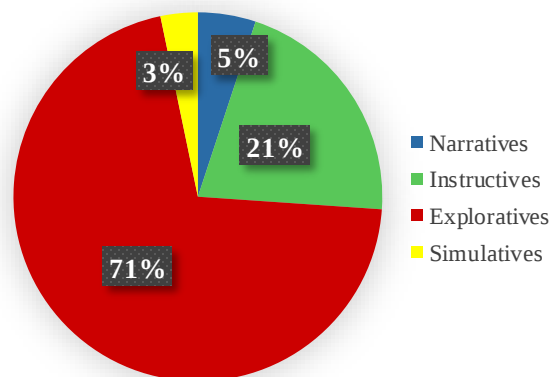


Figure 9: Communicative intent (Source: [Zwi16a])

Interactive infographics are most frequently used in online newspapers to illustrate information on the topic science and society with 46.01 % of all occurrences. 34.06 % of the analyzed infographics cover issues on politics and economics. 10.51 % cover sports, 6.16 % crime and 2.54 % consumption. Accidents and natural disaster are seldom discussed with the help of infographics (0.36 %). Another 0.36% could not be assigned clearly and were labeled as *Other* (Figure 10).

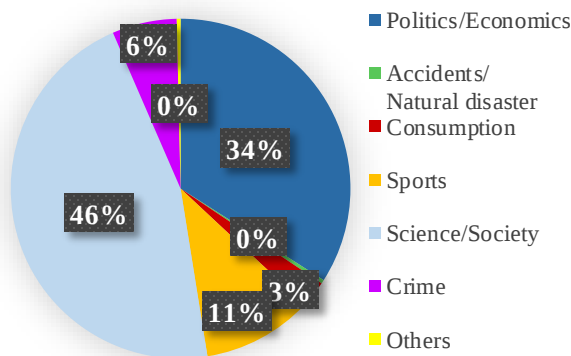


Figure 10: Topics (Source: [Zwi16a])

4 Utilization of Interactive Infographics by Readers

During the evaluation research process it turned out that interactive infographics are hard to identify in online newspapers. In particular, it was difficult to find infographics in the two Austrian online newspapers. Most newspapers have no dedicated sections aggregating interactive infographics and even the integrated search function often failed.

In this chapter we analyze how Austrian readers of online newspapers assess the availability and findability of interactive infographics and how they use the facilities for interaction. Our goal is the demonstration that readers of online newspapers search purposeful for interactive infographics or just use them by pure chance. We examine how laborious and time-consuming readers estimate searching for infographics. The intensity of the use of infographics and the frequency of the utilization of the individual facilities for interaction are determined.

4.1 Method

To determine the opinion of readers of online newspapers a quantitative research approach has been chosen [BB14]. Since the target group is very familiar with online tools we chose to conduct a nonrepresentative online survey [WH14]. The online survey was made up of 24 questions that included closed questions (single choice, multiple choice questions) as well as matrix questions with different evaluation scales. [MG14]

Only readers of online newspapers have been surveyed. Persons that got access to the survey, but do not read online newspapers were identified at the beginning using a knockout question. The survey was published in the off-topic forum of the Austrian newspaper “DerStandard”, on the Facebook page of the Austrian newspaper “Kurier”, and additionally on the Facebook account of one of the authors and among students of the University of Applied Sciences Burgenland [Zwi16b]. Survey period: June and July 2016.

259 persons participated in the survey. Due to the research design primarily Austrian readers of German-speaking online newspapers have been surveyed. 215 persons (83.01 %) answered the preceding knockout question positive and were identified as readers of online newspapers. The following outcome of the survey refers to this group.

4.2 Results

86.98 % of the respondents (187 persons of 215) deliberately view interactive infographics. Asked for the reasons of using those infographics they name the well-known advantages of infographics like illustration of all relevant numbers/facts (77.54 %), a clearly structured overview (63.64 %) or good memorability due to the combination of text and image (51.34 %). Table 3 shows the results of this question (multiple references possible).

The respondents could rate on a five-point Likert scale (“very intensive” to “less intensive”) how intensively they use the offered facilities to interact with the infographics. More than half of the persons questioned use them “moderately intensive” (54.01 %, 101 persons). The infographics are “very intensively” used by only 6.42 % respondents (12 persons). 25.13 % (47 persons) used them “intensively”. The option “rather less intensive” has been named by 13 persons (6.95 %) and there are 14 users who use the infographics “less intensive” (Fig. 11).

Table 3: Reasons for using interactive infographics
(Source: [Zwi16b])

Answer option	Percentage	#
Illustration of all relevant numbers/ facts	77.54 %	145
Clearly structured overviewput into graphs	63.64 %	119
Good memorability due to the combination of text and image	51.34 %	96
Relevant information can be filtered and visualized	34.22 %	64
Easy search for data/information	26.74 %	50
Do not like to read long text	21.93 %	41
Offers to view data/information in various representations	16.04 %	30
Other	1.60 %	3

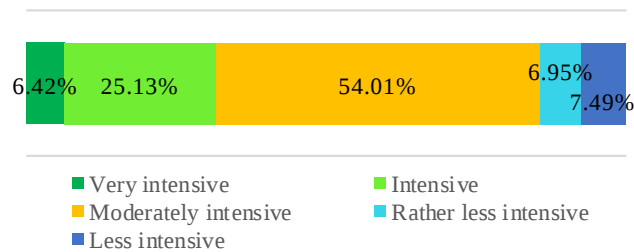


Figure 11: Intensity of using the facilities of interaction
(Source: [Zwi16b])

Interactive infographics offer different functions to control the graphics. Table 4 presents how frequently (or seldom) users apply those control tools.

Table 4: Frequency of use of control tools

<i>n</i> =187	Very frequently	Frequently	Occasionally	Seldom	Never
Start, Stop button	11,23 % 21	25,67 % 48	35,83 % 67	22,46 % 42	4,81 % 9
Forward, Backward button	10,70 % 20	29,95 % 56	39,57 % 74	18,18 % 34	1,60 % 3
Navigation bar (menu)	26,20 % 49	46,52 % 87	19,25 % 36	6,42 % 12	1,60 % 3
Filter	20,86 % 39	36,36 % 68	26,74 % 50	13,37 % 25	2,67 % 5
Timeline slider	9,09 % 17	25,13 % 47	37,97 % 71	21,93 % 41	5,88 % 11
Input box	3,21 % 6	18,18 % 34	35,29 % 66	32,09 % 60	11,23 % 21

The respondents have been asked whether those control functions are sufficiently recognizable and easy to identify. Only 2.67 % of the respondents (5 persons) consider the control tools as “very well recognizable”. 33.16 % (62 persons) consider them as “good recognizable” and the majority of 37.97 % (71 respondents) consider the control tools as “moderately recognizable”. 20.32 % respondents (38 persons) have not been satisfied with the visibility of the control tools and graded them as “poorly recognizable”. One respondent (0.53 %) did not find the control tools and answered “not recognizable” (10 persons, i.e., 5.35 %, did not specify) (Fig. 12). Obviously there is need for action.

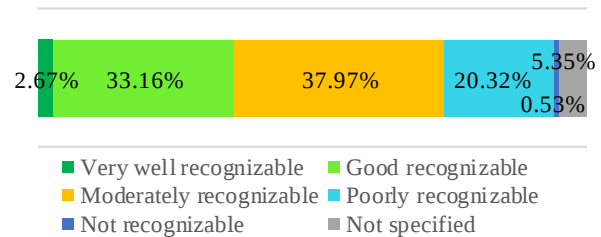


Figure 12: Perceptibility of control tools
(Source: [Zwi16b])

Only 24.06 % of the respondents (45 persons) indicated that they actively search for interactive infographics in online newspapers. These persons would see a big advantage if online newspapers mark or label interactive infographics or offer easy access using dedicated menu items. 75.94 % (142 respondents) do not search actively for articles that contain interactive infographics. However, a majority of three-quarters of those respondents (*n*=142; i.e., 106 persons) mentioned that they would use infographics more often, if they would be easier to find.

53.48 % respondents of the survey quoted that they think that currently most interactive infographics deal with politics. 24.60 % respondents indicated that most interactive infographics are about economics. The respondents would prefer if more interactive infographics are published concerning science (24.60 %), economics (22.99 %), consumption (10.70 %), crime (9.63 %) and politics (8.56 %) (remark: only single response allowed). However, 73.26 % of the respondents of the survey would appreciate an increasing offering of interactive infographics in online newspapers.

5 Conclusion

The evaluation of interactive infographics that have been published in the years 2014 and 2015 in five selected German-speaking online newspapers shows inhomogeneous and diverse results. The analyzed infographics depict that data-driven journalism in German, Austria and Switzerland typically makes use of infographics that belong to a single type (77.54 %). Most commonly used are bar charts at a percentage of 23.83 %. Often single type infographics are combined to hybrid forms that are used at a percentage of 22.46 %. Most examples of those hybrid forms (53.23 %) are cartographic infographics with statistics chart.

The majority of interactive visualizations only have a low degree of interactivity (43.11 %). Users can manipulate the infographics easily, e.g., by using *Next* or *Start* buttons or mouseover effects for showing additional information. Only a small percentage of 18.12 % of the analyzed infographics offer a high degree of interactivity and allow users to interact with the help of input boxes, data retrieval or filtering.

Three-quarters of the analyzed infographics have a nonlinear course of action. They offer several options to explore and manipulate the infographics. By means of navigation tools like input box, filter, menu item or mouseover effects the requested information can be displayed.

The survey of readers of German-speaking online newspapers demonstrates that the offering of interactive infographics is highly accepted. However, it is often hard to recognize that a graphics is an interactive infographics with corresponding control tools. Consequently, those control tools are only moderately or seldom used. There is potential for improvement to identify controls for interactivity more clearly and thus allowing users to fully utilize the offer of information of the infographics. For example the findability of interactive infographics might be improved by dedicated sections in the online newspapers aggregating infographics (e.g., specific menu items in the main navigation) or by others ways of identification. The reason why interactive infographics are often not used is due to the simple fact that they cannot be found. However, readers of online newspapers have strong interest in using and exploring interactive infographics.

6 Summary

Data-driven journalism deals with the collection, evaluation, interpretation and presentation of large

amounts of data. Frequently, visualizations are used to present these data in online reporting. Online media allow to design those infographics interactively. Users can determine by themselves which and how many information shall be shown. For example, interactive infographics with nonlinear course of action provide a high degree of interactivity up to free exploration without predefined navigation paths.

Based on the evaluation of 276 interactive infographics that have been published in 2014 and 2015 in five German-speaking online newspapers we demonstrated which types of visualization are used in data-driven journalism in Germany, Austria and Switzerland. The evaluation research shows a large variety of used types of infographics. At the same time, we recognize a great potential for improvement when applying those infographics in data-driven journalism. In particular, the degree of interactivity can be improved to facilitate even more flexibility when exploring those infographics.

From the point of view of readers of online newspapers we identified potential for improvement concerning the findability or recognizability of interactive infographics. Additionally, various control tools for the manipulation of infographics are available, but they are used only to a limited extend due to the fact that they cannot be identified conveniently. Therefore, improvements in the usability of interactive infographics might increase the utilization of infographics. Usability issues have not been investigated in the present analysis, but further research should examine the usability of interactive infographics in data-driven journalism.

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