

ATTITUDES OF LIBRARIANS TOWARDS EMERGING TECHNOLOGIES – EFFECTS OF A MULTILINEAR SCENARIO

Elke Brucker-Kley, Samuel Keller and Thomas Keller
ZHAW School of Management and Law, Winterthur, Switzerland

ABSTRACT

A study examined the attitudes of 457 librarians in Germany and Switzerland towards emerging technologies that are likely to change the face of their profession. A multilinear narrative enabled participants to live through the future with these technologies. With their decisions, they could change the course and the end of the story. Before and after this intervention, participants were surveyed online about their attitudes. The results show a clear gap between imaginability and desirability of the technologies portrayed. The effect of the narrative is small but statistically relevant and shows a more differentiated attitude of the participants. The use of multilinear narrative scenarios to trigger a discourse about the consequences of digitalization on a profession can therefore be recommended.

KEYWORDS

Technology Assessment, Science Fiction Prototyping, Multilinear Storytelling, Field Study

1. INTRODUCTION

Libraries are not isolated institutions but have always been a social space and a mirror of how society deals with knowledge and information (Verma, 2015). The professional identity of librarians has been shaped over time by the purpose of libraries but also by the characteristics of the media they provide to their users. Thus, librarians have evolved from humanistic custodians of knowledge to socio-technical professionals who have long used technologies to acquire, maintain and supply information (Tîrziman, 2017). However, the massive digitization and virtualization of the global information landscape over the last thirty years has raised very fundamental questions about the role of librarians in the 21st century. The information seeking behavior of library users and the nature of library operations have been transformed by the digitization of content and technologies that have revolutionized the way information is organized and accessed (Lee, 2020). In response, librarians emphasize their relevance as navigators and gatekeepers in a user-centered information delivery model, advising their users rather than focusing primarily on their physical and digital collections (Dold, 2013). The mission to ensure equal access to information (American Library Association, 2014) has by no means lost its importance, but it requires new competencies and an open mind. The ability to deal with rapid technological change and to use innovations more proactively is demanded (Liu & Shen, 2018), (Noh, 2015), (Yeh & Walter, n.d.)(Kane, 2017), (Buhalis et al., 2019). Consequently, it is essential that librarians consciously engage with emerging technologies that will shape both their professional lives and the experiences of their users. Emerging technologies are defined as technologies that are characterized by novelty, fast growth, prominent impact, uncertainty and ambiguity (Rotolo et al., 2015). Scenarios can contribute to better envision the specific use of emerging technologies in everyday work and to think in terms of alternatives (Bradfield et al., 2005), (Bishop et al., 2007), (Boerjeson et al., 2005). Multilinear narratives represent a format to interact with a future scenario, to make decisions and to experience the consequences in a tangible way (Brunner et al., 2020a; Koenitz et al., 2015).

2. RESEARCH OBJECTIVES

The research presented in this paper aims at three objectives.

(1) The first objective is to survey the attitudes of librarians towards the potential use of relevant emerging technologies in their professional environment. Attitudes in the sense of subjective opinions or feelings towards a technologies comprise cognitive, affective and behavioral components (Eagly & Chaiken, 1993). The cognitive component shall be assessed through the dimension of imaginability, i.e. how tangible an emerging technology is or how concretely librarians can imagine it in their everyday future work life. The affective component shall be assessed through the dimension of desirability, i.e. to which extend librarians would like to see or not see an emerging technology as part of their future professional life. The behavioral component shall be extrapolated from the decisions that librarians actually make in relation to the use of technologies in the context of a multilinear narrative.

(2) The second objective is to investigate whether the multilinear story has an impact on the attitudes of the participating librarians towards the portrayed technologies (Brunner et al., 2020b), (Brucker-Kley & Keller, 2019). It is essential to the research design that the study is not based on a directional hypothesis. The question is not whether the narrative increases the desirability of a technology, but whether the narrative changes the attitude of the subjects regardless of the direction. The multilinear scenarios are not normative but deliberately show different variants of the future. The decision whether a future is desirable or not lies solely with the reader.

(3) A third subordinate objective is to determine whether there is a difference in attitudes and change in attitudes towards emerging technologies between academic and public librarians.

3. METHODOLOGY AND APPROACH

The design, creation and evaluation of the multilinear story followed the method of Science Fiction Prototyping, an approach fostering the critical reflection of consequences of technological innovations (Johnson, 2011), (Atherton & Johnson, 2016). Science Fiction Prototyping comprises three main phases (Merrie et al., 2018): (1) Identify and analyze the drivers shaping the future of the domain (in this case the librarian profession); (2) Develop the narrative to portray the impact of the technologies on people; (3) Expose the audience to the narrative and reflect on the impact and resulting learnings.

3.1 Select Relevant Technologies and “Build the Future World”

First, relevant emerging technologies which have the potential to change the librarian domain in the future were identified based on literature research. To design a plausible stage for the technologies in use also the political, economic and sociocultural drivers had to be determined via a PEST analysis (Sammut-Bonnici & Galea, 2015). The analysis led to the following five emerging technologies and technology-driven concepts which show great potential to change the future of the librarian profession. The majority of these are concepts driven by emerging technologies and not technologies per se. To reduce linguistic complexity, we will henceforth refer to them generally as "technologies":

- Smart glasses (Schweizer, 2014),
- Open Access (Homans & Wilen, 1997),
- Virtual Meetings (Laitinen & Valo, 2018),
- Artificial intelligence (AI) (Russell & Norvig, 2016), and
- Streaming services

Potential future manifestations of the key drivers and their impact were defined by applying the creative-narrative scenario technique according to Kosow and Gassner (Kosow & Gaßner, 2008). For each technology premises for light, moderate and extensive usage of the technology in libraries were formulated as well as the corresponding “stage design” in terms of assumed future political, economic and sociocultural conditions.

3.2 Develop the Narrative

Once the stage was set and the key technologies to be portrayed were selected, a multilinear story was developed in which librarians can make technology decisions and experience the consequences of those decisions. In this paper, only the structure of the story is outlined since the presentation of a multilinear story in a linear fashion does not correspond to the format. The English translation of the multilinear story is available online (*LibraryStory*, n.d.).

3.2.1 The Introduction:

The reader

- is placed in the role of a librarian,
- creates her/his own identity, by which she/he is addressed in the story, and
- is introduced to the future setting in which the story takes place.

3.2.2 The Main Part

The course of the narrative (following a working day) is outlined right at the beginning and basically portrays three possible narrative threads:

- Light usage of the technologies
- Moderate usage of the technologies
- Extensive usage of the technologies

The plot of the story follows various dialogues, which are personalized. The reader is addressed in the second person ("you") to create a certain intimacy and identification with the protagonist. The library plot is kept as general as possible, so that the everyday work situations can take place in a public library as well as in an academic library. The complexity of a daily work routine is simplified as much as possible but presented as tangible as possible so that librarians can familiarize with it. Decisions are built in the story whenever the librarian has a choice to use a technology more or less intensively. This leads to the splitting of individual narrative threads and increases the complexity of the possible storyline.

3.2.3 The End

Depending on the storyline driven by the decisions of the reader. The story leads to one of the following three open endings:

- "Obsolete": Rather dystopian with a negative impact, but with a professional reorientation as a silver lining on the horizon.
- "Irreplaceable": Rather conservative with few changes to the status quo.
- "Unburdened": Rather utopian with major technology-driven changes that open up new freedoms for self-fulfillment.

The multi-linear narrative was implemented as an interactive hypertext (Twine) accessible via any Internet browser. The quality of the artefact was validated via prototyping and think-aloud test-runs in four iterations along three dimensions: usability, immersion and transformational capability.

3.3 Analyse the Impact of the Narrative Intervention

The impact of the resulting narrative intervention was evaluated online. Subjects were recruited via digital channels from libraries and professional networks in the German-speaking part of Switzerland and Germany. Each participant went through a fully logged continuous online session that included a pre-survey, reading the hypertext story and a post-survey. Both survey rounds and the logging of the narrative intervention were conducted anonymously via a digital platform (Elke Brucker-Kley & Thomas Keller, n.d.).

For all the technologies mentioned above, one question each was asked about future imaginability ("Can you personally imagine that technology X will be dominant to perform tasks Y,Z in libraries?...") and desirability

("Do you personally want technology X to be part of your everyday work in the library?"). The responses to pre- and post-surveys were collected using a 5-point Likert scale Table 1. Applied five-point Likert scale (Table 1).

The post-survey was concluded by one additional open question, "What other thoughts and open questions does the story trigger in you? ". Number and content of answers to this optional question were used as a proxy to evaluate the effect of the narrative on the readers willingness to reflect and discuss. Both surveys were an integral part of the multilinear story and can be viewed online (*LibraryStory*, n.d.).

4. ANALYSIS AND FINDINGS

Statistical analysis was performed using SPSS. All data are available online (*Survey Data on OSF: Digital Futures - Library Story*, n.d.)

The verbal qualifiers of the 5-point Likert scale that were used for the pre and post survey were quantified as presented in Table 1.

Table 1. Applied five-point Likert scale

Imaginability	Desirability	Value
Very likely	Very desirable	5
Rather likely	Rather desirable	4
Possibly likely	Possibly desirable	3
Rather unlikely	Rather not desirable	2
Not likely at all	Not desirable at all	1

4.1 The Characteristics of the Participants

The total of 457 analyzable records can be grouped according to the following characteristics: Gender, age, and library type.

Table 2. Participants by gender

Gender	No answer	Diverse	Male	Female	Total
[#]	10	3	101	343	457
[%]	2.2	0.7	22.1	75	100

The gender distribution of the sample (Table 2) corresponds to the gender distribution of librarians in the surveyed geographies. Librarians are among the professions most influenced by gender. More than 80% of librarians in Switzerland and 75% of librarians in Germany are women (BFS, 2018; IAB - Institute for Labor Market and Profession Research, 2017).

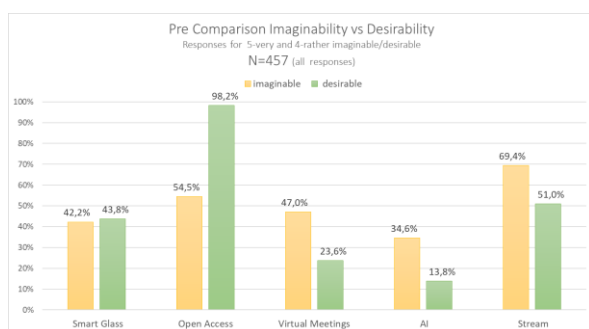


Figure 1. Imaginability and desirability of the portrayed technologies in the pre-survey

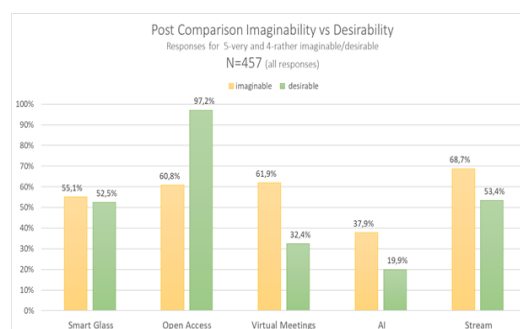


Figure 2. Imaginability and desirability of the portrayed technologies in the post-survey

The age distribution of the subjects does not reflect the age structure of librarians in the surveyed geographies. Librarians younger than 50 are more strongly represented in the survey than in reality. Age distribution data for information and documentation professions in Germany show that more than 47% of employees in that profession are 50 years and older, compared to 35% across all professions.

The sample shows that approximately $\frac{1}{4}$ of all participants work in a public library and almost $\frac{3}{4}$ in an academic library. The actual distribution of library staff according to Swiss library statistics (BfS, n.d.) is $\frac{2}{3}$ in general public libraries and $\frac{1}{3}$ in academic libraries. In Germany the jobs in public and scientific libraries are almost equally distributed (02. *German Library Statistics, Kerndaten, Engl. Ab 1999 - Bibliotheksstatistik - Hbz Service-Wiki*, n.d.). Thus, academic librarians are more strongly represented in the survey than in reality.

4.2 Imaginability Versus Desirability

The first objective was to identify the attitudes of the participating librarians towards the portrayed emerging technologies before reading the narrative scenario. Based on the results the cognitive aspect (imaginability) and the affective component (desirability) of the attitudes towards the technologies can be compared. For this purpose, the responses for "very likely" and "rather likely" as well as the responses for "very desirable" and "rather desirable" were cumulated. The responses for other options were not considered for this analysis.

The data show that smart glasses are equally imaginable and desirable for the participants before reading the scenario (Figure 1). Practically all participants would like to see Open Access as the predominant paradigm to access scientific publications, but only 50% can imagine this for the future. For all other technologies, the gap between envisioning and embracing the technology in their everyday work life is the other way around. This is particular true for Virtual Meetings and AI. The participants consider it realistic that Virtual Meetings will dominate in libraries in the future but wish this to happen to a much lesser extent. The vision that AI could not only support but take over certain administrative and advisory processes in a library completely, is significantly less imaginable and clearly less desirable for the participants.

The second objective was to find out whether the multilinear narrative has an impact on the attitude towards the portrayed technologies. Figure 2 illustrates imaginability and desirability after the participants went through the multilinear narrative. Table 3 compares the data from the pre and post survey and shows the relative change for the positive responses presented in Figure 1 and Figure 2. Both imaginability and desirability have increased moderately for all of the technologies after reading the narrative except for the desirability of Open Access and the imaginability of Streaming. However, the clear gap between imaginability and desirability has remained. A more in-depth discussion of the impact of the multilinear narrative on the subjects' attitudes including the full spectrum of responses follows in the next section.

Table 3. Pre/Post survey comparison

	Pre survey		Post-survey	
	Very or rather desirable	Very or rather imaginable	Very or rather desirable	Very or rather imaginable
Smart Glass	43.76%	42.23%	52.52%	55.14%
Δ			20.00%	30.57%
Open Access	98.25%	54.49%	97.16%	60.83%
Δ			-1.11%	11.65%
Virtual Meetings	23.63%	47.05%	32.39%	61.93%
Δ			37.04%	31.63%
AI	13.79%	34.57%	19.91%	37.86%
Δ			44.44%	9.49%
Stream- ing	50.98%	69.37%	53.39%	68.71%
Δ			4.72%	-0.95%

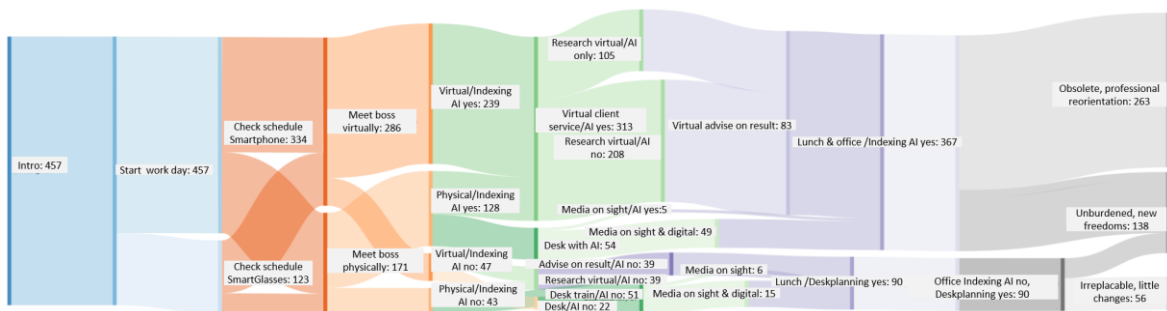


Figure 3. Sankey diagram illustrating the different paths the participants have taken in the story

4.3 The Impact of the Narrative

Based on the logged history of the individual paths of all participants (N=457) a Sankey diagram was generated (Figure 3). The thickness of the strands represents the quantity of the individuals who chose the different paths when interacting with the multilinear story. The Sankey diagram shows that many participants chose the strands with strong digitization. 313 participants opted for virtual customer service instead of supporting users on-sight at the customer service desk. Nevertheless only 105 participating librarians decided to leave the research for the user entirely up to AI in the virtual mode. 208 participants chose the virtual route but rejected the support of AI in conducting research. 263 participants closed the narrative experience with the rather dystopian ending (loss of job and professional reorientation). 138 experienced the rather utopian ending (freed up resources used for new ways of self-fulfillment). 56 participants left the experience with the rather conservative ending (light digital transformation resulting in little changes to the status-quo).

How did this predominantly dystopian narrative experience affect the attitude of the participants? The bubble charts visualize the change in attitude of the participants before and after the multilinear narrative for each portrayed technology, exemplarily for AI (Figure 4, Figure 6) and Smart Glasses (Figure 5, Figure 7) in this paper. The verbal qualifiers of the full Likert scale were recoded into numerical values (Table 1). Each datapoint is plotted in the coordinate system to express the response of the participant before (x-axis) and after (y-axis) the narrative experience. The bubble size represents the number of participants with the same response pattern. The bubbles along the diagonal of the diagram represent those participants whose attitudes remained the same before and after the narrative. The bubbles above the diagonal represent those participants who consider a technology more imaginable respectively more desirable after the narrative. The bubbles below the diagonal stand for negative changes in imaginability respectively desirability after the narrative.

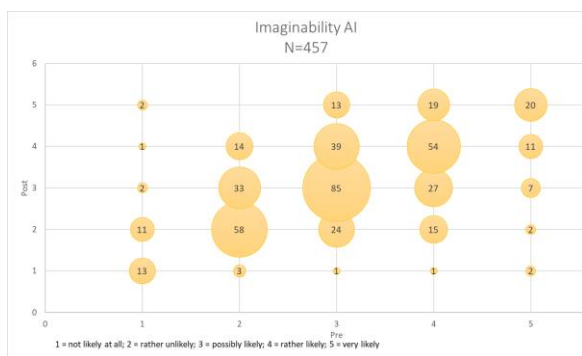


Figure 4. Imaginability of AI before and after reading the narrative

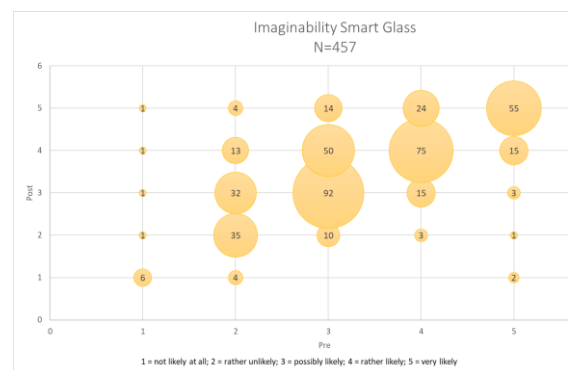


Figure 5. Imaginability of Smart Glasses before and after reading the narrative

The bubble diagrams clearly show the strikingly high proportion of users who have not changed their attitude according to pre- and post-survey. The bubbles along the diagonals in the case of smart glasses and AI represent more than half of the participants. The attitude towards Smart Glasses has not changed for 58% (imaginability) and 56% (desirability). Attitudes towards AI have not changed for 50% (imaginability) and 56% (desirability).

Overall, changes were small but nevertheless statistically significant. Significance was tested using the Wilcoxon signed ranked test, with a 0.05 significance level. For all technologies except for Streaming the measured differences between pre- and post-survey results were statistically significant for both imaginability and desirability. The null hypothesis that the narrative has no impact on the attitude of the participants can therefore be rejected for four of five technologies.

The bubble charts also show which technologies are more polarizing than others. In the case of the desirability of AI (Figure 6), for example, the bubble diagram reveals that almost one-third of the participants retained a negative attitude (rather not / not at all desirable). For Smart Glasses, the opinions are mainly in the indifferent and positive range and are more dynamic in terms of change from indifferent (3) to more desirable (4) (Figure 7).

To get an aggregated view on the strength of the changes in attitudes for each technology the sum of weighted positive and negative changes was calculated (v: variance in change, p: number of participants with the same variance in change)

$$\sum_{v+4}^{v-4} p_v \times v$$

The results are presented in Table 4. With the exception of the desirability of Open Access all technologies show an increase both of imaginability and desirability in the post-survey. Smart Glasses and Virtual Meetings became most tangible for the participants.

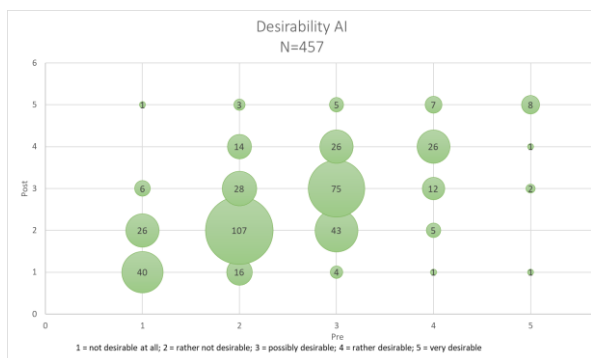


Figure 6. Desirability of AI before and after the narrative

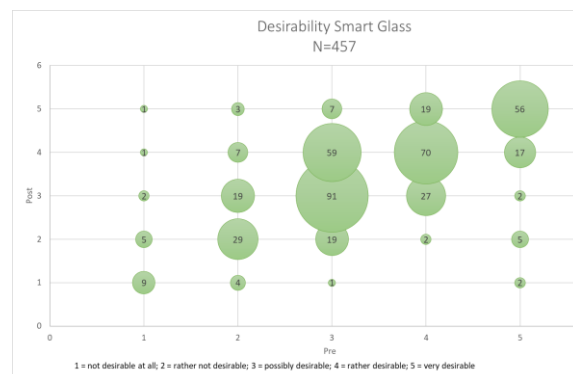


Figure 7. Desirability of Smart Glasses before and after the narrative

To compare and evaluate effect sizes in a standardized manner Pearson's r value was calculated based on the pre- and post-data (Table 5). Applying the classification for effect sizes in the social sciences according to Cohen (Cohen, 1988) (0.1=small, 0.3=medium, 0.5=large) to the results, it must be clearly declared that the effect size is small. For AI the effect is negligible, although statistically significant in the Wilcoxon test (0,04 for imaginability and 0,008 for desirability).

Table 4. Weighted changes of attitudes from pre to post survey

	Weighted change pre- to post survey	
	Imaginability	Desirability
Smart Glasses	+115	+50
Open Access	+60	-27
Virtual Meetings	+124	+76
AI	+43	+49
Streaming	+1	+18

Table 5. Effect sizes

	Effect size r	
	Imaginability	Desirability
Smart Glasses	0,20	0,10
Open Access	0,14	0,10
Virtual Meetings	0,21	0,15
AI	0,07	0,09
Streaming	0,00	0,04

4.4 Differences Based on Library Type

The Mann-Whitney U test with a significance level of 0,05 was applied to validate the statistical significance of differences between the attitudes and changes in attitudes of employees in public and academic libraries. Only for Virtual Meetings a statistically significant difference between public and scientific librarians could be identified. While 60% (52% post) of public librarians considered virtual meetings to be rather not or not at all desirable, only 37% (35% post) of scientific librarians shared the rather negative attitude. For all other technologies no statistically relevant difference could be observed. The null hypothesis ("There is no difference in attitudes between employees of general public and academic libraries") thus can be confirmed.

5. DISCUSSION

One goal of this study was to determine librarians' attitudes towards emerging technologies that are likely to change the face of their profession. This revealed a clear gap between cognitive and affective attitudes both before and after reading the narrative scenario. The portrayed technologies, except for Smart Glasses, are overall more imaginable than desirable for the participating librarians. AI and Virtual Meetings are the technologies with the least desirability. The result for Virtual Meetings was probably also influenced by the pandemic. Libraries were either closed or reopened with heavy restrictions and a high share of librarians was working from home while the study was conducted. The desirability of Virtual Meetings nevertheless increased after reading the narrative. The futuristic version of meeting colleagues and clients virtually was seemingly more desirable than the current reality. With AI, attitudes were more entrenched. Here, there was not even a small effect on attitudes, neither on imaginability nor on desirability. With AI, nevertheless, the change in attitude among those who were in the middle of the Likert scale before the narrative (3 of 5) is noteworthy. 153 (33%) of participants considered AI "possibly desirable" before the narrative. Only 75 (16%) retained this indifferent opinion after the narrative, 31 changed their attitude to the more positive, 47 to the more negative. This example shows that despite statistically small effects, the narrative nevertheless enabled many participants to form an opinion. This is confirmed by the fact that 55% of the participants in this study used the optional free text field at the end of the survey to share thoughts and open questions triggered by the narrative.

For Smart Glasses, Open Access and Virtual Meetings the effects on imaginability were stronger than on desirability. The narrative was able to make these technologies and their impact on everyday professional life more tangible. The fact that the majority of participants opted for highly digitized paths of the multilinear narrative may have contributed to this effect.

However, it is questionable whether these decisions in the multilinear story are suitable as determinators for actual behavior. For example, the fact that 68% of participants chose virtual customer service might suggest that librarians do not mind the loss of customer contact. However, it can also simply mean that many librarians were curious to experience this version of customer service in the narrative. It is notable, however, that for 4 of 5 technologies desirability slightly increased, even though 58% of participants completed the story with the dystopian ending. This could indicate an insufficient level of immersion and believability of the story, which had been defined and tested as quality criteria for the narrative. However, it can also be taken as a positive indication that the story lives up to its claim of presenting different versions of the future as neutrally and descriptively as possible, rather than normatively convincing readers of good and bad versions of the future. The motivation behind this research was not to increase technology acceptance among librarians or to warn them about the consequences of digitization, but to promote a conscious engagement with emerging technologies.

6. CONCLUSIONS

Multilinear scenarios have proven to be suited to make technologies imaginable. If we assume that imaginability is a prerequisite for engaging more consciously with technological change, multilinear narratives can contribute to a discourse on digitization and its consequences for the future of a profession.

We also consider the small changes in desirability to be relevant for this purpose, as they are an indicator that the readers of the narrative have developed a more differentiated attitude. Whether stronger effects are shown with more extreme scenarios is an interesting question for future inter- and transdisciplinary research. A multilinear narrative is a special form of intervention. It cannot be strictly controlled, even if it is created with the scientific methods outlined in this paper. The design of the narrative is ultimately also an artistic act and, despite testing, some bias in its creation cannot be prevented. The results of the study and feedback from readers suggests further design elements and design criteria worth exploring:

1. Avoid oversimplification. The attempt to make the experience fit for both public and scientific librarians did not work well. Public librarians found that the role of a library as a social space was underrepresented in the narrative.

2. Embed the possibility to experience the narrative from another perspective, e.g. of the library user. Roles and perspectives would allow to widen the scope of the audience and to pick or swap roles before and/or in the course of the story.

3. Reconsider the exclusive and irreversible choice of a path. Asking the readers at the end, whether they like this version of the future or whether they want to start the story again or return to a specific decision point, seems a promising new element both for the readers' experience and the research design.

4. Experiment with alternative formats for multilinear narratives. In the broader context of this study we experiment with immersive Virtual Reality (VR) to increase the emotional engagement of users. A "SciFi generator" allows to create VR experiences from textual Twines. Comparing the effects of textual twines versus immersive VR experiences is an interesting field of futures research.

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