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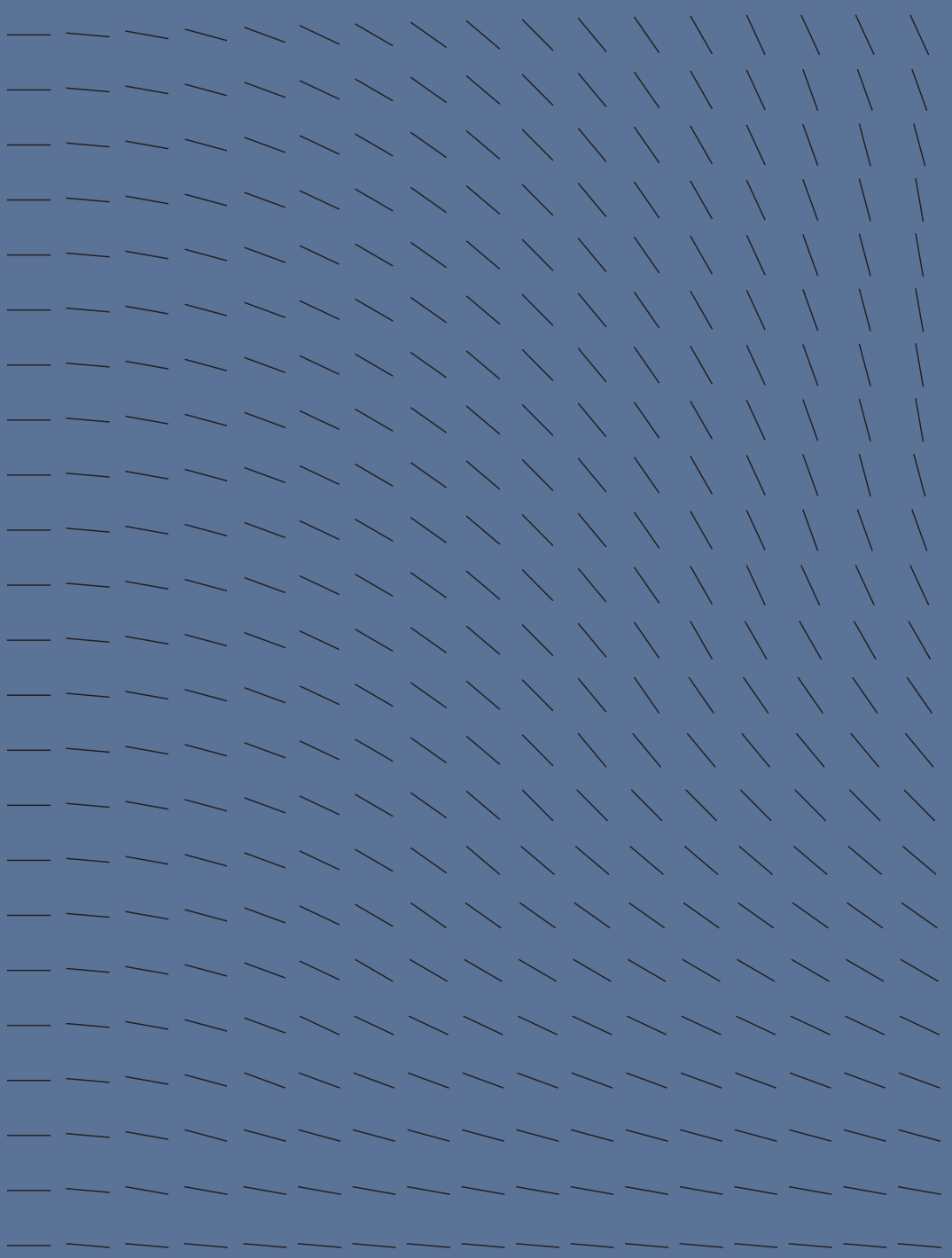

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SUSTAINABLE LABOR CONDITIONS IN THE GIG-ECONOMY – CASE STUDY: SUSTAINABLE CROWDLOGISTICS (NACL)

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ABSTRACT

With notion to radical changes in today's labor markets and especially for lower income jobs with a less required proficiency; this paper has faced a to gig economy labor challenge to propose a solution which achieves to multi goals obsessively eyed on the future society which needs cleaner cities, crowd working synergy based on sharing economy trends and fairer incomes and motivations following sustainability goals. The proposed last mile delivery solution called "NaCL" will be implemented in the city of Bremerhaven as a sustainable crowd sourced last mile logistics solution to be evaluated as sustainable business model in the field.

KEYWORDS

Crowd Logistics; Sustainability CRM; Green Logistics; Crowd Working; Sustainable Business Model.

1 INTRODUCTION

Labor Markets all over the world are facing dramatic changes. Especially in so-called industrial countries, people in low-level jobs fight with low incomes, bad working conditions, and limited job guarantees. (Abel et al., 2018)

The so-called gig economy proclaims flexible and fair working conditions. (Graham et al., 2017.) Gig Economy employment models are established for different markets like for the creative industry with Fiverr[1] but also especially in the mobility and logistics domain. Platforms like Uber[2] or deliveroo[3] are providing new labor markets for the mentioned low-level jobs. But these fully flexible employment relations are connected to several problems, both for employee and employer. On the one hand, the described problems of low-level jobs are increasing. Responsibilities and risks in different dimensions are transferred to the employees. Health insurance and social security are usually not financed to name some of the problems. (Desmond and Gershenson, 2016) On the other hand, workers are probably low motivated, and service quality is decreasing. (s) Traditional companies in the market like taxicab companies or logistics providers are struggling for survival because of superior (international) competitors. General problems in the logistics market can be identified in the social dimension because of precarious employment and the environmental dimension – 23% of worldwide Carbon emissions are produced by transport. (IPCC, 2014) This problem is mainly addressed in this paper.

[1] https://www.fiverr.com/
[2] www.uber.com
[3] https://deliveroo.co.uk/

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2 CROWD LOGISTICS

Currently, the platform provider Uber entered the logistics market[4]. Uber Freight can also be considered as a Crowd logistics approach in order of the following definition by Mehmann et al.:

"*Crowd Logistics designates the outsourcing of logistics services to a mass of actors, whereby the coordination is supported by a technical infrastructure. Crowd Logistics aims to achieve economic benefits for all stake- and shareholders.*" (Mehmann et al., 2011)

The original intention of crowd logistics was to transport goods by private individuals in a prosumer approach. E.g., the platform myrobin[5] calls its service a "lift for things". People who are on travel anyway can transport goods for other people in a prosumer approach. Such a service can be considered sustainable in the ecological dimension (no/few additional emissions) as well as in the social dimension (no precarious employment). Still, it is doubtable that such a service can master significant transport needs of our economy. Furthermore, jobs in the logistics market are erased.

3 CASE STUDY

Core subject of the research project "NaCl – Sustainable Crowd logistics" is the employment model development and piloted application of an innovative and sustainable logistics system based on a crowd logistics approach. Significant features of the logistics system are the very positive effects on the ecological dimension and the regional transport system since it is based on electrically driven cargo.

Besides, it holds interesting economic potentials for the logistics service provider, as it is more elastic compared to conventional systems based on vans, especially in the personnel area due to the lack of driving license requirement. This elasticity is assumed to be significantly increased by the crowd approach, thus strengthening the competitiveness of this ecologically sensible logistics system. (Carbone et al., 2017)

The most important aim of the project is to develop an employment model that is competitive and fair at the same time. So the flexibility of the crowd logistics model is applied only to cut load peaks. This should allow increasing the number of permanent employees. Permanent employees get regular fares, health, and social insurance etc. while the load peaks situation is not permanent at all! The crowd workers are recruited mostly in alternative milieus and should be motivated by intrinsic and extrinsic reasons belonging to participation in a sustainable last mile logistic service. For this existing incentive schemes of the Sustainability Customer Relationship Management (SusCRM) approach (Wagner vom Berg et al., 2013; Wagner vom Berg, 2015) will be adapted. This lead's the employment model to a balanced position of offering fair and competitive labor costs in temporary conditions with sustainability motivations.

4 CONCLUSION AND OUTLOOK

The field of logistics requires agile solutions in the ecological and social dimension of sustainability to meet the needs of future societies. The NaCl project started in June 2018 and is scheduled for two years. The goal of the project is the development of a prototypical information system meeting the proclaimed needs and the piloted application a test field in the city of Bremerhaven. Crowd workers will be recruited among the students of the University of Bremerhaven. The approach gives at least the chance to establish more permanent employment because of a better and more flexible planning base. Still, it is up to the company to use these advantages for improving labor conditions and not abuse the crowd approach only for cost reduction. Developing labor ethics and showing the advantages of satisfied employees is also part of the project.

[4] https://www.uberfreight.com/

[5] https://www.myrobin.com/

5 ACKNOWLEDGMENTS

The NaCl project is a joint project of the University of Applied Sciences Bremerhaven (project coordinator), Rytle GmbH[6] and Weser Eilboten[7]. The project is funded by EFRE within the program "Applied Environmental Research (AUF)" of the city of Bremen. (City of Bremen, 2018)

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[6] www.rytle.com

[7] http://weser-eilboten.de/

PROCEEDINGS OF THE WEIZENBAUM CONFERENCE 2019
CHALLENGES OF DIGITAL INEQUALITY
DIGITAL EDUCATION | DIGITAL WORK | DIGITAL LIFE

CHALLENGES OF ONLINE PARTICIPATION: DIGITAL INEQUALITY IN PARTY-INTERNAL PROCESSES

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ABSTRACT

Parties adopt online participation methods in the hope of engaging a wider group of participants. However, literature on the digital divide suggests that this is unlikely to happen, as online participation remains dependent on the same factors as offline participation: income, class, education. Based on a mixed methods study of members of the Green Party Germany, this paper discusses the expected and actual effects of online participation tools on the participation of party members. Expectations are that these tools will benefit nearly everyone, but in practice, the goal to engage inactive members is only partially achieved: Younger members and those with lower educational attainments are mobilised, but women are not. These effect differ depending on the type of technology. I argue that this is an expression of the prevailing digital divide, which needs to consider not only a socio-demographic divisions, but also the multifaceted effects of different technologies.

KEYWORDS

Online participation; party-internal participation, digital divide, digital inequality, mobilisation, reinforcement.

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1 INTRODUCTION

In this paper, I explore the effect of two online participation tools (OPTs) in the Green Party Germany on the participation behavior of the party members. While the use of technology by political parties has been widely researched, especially with regards to communication to and with the general public (Gibson and Ward, 1998; Graham et al., 2014), the use of technology in party-internal processes is not yet well explored (Bieber, 2014), and the effects of internal tools are virtually unknown. This paper is an attempt to fill this gap, and provide pointers to a future research agenda on party-internal online participation, by answering the research questions:

1. What are the expected effects of OPTs, and to which degree do they guide decisions about their implementation?
2. What are the actual effects, and how do they differ from expectations, and between groups and tools?

2 BACKGROUND

2.1 DIGITAL DIVIDE & ONLINE PARTICIPATION

The internet has been hailed as a force for democratization, but little of what it seemed to promise has materialized. One of the major challenge of online participation, be it within parties or society, is the digital divide, which was discussed ever since the internet became a regularly used tool. Its perception has shifted from a first level 'access divide', looking at who does or does not have access to the internet, to a skill or age divide (Hague and Loader, 1999), famously framed in the divide between digital natives and immigrants (Prensky, 2001). Most recently, the digital inequality perspective argues that offline inequalities are continued online (DiMaggio and Hargittai, 2001), and that individuals' socio-demographic status affects the degree to which they can benefit from using the web (Hargittai, 2008). Access to, use of, and benefits derived from use of the internet are not distributed equally in society, and inequalities that exist offline are reproduced online (Halford and Savage, 2010).

The participation divide, whereby influence on political decisions is "systematically biased in favor of more privileged citizens – those with higher incomes, greater wealth, and better education" (Lijphart, 1997) – is perpetuated or even exacerbated online. Not only are these privileged citizens more likely to participate politically in general, but they are also more likely to be online (Emmer et al., 2011; Loader and Mercea, 2011). In consequence, a selective group comprised of young, wealthy, highly educated, men, is the main beneficiary of online political participation opportunities.

In the context of online participation, the question of digital inequality is highly relevant. Arguably, if the internet is not equal, online participation cannot be equal either. This is especially problematic in democratic contexts, where equal opportunity to participate in decision-making processes is important to maintain the legitimacy of decisions (Michels and De Graaf, 2010). Adopting OPTs is therefore a particular challenge for parties such as the Green Party Germany, who intend to use online processes to foster equal participation (Kellner, 2015). If offline differences, such as age, education, or gender indeed affect whether party members would use OPTs, then how can these tools increase inclusion?

Two concepts are frequently used to assess the effects of online platforms: Mobilisation and reinforcement. The mobilisation theory poses that with new opportunities to participate online, more, and more diverse, participants will engage in the political process (Ward et al., 2002). The reinforcement theory on the other hand suggests that, as more online participation opportunities become available, these are being picked up by those who are already active, giving them an additional advantage (Gibson et al., 2017). Reinforcement is a much more common result of tool introductions than mobilisation (Gerl et al.,

2018; Kersting, 2014). However, there is also evidence of mobilisation happening over time, once tools are established (Kerr and Waddington, 2014).

2.2 GREEN PARTY GERMANY

The Green Party Germany was founded in 1980, out of the women's, environmental, and peace movements (Frankland, 2008). It was developed bottom-up, with local branches being created first, and a national umbrella organisation following later (Switek, 2012). Due to these roots, the party has a tradition of grass-roots participation, and uses bottom-up processes. The party leadership sets the agenda, but does not make policy decisions. A national delegate assembly, comprising over 800 delegates from 416 local chapters, is the main decision-making body (*Bündnis 90 / Die Grünen*, 2015).

Since the party was founded and its participation processes developed well before the rise of the web, all processes are offline by default (Thuermer et al., 2016). The party has strong measures to ensure their grass-roots ideal is followed, for example through limitations on party leaders holding mandates or positions in government. One aspect that is particularly important to the party is gender balance – owing to their roots in women's movements. This is enshrined in the women's statute, which includes regulations like a gender quota for all elections, where half of all positions must be filled with women. It also includes procedural rules, such as gendered speaker lists at all assemblies, so that women and men have equal opportunity and time to speak in debates, as well as women-only votes and committees. All of these influence both the lived experience of balanced participation in the party, and how OPTs are perceived. The parties' commitment to participation and equality make it an ideal case to study the effects of OPTs; if OPTs can be successful anywhere, it should be here.

At the time of the data collection for this project, the party had just grown to 70,000 members, the highest count in their history. The party leadership wanted to engage the members and maintain the grass-roots participation ideal by using online technology (Bundesvorstand Bündnis 90 / Die Grünen, 2016). They introduced two OPTs to engage more members, and especially those who struggle to do so through formal routes:

- *Antragsgrün,* an online platform where members can publish, comment on, support and submit proposals for assemblies. The platform was introduced in 2014, and consistently developed, with the addition of a verification process for supporters added in 2017, and tracking for the status of proposals in 2018.
- *Mitgliederbegehren (Begehren)*, a petition system through which members can collectively make a demand from the executive board. It is based on the same, custom-built online system as *Antragsgrün*. The board does not have to act on these petitions, but must justify their decision. The tool was introduced in 2018.

3 METHODOLOGY

A panel survey among a stratified sample of 4,236 party members was conducted, with the first wave in November 2017, and the second in July 2018. To prevent a bias towards members who are already engaged online, the sample included 500 members who did not communicate with the party by email, and an equivalent number of members who did. All participants had the option to respond either online or on paper. The first survey received 572 responses, with a response rate of 14%, and the second 457 responses, or 11%. Both are comparable to similar studies (cf. Gerl et al., 2018).

The survey included questions around members' views on and use of the OPTs, their expectations of those tools, views on participation in general, and a set of demographic questions. For this paper, two sets of questions are relevant:

1. *How do you think more opportunities to participate online are going to influence the participation of these groups?*

Groups were arranged in complementary pairs (see **Figure 1**), and measured on a five-point Likert scale, from '(1) Participation becomes harder' to '(5) Participation becomes easier'. The pairs, based on the first panel surveys, are summarised (see **Figure 1** below) and compared to assess members' expectations. All statements were also tested for correlations between respondents' own situation and their assumptions about groups that they would or would not be considered to belong to, to see whether, for example, respondents' age influenced their assumptions about the effect of online participation on younger or older members. However, none of these resulted in significant correlations.

2. *How do you think the [*Antragsgrün/Begehren*] has affected your own participation?*

Possible responses included 'I participated more / the same / less / differently'. Binary logistic regression models were developed based on the second survey, with 'I participated more' as the dependent variable, allowing conclusions over the factors that contributed to increased participation.

A factor score was generated to gauge participants' activity within the party, based on the frequency and channels (e.g. email, meetings) used. This allows to distinguish between mobilisation, when groups become active without having been so before, and reinforcement, when groups increase their participation although they have already been more active than others.

In addition to the surveys, 38 interviews were conducted with members and stakeholders of the party who were involved in the discussion or implementation of OPTs, between November 2016 and March 2018. These were transcribed and coded thematically, to understand the assumptions, expectations, and views on the OPTs. In this paper, the interviews are used to contextualise survey findings; a detailed analysis of the interviews is available in Thuermer et al., 2018.

4 FINDINGS & DISCUSSION

Previous, qualitative work based on interviews and observations has shown that party members expect these new OPTs to empower members who are currently excluded from participation (Thuermer et al., 2018). However, while their general assumption is that online participation opportunities will mainly be beneficial for 'others', whom they believed to be disadvantaged through current processes. They hardly reflected on the potential effect these online processes would have on their own participation though. Using this insight as a starting point, the panel surveys were used to validate these assumptions at scale with the wider member base. The assumptions are discussed first, and then compared to actual participation changes.

4.1 ASSUMPTIONS ABOUT ONLINE PARTICIPATION EFFECTS

What members assume, at a collective level, is important, because of the grass-roots structure of the Green Party. Members make the decisions, either through votes at (delegate) assemblies, where they decide about tools to be implemented in the future, or through voting with their feet, by either using or not using the tools that are introduced. If they think the tools are useful for all, the results of those tools are also likely to be more legitimate. A higher legitimacy in turn would give the outcomes of these processes more recognition and leverage in future policy development processes, making the tools themselves more influential (Koch et al., 2014). My interviews have shown that both members and leaders of the Green Party are convinced that online tools *can* help engage a wider group of members, particularly those who cannot participate though traditional routes, such as local meetings. The dominating assumption was that OPTs would both increase and diversify the members who engage with policy processes: *"Every member that has access to the internet can participate. That's definitely more than ever*

before. (...) There are people who do not have the option to attend a meeting (...) That limits the circle of people who could participate. And we do not want that."

The interview results are closely aligned with the survey respondents. **Figure 1** shows a summary of their assumption: OPTs will make participation a lot easier for younger members, while making it slightly harder for older members. The *Antragsgrün* replaced an offline process, but this change happened several years ago; the further development of the tool may have made its use more complex and this indeed made participation harder. The *Begehren* on the other hand does not replace or replicate existing processes, but offers an *additional* route to influence the parties' decisions. It cannot thus make participation harder per se, but may be less accessible to these 'older members'– the only group for which participation is assumed to become harder with online tools. The assumption that older members will struggle to leverage the new tools is unsurprising, as age – in the form of digital natives and immigrants (Prensky, 2001) – is the one demographic category affecting digital divides that has reached mainstream attention. Although this concept in itself is too narrow (White and Le Cornu, 2011), age has been shown to be a relevant factor for internet use time and time again (Emmer et al., 2011; Oser et al., 2013; Vowe, 2014; Ward et al., 2002). Based on the literature, members are right to worry that older members may struggle to use the new online tools.

Respondents further assume that OPTs will make participation easier for members with good and poor networks, though slightly less so for the latter. This is in line with the interviews, where members commented on network size being a positive determinant for online participation. It also fits with the theory of social capital (Bourdieu, 1986), which suggests that those with richer social connections make their participation both easier and more impactful. There are indications that internet use can help underrepresented groups to form and then leverage new networks though (Brock et al., 2010). While members with larger networks may benefit more in the short term, others should be able to *build* their networks and increase their reach through the new online tools, and thus catch up with them.

The place of residence is assumed to positively influence participation, although members in densely populated are expected to benefit more than in sparsely populated areas. This makes sense from a perspective of internet connectivity, as cities are more likely to have good internet connections than rural areas. While 92% of households in Germany have access to broadband (Eurostat, 2017), connectivity is significantly lower in rural areas (BMVI, 2016, p. 21). On the other hand, given the potential to expand networks online, rural areas could benefit by connecting with members within and across these sparsely populated regions.

There is virtually no difference between participation expectations for men and women: Members assume that participation gets easier for both at the same rate. Women and men make this assumption equally. This is the only category where respondents very distinctly diverge from what the literature would assume to happen. There is a clear gender difference, both in terms of political participation (Niedermayer, 2017),

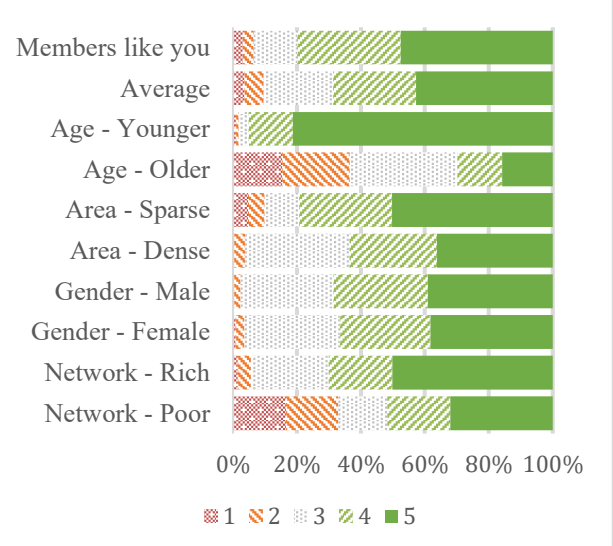

Figure 1. Overview of assumptions about the effect of online participation methods on the participation of selected groups, on a Likert scale from 1 (Participation becomes harder) to 5 (Participation becomes easier). N = 572

and internet use (Emmer et al., 2011). Although women do catch up with men, and may be able to derive larger benefits from web use (Gil de Zúñiga et al., 2010), this effect is observed over time, rather than immediately from the introduction of online tools (Kerr and Waddington, 2014). While members at scale assume that men and women would be affected by OPTs in the same way, interview participants frequently assumed that women, particularly women with small children, were currently excluded, and thus could benefit more through online tools.

This divergence in views may have several causes. Given the cultural context of the party, these responses are likely based on ideological belief and lived experience. The parties' women's statute (*Bündnis 90 / Die Grünen*, 2015) stipulates that participation has to be gender balanced. This regulation leads to the experience in offline participation that women are on par with men in the party. This may in turn lead members to assume that the same will apply online. However, there is no practical application of the statute to online participation.

Respondents assume that participation becomes easier for everyone, on average: the average rating across all groups is 3.98. Respondents also assume that, on average, participation will be easier for them than for others, with 'members like you' averaging at 4.18. There is a statistically significant linear relationship ($p < 0.000$, and $R^2 = 0.229$) between how online participation is assumed to influence other groups, and the assumed effect on 'members like you': The easier they think it will be for themselves, the easier they think it will be for everyone.

In summary, members think that participation gets easier for everyone apart from 'old people', and that members like themselves will be better off than others. This is contradictory in that surely the respondents are part of some of the groups included in the survey. This reflects the earlier results, where benefits that online processes would bring for the participants were hardly ever mentioned, and all potential benefits reflected onto others (Thuermer et al., 2018).

4.2 ACTUAL PARTICIPATION CHANGES

In order to identify mobilisation and reinforcement effects, I compare indicators for activity in the party, and an increase in participation. As shown in Table 1, there were several distinct features of active party members in 2017: Members engaged in the party wings were more active than those who were not; women were slightly more active than men. Members who expected positive effects for themselves from online participation were less active, and so were members who preferred voting over discussions, members who hold doctorates (as compared to lower university degrees), and who live in cities. This in itself contradicts some of the assumptions of the participation divide: Members who are higher educated, live in cities, or are male, would be expected to be more active (Lijphart, 1997). In that, the Green Party Germany already behaves in a way that does not align with the digital divide.

I now compare these figures, for activity in 2017, and changes to participation by 2018. As shown in Table 2, there is some overlap of indicators, but some new ones arise as well. The picture looks very different for the two online participation methods. The Antragsgrün was more likely to increase participation for members who are younger, male, hold no university degree, and already used the tool. The Begehren was more likely to increase participation for members who are not online every day, who expect benefits from online tools, and do not hold a university degree.

What stands out is the consistently negative effect of higher education, which contradicts both the participation and digital divide literature (Jensen, 2013; Lijphart, 1997; Vowe, 2014). It seems that the higher a degree a member holds, the less likely they are both to participate, and to increase their participation. Rather than simply mobilising members with lower education, the online tools actually reinforce their already intense participation.

	B
Constant	1.045
Network in party wings (None)	
Left	0.638
Reformer	0.881
Gender (female)	0.129
Expected effect (Likert)	-0.065
Preference of Participation Type (Vote)	-0.113
Education (University Degree)	
PhD	-0.213
Residence (Rural)	
Directly within a city	-0.181

Table 1: Linear Regression Model for Activity in the party in 2017 (N = 359; R^2 = 0.228). Comparison categories provided in brackets. All significant at p < 0.05.

	Antragsgrün			Begehren		
	N	Odds	CI L-U	N	Odds	CI L-U
Age	294	0.968	0.955 0.982		-	
Daily Internet Use		-		314	0.054	0.016 0.186
Expected effect (Likert)		-		325	1.479	1.115 1.961
Gender (Female)	107	0.342	0.151 0.773		-	
University Degree	214	0.402	0.200 0.808	232	0.514	0.283 0.935
Use of Tool	109	4.845	2.476 9.841		-	

Table 2: Odds Ratios for Increase in Participation through *Antragsgrün* (N = 294; Nagelkerke's R Square = 0.637) and *Begehren* (N = 325; Nagelkerke's R Square = 0.570). All significant at p < 0.05.

Particularly interesting in the context of the Green Party, with their focus on gender equality, is the effect on women: They tend to be more active in the party in general, but are significantly less likely to increase their participation online. It is men who are mobilised through the *Antragsgrün*. Given the central role of the tool in the decision-making process, this may increase their influence beyond the currently higher activity rate of women. While this is not surprising from a literature perspective – women tend to be less interested and less active, both politically and online (Emmer et al., 2011; Jensen, 2013) – it directly contradicts the assumptions participants made in surveys and interviews: Rather than having the same effect on men and women, or excluded women being empowered, the *Antragsgrün* favours male members. However, this cannot be classed as reinforcement either, as men were slightly less active before. Depending on how this trajectory continues, with men increasing their participation while women do not, this balancing effect may turn into reinforcement over time.

While age was not a significant predictor for activity in 2017, it was significant for an increase in participation through the *Antragsgrün*: The older members were, the less likely they were to increase their participation. Younger members are mobilised, but older members are not. This reflects the digital divide, where youth indicates more online activity (Vowe, 2014).

The positive influence of the expected effects of online tools confirms, to some degree, the hopes with which these tools were introduced. While members who expect the tools to make participation easier for them were less active in 2017, they have significantly increased their participation through the *Begehren*. These do not even seem to be the members who are 'online anyway', as daily internet use is a significant negative predictor for this increase: Members who are online every day were less likely to increase their participation through the *Begehren*. That speaks for mobilisation of less active users. However, interviews also indicated that members may not be particularly familiar with the tools, as many participants were not even aware of what the *Begehren* is.

5 CONCLUSION

The comparison between party members' expectations and actions has shown a clear divergence. In response to the second research question, 'What are the expected effects of OPTs, and to which degree do they guide decisions about their implementation?', participants had distinct expectations of who will benefit: OPTs

would make participation easier for everyone, apart from 'old people', and enable those who are currently excluded. Members who are younger, well connected, and living in sparsely populated areas, were assumed to benefit the most. To some degree, this reflects members who are not currently active, as older members and cities-dwellers are more likely to be active. Overall though, respondents assumed that, on average, participation would become easier for members like themselves than for others.

If these assumptions were true, it would be logical to expect the introduction of OPTs to lead to a mobilisation effect. It would be easier for members who are currently excluded to participate, therefore online tools could help to increase their participation, and enable them to catch up with their highly active peers.

But these are only assumptions about potential, and the picture for actual use looks rather different: those who did increase their participation are either on the positive side of the digital divide, or in favour of the tools. This provides a clear answer to the first research question: 'What are the actual effects, and how do they differ between groups and tools?'

The effects do differ between groups, and from expectations, particularly concerning gender: While respondents assumed the same effects for men and women, women were significantly less likely to increase their participation. Some of this effect is balanced by the fact that women are slightly more active overall; however, the increase in participation by men through the *Antragsgrün* far outweighs the current advantage of the women. By selectively mobilising men, the use of the online tool could open a rift that does currently not exist in the participation practice of the party. This is exacerbated – or caused – by the lack of control mechanisms for gender equality online. Without these, the party appears to be hit by both the participation divide, with women being generally less likely to engage in politics (which is balanced through the *Frauenstatut* in their offline processes), *and* the digital divide, where women are less likely to engage politically online.

All in all, the results indicate a mobilisation effect for men, members who are younger, and have lower educational attainment. The best predictor of increased participation through both tools is a high opinion of the OPTs, and a positive outlook on online participation. If members like the tools, and believe that they will help them, they are more likely to increase their participation, which is underlined particularly by the lack of awareness of the *Begehren*. This is a result the party, or any organisation, could build on, for example by offering information and training, or a staged on-boarding process, as increasing knowledge is likely to translate directly into increased approval and adoption.

At last, it is worth to step back and consider that the effects of both tools analysed in this paper were very different. While the *Antragsgrün* engages members of young age, and male gender, low internet use and high enthusiasm for online tools were more relevant for increased activity through the *Begehren*. Education was the only category that affected the activity of participants in general, and for both tools – but in all cases, the effect was the opposite of the digital divide, with higher education indicating less, rather than more participation.

In summary, these results give an important indication for future research: We need to look at the effects of online participation not only through the lens of the digital divide, considering access, skill and use, but also include the role and functionality of the tools, their institutional context, and the appeal to intended users.

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PROCEEDINGS OF THE WEIZENBAUM CONFERENCE 2019
CHALLENGES OF DIGITAL INEQUALITY
DIGITAL EDUCATION | DIGITAL WORK | DIGITAL LIFE

THE RELEVANCE OF STUDENTS' DIGITAL MEDIA BEHAVIOUR AND SELF-EFFICACY FOR ACADEMIC ACHIEVEMENT IN VIEW OF THEIR SOCIO-ECONOMIC BACKGROUND

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ABSTRACT

Research suggests a link between students' social background, e.g. educational background of parents, academic self-efficacy expectations and study behaviour. Often, lower academic achievement is expected of those students' whose parents are characterized by lower educational background. Although digital media are prevalent in several areas of everyday life, their relevance for academic achievement is not satisfactorily explored. Furthermore, it remains largely unknown in this context whether media usage is related to social background factors. In consequence, it is important to investigate if existing inequalities in higher education are stable, further enhanced or even reduced by means of "digitalisation". The present study explores the relationships between individual, contextual as well as social background factors, with a special focus on academic and digital media self-efficacy expectations. Data was collected at four German universities in summer 2018 (n = 2039). Currently, data is analysed by means of structural equation models.

KEYWORDS

Socio-economic background; digital media self-efficacy; digital media in higher education

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1 INTRODUCTION

Although digital media are prevalent in several areas of everyday life, their role in academic settings and their relevance for academic achievement are not satisfactorily explored. Research concerning academic attainment is often focused on the link between students' self-efficacy expectations and motivation (e. g. Komarraju & Dial, 2014; Pajares & Schunk, 2001; Putwain, Sander, & Larkin, 2013; Zimmerman, 2000), stating that self-efficacy expectations are an important predictor for academic goal setting and achievement.

Based on Bandura's social cognitive theory (SCT) (e. g. 1977, 2012), self-efficacy beliefs are expectations regarding one's capabilities to successfully master individual or study-related tasks and situations. The higher the self-efficacy belief, the higher the effort people will put into an activity, the longer they will preserve when confronted with obstacles (Pajares, 1996, p. 544). Thus, the SCT and self-efficacy expectations may be used as a theoretical framework to analyse thoughts, motivation and behaviour in academic contexts and, therefore, appear to be well suited to the aim of the study at hand.

In addition to the self-efficacy-achievement-relation, academic achievement varies between different social groups, such as migrants, students with children or low socio-economic status (SES) (Röwert, Lah, Dahms, Berthold, & Stuckrad, 2017). In this regard, research suggests that students' SES may affect academic achievement via self-efficacy (Weiser & Riggio, 2010). Surprisingly, whether media usage resp. certain types of media usage are relevant for academic achievement and their relation to social background factors remains largely unknown in this context.

Previous work on digital media at universities is predominantly based on empirical studies that describe different types of media usage patterns. These studies show that students with different characteristics (e.g. age, family status or ambitions) show differing patterns of digital media use in academic settings (Grosch, 2012; Zawacki-Richter, 2015; Zawacki-Richter, Dolch, & Müskens, 2017). However, the impact of digital media on studying itself as well as factors such as underlying motivations, emotions, self-evaluations, self-efficacy or students' social background are hardly considered in these studies. In consequence, it is unknown if existing inequalities in higher education are stable, further enhanced or even reduced by means of "digitalisation".

As academic self-efficacy expectations are deemed relevant for academic behaviour and achievement and certain types of digital media usage are supposedly relevant in terms of successful studying as well, self-efficacy expectations regarding digital media use (DMSE) should also be taken into account.

Apart from that, in other research on academic achievement, evidence for the association with the following constructs were often found: gender; previous academic performance (Talsma, Schüz, Schwarzer, & Norris, 2018); motivation and goal orientation (Hsieh, Sullivan, & Guerra, 2007) because of its relevance for interest and self-regulation and its dependence on self-efficacy (Honicke & Broadbent, 2016); emotions like anxiety (Hsieh, Sullivan, Sass, & Guerra, 2012); perceived control over actions and outcomes (Pekrun, 2006) and certain personality traits like conscientiousness due to its link to self-discipline (Lievens, Ones, & Dilchert, 2009).

A sketch of the assumed relationships is shown in Figure 1. Next to these often found connections, we aim to explore the relevance of digital media and of the associated self-efficacy expectations for academic achievement (highlighted), in order to fill this research gap and to supplement current research on learning in higher education institutions.

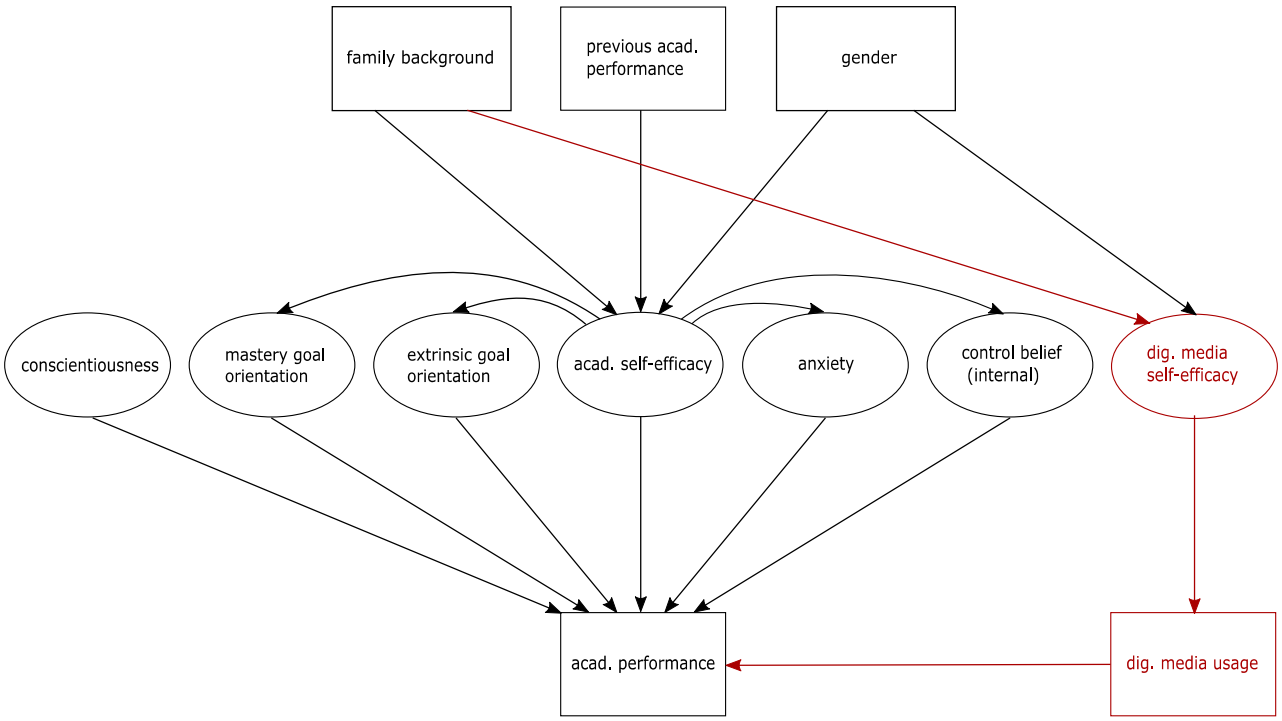

Figure 1: Path diagram of theoretically assumed relationship of constructs.

2 Data & Methods

In order to analyse the above mentioned relationships, data was collected by using a recently developed survey instrument that allows addressing the multi-faceted character of academic studies and digital media behaviour (Pumptow & Brahm, under review).

The scales of the questionnaire are based on approved scales taken from instruments in current research in the subject area (Brahm & Jenert, 2015; Grosch & Gidion, 2011; Jerusalem & Schwarzer, 2002; Lang & Hillmert, 2014; Leichsenring, 2011; Zawacki-Richter, 2015). Additionally, based on the general self-efficacy scale by Schwarzer and Jerusalem (2010), a scale for self-efficacy in terms of digital media was newly constructed to capture students' media-related self-efficacy. Data collection took place at four German universities from May to July 2018. In total, 3342 students participated in the online-survey of which 2039 cases remain after excluding cases due to missing data. Currently, data is analysed in terms of the above mentioned relationships by means of structural equation models.

3 Results

Initial multiple regression analyses indicate that the expected relationships between the above mentioned constructs (see Figure 1) can be confirmed with our empirical data. Results of the in depth-analyses will be presented at the conference.

4 Conclusion

The results will show first insights into the relevance of certain types of digital media behaviour for academic success in higher education. Furthermore, it is shown how digital media self-efficacy is linked to this observable media behaviour and to students' social backgrounds. In this regard, our research contributes to the important question of the relation between students' digital media use, their social background and their study success.

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PROCEEDINGS OF THE WEIZENBAUM CONFERENCE 2019
CHALLENGES OF DIGITAL INEQUALITY
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DIGITAL PLATFORMS AND DIGITAL INEQUALITY- AN ANALYSIS FROM INFORMATION ETHICS PERSPECTIVE

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ABSTRACT

Digital platforms are information technology artifacts that erode established market structures by providing a digital interaction space for producers and consumers. Therefore, it is argued here that digital platforms inherently support digital divide. This potential, if not governed or made visible for the involved actors, can lead and is already leading to undesired societal and ethical consequences. To derive these insights, Information Systems (IS) perspective is enriched with the Information Ethics approach and terminology. This interdisciplinary view allows considering both the technical and the social side of the problem. The analysis of interactions and roles is performed using the four ethical issues identified by Mason as a general taxonomy of ethical concerns in IS context. The identified aspects offer insights on the potentials of digital platforms that fosters digital inequality. Power asymmetries between the digital platform and its users are identified, outlining their potential for manifestation of the digital divide.

KEYWORDS

Digital platforms; Information Ethics; digital inequality.

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1 INTRODUCTION

Digital platforms are increasingly present in the discussions in public media but also in Information Systems (IS) research (Reuver, Sørensen and Basole, 2018). Their influence is reaching beyond technical aspects to economic and social debates (Reuver, Sørensen and Basole, 2018). Thus, one of the challenges in platform research, is their complex and intertwined structure on technical but also social levels.

This research augments the platform research agenda by extending the question about the platform design with the focus on ethical implications of the design decisions. To do so, the background of Information Ethics (Floridi, 1999) is applied to analyze platform governance aspects using the four categories of ethical issues in Information Systems as described by (Mason, 1986). In order to effectively shape the digital artifacts and the digital society as a whole in a socially and ethically responsible way, it is crucial to have a clear understanding of their ethical implications. As a result, an overview of the potential ethical issues relevant for platform actors is provided. The identified aspects offer insights on the dominance potential of digital platforms for digital inequality. This result can be used to provide ethical platform governance creation for digital platforms that minimize the potential for digital inequality.

2 DIGITAL PLATFORMS, THEIR GOVERNANCE AND INFORMATION ETHICS

Digital platforms are often positioned as a digital ecosystem, see e.g. (Tiwana, 2013; Schreieck, 2016). An ecosystem in the ecology context is defined as a dynamic complex of communities and their environment that interact with each other as a functional entity (Schulze, Beck and Müller-Hohenstein, 2005). In the digital context the other communities are: platform provider, platform user as well as application and data providers, i.e. content providers. These elements are interacting towards the preservation and success of the platform that is measured by e.g. the frequency of platform visits (Bosch, 2009), the number of applications being hosted and used (Kim, Kim and Lee, 2010; Haile and Altmann, 2013) or the online traffic being generated towards the platform (Evans and Gawer, 2016). As platforms are affected by network effects, the success of a platform is determined by having enough participants on the development side to attract the customer side and vice versa. These stakeholder interests need to be aligned by governance (Wheelwright and Clark, 1992; Golding and Donaldson, 2009). Therefore, the governance of the platform is a crucial aspect of platform creation and successful operation. (Schreieck, 2016) divides the design and governance concepts of a platform ecosystem as: roles, pricing and revenue sharing; boundary resources; openness; control; technical design; competitive strategy; trust. In this paper, the addition of the ethical dimension as a governance concept based on the information ethics approach is suggested. To do so, the concepts from Information Ethics are applied to conduct the analysis and examine the results.

Information ethics is concerned with the morality of the information society (Kuhlen 2004; Floridi 2015; Bendel 2016). As an operationalization of these principles, the analysis of interactions and roles on a digital platform is performed using the four ethical issues identified by (Mason, 1986) as relevant for developing and using IS as a general taxonomy of ethical concerns. These four dimensions for ethical vulnerability of information are: privacy, accuracy, property and accessibility. It is argued here that the platform designers and providers are able to distribute their power along these dimensions to potentially diminish user influence on the platform interactions. Hence, power asymmetries between the digital platform and its users are identified, outlining their potential for manifestation of the digital divide.

3 ETHICAL ISSUES AND DIGITAL PLATFORM GOVERNANCE

Digital platforms bring together supply and demand via smart assessment mechanisms and create a trusted environment by facilitating transactions. This constellation favors the potentials for power asymmetries leading to ethical issues. Table 1 summarizes an excerpt from the potentials for exercising power asymmetries between the platform and the users or content providers.

Platforms can decide unilaterally to deny a user access to the platform. This is the case at service platforms, e.g. Uber where the drivers need to have a specific rating to be able to participate (Cook, 2015). Applied technology is also a factor in the access governance. By setting a technological standards, e.g. APIs or specific software development language, the platform manifests an asymmetrical relationship on the level of accessibility for content providers (Royakkers, Timmer, Kool and van Est, 2018). Moreover, platforms tend to collect user data in the first step of the registration process. By defining the mandatory data fields, the platform defines the accessibility possibility for users. Via the profile settings, e.g., the platform exerts the power over privacy and accessibility issues for users. While the user is the source of the accuracy of his/her data, the platform decides about the verification rules. The user is participating in the process of the disclosure of his/her data, partly due to the relatively new (regionally focused) legislation such as GDPR[1]. The most potent but also a rarely read (Obar and Oeldorf-Hirsch, 2016) document governing these issues, is the terms of use document, where the above-mentioned aspects such as mandatory profile data, content visibility, copy rights or technology standards for content presentation are governed. Only recently the potential of its misuse became regulated by the legal efforts such as GDPR and the digital copy right rules. Despite the appeals form different sources (Briegleb, 2018) this first regulations are still limited to the European region.

Privacy	Accessibility	Property	Accuracy
Registration or profile data	Role-based access	Terms of use	Accumulates user data
Visibility of profile	Content recommendation	General terms	Processes data
Data security	Membership conditions	User generated content	Enriches data
Website tracking	Banning conditions	Hardware infrastructure	Authentication
Data processing	SignIn-conditions …	…..	….

Table 1. Potentials for power asymmetries on the platform along the IS ethical issues dimensions (excerpt).

The concerns mentioned above and in Table 1 show the ethical issues and their implementation via the platform. It is essential to understand these aspects when designing and participating in a successful platform.

4 CONCLUSION

This short overview shows that from the user's point of view informational autonomy, privacy and balance of power are at risk when the governance of the interactions on the digital platform are left to their own devices or to the platform provider. It was outlined that digital platforms can foster inequality in information provision by controlling access for both content provider and user via access criteria to the platform, content visibility as well data collection and processing definitions. These arguments provide a basis for further discussion of the power asymmetry potentials between the user

[1] GDPR: EU General Data Protection Regulation

and the platform as well as on digital divide based on information access management.

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HOW PRIVACY CONCERNS AND SOCIAL MEDIA PLATFORM USE AFFECT ONLINE POLITICAL PARTICIPATION IN GERMANY

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ABSTRACT

Digital inequalities research has investigated who engages in online political participation, finding gaps along socioeconomic variables such as gender and education. Recent research has also highlighted how online platforms may facilitate political participation. Especially for multi-purpose platforms such as Facebook, where users are supposed to use their real names, issues of adequate self-presentation arise. The diversity of multiple audiences engenders privacy concerns, particularly when controversial political issues are discussed. We add to existing research on digital inequalities by focusing on privacy concerns as a critical construct. Using a survey of German Internet users, we test the effect of privacy concerns on online political participation. Unexpectedly, privacy concerns increase political participation. As privacy concerns are spread evenly throughout the population, they contribute little to the socioeconomic stratification of online political participation. Social media use, however, exerts a strong positive effect on political participation, and differs significantly among socioeconomic groups.

KEYWORDS

Digital Inequality; Privacy; Survey; Social Media; Social Network Sites

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1 INTRODUCTION AND LITERATURE REVIEW

New media can foster political participation through different mechanisms, for example by offering low-threshold forms of engagement. Expressing one's opinion online can be as easy as clicking a like button on Facebook or retweeting someone else's tweet. Signing e-petitions, posting videos, and commenting on online news are other activities that require limited effort for political expression and participation. Social media, in particular, have facilitated political online engagement due to their affordances (Vitak and Kim, 2014). Consequently, previous research has found that social media use is positively related to political participation (Boulianne, 2015).

Yet in Western nations such as the United States, the United Kingdom or Germany, online political participation is still a minority phenomenon (Blank, 2013; Emmer et al., 2012; Smith, 2013). Just like in the offline world, few citizens show high levels of political engagement in the digital sphere (Köcher and Bruttel, 2011). In addition, online political participation is not evenly distributed throughout the population. Male and educated citizens tend to be most active in that regard (Lutz et al., 2014). Accordingly, some authors have pointed out a divide in political participation on the Internet and in social media (Bode, 2017; Vochocova et al., 2016).

Given the unequal distribution of political participation in the offline world, a critical question today is whether the sociodemographic stratification of online political participation merely replicates offline dynamics or whether online media provide specific obstacles to political participation that shape the online divide. One such obstacle of interest are privacy concerns. While privacy concerns, generally, can be seen as a deterrent from online engagement (Smith et al., 2011), they may pose specific challenges to online political participation. Political participation has variously been described as performative, as it is geared towards others and exposes the participant to the scrutiny of others (Scheufele and Eveland, 2001). From publicly expressing a political opinion, reaching out and trying to persuade others, to displaying a political position in the form of t-shirts, stickers or memes – by participating politically, citizens share personal data and information (Endersby and Towle, 1996; Kann et al., 2007).

The slacktivism hypothesis (Morozov, 2009) holds that this performative dimension fuels online political participation, as users engage in impression management and self-staging. In fact, political posturing on the Internet is suspected to aggravate confrontational or uncivil political discourses (Dahlgren, 2005; Papacharissi, 2004). At the same time, recent studies have shown that less expressive and outspoken individuals might instead silence their political opinions and avoid speaking out in online contexts to avoid alienating other users, creating a digital "spiral of silence" (Hampton et al., 2014; Kim et al., 2014; Zerback and Fawzi, 2016). As a recent example, Bode (2017) finds that online outspokenness contributes to the online participation divide, with men more eager to engage in visible behavior: "The greater the visibility of the behaviors, the greater the gender gap that emerges" (p. 587).

All of these findings confirm that online media do indeed constitute an environment providing specific incentives, but also challenges or obstacles to political participation. In particular, the opportunity to easily share information online, while rendering political participation more convenient, necessitates a careful consideration of the associated risks by users. To date, privacy and digital inequality stand apart as two relatively separate streams in Internet and social media research (Wilson et al., 2012; Zhang and Leung, 2015). In this contribution, we combine insights on online political participation and online privacy to argue that privacy concerns

may mitigate online political participation, possibly contributing to a divide in online political participation. We analyze the role of privacy concerns as a barrier to online political participation based on a survey of 1008 individuals in Germany. Exploring the role of privacy concerns in online political participation sheds light on which citizens might be more likely to benefit from the participatory affordances of new media. In short, our study will address the following research question: *How do privacy concerns affect users' online political participation?*

2 METHODS

We use data collected through an online survey in Germany to answer the research question. The survey was in the field throughout November and early December 2017. A certified market research institute provided access to the participants. 1008 respondents completed the survey. However, 24 of them were minors and subsequently excluded, leaving us with a sample of 984 respondents. 49 percent of these respondents are male and 51 are female. The average age was 51 years (SD = 17.5 years). Educational levels varied, with 1 percent reporting no formal degree, 14 percent a lower secondary degree (Volks- und Hauptschule in Germany), 36 percent an intermediary secondary degree (Mittlere Reife/Realschule in Germany), 13 percent an upper secondary degree (Fachhochschulreife), with 35 percent being in the highest category (Allgemeine Hochschulreife). About 1 percent reported other degrees. Compared to the German population, the sample is slightly skewed towards older and more educated individuals.

The *questionnaire* first queried participants on their sociodemographic data. It then included eight items on their online political participation, asking respondents about their frequency of participatory activities (e.g., *Signing a petition on the Internet*; *Engagement in a political online group*). These measures were translated into German from existing studies on online political participation (Calenda and Meijer, 2009; Hoffmann et al., 2015). Principal component analysis showed that all items loaded neatly on one factor. Cronbach's α was high, with 0.94, indicating high internal consistency.

Privacy concerns were measured with four items. This scale was slightly adapted from Malhotra and colleagues (2004) and had sufficient reliability, with a Cronbach's Alpha α of 0.77. Respondents showed moderate to high privacy concerns, with an arithmetic mean of 3.32 across all items (SD = 0.97).

We included respondents' political orientation on a left-right scale as a control variable. The scale ranged from 1-very left to 10-very right, with an arithmetic mean of 5.11 (SD = 1.71).

Internet use frequency was measured with one item, querying respondents to report how often they use the Internet on a 5-point scale. The answer options were 1-all the time, 2-several times a day, 3-once a day, 4-once per week, 5-less often. Thus, low values indicate high Internet use frequency. The arithmetic mean was 1.95 (SD = 0.64), showing that the respondents use the Internet often.

Internet skills were measured based on Hargittai's (2009) scale, which queries respondents for their knowledge of Internet and computer terms and has been shown to capture actual skills well. Respondents had to indicate their level of understanding of these terms using a 5-point scale that ranged from 1-no understanding to 5-full understanding. To keep the survey reasonably short, we selected seven items with varying levels of technicality out of the original 30 item inventory, including one bogus item. We bundled six of the seven items, excluding the bogus item, through a principal component analysis. All six remaining items loaded neatly on one factor and revealed high internal consistency (Cronbach's α = 0.90).

Social media use frequency was assessed for five major platforms: Facebook, Twitter,

YouTube, Instagram, and Snapchat. Respondents had to indicate on a 5-point frequency scale how often they used each platform, including the categories 1-never, 2-less frequently, 3-weekly, 4-daily, 5-several times a day. Facebook emerged clearly as the most frequently used platform, with an arithmetic mean of 2.97 (SD = 1.64). YouTube was the second most used platform, with an arithmetic mean of 2.67 (SD = 1.32). The remaining platforms had low average use, with arithmetic means of 1.58 for Twitter (SD = 1.13), 1.78 for Instagram (SD = 1.35), and 1.41 for Snapchat (SD = 1.06).

We relied on linear regression analysis to answer the research question, using Stata (v.14) statistical software and robust standard errors due to the skewed dependent variable. We also checked for multicollinearity but did not find variance inflation factors exceeding 5, thus ruling out severe multicollinearity.

3 RESULTS

Before we turn to the results of the regression analysis, we report demographic differences in the key variables of privacy concerns and online political participation.

As shown in Table 1, demographic characteristics do not differentiate privacy concerns but there are significant differences in online political participation between men and women, and between users of different education and age levels. Men are more politically engaged than women and younger users are more engaged than older users. By contrast, the education differences are more complex. Generally, online political participation seems to increase slightly with education but respondents with no formal education report comparatively high values. However, since this group is small and includes only 16 respondents, the arithmetic mean should be interpreted with caution, as it might have been affected by outliers. Overall, the descriptive results indicate that among German Internet users, there are demographic divides in online political participation but not in privacy concerns.

Attribute	**Privacy Concerns**	**Online Political Participation**
Gender		
Female	3.32 (0.72)	1.38*** (0.67)
Male	3.31 (0.75)	1.58*** (0.84)
Total	3.32 (0.74)	1.48 (0.77)
Education Level		
No formal education	2.64 (1.14)	1.58** (0.88)
Lower secondary	3.36 (0.73)	1.31** (0.60)
Intermediary secondary	3.30 (0.72)	1.42** (0.72)
Upper secondary	3.43 (0.78)	1.50** (0.80)
University ready and higher	3.30 (0.71)	1.60** (0.84)
Other	3.33 (0.81)	1.43** (0.70)
***Age* (Correlation)**	0.03	-0.28***
***Income* (Correlation)**	0.01	0.09**

Table Note: Arithmetic means reported; 1-5 Likert scales; Standard deviation in brackets; *** p < 0.001; ** p < 0.01; * p < 0.05; a two-sample t-test for gender and a one-way ANOVA for education were conducted to test significance

Table 1. Demographic Differences in Privacy Concerns and Online Political Participation.

Table 2 (last page) shows the results of a stepwise linear regression analysis. The columns of model 1 include only the control variables, in model 2, we then introduce privacy concerns as the central variable of interest.

Comparing tables 1 and model 1 in table 2, we see that education and age are no longer significant predictors of online political participation when we control for Internet use and social media use, in particular. Facebook, Twitter, YouTube, and Snapchat use are positively related to online political participation. The only social media platform that is not significant is Instagram. However, significant gender effects

remain in the multivariate model, but only at the 5 percent significance level.

Turning to model 2, privacy concerns have a positive and significant but weak effect on online political participation. Thus, users with more privacy concerns will engage more, and not less, in political activities on the Internet, compared with users who report low levels of concern. Of the demographic predictors, only gender has a significant effect, at similar magnitude as in model 1. Men engage more frequently in online political participation than women. Again, we did not detect any further socioeconomic effects. Sociodemographic effects also do not appear to be moderated by privacy concerns, which is to be expected given the descriptive data presented in Table 1. Political attitudes and Internet use frequency did not significantly influence the dependent variable, and neither did online skills. Finally, five out of six social media platforms exert a significant effect on online political participation – all platforms considered except for Instagram. In all cases, the effects were positive, indicating that heightened social media use will strengthen online political participation.

4 DISCUSSION AND CONCLUSION

Based on an empirical analysis of German Internet users, we can draw three main conclusions. Frist, privacy concerns appear evenly distributed throughout the population, as we did not identify a sociodemographic stratification of general privacy concerns. Second, social media use has a significant positive relationship with online political participation. We find that, overall, male, younger and more educated Internet users are more politically engaged than their female, older and less educated counterparts. However, these differences are largely mediated through social media use. Controlling for social media use, only a significant gender divide remains, with male users participating more than female ones.

Our study confirms previous findings from studies in the US (Best and Krueger, 2011) and in Germany (Hoffmann et al., 2015) that have similarly found positive associations between privacy concerns and political engagement. Despite political participation – particularly in social media – being associated with the disclosure of personal information, privacy concerns do not deter from political engagement, independent of age, gender or education. Several explanations could account for this positive effect. First, political interest or political milieu could drive both privacy concerns and online political participation. Politically interested users and those in a social milieu that is conducive to discussing political topics may be expected to be more outspoken online in political terms (Lutz, 2016), while also being relatively aware of privacy risks. Privacy might even be a topic that is conceived in political terms, particularly in a country like Germany, with a specific history of government surveillance. Privacy concerns might also be secondary to a desire for political expression, in the vein of the privacy paradox. Similarly to situations of general self-disclosure on the Internet, the perceived benefits of sharing political information and opinions might override the concerns (Dinev and Hart, 2006).

We found that in Germany, a wealthy Western democracy, demographic and socioeconomic differences in online political participation are not particularly pronounced. Besides gender, none of the variables considered had a significant effect on the outcome variable in the regression models. Thus, online political participation seems to be less stratified than other online activities such as social and entertainment production (Blank, 2013; Hoffmann et al., 2015). The gender effect in our study is in line with other studies on online engagement (Bode, 2017; Lutz et al., 2014; Vochocova et al., 2016), showing

that men participate more actively online in political terms than women. Given that, at least in English-speaking countries (Greenwood, Perrin, and Duggan, 2016; Blank and Lutz, 2017), women tend to be more active on social media than men, this gender divide does merit further inquiry.

Interestingly, we identified significant age and education differences in online political participation before controlling for Internet and social media use. The results of the regression analysis indicate that they might be caused by uneven Internet and social media use patterns (Blank and Lutz, 2017; Hargittai, 2015). As shown in studies on online content creation more generally, young users tend to engage more actively in participatory Internet activities across different online contexts, compared with older users (Blank, 2013; Hargittai and Walejko, 2008; Hoffmann et al., 2015; Schradie, 2011). The disappearance of the education effect after controlling for Internet and social media use indicates that educational stratification seems to be stronger for social media use in the first place than for online political engagement.

Finally, the strong effect of the frequency of using different social media platforms shows how online political participation is strongly connected to social media. It is plausible that many of the activities captured by the dependent variable in the regression model take place on social media. However, somewhat surprisingly, some platforms not primarily conceived as contexts for political action, such as YouTube and Snapchat, had a positive effect on online political participation, too. For more entertainment-oriented platforms such as YouTube and Snapchat, users might be exposed to political content, even though they are not directly searching for it. Such accidental or incidental exposure effects have been increasingly discussed in literature on political communication (Kim et al., 2013; Tang and Lee, 2013; Valeriani and Vaccari, 2016). Future research might study specific platforms, such as YouTube or Snapchat, in terms of how they might enable political online participation indirectly, through accidental exposure.

In addition to the limitations already mentioned, our study has several shortcomings. First, we conducted a cross-sectional survey. Future research should use longitudinal surveys to investigate changes over time or experimental designs to identify clear causal effects how privacy concerns might (or might not) affect online political participation. Second, we only collected data in one country. Future research should use comparative research designs to isolate the role the political and cultural system plays in shaping online political participation. Third, future studies should take further explanatory variables, such as users' social capital (both online and offline) and their engagement in traditional politics, into consideration.

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	Model 1		Model 2	
Attribute	Unstandardized Coefficient	β	Unstandardized Coefficient	β
Age	-0.00 (0.00)	-0.00	-0.00 (0.00)	-0.01
Gender	-0.15** (0.06)	-0.07**	-0.15** (0.05)	-0.07**
Income	0.01 (0.01)	0.01	0.01 (0.01)	0.04
Education	-0.02 (0.03)	-0.02	-0.02 (0.03)	-0.03
Political Attitude	0.01 (0.02)	0.02	0.01 (0.02)	0.02
Internet Use Frequency	-0.05 (0.04)	-0.03	-0.06 (0.05)	-0.04
Facebook	0.10*** (0.02)	0.16***	0.11*** (0.02)	0.17***
Twitter	0.23*** (0.04)	0.25***	0.20*** (0.04)	0.22***
Youtube	0.05* (0.03)	0.07*	0.06* (0.03)	0.08*
Instagram	0.01 (0.04)	0.01	0.02 (0.04)	0.03
Snapchat	0.35*** (0.06)	0.32***	0.36*** (0.06)	0.33***
Skills	0.01 (0.03)	0.01	0.01 (0.03)	0.01
Privacy Concerns			0.10** (0.03)	0.09**
Constant	-1.00 (0.26)	.	-0.96 (0.27)	.
R^2	0.40		0.41	
N	931		913	

Table 2. Multiple Regression Model Predicting Online Political Participation.

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PROFESSIONALS AS ONLINE STUDENTS:

NON-ACADEMIC SATISFACTION DRIVERS

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ABSTRACT

As student populations become more heterogeneous, it is becoming apparent that the traditional and learner-specific predictors of student satisfaction are not the only important variables that predict students' experience. Using a two-stage data collection process, we examined predictors in a sample of online MBA students over the course of a two-part survey. Regression analysis suggested that perceived control over one's schedule at work was a significant predictor of distance learning satisfaction and program satisfaction. This suggested that the MBA students' ability to maintain a work-life balance (which allows for both work and studies) plays a significant role in shaping student satisfaction. Correlations further suggested the higher the expectations of the students about program provisions and feedback, the lower their subsequent distance learning satisfaction scores. The results bring the importance of pre-enrolment program communication (rather than program efforts) as well as inclusion into focus.

KEYWORDS

Distance learning education; Expectation management; Program satisfaction; Inclusion

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1 INTRODUCTION

The number of students enrolled in Masters of Business Administration (MBA) programs in the UK who hail from abroad has risen continuously in the last few years (see also Rowland and Hall, 2012). Universities are increasingly experiencing competition on the MBA, a trend that is further driven by corporate MBA programs (Sharkey and Beeman, 2008), Executive MBAs, online MBAs and other specialized programs (Kathawala, Abdou, and Elmuti, 2002).

This trend reflects the increasing role of technology in MBA education and the emergence of online MBA programs in markets around the world. Distance learning programs such as online MBAs are particularly interesting to mature students who need to balance demands due to their jobs, family and education (Liu and Schwen, 2006). Program directors are also increasingly under pressure to stand up to the international competition. This means minimizing students' dropouts and increasing student satisfaction with the program.

As the number of online learners rises from one year to the next (with 35 million learners in 2015 as reported by Sunar, White, Abdullah, and Davis, 2016), attrition and dropout levels are a major concern for many program managers. Given the lack of real-life interaction in distance programs, students and educators may normally rely on communication media such as email and chat to interact, particularly when geographic distance means different time zones take effect. Providing high quality instructional tools is often seen as key to ensuring student and tutor interaction in online settings (Strang, 2011). Despite many platforms being available, this remains a challenge for many distance learning programs when teaching staff and students are located in different time zones and the classes are quite large.

Keeping this in mind, many program directors are seeking to identify all variables that help them to improve student satisfaction on distance learning programs. Traditionally, the focus has been on program-specific or system elements. However, anecdotal evidence suggests that many other, non-academic predictors come into play. The current paper considers the kind of predictors that might also play a role in determining satisfaction as education opens up to less traditional student groups such as professionals. This is where inclusive efforts also require some reflection of which factors will foster success among more heterogeneous student groups.

2 NON-ACADEMIC PREDICTORS

Distance learning comes with a number of challenges, many of which are connected to non-academic predictors. Expectancies, perceived extrinsic utility and intrinsic value in education (Chiu and Wang, 2008; Plante, O'Keefe, and Theoret, 2013) are among these. A mismatch of expectations between staff and students in terms of full-time MBA students' ability and skill to engage in self-regulated learning further adds to the puzzle (Schedlitzki and Witney, 2014).

This leads us to the second point. Student expectations of success may also be based on their assessment of their personal and work circumstances that support or hinder their ability to handle the requirements of a program, such as their ability to take control over their time and schedule. The ability to manage time effectively may further impact satisfaction with a program, as those who struggle may also perform more poorly. We propose that external facilitating conditions include the actual support provided, and control students have, over their schedule, to accommodate their studies. Scheduling control in particular may facilitate and enable distance learning students to juggle several simultaneously held roles as member of families, communities and organizations (Liu and Schwen, 2006).

The paper is structured as follows. In the next section, we consider our core research question, the methods and the results of a study conducted with professionals enrolled in a suite of online

MBA programs in the UK. In the second section, we discuss study-specific implications, limitations and future research. Lastly, we summarize our thoughts on inclusion of non-traditional, professional students in education.

3 RESEARCH QUESTION

In line with the previous research, we wish to answer the following question:
Which specific non-academic predictors (e.g., perceived extrinsic utility and scheduling control) in the context of an online MBA program increase distance and program satisfaction?

In order to reduce the influence of learner specific variables, the research design also considers the role of self-efficacy, learning motivation, planning skills, and use of performance feedback. This is based on previous work according to which self-efficacy correlates with satisfaction measures (Alshare et al., 2011), while learner motivation (Dakduk et al., 2016) as well as planning and implementation skills can influence the degree to which students are satisfied with their program and continue to take distance learning courses.

4 METHODS

4.1 PROCEDURE/PARTICIPANTS

Following ethics approval, MBA students in a suite of online programs were invited to participate via email invitation and a survey link. No personally identifying information was obtained (no names, IP or email addresses were collected). However, we collected the eight digit student IDs to match participants (data collection between 2017 and 2018). Only participants who completed part 1 of the survey (n = 139) were invited via email to participate in part 2 (n = 54). The data collection rounds for the two parts were 3 months apart. Survey part 1 was accessed and completed by 139 participants. Survey part 2 was completed by 54 participants (who also completed Survey 1). The final sample included 29 males and 25 females (between 23 and 56 years old, average age M = 37.40, SD = 8.73). Due to attrition, some of the analyses had to be limited to the sample size of the second survey only.

4.2 MEASURES

Part 1 Survey measures are indicated with S1 (and vice versa for part 2 of the survey = S2). Information about the used items can be requested from the second author.

Past experience (S1). This was assessed using a dichotomous question "Is this your first distance education course?" The response options were (a) "Yes" (n = 32), and (b) "No" (n = 22).

Progress and programme expectations (S1). This was assessed using six items (two from Ritter Pollack (2007, pg. 98-104) and four in-spired by the work Deggs, Grover, and Kacirek (2010). The items focus on expectations regarding course flexibility, interactivity and the nature of course materials, assignments, and the distance learning system. When combining all items into one composite, higher scores represented higher expectations about the progress and the program. The five response options ranged from (1) "strong disagree" to (5) "strongly agree" (α = .42, M = 4.32, SD = 0.37). This suggests low reliability, a potential concern for subsequent analyses.

Extrinsic utility (S1). The extrinsic utility was measured using three items (copied from Chiu and Wang, 2008). The focus was on the usefulness of the degree for future jobs, one's career or promotions. The response options ranged from (1) "strongly disagree" to (7) "strongly agree" (α = .81, M = 6.22, SD = 0.81).

Intrinsic value (S1). The three items used to measure intrinsic value were taken from Chiu and Wang (2008). The items focused on the experience of learning as interesting, enjoyable and fun. The response options were the same as for the utility value assessment (α = .87, M = 5.52, SD = 1.16).

Measures	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.
1. Feedback expect. (S1)	1	.18	-.04	.03	.07	-.05	-.11	-.25	-.05	-.26	-.40**
2. Extrinsic utility (S1)		1	.52**	.36*	.42**	.53**	.20	.15	.12	.16	.13
3. Intrinsic value (S1)			1	.29	.49**	.63**	.20	.41**	.39*	.41**	.37*
4. Self-efficacy (S1)				1	.38*	.43*	.28	.31*	.25	.25	.18
5. Learning motiv. (S1)					1	.68**	.14	.27	.22	.34*	.42**
6. Planning skills (S1)						1	.22	.44*	.24	.41	.50*
7. Perc. control (S2)							1	.39**	.42**	.48**	.42**
8. Use of feedback (S2)								1	.46**	.79**	.73**
9. Actual support (S2)									1	.51**	.51**
10. Progr. satisfact.(S2)										1	.81**
11. Distance satis. (S2)											1

Note. Participants $n = 54$. * $p < .05$, ** $p < .01$. Participant age did not correlate with any of the other measures.

Table 1. Correlations of main constructs.

Self-efficacy (S1). This was assessed using five out of 10 items taken from the general self-efficacy scale (Schwarzer and Jerusalem, 1993, 2000). The response options were (1) "not at all" to (4) "exactly true." Higher scores are indicative of higher self-efficacy ($\alpha = .73$, $M = 3.34$, $SD = 0.38$).

Learning motivation (S1). Intrinsic learning motivation was assessed using five items from the self-directed learning scale developed by Cheng et al. (2010). The response options ranged from (1) "strongly disagree" (SD) to (5) "strongly agree" (SA) ($\alpha = .73$, $M = 4.34$, $SD = 0.43$).

Planning skills (S1) were part of a five-item subscale from the self-directed learning scale (Cheng et al., 2010). The response options ranged from (1) "SD" to (5) "SA" ($\alpha = .79$, $M = 4.09$, $SD = 0.49$).

Actual support experience (S2). This involved four items inspired by the work of Deggs et al. (2010). The response options ranged from (1) "strongly disagree" to (5) "strongly agree" ($\alpha = .74$, $M = 3.82$, $SD = 0.64$).

Use of performance feedback (S2). The use of feedback participants received was also assessed using three questions from Jeske (2012). The response options ranged from (1) "SD" to (5) "SA" ($\alpha = .91$, $M = 4.02$, $SD = 0.75$).

Perceived control (S2). The four items were taken from a subscale on work control produced by Tetrick and LaRocco (1987). The response options was changed from seven to five options that ranged from (1) "not at all" to (5) "very often" to be in line with other response options ($\alpha = .77$, $M = 3.44$, $SD = 0.75$).

Program satisfaction (S2). This measure was based on four items by Ritter Pollack (2007). The response options ranged from (1) "SD" to (5) "SA" ($\alpha = .79$, $M = 3.71$, $SD = 0.75$).

Distance learning satisfaction (S2). This included one question: "How would you rate your satisfaction with this distance education course?" with response options ranging from (1) "very dissatisfied" to (5) "very satisfied" ($M = 3.90$, $SD = 0.86$).

Demographics (S1 and S2). This included age, enrolment date and gender. This information was collected in both surveys.

5 RESULTS

The correlations of all measures were summarized in Table 1 above. Only the most relevant are briefly discussed. Essentially, correlations suggest that the higher the expectations of the students about program provisions and feedback, the lower their subsequent distance learning satisfaction scores ($r = -.399$, $p = .009$). Perceived control (related to work-life management and balance) correlated positively with distance outcomes ($r > .4$, $p < .01$).

	Satisfaction (S2)	
Learner-specific predictors	Distance learning	Program
Self-efficacy (S1)	β = -0.17	β = -0.05
Learning motiv. (S1)	β = 0.28*	β = 0.16
Planning skills (S1)	β = 0.07	β = -0.10
Intrinsic utility (S1)	β = -0.05	β = 0.09
Use of feedback (S2)	β = 0.70**	β = 0.73**
Total R^2	.60**	.63**
N	43	43

Table 2. Regression results.

	Satisfaction (S2)	
Non-academic predictors	Distance learning	Program
Expectations (S1)	β = -0.38**	β = -0.23
Extrinsic utility (S1)	β = 0.12	β = 0.11
Perc. control (S2)	β = 0.36*	β = 0.43**
Total R^2	.32**	.29**
N	42	42

Note. ** p < .01. Sample size declined due to the degrees of freedom and missing variables. S1 includes measures collected in part 1 of the survey. S2 refers to measures that were collected in part 2 of the survey.

Table 3. Regression results.

Correlational results do not, however, imply, causality, nor do they clarify the directionality of effects. In some cases, they may be mutually reinforcing. For example, what is not clear is whether the positive correlation between actual program support and perceived control (r = .422, p = .006) was related to the fact that more support increases the perception of control among students - or the perception of control by participants led to more seeking of and subsequent reception of support from instructors.

Learner-specific predictors. We considered the extent to which learner variables collected in part 1 would predict satisfaction outcomes collected in part 2 of the survey. We also included the actual use of performance feedback as a predictor (also collected in part 2) as engaging with feedback is very much a learner-specific option. First indications suggested that neither gender, age nor enrolment date played a role. As a result, the regression was run without covariates in the first step. Our results (see Table 2) showed that distance learning satisfaction was predicted by students' learning motivation (β = 0.28; p = .039) and own use of performance feedback (β = 0.70; p < .001). Program satisfaction was predicted by the use of performance feedback (β = 0.73; p < .001).

Non-academic predictors. In the next step, we wanted to assess if the non-academic predictors explained satisfaction with distance learning and program satisfaction (Table 3). We controlled for the learner-specific predictors in the first step of the model (self-efficacy, motivation, planning skills, intrinsic utility, and use of performance feedback).

Preliminary results showed that only one of these (planning skills) remained a significant predictors of distance satisfaction in the presence of our main variables (expectations, extrinsic utility, and perceived control). Controlling for planning skills (β = .50, p = .005), distance learning satisfaction was predicted by expectations (β = -.49; p > .001), but no other factors such as perceived extrinsic utility and scheduling control. However, in the absence of planning skills (Table 2), both expectations (β = -.38; p = .009) and perceived control were significant (β = .36; p = .014).

In the case of program satisfaction, planning skills were again a significant covariate measure (β = .41; p = .025). Both expectations and extrinsic utility were only marginally significant predictors (p < .10). However, as soon as planning skills were excluded, perceived scheduling control emerged as the main predictor (β = 0.433; p = .004).

6 DISCUSSION

In the current paper, we considered predictors of satisfaction with an online MBA program experience. Both perceived control and expectations predicted satisfaction, however, the actual ef-

fects were dependent on the learners' own planning skills. Whereas perceived control over one's schedule predicted later satisfaction, expectations had a negative relationship with distance learning satisfaction.

This suggested that the MBA students' ability to maintain a work-life balance (which allows for both work and studies) plays a significant role in shaping student satisfaction. This means the ability to control work commitments and one's schedule has a significant impact on satisfaction. In addition, expectations matter specifically in relation to program satisfaction – potentially due to the online nature of the programs attended by our participants. Specific student expectations may backfire if they are unrealistic and reduce distance learning satisfaction as a result, a finding also noted by Eagleton (2015). This suggests there is a need to proactively engage in expectation setting and management, rather than assuming that students have a realistic picture of the comprehensiveness of the course, the challenges involved, and the interactive nature of the distance learning system.

6.1. Towards Inclusion?

Ensuring student satisfaction is just one of the outcomes of interest to educators, but the results of our study highlight the need for a more encompassing understanding of what drives student satisfaction among non-traditional, professional students. Digitization alone will not solve these challenges in education. The following section outlines some future-oriented contemplations for educators.

One important misperception is this: Professionals who are re-entering education are expected to be miraculously competent or equipped to succeed in their educational journey regardless of their background on the basis of their experience. However, they engage on a journey that is normally designed for young adults enrolled full-time with no competing demands on their times. This misperception generates a number of challenges for the effectiveness and success of educational programs and should come as no surprise. We comment on four developments that deserve more consideration.

First, career shifts are no longer a rarity, particularly as entire industries disappear in favor of new ones, leading to the disappearance of many roles. Responding to this development, many educational institutions offer new educational path to non-traditional students with vocational rather than higher education experience under their belt. This is certainly praiseworthy. However, such endeavors must be met by the appropriate support from tutors, peers, and student services. For example, how many 40, 50 or 60 year old student models are currently featured on university websites or catalogues? And how many of the many tutors and representatives of student services have the insight and knowledge to relate to the social and information support needs of this age group (measures we did not assess specifically in this study)?

There is still room for improvement to ensure that higher education becomes an inclusive and supportive environment for those from non-traditional backgrounds. For future research, we need to examine whether or not traditional recruitment and application processes, student admissions, induction and online support of distance learning programs are fit for purpose and fit the intended target audience.

Second, more and more individuals return to education after a life time as employees. Many will follow up their original Bachelor's degrees by seeking degrees such as MBAs. In our experience, many of these professionals have the practical, managerial and leadership experience on par with many senior leaders in education. Their wealth of experience enriches class interactions and expands on known practice and theory. The dialogue with professionals to address their skills, their skill gaps, and their expectations is not, however, a common feature yet.

Third, while student expectations are often not examined or addressed (leading to disappointment later on), many academics are in the same

boat. Everybody has expectations of what students know. Educators assume certain things about their preparedness for education, or how they will perform under pressure. However, how many reflect on these? If we want professionals to be successful upon their return to education, life-long learning has to go both ways. New competence models for educators may be just as worthy of consideration as new programs for those returning to education.

Fourth then, and this is related to the above points, work-life balance and scheduling control are both concepts that need to be central to the discussion around inclusion. Those entering education in their 30s and 40s are often part of the sandwich generation. They will juggle responsibilities for work, their children and their parents at the same time (so-called crossover and spillover effects). These circumstances also impact upon their ability to plan ahead and meet rigid academic deadlines. Putting lectures online is only one way to support these professionals on their educational journey. If we want to support their participation in education, it will be important to review how we design our curriculum, our assessment and teaching modes. Including work-life balance as a topic worthy of discussion and relevant to inclusion in education will become more and more important over time.

6.2. Practical Implications

The results suggest that satisfaction might be positively influenced by program leaders by: (a) communicating the importance of scheduling control to succeed in distance learning programs; and (b) engaging in expectation management and appropriate inter-departmental communications.

In terms of the first point, the influence of scheduling control on satisfaction is one aspect educators have little influence over as this is largely affected by the personal circumstances of the learner. Nonetheless, it does hint at the fact that some satisfaction outcomes may be subject to external factors outside the educational experience made available to students and general provisions provided by the university.

This brings us to the second point on expectation management and appropriate inter-departmental communications. Eom and Ashill (2016) observed instructor-student dialogue and interactions between peers as significant predictors of student satisfaction and learning outcomes. Gonzalez-Marcos et al. (2016, pg. 172) further proposed that student performance can be facilitated by "(1) positive expectations of future professional development, (2) clear learning objectives that consistently relate to the content of the course, (3) positive feelings induced by teachers' support in resolving doubts, and (4) academic self-perception."

6.3. Study Limitations

The study was based on self-reports from students, but did not include reports from instructors. The reliability of some of the measures were lower than desirable (with coefficient alpha's below .7). For example, we do not have a sense of the amount of interaction that was promoted by their instructors or the degree to which students experienced personal support and feedback (different approaches exist to encourage quiet or disengaged students to engage more with an instructor; see also Strang, 2011). In addition, we did not collect information about the nationality of each of our participants as this might have compromised anonymity due to the small sample size. Differences in educational and cultural backgrounds require content adjustments (including more global and international dimensions; Mellahi, 2000). This raises the question of how national cultures and values as well as career expectations vary across countries (Ng, Burke, and Fiksenbaum, 2008). This may have been a potential confound in our analysis on extrinsic utility.

6.4. Future Research

As educational providers recruit more professionals, it may be important to investigate alternative influencers. For example, what is the role of word of mouth or online program reviews? Which platforms do professionals use to identify program options, and who do they turn to for advice? What is the role of alumni and other (professional, industry, or regional) networks? Answering these questions might be important in order to understand how expectations are formed. The role of diverse agents being used for international recruitment is just one variable here.

Future research endeavors may therefore wish to explore some of avenues we did not follow ourselves. For example, what effects do different degrees of instructor-student or peer-to-peer dialogue have on satisfaction scores? This question may also provide a better sense of how and when (unrealistic) expectations about the distance learning course or program influence satisfaction (thus expanding on Eagleton, 2015).

In addition, how do nationality and thus cultural influences shape student expectations and satisfaction? And third, modifications of teaching methods, but also attitudes towards assessment forms (Rowland and Hall, 2012) may be worth studying among instructors. Instructors may also need to find assessments that pre-empt potential performance differences between MBA cohorts (Tse, 2010). Prior overseas experience may help instructors to understand these differences (Rowland and Hall, 2012), enabling them to accommodate students accordingly. Research on MBAs may therefore be helpful to understand the implications of previous national learning experience, cultural values (e.g. Hofstede, 1984) and diversity experience in terms of satisfaction with distance learning programs.

7 Conclusion

A key challenge in distance learning education is to identify what factors contribute to student satisfaction. Factors of interest in the discussed study included circumstances external to the distance learning program, but relevant to students' engagement with online content. The results of the study suggest that professional programs may benefit from the following efforts.

First, as more and more non-traditional, professional students (re-)enter education after several years in employment (often in middle or senior roles), it is important to emphasize scheduling control from the outset, but also develop flexible modes of assessment and delivery in programs.

Second, it is important for educational providers to implement communication practices that explicitly clarify and adjust upfront expectations regarding the learning experience and support provided to students enrolled in distance learning programs. Both recommendations require effective pre-enrolment and interdepartmental communication strategies (linking marketing, international office, student counselling and program management), a significant challenge considering the number of departments involved and the frequent use of overseas agencies and representatives in the recruitment of students for distance learning programs.

The debate around student satisfaction is but one indication that we need to rethink what matters in the education as new cohorts of students join the ranks of more traditional, younger, full-time students. Digitalization in education is not itself a guarantee that new cohorts will be included in the educational experience. Greater heterogeneity requires a renewed focus on inclusion, and how this might be achieved. Focusing on traditional and learner-specific variables may not be sufficient in the world where students come from different walks of life, carry different and potentially competing responsibilities.

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TECHNOLOGICAL OPACITY OF MACHINE LEARNING IN HEALTHCARE

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ABSTRACT

Recently, a host of propositions for guidelines for the ethical development and use of artificial intelligence (AI) has been published. This body of work contains timely contributions for sensitizing developers to the ethical and societal implications of their work. However, a sustained embedding of ethics in largely algorithm-based technology development, research and studies requires a precise framing of the origins of the new vulnerabilities created. Recently, scholars have been referring to ethics associated with technology that is in some way "opaque" to at least part of its associated stakeholders. This "opacity" can take several forms which will be discussed in this paper. There are various ways in which such an opacity can create vulnerabilities and, hence, relevant ethical, societal, epistemic and regulatory challenges. This paper provides a non-exhaustive list of examples in healthcare that call for educational resources and consideration in development processes that try to reveal and counter these opacities.

KEYWORDS

Artificial Intelligence; Machine Learning; Ethical and Societal Implications; Technological Opacity; Healthcare

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1 INTRODUCTION

The field of "control engineering"—a field that is in an increasingly close connection to the field of "machine learning"—has been famously dubbed a "hidden technology" by Karl J. Åström in 1999. Åström, a remarkable pioneer in his science, characterized the field as mostly "hidden", despite the fact that it solves novel problems humans are incapable of, is critical to a system's successful operation and almost omnipresent. Application examples range from "generation and transmission of energy, process control, manufacturing, communication, transportation and entertainment" (Åström, 1999). This perception has been reiterated as recently as on Sept. 21st, 2018, by Ian Craig in 2018, in his presentation "Automatic control: The hidden technology that modern society cannot live without". Being a control scientist by trade myself, I have to admit that this almost romantic notion is not without appeal. However, as has been noted, automatic control can "'camouflage' system failure by controlling against the variable changes, so that trends do not become apparent until they are beyond control" (Bainbridge, 1983). Thus "hiddenness" or "opacity" must be a prime consideration in holistic system designs. In case the presence of some control algorithm acting on the system is not apparent at all, every chance to counteract may be lost.

The field of "machine learning" constitutes a fundamental building brick of what is nowadays considered artificial intelligence (AI) and cannot be accused of being underreported even in mainstream media outlets these days, see, e.g., Brennen, Howard and Nielsen, 2018. In terms of popularization, politics and economics, the general existence of AI solutions is far from hidden, yet it may be, or bound to become, a "technology that modern society cannot live without".

As such, many use-cases of AI can be categorized as classification tasks and decision support systems, whereas this in turn can be viewed as the sensory input to human-in-the-loop control. In the future, some of these approaches may extend to fully automated decisions with a mere human supervision, e.g., in healthcare or autonomous driving (Topol, 2019). Since the range of applications of machine learning has been tremendously enriched as compared to classical control engineering due to the ability to operate on largely unstructured data, it is the task of this paper to investigate ways in which opacity in machine learning and AI applications may yield potentially undesirable ethical, legal and societal implications (ELSI).

The term "AI" is quickly changing and adapts to the current state of the art. From a scientific perspective, however, there is a need to identify sources of ELSI reliably in terms of a commonly understood und persisting taxonomy. One such potential class of sources has recently been discussed by means of the term "technological opacity". As a contribution to the discussion, this paper aims at further refining the taxonomy of forms of technological opacity. An application to the healthcare sector, a field in which adverse effects are often among the most dramatic, is aimed at showcasing the applicability of the proposed refinement.

The remainder is structured as follows: Section 2 reviews literature on the forms of opacity found in algorithmic technology development. Section 3 proposes an extended, but concise list of forms of technological and techno-social opacities, while section 4 provides examples in healthcare and section 5 outlines proposals for remedies. Section 6 concludes the paper.

2 TECHNOLOGICAL OPACITY—A BRIEF REVIEW

Technological opacity is a rather recent framework to denote that long- and short-term effects, ways of interaction, interdependencies, the inner workings, an influence on one self's or other's actions or the very existence of some technology and its application remains hidden to some stakeholders. While this is an attempt at an all-encompassing denomination, the literature does

not seem to have converged to a common definition so far.

For instance, Surden and Williams, 2016, define technological opacity in the following way:

> *"[…]'technological opacity' applies any time a technological system engages in behaviors that, while appropriate, may be hard to understand or predict, from the perspective of human users."*

In their paper, the authors argue that autonomous vehicles will typically not conform to the average driver's mental model about how other participants in traffic react. While they do assume that autonomous driving will yield reduced rates of traffic accidents, they essentially call for technology developers and regulators to standardize the behavior of autonomous vehicles. Considering a future, where autonomous vehicles abound, it might be meaningful not to restrict the afore-mentioned form of technological opacity to concern only "human users", as Surden and Williams do. If autonomous vehicles remain interconnected in ways that prevent a faultless prediction of future trajectories, this could also be denoted a technological opacity.

In a completely different context, Endo, 2018, identifies technological opacity in "predictive coding", which is machine learning used to assess or predict the relevance of documents in law-suits. Predictive coding is advertised as a technological fix to make the assessment of large amounts of documents economically viable, even in small-value claims and for parties with few resources. However, Endo argues that, currently, a lack of understanding of the technology and the cost of hiring technological experts actually prevents parties with few financial resources to make use of the technology.

Pasquale, 2015, focusses on opaque algorithms used in finance and largely attributes its existence to corporate secrecy, or rather the fear to give away economic advantages and attempts to consolidate power. Topol, 2019, in turn, associates the intransparency of trained deep neural networks in healthcare—or more specifically, a lack of means to interpret how actual outputs are determined from input data—with the controversy about "black box algorithms". Topol remarks that the recognition of the existence of such algorithmic opacity has led to the incorporation of transparency requirements in the European Union's General Data Protection Regulation (GDPR) as a prerequisite for practical deployment.

Vallor, 2016, introduces the term "techno-social opacity" which can be broadly referred to as the lack of understanding about the societal implications of specific technologies. While this review remains non-exhaustive and limited to literature that actually uses the term "opacity", the afore-mentioned references largely refer each to a single and specific form of opacity. In what follows, an attempt is made to distinguish between several forms with the aim to allow a systematic and holistic analysis of technological opacities ranging from opacity that is intentional, opacity based on a lack of understanding or complexity, opacity based on a lack of perception of societal effects over opacity from transdisciplinarity to procedural opacity.

3 FORMS OF TECHNOLOGICAL OPACITY

Burrell, 2016, provides a nuanced view on technological opacity with respect to algorithms and identifies three forms: (i) Opacity as intentional secrecy (attributed to Pasquale, 2015), (ii) opacity as technical illiteracy and (iii) opacity from complexity as the mismatch between mathematical machine learning outputs and human ways of interpretation.

The above forms of opacity address different stakeholders: While the first form is largely associated with active decisions on the part of the developing enterprise or intentional regulatory omissions, the second form is passive in the sense that it is associated with the fact that, e.g., the majority of the population is not capable to understand the intricacies of technological development and its products, e.g., programming. Burrell disambiguates this form from the third,

which also applies to proficient technology developers and elaborates that at the heart of the third form of opacity are (self-)learning algorithms that may change the decision logic and operate on vast amounts of data. Such algorithms hence incur complexity that results in algorithmic outputs whose underlying rationale may be difficult to comprehend. Similarly, Matthias, 2004, observes that machine learning can yield algorithms, derived, e.g., by supervised learning, for which *"the human trainer himself is unable to provide an algorithmic representation."* Opacity arising from technological complexity is also the apparent focus of Stahl and Coeckelbergh, 2016, who identify "ubiquity and pervasiveness", "speed of innovation", the "distributed and networked nature" and "logical malleability" (unforeseeable other use-cases) as novel challenges in information and communication technologies (ICT). Royakkers *et al.*, 2018, add that (self-)learning algorithms also challenge the mental models of users, which may fail to have a working anticipative notion of what a self-learning algorithm may do.

Technology related to 'Big Data' are solutions that help analyze amounts of data that humans cannot handle (Mittelstadt and Floridi, 2016). With increasing computational resources, in some years' time, ever larger amounts of data may not be difficult to analyze technologically, but whether the technology that was used to analyze it is still humanly manageable is an issue of technological opacity resulting from complexity. Unforeseeable use-cases and effects are also covered by Vallor, 2016, who has further introduced the notion of *techno-social opacity*, meaning the inadequacy of abilities to either predict adverse effects or to work towards desired societal effects by means of technological innovation (or refraining from it). In the following, I propose to append the list of forms of opacity by a fifth and sixth notion, which, in the sequel, will be argued to be distinct from the other notions by means of illustrating their relevance in the healthcare context. The fifth form denotes opacity as a result of the transdisciplinary nature of applications and the complexity this incurs. This form is not specific to machine learning algorithms, while at the same time, I acknowledge that possibly the primary examples for such applications today stem from this field. To a large degree this is a result of the complexity incurred when the design of algorithms requires both in-depth mathematical and technical knowledge as well as application knowledge, e.g., proficiency in the medical sciences. This form is distinct from techno-social opacity, in that the development team may boast a clear vision about what societal impact is desired, but, e.g., fails to identify the relevant modalities, such as prevailing hospital workflows, lack of practitioner training, etc., that hinders their development in realizing this impact.

A sixth and—for the purposes of this paper—final form of opacity can be found in *procedural opacity.* While one might reasonably choose to consider this as part of broader, fourth and fifth forms, I argue that it is more appropriate to reserve yet another form of technological opacity associated with effects on behalf of a processes end-point, or "customer". While this can be argued to not be strictly a form of *technological* opacity, I further argue that the achievements in machine learning and its endeavors in, e.g., administrative automation, intertwine both processes and technology in novel ways. For instance, the above-mentioned example of predictive coding may encompass this form of opacity if other parties in some law-suit are not even aware if, on which data sets and to which extent the technology has been applied (Endo, 2018). Procedural opacity in the technological sense may also always exist in situations where end-customers, patients or any form of recipient relying on some service has to trust that within the underlying technology-supported process (possibly unknown to her or him due to intentional secrecy) the responsible personnel did not suffer from too much technical illiteracy and the development team had enough transdisciplinary competence and kept technological complexity at a manageable level. In this sense, opacity

resulting from faults in technology-driven processes usually concerns the interaction of humans and technology, e.g., algorithmic decision support systems. It can be dismissed as being a meta-form aggregating other occurrences of technological opacity—however, it stimulates a holistic perspective on the involved processes and is hence useful for this reason.

To summarize, it is proposed to distinguish the following forms of technological opacity:

i. Opacity from intentional secrecy
ii. Opacity from technical illiteracy
iii. Opacity from technological complexity
iv. Opacity from techno-social interdependence
v. Opacity from application transdisciplinarity
vi. Opacity from technology-driven processes

This list may not be complete, but it will hopefully act as a structuring taxonomy for future discussions and will provide a frame for examples of technological opacity in healthcare.

4 Technological Opacity in Healthcare

In what follows, a non-exhaustive overview is given about potential issues in healthcare that may arise due technological and techno-social opacity. This overview is intended to act as a stimulator to discussions, more in-depth analyses and a means of sensitization for those unfamiliar with the context. In pointing out issues particular to novel machine learning algorithms applied in the healthcare context, the aim is to help development teams adequately realize the potential of machine learning solutions in healthcare, where it is an appropriate technological fix (Sarewitz and Nelson, 2008).

4.1 Informational Power and Medical Data

Information is power and producing information from data that would otherwise not be informative is an instrument of power. Such an instrument requires regulation as it can lead to data processors having superior power over the subjects of the data (Mittelstadt et al., 2016). Especially in healthcare, data-driven medical technology, e.g., automated diagnosis tools, may potentially shift the balance in terms of the authority w.r.t. medical expertise from physicians to medical technology providers. In the extreme, the aggregation of diverse types and large amounts of information can drive humans out of the loop (Royakkers *et al.*, 2018). This has also epistemic implications, elaborated on in section 4.3. Without regulatory intervention, medical technology providers can consolidate their informational power by applying algorithm secrecy as a means to intentionally generate opacity. This may be largely considered an objectionable transition as educational resources should be freely available and may amount to increased commercialization of medical knowledge, and hence a driver of increased inequality.

Artificial intelligence tools might further provide the possibility for self-diagnosis. Here, it is highly probable that medical technology providers could try to prevent accidental diagnosis, e.g., by blocking access to the raw image material in image-guided medical diagnosis systems, for fear of being held morally obliged to provide the technological means to diagnose everything. What if the patient performing self-diagnosis actually observes something to diagnose from the raw image material, but the device does not recognize it? This would result in unwanted bad publicity and (a justified) loss in trust. Blocking access to raw image material hence incurs opacity both from, possibly unwarrantable, intentional secrecy and from the process itself.

4.2 Technological Illiteracy

Medical practice is multifaceted, subject to time pressure, and social and psychological nuances are highly relevant in making diagnoses. If electrocardiographic pathology detection would follow a set of simple rules, devoid of experience and objective guidelines that are easy to formalize, deep learning would not be needed to automate it (Hannun *et al.*, 2019). With the current

load of knowledge that medical practitioners always need to have at their disposal, it is questionable how much in-depth understanding of the inner workings, e.g., of algorithmic decision support systems, can be reasonably expected. However, automated diagnosis support is expected to curb costs, improve on diagnosis quality and potentially even transfer healthcare to home care (Derrington, 2017).

While patient compliance in medicine is an ongoing issue, it stands to reason that patients with varying degrees of technological illiteracy may show 'consent fatigue' (Royakkers *et al.*, 2018), when confronted with algorithmic suggestions. Further, it may not be meaningful to require disabled and impaired people (e.g., when suffering from dementia) to consent to technology that, e.g., monitors them (Royakkers *et al.*, 2018) for lack of an understanding about the implications. Home care tools following the rationale of "technological paternalism" as a concept denoting that "technology knows better what is good for us" may infringe upon personal autonomy, especially if performed without consent or knowledge of the user (Royakkers *et al.*, 2018). For patients with sufficient mental capabilities, this can be potentially addressed by forms of tolerant paternalism (Floridi, 2015), a framework that intents to increase the level of knowledge and to provoke a more informed decision.

4.3 Epistemic Issues

Sometimes, AI evangelists propagate a vision of a utopian healthcare system, in which medical data can be securely shared under privacy regulations and can be effectively used for a globalized, automated inference-based diagnosis. However unlikely (Topol, 2019), in a transition towards this vision, physicians would have to work cooperatively with medical diagnosis devices and would need to understand the principles of the learning algorithms, be provided with transparent interfaces to be able to enter data with the appropriate quality and, hence, make use of automated diagnosis tools responsibly (Char, Shah and Magnus, 2018). These tools could rely on data that can be biased (most of the medical data is acquired in intensive care situations, which is often not representative), incomplete or out-of-date, facts that could not be apparent to the medical practitioner, the development team or service provider and, least of all, the patient.

Furthermore, the apparent superiority of some AI systems in clinical trials (Hannun *et al.*, 2019; Topol, 2019) may lead doctors to refrain from questioning the validity of the computer models altogether and develop over-confidence in machine intelligence (Burrell, 2016). Practitioners might not be able to take responsible action, in particular, when the data presentation is overwhelming and poorly interpretable. The process of knowledge generation and preservation might become largely commercialized and potentially opaque to science or unavailable as educational resources. The distributed nature of medical data fusion and aggregation may further result in epistemic opacity.

Similarly, economic pressures could lead to the early deployment of opaque AI-based solutions at the risk of significantly reducing life-saving accidental diagnoses, because the system's focus may be too narrow and is promoted to work entirely without physician intervention. Data-driven systems that are end-to-end, i.e., that aim at directly drawing actionable conclusions from largely unstructured data, potentially only imply a modeling process (defined as deriving a semantic description of a system that is generalizable to some other system to at least some extent), however, one which neither practitioner nor developer has fully specified and hence been able to investigate its implications. If a technology's applicability to real-world scenarios is immediate, with little or no pre-processing of data and accessible tools, this can create the illusion of simplicity where this is actually not true. At the heart of this, there may be a conflation or confusion of causation and correlation (Lipton and Steinhardt, 2018). In complex applications, epistemic opacity at some level in the

dependence structure from methodical experts, application experts, economic stakeholders to application subjects will create vulnerabilities that propagate, eventually affecting the patients directly. Clearly, errors can never be completely avoided, but it appears as though popular algorithms in machine learning, such as deep learning, currently are susceptible to incorporating large epistemic gaps, i.e., a lack of scientific foundation in the modeling approach, that incurs opacity.

4.4 Techno-Social Interdependence

Access to both medical data and expertise for training AI systems will become (or rather already is) a commodity, novel stakeholders can acquire, utilize and trade. The low running costs of machine-support lead to a strong potential to realize greater epistemic equality via access to intelligent decision support systems (on par with the skill of medical experts) by the less privileged, e.g., for citizens of areas with lower density of healthcare professionals. But without proper considerations, AI-based decision support systems could be distributed unequally. There appears to be a high degree of uncertainty about whether either greater equality or inequality will come to pass using AI-based healthcare solutions (Topol, 2019). It becomes apparent, however, that an ever more wide-spread use of automated analysis of medical data could eventually force patients to consent to data sharing and opting-out of their rights to privacy, as otherwise they cannot be sure to receive the same quality of treatment (Char, Shah and Magnus, 2018). The fiduciary relationship between physician and patient may break entirely, potentially leaving patients without an adequate notion about the whereabouts of their data.

4.5 Application Transdisciplinarity

An explicit example that showcases the effects of inadequately addressing transdisciplinary issues in technology development can be observed in many current use cases of electronic health records (EHR) in the United States. Studies have shown that current EHR systems have, in fact, increased the workload and stress of physicians (Gardner *et al.*, 2019). An adequate transdisciplinary consideration of aspects of human-computer interaction, work psychology and knowledge aggregation can be a remedy.
A further example on the intricacies of transdisciplinary research is the automated drug delivery during anesthesia, which has largely relied on rather transparent dynamic pharmacokinetic model structures potentially augmented by inference algorithms for individualizing the model to a specific patient (Neckebroek, De Smet and Struys, 2013). However, automated drug delivery is not yet fully realized. It is illustrative to compare the model semantics in papers written for technologists and physicians, which gives a hint on the difficulty to express mathematical expressions in, e.g., prose. This friction in transdisciplinary research cannot be avoided, but it is important to be sensitive to the mutual opacities of the partners in a development team.

4.6 Procedural Opacity

At least initially, algorithmic decision support systems in healthcare, pathology detection algorithms or diagnosis tools will most likely be designed for a single or, at least, only a few multiple use-cases. Effectively incorporating these tools into the medical workflow will be challenging and their limits need to be clear. If some pathology detection tool, e.g., on electrocardiographs, is deployed only for specific detection tasks with the promise of curbing costs, it might, in fact, prevent the accidental diagnosis of other pathologies it is not designed for. On behalf of the patient, this incurs procedural opacity, because expectations might be to receive an all-encompassing treatment or diagnosis. Compartmentalization in the medical domain is already observable to thwart the full realization of this expectation. However, it is—for the most part—

sufficiently obvious for any patient to receive only specialized treatment. With automated and specialized diagnosis tools, further compartmentalization may yield further opacity. To counter this and at the same time provide an actual perspective in saving time for medical specialists, automated diagnosis technology should be designed as holistically as possible, which is more challenging to achieve than advertised.

Char, Shah and Magnus, 2018, further warn that machine learning designers could be tempted to optimize for reimbursement rather than quality of care—a vision which lies at the intersection of opacity in processes and from complexity.

5 POSSIBLE REMEDIES

Within the literature, there is a range of remedies proposed to mitigate the effects of technological opacity. For instance, Andras *et al.*, 2018, ask for natural language processing to provide explanations for opaque machine learning applications. Explainable AI is a current research topic that can range from image highlighting to automatically derive explanatory labels that shed light, e.g., on the rationale behind a classification task. Explainable AI can provide an inward look into trained models post-hoc, but the success of the training could remain trial and error and hence amounts to opacity from complexity on behalf of the developers.

To mitigate complexity in (supervised) learning-based algorithms and what is sometimes termed the "Reproducibility Crisis" of AI (Voosen, 2017; Hutson, 2018), leading researchers demand more rigor in neural network training (Sculley *et al.*, 2014; Rahimi and Recht, 2017). So-called "black-box" modeling approaches are quite common in control theory, where it is conservatively applied. "Conservatively", here refers to specialized data pre-processing, highly structured input-output data, reflection on modeling assumptions and structure as well as model verification and validation. In contrast, black-box neural network-based modeling processes are difficult to be validated and it appears to be both one of the largest advantages and (epistemic) weaknesses about the technology that it can be applied to very unstructured data.

Apart from technical remedies, non-technical solutions are required for all other technological opacities. Extending the application of "Responsible Research and Innovation" (RRI) (Grunwald, 2011) may be a solution (Stahl and Coeckelbergh, 2016), in which a wide range of stakeholders need to cooperate closely. Furthermore, post-hoc analysis of cases, in which (assumedly unintended) opacity yielded adverse effects, is necessary to answer essential questions, e.g., on the degree of necessary interdisciplinary education of engineers. Driving factors of specialization and the complexity of the technology will possibly set a limit, but an awareness for potential opacity should be a minimum goal. Consequently, there might be a need for a class of engineers trained in RRI.

6 CONCLUSION

The paper provided a non-exhaustive list of examples of technological opacities in healthcare, categorized into different forms and compiled with the purpose to illustrate the multi-faceted ways in which opacity can be generated by automation and machine learning. There exists no panacea that can act as a solution, but, it appears as though the variety of issues presented illustrate a need for transdisciplinary research teams to work on holistic approaches to machine learning and artificial intelligence solutions in healthcare that mix well with current workflows or improve them, circumvent a range of the above-mentioned adverse ethical, legal and societal implications and actually contribute to the improvement of the quality, equality and effectiveness in healthcare.

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THE IMPACT OF DIGITAL TRANSFORMATION ON REGIONAL LABOUR MARKETS IN GERMANY: SUBSTITUTION POTENTIALS OF OCCUPATIONAL TASKS

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ABSTRACT

The digital transformation may have large impact on the labour market. In order to determine the extent to which occupational tasks are currently replaceable by computers or computer-controlled machines, Dengler and Matthes (2015b, 2018b, 2018a) calculated substitution potentials of occupations. In this paper, we investigate the impact of digital transformation on different regions in Germany by analysing substitution potentials of occupational tasks on two different regional levels: administrative districts and regional labour markets.
On the level of districts, it becomes clear that urban service centres and some rural areas have a much lower share of employees working in a highly substitutable occupation compared with manufacturing regions. In many cases, low and high values cancel each other out within regional labour markets. Nevertheless, the values still range from 15 to 38 percent. In high value regions, close monitoring of future labour market developments and (further) education appear to be of particular importance to meet the challenges of the digital transformation.

KEYWORDS

Digital transformation; Occupational tasks; Regional Labour markets; Germany

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1 INTRODUCTION

The impact of digital transformation on the labour market is currently being discussed in many public and scientific debates. There are fears that the ongoing digital transformation may substitute jobs. In fact, there are more and more areas of work in which computers or computer-controlled machines perform tasks that could previously only be done by humans. However, the impact of digital transformation on employment is controversial. On the one hand, machines can take over more and more tasks and thus lead to job losses (Keynes, 1933). On the other hand, new technologies also create new opportunities. Occupations may be freed from monotonous tasks and could become more interesting and productive, and therefore eventually better payed. Additional jobs may be created as the new products and services have to be built and provided. In addition, new jobs can also be created through productivity gains, as prices fall and demand increases (Appelbaum and Schettkat, 1995). Previous empirical studies also come to controversial conclusions. For example, Acemoglu and Restrepo (2017) investigate the effects of industrial robots between 1990 and 2007 in the USA and find a decline in employment. Dauth et al. (2017), on the other hand, find no negative effects of industrial robots on total employment in Germany.

Another branch of literature deals with automation probabilities of occupations. The prominent study by Frey and Osborne (2017) suggests that approximately 47% of jobs in the USA will be replaced by computers or computer-controlled machines in the next 10 to 20 years. This study uses assessments by technology experts on future automation probabilities of occupations. As technology experts may overestimate the technical possibilities, the automation probabilities may be exaggerated (Dengler and Matthes, 2018a). If the results of Frey and Osborne (2017) are transferred to Germany, similarly high values are obtained (Bonin et al., 2015; Brzeski and Burk, 2015; Arntz et al., 2016). What these studies have in common is that they assess entire occupations by their automation probabilities. Studies that consider tasks within occupations show that only 9% of US employees and 12% of German employees are at risk of automation in the next 10 to 20 years (Bonin et al., 2015; Arntz et al., 2016, 2017). Nevertheless, these studies also use the automation probabilities of Frey and Osborne (2017).

In order to avoid all these problems, Dengler and Matthes (2015b, 2018b, 2018a) calculate automation probabilities, so-called substitution potentials of occupations, directly for Germany on the basis of the expert database BERUFENET of the Federal Employment Agency. The BERUFENET contains occupational information for all known occupations in Germany, such as occupations. Dengler and Matthes (2015b, 2018b, 2018a) then determine the substitution potential for each of the approximately 4,000 occupations in Germany by determining the proportion of tasks that could already be taken over by computers or computer-controlled machines today on the basis of the task-based approach of Autor et al. (2003). The decision of whether a task is substitutable corresponds to the distinction between routine tasks and non-routine tasks in the task-based approach (Dengler et al., 2014). The term ‘routine’ means that an activity can be broken down into machine-programmable sub-elements and can be replaced by machines. Three coders independently researched whether each of the approximately 8,000 tasks could be performed by computer-controlled machines or computer algorithms automatically. This assessment is all about the current technical feasibility and does not consider future substitution potentials. Whether these tasks are actually taken over by computers will also depend on other factors such as legal and ethical obstacles, cost considerations and preferences. For example, if human work is more economical, more flexible or of better quality, or if legal or ethical obstacles prevent automation, there will be no substitution (Dengler and Matthes, 2018a).

Thus, the substitution potentials measure the extent to which occupational tasks are currently replaceable by computers or computer-controlled machines. The substitution potentials were first calculated for the year 2013 (Dengler and Matthes, 2015b, 2018a). However, as the digital transformation progresses, Dengler and Matthes (2018b) updated the substitution potentials for the technological possibilities in 2016. Between 2013 and 2016, many new technologies have become market-ready. These include in particular mobile, collaborative robots and machine learning as well as the first applications of 3D printing and virtual reality. For example, insurance applications can be checked fully automatically or prostheses and dental prostheses can be manufactured using 3D printing. At the same time, however, occupational profiles have also changed in recent years: tasks in some occupations have changed and new tasks or occupations have emerged.

In this paper, we analyse substitution potentials of occupational tasks on regional labour markets in Germany for the year 2016. We focus on occupations in which more than 70 percent of the tasks are replaceable by computers or computer-controlled machines. The share of employees working in such occupations has risen from approximately 15 to 25 percent between 2013 and 2016 (Dengler and Matthes, 2018b). However, the authors do not expect the same number of jobs to be lost. On the contrary, they assume that occupations and tasks will change.

2 VARIATION BY DISTRICTS

Depending on the regional occupational structure, regions differ considerably with regard to the share of employees working in occupations in which more than 70 percent of the tasks are replaceable by computers or computer-controlled machines (Dengler et al., 2018). Figure 1 shows that the values range from 14.3 percent in Vorpommern-Ruegen to 51 percent in Dingolfing-Landau. In order to reflect how districts are

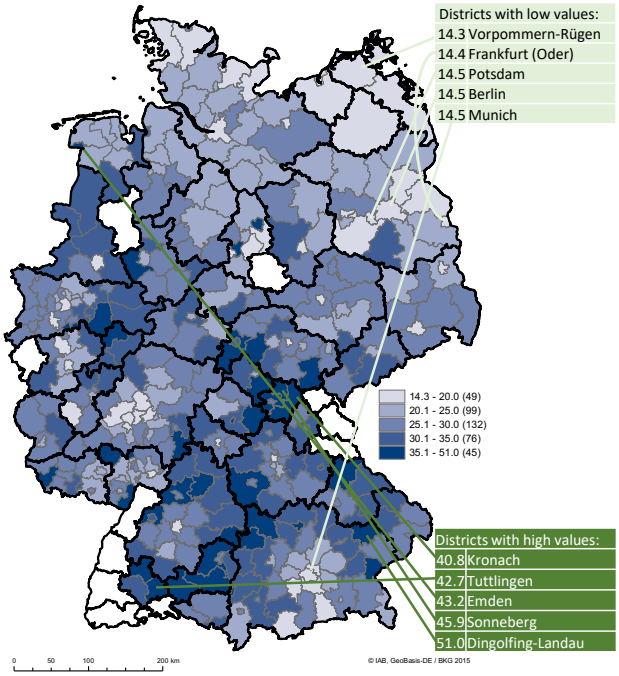

Figure 1: Share of employees working in occupations with high substitution potential by districts

Source: Dengler and Matthes (2018b), Statistics of the Federal Employment Agency (30 June 2017), Berufenet (2016), Kropp and Schwengler (2016).

connected by commuting employees, the borders of regional labour markets (Kropp and Schwengler, 2016) are drawn in the map. We will discuss them in the next section.

In addition to some rural districts – especially in the north and northeast of Germany – urban districts show low values. A notable exception is the city of Emden, where the port and a large VW plant employ many people in manufacturing and logistics. Overall, a pattern emerges that is the result of the economic specialisation of regions (Buch et al., 2016; Dengler et al., 2018). In particular, where the manufacturing industry is strongly represented, many employees work in manufacturing occupations or occupations concerned with production technology – occupations with a high substitution potential. Where, on the other hand, branches with occupations with low substitution potentials predominate, such as health and social services or the hotel and restaurant industry, the regional values are correspondingly low.

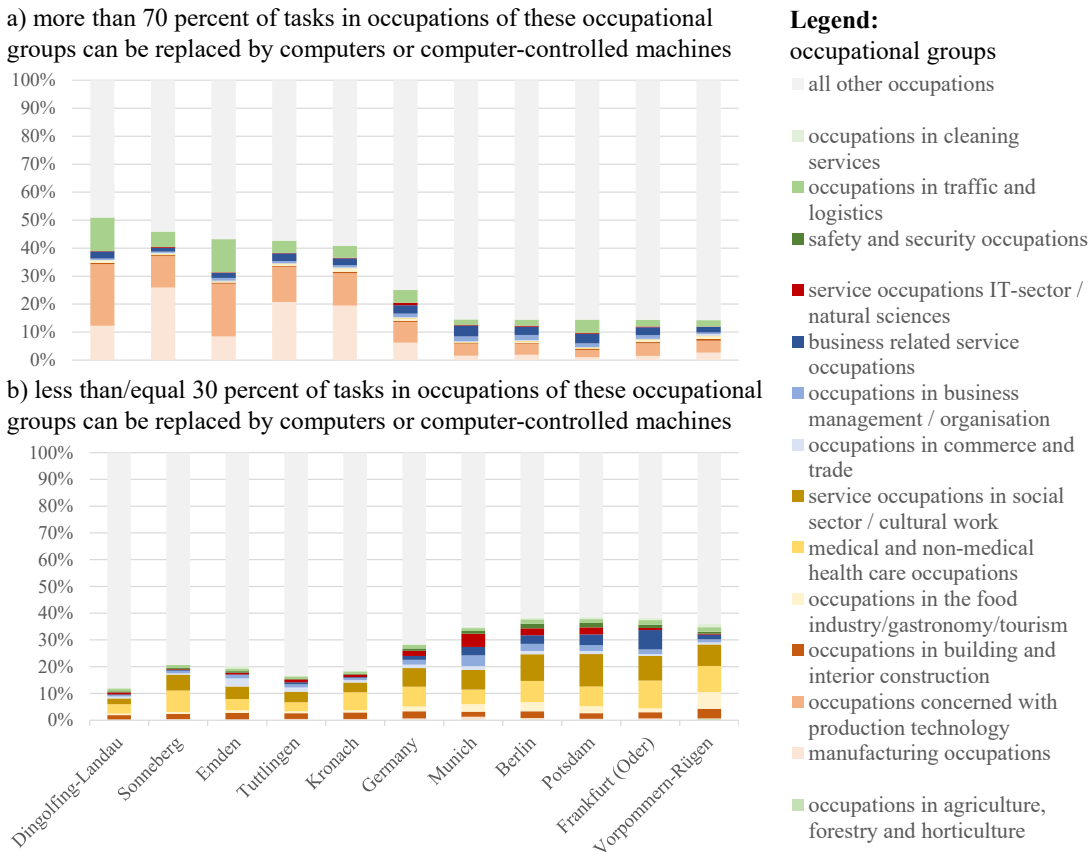

Figure 2: Districts with high and low shares of employees in highly (a) and low (b) substitutable occupations
Source: Dengler and Matthes (2018b), Statistics of the Federal Employment Agency (30 June 2017), Berufenet (2016).

Figure 2 illustrates the relationship between economic specialisation and substitution potentials by districts. It shows the occupational structure for the five districts with the highest number of employees and the five districts with the lowest number of employees in highly or low substitutable occupations as well as for Germany. The proportions of employees in the respective occupations are assigned to the corresponding occupational segments.

The five districts most affected – Kronach, Tuttlingen, Emden Stadt, Sonneberg, Dingolfing-Landau – reveal high proportions of employees working in the manufacturing occupations and occupations concerned with production technology. However, traffic and logistics occupations and business-related service occupations also play a major role here. Most other occupational segments contain comparatively few or no occupations in which more than 70 percent of tasks could be replaced by computers or computer-controlled machines.

By contrast, in the five least affected districts – Vorpommern-Ruegen, Frankfurt (Oder), Potsdam, Berlin and Munich – many employees work in low substitutable service occupations. Occupations in which at most 30 percent of all tasks could be replaced by computers or computer-controlled machines are low substitutable. These are social and cultural service occupations and medical and non-medical health care occupations, as well as occupations in the food industry, gastronomy, and tourism in Vorpommern-Ruegen and service occupations in the IT sector and natural sciences in Munich. A number of occupations with low substitution potential can be assigned to business-related service occupations as well as to traffic and logistics occupations.[1]

[1] Business-related service occupations as well as traffic and logistics occupations are the occupational segments in which there are relatively many employees in both low substitutable occupations (e.g. specialists in dialogue marketing or specialists in advertising and marketing) and

3 VARIATION BY REGIONAL LABOUR MARKETS

To draw conclusions in a more comprehensive way, the focus should not only be on the results at the district level, but on those of regional labour markets within which one can expect compensating mechanisms. As can be seen in Figure 1, regions with low and high values are often close to each other. In order to take into account the extent to which the districts are linked to one another by employment flows, we consider the substitution potentials of regional labour markets. Compensating mechanisms can be expected within regional labour markets. If the digital transformation leads, for example, to an increase in the demand for highly qualified workers in a district, these workers can also be recruited from (neighbouring) districts within the same labour market. However, if the digital transformation leads to lay-offs of workers in a district, employment opportunities may arise in a neighbouring district of the same labour market. In regional labour markets that do not have a mixture of substitution potentials and predominantly consist of districts with a high proportion of highly or low substitutable occupations such compensating mechanisms are only possible to a very limited extent.

Figure 3 shows the proportion of employees working in a highly substitutable occupation by regional labour markets. The regions of Schwarzbach-Baar, Wunsiedel, Coburg and Siegen show the highest values with over a third of the employees in highly substitutable occupations, while Neubrandenburg, Rostock, Berlin and Greifswald/Stralsund show the lowest values with less than 20 per cent. Even though the aggregation of district values in regional labour markets has reduced the range of the values, there are regional labour markets, which are characterised by comparatively high values.

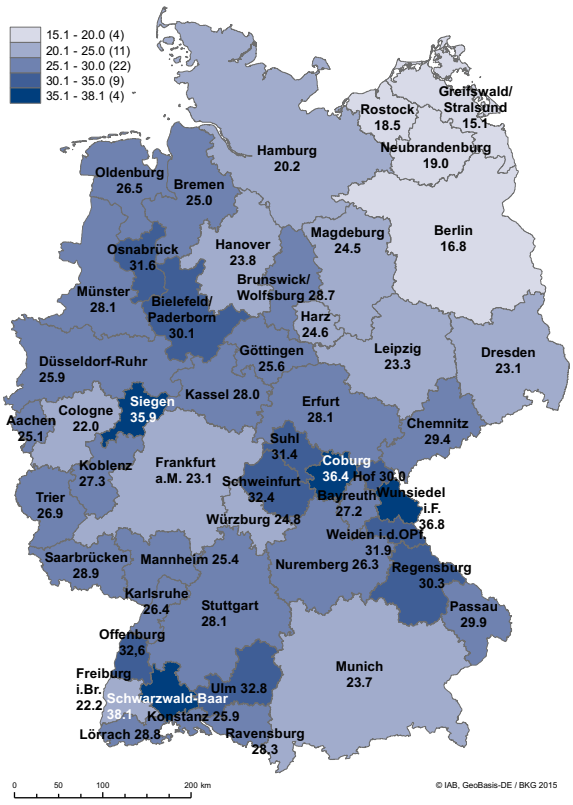

Figure 3: Share of employees working in highly substitutable occupations by regional labour markets

Source: Dengler and Matthes (2018b), Statistics of the Federal Employment Agency (30 June 2017), Berufenet (2016), Kropp and Schwengler (2016).

Similar to the districts, the share of employees in the manufacturing occupations and occupations concerned with production technology increases the regional substitution potential, while a high share of employees in the social and cultural service occupations or medical and non-medical health care occupations reduces it. Figure 4 analyses the occupational structure of low and high value regions. The occupational structure of regions with high and low values is very similar to figure 2.

Even if the employment shares in highly substitutable occupations do not differ as much between regional labour markets as between districts, the values in regional labour markets with high shares of employees in highly substitutable occupations are approximately twice as high as in regional labour markets with low shares of

highly substitutable occupations (e.g. bank clerks (skilled workers) and specialists in accounting).

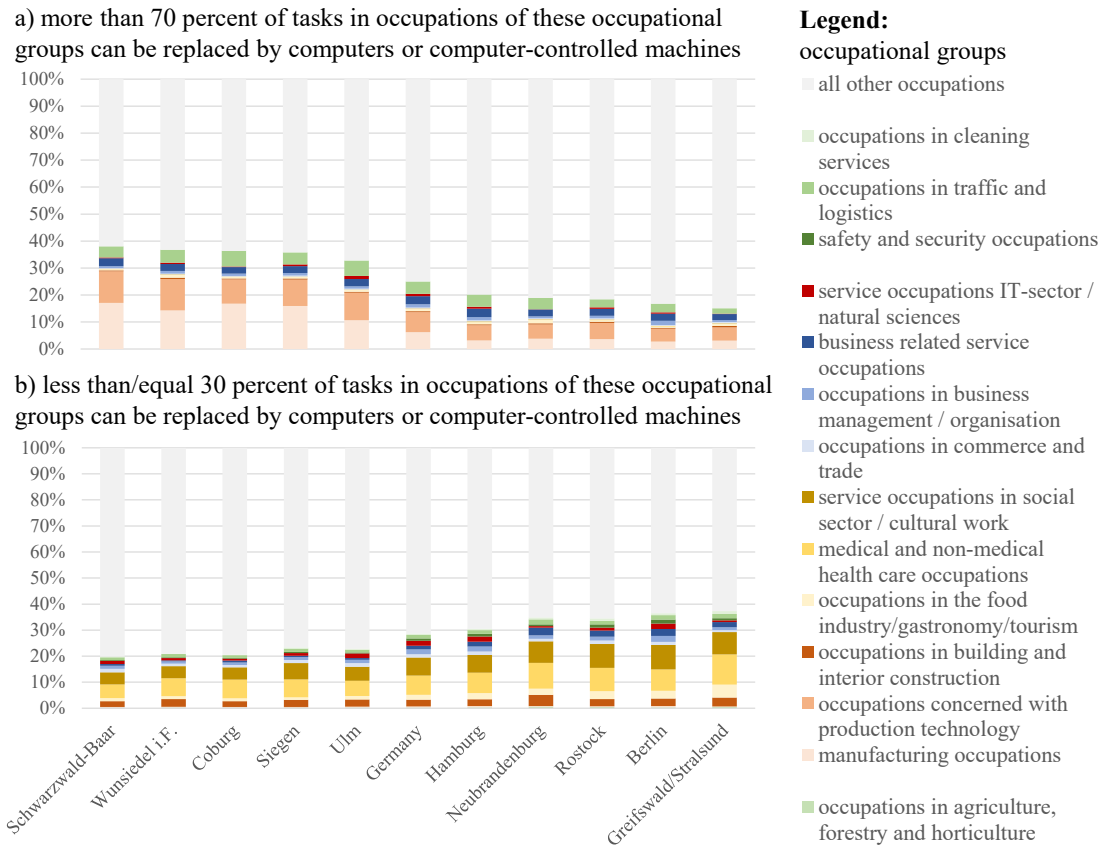

Figure 4: Regional labour markets with high and low shares of employees in highly (a) and low (b) substitutable occupations

Source: Dengler and Matthes (2018b), Statistics of the Federal Employment Agency (30 June 2017), Berufenet (2016).

employees working in a highly substitutable occupation. High substitution potentials may lead to greater changes in the occupational structure, either because occupations and their occupational profiles will change or because some occupations will shrink in number and others will grow, then labour market policy support and qualification offers are especially important in regional labour markets with high values.

4 Conclusion

The present study has shown how the occupational structure contributes significantly to regional differences in the share of highly substitutable occupations. The values for the districts in Germany ranged from 14 to 51 percent. The occupational structure in turn depends on the structure of the industry (Buch et al., 2016; Dengler et al., 2018). In particular, high shares of employees in the manufacturing industry lead to high proportions of employees in highly substitutable occupations, while high proportions of employees in most service sectors significantly reduce them.

In many cases, low and high values cancel each other out within regional labour markets. Nevertheless, the share of employees in highly substitutable occupations still ranges from 15 to 38 percent. In the high value regions, labour market monitoring of future developments and further education appear to be of particular importance to meet the challenges of the digital transformation, because in these regions compensating mechanisms between regions with high and low substitution potentials are not to be expected.

However, we do not assume that occupations with high substitution potentials may disappear or jobs get lost in regions with high shares of employees working in highly substitutable occupations. Substitution potentials consider only the technical feasibility. Whether these tasks are

actually taken over by computers will also depend on other factors such as legal and ethical obstacles, cost considerations and preferences (Dengler and Matthes, 2018a).

Projections up to 2035 show that 1.5 million jobs will be lost because of ongoing digital transformation, but at the same time the same number of new jobs will be created (Zika et al., 2018). This means that the challenge of the digital transformation lies less in the number of job losses rather than in the rapidly changing industry and occupational structure. Occupations will rarely disappear, they may adapt to new circumstances. Thus, the most important future challenge in the course of digital transformation is (further) education (Dengler and Matthes, 2015a).

Focusing on substitution potentials in occupations is in a way simplifying the reality of technological change. This view may underestimate the speed of adoption of new technologies in enterprises (Arntz et al., 2018) and it may overestimate the share of automatable jobs by neglecting the substantial heterogeneity of tasks within occupations as well as the adaptability of jobs in the digital transformation (Arntz et. al. 2017; Pfeiffer 2018). Nevertheless, we assume that occupations with high substitution potentials will change more due to the digital transformation than jobs with low substitution potentials, and regions with high values of employees in highly substitutable occupations experience also more change than regions with low values. This focus might help to guide further research about how vocational education and further education can facilitate the occupational mobility necessary to adopt to structural changes of the labour market.

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CHALLENGES OF DIGITAL INEQUALITY
DIGITAL EDUCATION | DIGITAL WORK | DIGITAL LIFE

INEQUALITY IS THE NAME OF THE GAME. THOUGHTS ON THE EMERGING FIELD OF TECHNOLOGY, ETHICS AND SOCIAL JUSTICE.

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ABSTRACT

This paper argues that the hype around 'ethics' as panacea for remedying algorithmic discrimination is a smokescreen for carrying on with business as usual. First, it analyses how the current discourses around digital innovation and algorithmic technologies (including artificial intelligence or AI), newly emerging technology policy and governmental funding patterns as well as global industry developments are currently re-configured around 'ethical' considerations. Here, the paper shows how this phenomenon can be broken down into policy approaches and technological approaches. Second, it sets out to provide three pillars for a sociological framework that can help reconceptualize the algorithmic harm and discrimination as an issue of *social inequality*, rather than ethics. Here, it builds on works on data classification, human agency in design and intersectional inequality. To conclude, the paper suggests three pragmatic steps that should be taken in order to center social justice in technology policy and computer science education.

KEYWORDS

Algorithms; Ethics; Inequality; Sociology; Design

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1 INTRODUCTION

This paper provocatively argues that the hype around 'ethics' as panacea for offsetting discrimination in and through algorithmic technologies[1] is a smokescreen for carrying on with business as usual. It suggests that 'ethics' is largely deployed to gain competitive advantage (between firms, industries, nations) rather than initiating a genuine push towards social justice. The paper builds this argument in three steps: First, it analyses *how* the current discourse around algorithm innovation is re-configured around 'ethical' considerations. As part of that, it delves into current computer science scholarship on 'moral machines' and puts this into context with the latest works on technology and discrimination. Second, it provides a sociological framework for conceptualizing the harm and discrimination that can be caused by digital technologies as an issue of *social inequality*, rather than ethics. Here, it builds on sociological approaches to notions of 'the social' in data classification, human agency in networks of design and intersectional inequality. Based on that it, third, suggests three points that must inform new technology policy and computer science pedagogy in order to center digital innovation on social justice.

2 ALGORITHMIC HARM: ETHICS TO THE RESCUE?

Over the past years, we have seen more and more evidence that algorithmic technologies can disproportionately disadvantage and/or harm social groups that are already negatively affected by social segregation and oppression (Bolukbasi et al 2016; Buolamwini and Gebru 2018; Eubanks 2018; Noble 2018; O'Neil 2016). In response, many technologists and policy makers set out to remedy this situation by way of 'ethics'.

The issues of algorithmic discrimination and harm are increasingly addressed through emphasizing the need for 'ethics' in algorithmic technologies. While there is a substantial body of work that has long argued that technical artifacts *do* have politics (see famously Winner 1980) and thus *do* contain, in one form or another, values (see for example Nissenbaum 2010), the idea of ethics in algorithmic technology has recently taken particular shapes: 'ethical AI' has not only been announced as a 'top technology trend for 2019' (Lomas 2018), but is also being positioned as a key element in the global race for technology leadership, informing heavily funded university initiatives (such as MIT's $1 billion investment into the Stephen A. Schwarzman College of Computing which will have an explicit focus on 'ethical considerations relevant to computing and AI' [MIT News 2018]) as well as government and industry investments (Dutton 2018, Sloane 2018).

In practice, the recent rise of 'ethics' in the context of algorithmic technologies has informed two types of (often overlapping) approaches to mitigating algorithmic harm: ethics as a *policy* approach[2] and ethics as a *technology* approach. The *policy* approach often materializes as a form of self-regulation, for example through ethics codes, frameworks and principles that set out to define sets of rules and values to help guide a 'responsible' development of AI technology[3].

[1] In this paper, the term 'algorithmic technologies' refers broadly to any *digital* technology that is put to work based on an algorithm (including machine learning technologies), whereby an algorithm is a 'computational procedure for deriving a result, much like a recipe is a procedure for making a particular dish' (Broussard 2018, p. 20). Furthermore, the term 'algorithmic technologies', here, includes automated decision-making systems, commonly referred to as 'artificial intelligence' or 'AI'.

[2] Due to the limited scope of this paper, the policy approach, here, does exclude legislative frameworks that regulate issues adjacent to algorithmic technology, such as data (e.g. the EU's General Data Protection Regulation [GDPR]).

[3] Prominent examples include Google's 'Objectives for AI Applications' (Pichai 2018), the newly updated 'Code of Ethics and Professional Conduct' by the Association of Computing Machinery (ACM 2018) or the Institute of

But it may also take the form of external 'ethics boards'[4], fairness and ethics trainings for computer science students and professionals (Fiesler 2018; Vallor 2018) or the suggestion of algorithm designers and engineers swearing a 'Hippocratic Oath' (Etzioni 2018).

While the policy approach targets the human lead within algorithm design, the *technology* approach sets out to create what we may call 'moral machines' (Wallach and Allen 2009). The notion of 'ethics' that informs these efforts tends to be grounded in the tradition of moral philosophy. Without wanting to crudely simplify the vast scholarly tradition of moral philosophy dating back to Kant's categorical imperative, we may describe moral philosophy as a theory that is fundamentally concerned with what counts as a good life as basis for making a decision (Vallor 2016). The overarching goal of creating 'moral machines' is to work ethics, morality and values into the machines themselves (Anderson and Leigh Anderson 2011; Yu et al 2018). This consideration has become more urgent in the context of the increased complexity and computational capability of algorithmic technologies that are deployed as autonomous agents (or as 'AI'). The common rationale is that these agents now require a 'capacity for moral decision making' (Moniz Pereira and Saptawijaya 2016) when working towards achieving goals[5]. Related considerations and new strategies are emerging in the context of 'fairness' enhancement and 'bias' mitigation in algorithmic technologies[6].

3 INEQUALITY IS THE NAME OF THE GAME

Unsurprisingly, the way in which 'ethics' is currently enacted and deployed is increasingly criticized. A key critique is the fact that neither the policy approach, nor the technological approach to 'ethics' is grounded in a legal framework – 'ethics' is simply not enforceable by law (Chadwick 2018) and ultimately remains a gesture of goodwill of those who create algorithmic technologies. The overwhelming – and voluntary – commitment to 'ethics' by companies selling algorithmic technologies can, therefore, be seen as a form of 'whitewashing' (Wagner 2018). Additionally, there is new evidence indicating that ethical frameworks simply do not affect the decision making of technologists (McNamara, Smith and Murphy-Hill 2018). And as Greene, Hoffman and Stark (2018) show, 'ethics' tend to position algorithmic harm as a *social* problem that requires a *technical* solution. That the social problem is deeply entangled with the existing fault lines of social stratification falls somewhat outside of the ontology of 'ethical algorithms'. Therefore, relying on 'ethics', whether through policy or technical approaches, implies that the mechanics retaining the status quo remain untouched. In other words, the notion of 'ethics' does *not* require us to examine the historic,

Electrical and Electronics Engineers' (IEEE) framework for 'Ethically Aligned Design' (IEEE 2018).

[4] See, for example, the Axon AI and Policing Technology Ethics Board (Axon 2019), or Google's newly appointed Advanced Technology External Advisory Council (Walker 2019).

[5] See especially Noothigattu et al (2018) for insight into how autonomous agents may balance 'moral values' and 'game rewards' in the context of value-alignment.

[6] A substantial part of the discourse around 'fairness' in machine learning (and especially prediction-based decision-making systems) focuses on the question whether and how inequality patterns that inevitably emerge through data sets can be mitigated algorithmically (see especially the proceedings of the 2019 ACM Conference on Fairness, Accountability, and Transparency [ACM FAT*], as well as Mitchell, Portash and Barocas 2018). Here, however, many fairness-in-machine learning scholars are careful not to suggest that the data that is used to train algorithmic systems and that describes the social world can be somewhat independent of the (unequal) structures that make up that social world (see especially Barocas, Hardt and Narayanan 2018). Sebastian Benthall and Bruce D. Haynes (2018) go further to argue that the social categories that are routinely used to classify social data are complicit in anchoring mechanisms of inequality and oppression. They take the case of racial categories in machine learning to illustrate this argument. Here, they suggest using *unsupervised* machine learning to dynamically detect patterns of segregation *prior* to group fairness interventions with the goal of preventing the perpetuation of racial categories as status categories of disadvantage.

systematic and complex inequalities that *cause* algorithmic bias and violence – even when we return to the fundamentals of moral philosophy: asking whether something is 'done ethically' does not question *who* defines and enforces what a good life is, and for whom, and from what position of power, or not, that decision is being made. That is to say that 'ethics' does not prompt us to reflect on and intervene in the social organization of algorithm design at large and the cultures and power relations that underpin it.

To illustrate this point, let us put it into the context of the current tech landscape: I would argue that there is a link between the fact that Alphabet Inc.'s search algorithm ('Google') tends to show white, male individuals in searches for the term 'CEO' (Sottek 2015), that Alphabet Inc. paid out a $90 Million exit package to a senior executive who had a track record in sexually harassing coworkers and that very recently 20,000 Google employees walked out of their offices in protest of this incident, and a misogynist work culture at large (Wakabayashi and Benner 2018). The link between these events is social, historical and cultural and it points to the ways in which different kinds of inequality manifest across all domains of social life, including technology design and the technology industry at large. And there is a growing body of work that supports this claim: Meredith Broussard (2018) has recently argued that the sexism and 'bro-culture' that is rampant in the tech industry is deeply entangled with the history of computing and mathematics in general while Marie Hicks (2017) has demonstrated how gendered inequalities in computation are not accidental, but derive from a particular cultural landscape and a series of policy decisions. Safiya Umoja Noble (2018) seminal study of search algorithms has revealed how capital, gender and race are central to the technological formation of social oppression. What cuts across these studies is one message: inequality, as a complex, historical and emergent phenomenon, is 'the name of the game'. And a narrow focus on 'ethics' through policy and technological approaches prevent us from examining the rules of this game from a *critical* point of view.

4 RECONFIGURING THE CONVERSATION

Clearly then, reclaiming this critical point of view requires a framework for conceptualizing the harm and discrimination that can be caused through algorithmic technologies as an issue of *social inequality*, rather than 'ethics'. This framework must narrow in on what we mean by 'inequality' in the context of algorithmic technology. It must also enable a critical observation of the contingencies of social life and the historical and cultural make-up of the contexts in which algorithmic technologies emerge. Here, it is useful to turn to the social sciences who have long dealt with these kinds of issues. I therefore propose to build on social and cultural theory and consider the following three aspects (which are not separate, but overlap) as part of pursuing more socially just technology design:

'The social' in data – As a basis for understanding inequality in algorithmic technology design, we must ask broader questions around *how* different notions of 'the social' get classified (see also Bowker and Leigh Star 1999) and embedded into the datasets that form the basis for algorithmic technology. Data selection and data classification are a way of world-making, they are based on humans making judgements about other things, social environments, other humans and so on. This world-making through the collection of data is not neutral, but steeped in history, culture, personal experience, social position and so on. This is where algorithmic inequality materializes as a continuation of existing social stratification and oppression. As judgements turn into data labels and data sets, they are decontextualized, so the backstory to their emergence is not carried over into the system. The issue of abstraction (see also Selbst et al 2018), of course, is one of the eternal tensions between quantitative and qualitative traditions of

knowing and describing the world. But as algorithmic technology takes on a constitutive role in the mediation of social life, the implications of abstractions scale up significantly. Ethics frameworks and moral machines do not put a question mark behind the way in which data becomes a social object and enshrines the status quo.

Human agency in technology design – Even though the current rhetoric cultivates the notion that algorithmic systems (especially 'AI') are capable of developing their own agency, it is clear that we are far away from systems that resemble a general artificial intelligence (Knight and Hao 2019). But it is a reality that algorithms are increasingly entrusted with making decisions about humans (Whittaker et al 2018). This means that we need a conceptual handle for assessing this new area of tension. That non-human actors play a constitutive role in society has long been established by schools of thought such as Science and Technology Studies (STS) and Actor-Network Theory (ANT). They are therefore useful for getting our heads around the relationship that evolves between humans and (computational) machines. Put broadly, STS and ANT promote an ontology whereby agency emerges in a network *between* human and non-human actors (Latour 2005). But the rise of algorithmic technology, paradoxically, makes a good case for *human* agency taking the lead in the formation of this assemblage: humans determine *who* becomes an algorithm designer, *how* the system is designed, how the *data* is selected and optimization targets (implicitly or explicitly) are set, and so on. And yet, the materiality of computational systems (from the increasingly powerful hardware to the 'neural network' structures enabling 'deep learning') plays a central role in the rise of algorithmic technologies. This means that in order to better understand the unfolding of agency (and politics) in algorithmic technology design, deployment and integration, we need a productive critique of STS and ANT. While 'ethics' are not a good vehicle for that, newer debates emerging adjacent to STS/ANT become central, particularly Antoine Hennion's (2016)[7] notion of pragmatism and Laura Forlano's (2017)[8] work on design in the context of nonhuman, the posthuman and the more than human.

Intersectional inequality – The use of 'ethics' in much of the current landscape of algorithmic technology does not only circumnavigate the concept of social inequality at large, but *intersectional* inequality specifically. Kimberlé Crenshaw's (1991) original notion of 'intersectionality' shows how categories of inequality, such as race, class and gender, intersect and are experienced. Crenshaw's study outlined how women of color were disproportionately affected by hiring discrimination and how neither the category of race, nor the category of gender fully captured their experience and could be leveraged in an anti-discrimination suit in court. Patricia Hill Collins (2000) developed the notion of intersectionality outside of the legal domain and proposed it as a general form of analysis 'claiming that systems of race, social class, gender, sexuality, ethnicity, nation, and age form mutually constructing features of social organization' (Collins 2000, p. 299). As a framework, intersectionality 'provides a complex understanding of inequality that takes multiple sources of disadvantage as the source and solution for inequality' (Hurtado 2018). Taking intersectional inequality seriously in the context of algorithmic technology means putting the lived

[7] Hennion (2016) positions pragmatism as a critique of ANT, starting from the issue that ANT's focus on object-people relation comes at the cost of diluting agency in a network between human and non-human actors. For him, pragmatism means "'socializing' objects, but not by emptying out their content" (Hennion, 2016, p. 299)

[8] Forlano (2017) critically analyses emergent design practices and perspectives against the backdrop of key works on the nonhuman, the posthuman and the more than human to suggest that it is important to acknowledge that posthumanism may not serve those communities who have traditionally been excluded from humanism in the first place, such as women, people of color, the LGTBQ community, and others.

experience of those affected by (algorithmic) discrimination front and centre in discussions around technology and social justice.

The notion of intersectional inequality is already informing new and important research in the context of algorithmic technology and design. Most notably, Sasha Costanza-Chock (2018) has built on the notion of intersectionality to show how *design* – as a socio-technical system at large – reproduces and is reproduced by a 'matrix of domination' in which gender, class and race serve as interlocking systems of oppression to formulate 'design justice principles' that can help break design's complicity with oppression. Relatedly, Joy Buolamwini and Timnit Gebru (2018) have taken intersectionality as a cue to use the Fitzpatrick skin type scale as a basis for a phenotypic evaluation of face-based gender classification accuracy in automated facial analysis. Schlesinger, Edwards and Grinter (2017) have built on the intersectionality lens in order to show how human-computer interaction (HCI) research can be comprised of clearer reporting of context to foster a deeper engagement with identity complexities.

These are all important advancements. But to help address the social problem of inequality *at large*, beyond the technological and ethical realm and as a broad research and policy goal, they need to by synthesized into a holistic framework that can help examine data categorization, materiality and agency, as suggested above.

5 MOVING FORWARD

On a pragmatic level, we must then take the following steps to foster a more focused consideration of inequality in technology practice and policy as well as computer science pedagogy:

(1) We must bring questions of data epistemology onto the top of the agenda, because knowing how data comes to describe and organize the social is key for understanding and mitigating algorithmic harm[9] and social inequality more broadly. Here, we may have to flip the script and focus on data classification as emerging from the lived experience of social actors, rather than as based on external evaluation and categorization. This acknowledges that data describing the social world can never be independent from the categories and hierarchies that organize that world. I can also put intersectional inequality at the heart of efforts to make algorithmic technologies socially just and prompt new political discussions about inequality *beyond* the technical realm.

(2) We need better collaborations between quantitative and qualitative scholarship, especially in the context of computer science pedagogy. Computer science students must be equipped with the conceptual tools they need to reflexively locate themselves, and their practice, in the social world. By the same token, we need social science and humanities scholars who are able to actively engage in data and computer science practice.

(3) We need a clearer picture of the terms that are at stake and currently do important political work, because the unclarity about key terms (such as 'algorithm', 'digitization', 'machine learning' and so on, but also 'fairness', 'bias', 'standardization', 'accountability') impacts our ability to have more productive conversations about the abilities and limits of new technologies, and explore regulatory possibilities.

These considerations, together with a framework that allows us to explore questions in the context of data classification, human agency and intersectional inequality in algorithm design, will allow us to reclaim digitization as a positive, rather than threatening, new way of knowing social life (see also Marres 2017). This will open up new possibilities for addressing the issue of social inequality at large, beyond the digital space.

[9] This is particularly salient in the context of the co-called 'black box problem', whereby it is unclear to the human actor how the algorithm reached its conclusion/prediction.

6 CONCLUSION

This paper has argued that the current focus on and enactment of 'ethics' will *not* facilitate social justice in algorithmic technology. To do so, it has mapped out how ethics – as policy approach and ethics as technological approach – fails to solve the root problem of algorithmic discrimination. To illustrate this point, the paper has built on recent developments in the tech industry and argued that the historic continuation of certain cultures, power structures and ways of socially organizing algorithm design require a conceptual handle that reconfigures algorithmic discrimination as an issue of *social inequality*, rather than ethics. Here, it has suggested to combine sociological approaches to notions of 'the social' in data classification, human agency in networks of design and intersectional inequality. To conclude, the paper has taken this framework as a cue to suggest three pragmatic steps that must be taken in order to move forward in technology policy and computer science education: (1) focusing on data epistemology as emergent from lived experience, (2) better dialogue between quantitative and qualitative scholarships, (especially in the context of computer science pedagogy), and (3) more clarity about key terms that are currently at stake in the discourse around digitization, algorithmic technology and inequality.

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PROCEEDINGS OF THE WEIZENBAUM CONFERENCE 2019
CHALLENGES OF DIGITAL INEQUALITY
DIGITAL EDUCATION | DIGITAL WORK | DIGITAL LIFE

THE REPRODUCTION AND RESTRUCTURING OF INEQUALITY THROUGH PLATFORMS

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ABSTRACT

Platforms are the avant-garde of digitized work. Based on digital techniques, they develop innovative business models and new organisational forms. With this process, new inequalities arise and old ones are reproduced or transformed. The paper focuses on this transformation of inequalities via platforms. Specifically, with food courier work and private cleaning services, two major types of locally-linked, platform-mediated services in Germany are analyzed comparatively. These affect both vertical and horizontal inequalities.

KEYWORDS

Platform Work; Intersectionality; Gender; Inequality; Digitalization

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1 INTRODUCTION

Platforms are the avant-garde of digitized work. Based on digital techniques, they develop innovative business models and new organisational forms. With this process new inequalities arise and old ones are reproduced or transformed. The paper focuses on this transformation of inequalities via platforms. Specifically, with food courier work and private cleaning services, two major types of locally-linked, platform-mediated services in Germany are analyzed comparatively. These affect both vertical and horizontal inequalities.

2 PLATFORM WORK

Digitization leads to a "radical structural change" of the economy (Roland Berger & BDI, 2015, S. 44). Signum of this development are online platforms, so that there is already talk of a platform capitalism (Lobo, 2014; Srnicek, 2017). Platforms are not a new development (Brinkmann & Seifert, 2001), but by now they can also be used to organize complex industrial relations, which are being extensively reorganized in this way. While this field of platform work evidently exists and shows marked growth, there are currently no reliable figures on actual size and, hence economic relevance. Nonetheless, platforms are an avant-garde as they explore and establish new ways of organizing work. In the course of this, the question arises to what extent well-known inequalities in the context of platform work are reproduced or whether they are transformed or even new inequalities arise. The paper is dedicated to this question, focusing on the two most relevant fields of platform work in Germany: food couriers and private cleaning staff.

3 METHODOLOGY

The paper is based on a research project on platform-based courier work, in which 35 interviews in seven German cities, an online survey (n= 261) and ethnographic surveys (>700h) were conducted. For contrasting, ten interviews with platform mediated cleaners were conducted. All interviews were semi-structured, took over an hour, were recorded and afterwards transcribed and then digitally coded and analyzed.

4 THREE TRANSFORMATIONS

As the following comparison shows, the different types of platform work have ambivalent consequences. They transform inequalities (4.1), exacerbate and reduce them at the same time (4.2) and draw boundaries that make previously latent inequalities manifest (4.3).

4.1 MARKET INSTEAD OF LOVE

(Locally bounded) platform work is not the result of solely new technological possibilities, which now allow work to be organized inexpensively, flexibly and remotely. Likewise, they go back to a specific social change. Even though the primary and in particular the secondary sector has by no means become irrelevant, an increase in services can be observed in all Western societies. This "collective hunger for the tertiary" (Fourastié) is partly the result of increasing female employment and increased demands for work due to flexibility and longer working hours.

Next to technological innovations, the emergence of platform-based services is the result of large quantities of finance capital in search for profitable investments in the aftermath of the 2008 financial crisis. As a consequence, these new platforms give higher classes the possibility to outsource reproductive labour to workers instead of taking over themselves. Unequal gender orders in individual households are externalized and applied to lower classes.

Reproduction work, which was previously a "love service" performed mostly by women (Klinger, 2012), is now being traded on the market. This can be understood as a shift in horizontal inequalities between the different genders towards vertical inequalities between

the classes. The result is the creation of a new service caste that handles care work for upper and middle classes when needed (Andall, 2003).

4.2 Heteronomy and Autonomy

Depending on how strongly and restrictively work is controlled, employees have different scope for action. The simple service work considered here is commonly characterized by limited rationalization and mostly personal control. However, the platformization also affects the control of the work and thus the autonomy of the employees.

Platform-based couriers experience an increasing heteronomy. Their location is communicated to the platforms at all times, every step of the process must be confirmed within the app, and the platforms establish comprehensive information asymmetries. By no means are the couriers without any agency, but their autonomy is noticeably limited (Heiland & Brinkmann, 2019).

In contrast, the platform-based organization of cleaners is also subject to the platforms' control efforts, but these are far less effective as a result of the specific work process. In addition, the platform is a mediating third party in the service relationship between workers and customers, and thus a valuable resource for the cleaners, giving new autonomy. The classic form of private cleaning work is usually unreported and directly depends on the employer. If, on the other hand, the work is organized by platforms, the cleaning staff can use it in cases of conflict and also benefit from a formalized settlement of the payment. In accordance with the "autonomy-control paradox" (Mazmanian, Orlikowski & Yates, 2013), the platform workers are able to use the organizations for new kinds of self-organization.

However, this is not a zero-sum game. The preceding horizontal as well as vertical gender segregation of the various works leads to diverging developments. Male-dominated courier work is more heteronomous as a result of the platform organization. Used to a low organizational level, primarily female, private cleaners experience new freedoms.

4.3 Platforms as gatekeepers

With the platforms another actor has entered the market, which acts as a gatekeeper. While the platforms are solely interested in workers' labor, regardless of ascriptive attributes, they often formalize informal working relationships and subsequently exclude some workers in those sectors.

Namely non-German people without legal residence status and work permit have no way of getting jobs from platforms. For this already vulnerable group the job opportunities are reduced, which makes them even more fragile for exploitation.

5 Conclusion

The new Platforms are shifting the prioritization of the “axes of inequality”. In domestic work, the class comes to the fore as a result of the externalization of gendered work. In platform work itself, the degrees of freedom differ, but the primarily female workers gain new forms of agency. At the same time, the exclusion of non-German workers from these organizations has created a new division along nationality.

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CHALLENGES OF DIGITAL INEQUALITY
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BIG DATA: INEQUALITY BY DESIGN?

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ABSTRACT

This paper proposes to tackle the problem of digital inequality by introducing digital technologies of knowledge generation and decision-making to a feminist critique of rationality that is informed by discourse theory and intersectional perspectives on gender and gendered relations of inequality. Therefore, it takes a closer look at the epistemological foundations of Big Data as one prominent representation of digital technologies. While Big Data and Big Data-based results and decisions are generally believed to be objective and neutral, numeral cases of algorithmic discrimination have lately begged to differ. This paper argues that algorithmic discrimination is neither random nor accidental; on the contrary, it is – amongst others – the result of the epistemological foundation of Big Data – namely: data fundamentalism, post-explanatory anticipatory pragmatics, and anti-political solutionism. As a consequence, a critical engagement with the concepts and premises that become materialized in the design of digital technologies is needed, if they are not to silently (re)produce social inequalities.

KEYWORDS

Big Data; Algorithmic Discrimination; Feminist Critique of Rationality; Epistemology; Intersectionality

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1 INTRODUCTION

The algorithmically processed and (partially) autonomous generation and analysis of mostly heterogeneous and unstructured large-scale data sets, so-called Big Data, for the production of knowledge is a prominent and much debated example of current developments in digital technology.[1] Advocates of Big Data promise the production of more, better, and most importantly predictive knowledge that is said to improve the lives of all human beings and solve the great problems of mankind (Anderson 2008; Mayer-Schönberger and Cukier 2013; Geiselberger and Moorstedt 2013). Critics, contrariwise, warn against potential privacy breaches and surveillance risks should Big Data turn into Big Brother (van Dijk 2014; Zuboff 2015). Lately, a growing number of research, mostly informed by science and technology studies (STS), refuses to take a deterministic or essentialist stance and calls for differentiated analyses of the historical, sociocultural, political, and economic preconditions and effects of Big Data (early: boyd and Crawford 2012; Gitelman 2013).[2] The latter strand of research tends to be skeptical of the promises made in the name of Big Data, and emphasizes the disparities between the programmatic discourses surrounding Big Data and the material phenomenon called Big Data.[3] All parties alike, however, seem to agree that Big Data constitutes a "computational turn in thought and research" (boyd and Crawford 2012: 665; also Kitchin 2014), whereas Big Data can be understood as an "emerging *Weltanschauung* grounded across multiple domains in the public and private sectors, one that is need of [sic] deeper critical engagement." (Crawford et al. 2014: 1664; original emphasis)

Big Data and Big Data-based results and decisions are generally believed to be objective and neutral; however, numeral cases of algorithmic discrimination have lately begged to differ (O'Neil 2018 [2016]; Eubanks 2018). Google's ad posting algorithm has, for example, been demonstrated to display advertisements for jobs in management positions as well as for executive training programs significantly more often to persons whose browser profile identifies them as male, than to those whose profile identifies them as female (Datta et al. 2015). Data-based risk assessment tools, which are widely employed in the US criminal justice system, to name a second example, have been shown to systematically attest African Americans a higher risk of committing a future crime than so-called white Americans (Angwin et al. 2016). When these and similar cases of algorithmic discrimination gain the attention of the wider public, the resounding outcry testifies to the broken promises of objective knowledge production and neutral decision-making. The vocabulary used to understand what is going on, when algorithms are sexist or racist, often refers to terms such as bias, error or distortion, suggesting that objective results are possible once all errors are eliminated (Zweig 2018) and, thereby, maintaining the modern ideal of "mechanical objectivity" (Daston and Gallison 1992).

This paper, by contrast, draws on the insights of STS in assuming that processes and practices of knowledge production as well as the technical artifacts employed within these processes are

[1] Within Big Data two theoretically and technically distinct phenomena – algorithmic processing and data – come together, whose distinction and relation demand a thorough examination that cannot be accomplished here.

[2] Research concerned with these kind of questions is predominantly conducted under the labels *Critical Data Studies*, *Critical Algorithm Studies,* or *Critical Code Stud-ies* displaying the yet to be closed terminological discus-sions. In the German-speaking context the discussion is only just beginning, with pioneering publications such as Mämecke et al. 2018, and Houben and Prietl 2018.

[3] Discursively powerful buzzwords such as 'digital transformation' and 'data revolution' suggest that Big Data has no history, whereas the material phenomenon of Big Data is far older than its discursive popularity (Barnes 2013; Barnes and Wilson 2014: 1-2). At the same time, current manifestations of Big Data fall far behind the promises made its name (Beer 2016: 2).

neither neutral, nor objective, but highly political (Winner 1980). From this perspective it is of paramount importance to critically analyze the epistemological foundations and premises of digital technologies such as Big Data. This paper contributes to this endeavor by introducing Big Data to a feminist critique of rationality that is informed by discourse theoretical perspectives on the relation of knowledge and power and intersectional perspectives on gender and gendered relations of inequality (see section 2). It, therefore, focusses on the epistemological foundation and premises of Big Data-based knowledge production and decision-making as they are articulated within the discourses surrounding Big Data. Following David Beer (2016: 5), it is vital to better understand the discourses produced in the name of Big Data as "it is also the very concept of Big Data itself that shapes decisions, judgments and notions of value – as it brings with it a vision for particular types of calculative or numerical knowing about individuals, groups and the social world".[4] Synthesizing the promises made in the name of Big Data as well as the critique brought against Big Data, three epistemological premises are portrayed as central to Big Data-based knowledge production and decision making – namely: *data fundamentalism*, *post-explanatory anticipatory pragmatics*, and *anti-political solutionism*. In order to introduce this epistemological triad of Big Data to a feminist critique of rationality, it is asked how these assumptions underlying Big Data are related to gender and gendered relations of power and inequality.[5] Put differently, this paper is concerned with how Big Data is gendered on the level of its epistemological foundation (see section 3). Finally, the results of this analysis are summarized and discussed (see section 4).

2 THEORETICAL APPROACH

This paper is situated in the tradition of critical engagements with (Western, masculine) rationality and modern objectivity within STS, but also more generally within the social sciences and humanities.[6] It, thus, assumes that (scientific) knowledge production is a social endeavor of utmost political significance, whereat technical artifacts play a crucial role and do themselves have politics (for an overview from a feminist perspective see Singer 2005). This paper's *feminist* critique of rationality is especially inspired by Donna Haraway's work that is known for its early posthumanist and neomaterialist perspectives on the power dynamics embedded in information and communication technologies (ICTs). The analysis proposed further draws on Foucault'ian discourse theoretical perspectives on knowledge production and truth claims as well as on intersectional approaches to gender, according to which gender is always intersecting with other categories of social differentiation and inequality.

Haraway describes ICTs as essential for the development of hybrid assemblages called "technosciences" within which the boundaries between technical and natural sciences, applied and basic research, science, economy, and politics become blurred (Singer 2005: 21). Technosciences establish a new mode of reasoning that is no longer based on the Newtonian logics of deduction and induction, but promotes a reflexive trial-and-error approach. Instead of searching for the universal laws of nature, research and knowledge production shift to finding (technical) solutions and real-world applications of knowledge (Weber 2017: 350-353). Following Haraway, technosciences such as Big Data are to be understood as concrete representations of

[4] As discursive phenomenon the discourses surrounding Big Data are neither congruent with the socio-material phenomenon called Big Data, nor can the one be directly deduced from or reduced to the other.

[5] Thus, the focus of this paper is neither on the gendered inequalities of data-based resource allocation (Fourcade and Healy 2013), nor on the gender aspects of the so-called "digital divide" or "digital inequality" (DiMaggio et al. 2004).

[6] Important contributions to this discussion stem also from the eponym of this conference, Joseph Weizenbaum (e.g. 1990 [1976]).

globally dominant technologies, but also as a specific approach to the world that transports certain possibilities of generating knowledge and of political engagement.

Haraway further offers a feminist and anti-racist perspective on technosciences that sensitizes to structures and processes of patriarchal, colonial, and capitalist power embedded within scientific practices and technical artifacts, without demonizing technology in general or claiming innocence for feminist approaches.[7] Emphasizing that every knowledge or truth claim is "situated", Haraway calls for taking responsibility for one's truth claims and making one's standpoint visible (2017 [1995]). This includes technical artifacts such as technologies of measurement or visualization that Haraway understands as agents in the discursive-material processes of knowledge production. According to Haraway, the technical reconfiguration of the world cannot be understood as a neutral project, but as a highly contested political endeavor. Therefore, it is important for a feminist critique of rationality as well as for an engaged intervention in the technological development to scrutinize the mode of reasoning, the rationalities, and the powerful norms of producing knowledge and making decisions promoted by the concept of Big Data.

Drawing on the discourse theoretical work of Michel Foucault (2012 [1976]) the interdependencies between knowledge and power can be conceptualized in some more detail. According to Foucault, there is no such thing as objective truth, but only knowledge claims that are acknowledged to be true. Thereby, power unfolds by means of knowledge, by "developing, organizing, and circulating a certain knowledge or rather knowledge apparatuses" (1978: 87). These knowledge apparatuses work as historically contingent "regimes of truth" that (pre)structure the acknowledged modes of reasoning as well as the norms according to which someone can come to know something at all. As indicated by Beer (2016), Big Data can be understood as such a regime of truth and, thus, needs to be confronted with the question of *who* can become a producer of true knowledge within the concept of Big Data, *how* can truth claims be made, and *what* can consequently be known and what not.

Last but not least, this paper takes an intersectional perspective on gender and gendered relations of power and inequality. According to the concept of intersectionality gender is always intersecting with other categories of social differentiation such as class, age, sexuality or race/ethnicity. Instead of taking one form of domination/marginalization as prior to others, it is an empirical question, how different modes of domination/subordination intersect, reinforcing each other or suspending one another (for an overview see Davis 2008; Bührmann 2009). Accordingly, this analysis is not limited to binary forms of gendered power relations or relations of inequality, such as men vs. women or masculine vs. feminine, but takes into account more complex forms of intersecting axes of power and inequality.

3 The Epistemological Triad of Big Data

Data Fundamentalism

"Before big data, our analysis was usually limited to testing a small number of hypotheses that we defined well before we even collected the data. When we let the data speak, we can make connections that we had never thought existed." (Mayer-Schönberger and Cukier 2013)

The concept of Big data promotes the idea of a "data-driven rather than knowledge-driven science" (Kitchin 2014: 1). The key to this supposedly strictly inductive mode of reasoning is the idea that (self-learning) algorithms search 'freely' – that is without recourse to theoretical

[7] In her famous *Cyborg Manifesto* she highlights the possibilities of overcoming the modern hierarchies between male and female or culture and nature by technical means (Haraway 2004 [1985]).

models or hypotheses – for patterns in large data sets, uncovering connections between different variables that would not have been foreseeable, thus producing new knowledge in its purest form. Instead of testing theoretical models and hypotheses, and thereby proceeding deductively, the concept of Big Data idealizes "the primacy of inductive reasoning in the form of a technology-based empiricism" (Mazzocchi 2014: 1250).

Big Data's "data fundamentalism" (Crawford 2013) apparently resides on two equally controversial epistemological premises: first "the belief that life can be captured and modeled by data or even fully transformed into it" (Thatcher 2014: 1768), and second the assumption that objectivity is the result of subject-free and therefore neutral production of knowledge. Both ideas have been heavily criticized within STS and shown to form specifically modern ideals of science.

Historians of science have described how the idea that 'nature should speak for itself' became dominant throughout the 19th century in modern Western societies. Whereas personal judgment was considered an important prerequisite for any scientist in the 18th century, the new notion of "mechanical" or "non-interventionist" objectivity (Daston and Galison 1992) disavowed the scientist as the subject of knowledge production. In contrast to the then spreading machines and technical apparatuses of observation and measurement the scientist was portrayed as a source of prejudice and misinterpretation and, thus, as a threat to the supposedly pure image of nature. With the replacement of the human body with technical artifacts, numerical data became increasingly important for the production and communication of scientific knowledge. Since numbers can be communicated independently, or so it seems, from the persons, places, times, and contexts of their production, they became swiftly regarded as the ideal manifestation of neutral objectivity (also Heintz 2007; Singer 2005: 62-67).

Numerous contributions within STS have pointed out that there is no such thing as a subject-free, neutral discovery of the laws of nature. Neither can reality be simply depicted by or transferred into data. Recently, Critical Data Studies have pointed out with regards to Big Data that the notion of "raw data is an oxymoron" (Gitelman 2013), as data are always already 'cooked'. Consequently, also Big Data have to be understood as the product of numerous practices of categorization and classification, of the production of comparability, and of the demarcation between what gets included and what is not, between what is considered as relevant and what is not (see also Heintz 2010; Mau 2017: 30; Busch 2017).

Feminist work in STS has further demonstrated that the modern Western ideal of science resides on the notion of a rational, non-situated, and bodyless subject of knowledge that has been constituted in contrast to the notion of the emotionally bound and physically situated 'others', namely: women and people of color (Singer 2005: 83). Thus, the notion of objectivity as a 'view from nowhere' has to be considered to be androcentric as well as Eurocentric. It has long served to legitimize the exclusion of women and people of color from academia, and continues to marginalize forms of knowledge and modes of reasoning that are based on lived bodily experience or oral traditions (Haraway 2017 [1995]; also Bath 2009).

In the context of Big Data a revival of this modern ideal of western, masculine rationality and subject-free objectivity can be witnessed that potentially reopens the doors for diverse gendered inequalities. Renyi Hong (2016), for example, observes a double marginalization of women in the course of profiling Big Data-methods within human resources (HR): First the association of computing, programming, and analytical skills with masculinity paths the way for discriminating against women professionals in HR. Second, the demand for 'hard numbers' in HR tends to neglect emotional work and other work mostly done by women that is difficult to

quantify and model by data. Others draw comparable lessons from historic experiences of quantification efforts in human geography or social physics: The call for numerical representation is considered to favor mechanistic conceptions of the world that tend to be unsuitable to grasp power relations, inequalities, and cultural or symbolic phenomena (Barnes and Wilson 2014: 10; Kitchin 2014: 8; Mazzocchi 2014).

Post-Explanatory Anticipatory Pragmatics

"Who knows why people do what they do? The point is they do it, and we can track and measure it with unprecedented fidelity." (Anderson 2008)

The concept of Big Data shifts the prime object of knowledge production from understanding or explaining a phenomenon – that is asking the *why*- or *how*-questions – to generating probabilistic predictions about a phenomenon that allow for describing or predicting its future appearance. Reasoning then moves increasingly from "data gathered about the past to simulations or probabilistic anticipations of the future that in turn demand action in the present" (Adams et al. 2009: 255), as can currently be observed in fields as diverse as the criminal justice system or credit scoring, where "post-explanatory pragmatics" (Andrejevic 2014: 1675) meet with a "regime of anticipation" (Adams et al. 2009).

The method of choice to implement this new purpose of knowledge production is processing large amounts of data with the help of regression analysis (boyd and Crawford 2012). Regression analysis searches for patterns in the relationship between different variables by calculating how they correlate in a given data sample; proposing a model of this relationship, it then allows for predicting how these variables co-develop in the future. Put differently, big data analysis operates on the assumption that patterns found in data of the past allow for approximating the future.

Geoffrey Bowker (2014) argues that Big Data, by virtue of this methodological approach, offers a possibility of finding patterns for instance in human behavior that do not originate in stereotypical classifications such as women being more social. The tendency, however, to refrain from understanding the correlations identified, quickly turns this advantage into a disadvantage, as can be exemplified through Google's sexist ad posting algorithm: When the fact that women are underrepresented in leading positions is discovered as a pattern in data analysis – which is highly likely due to the gendered segregation of the labor market – and this pattern then forms the basis for choices in ad posting – what can only be assumed due to the lack of transparency of Google's algorithms –, women will by the very means of this data-based technology be less encouraged to make a career, eventually confirming the initially found pattern – or sociologically speaking, reproducing the existing social inequalities. In other words, not asking *why* there are few women in leadership positions, easily leads to misjudging the patterns discovered by data analysis as positivistic expression of the truth, and consequently confirming the gendered structures of social inequality.

The motto "correlation trumps causation" (Bowker 2014) within the concept of Big Data, therefore, rapidly unfolds a conservative tendency, with social inequalities being reproduced by the very means of the epistemological and methodological design of Big Data-technologies.[8] Whereas this may seem harmless when it comes to ad postings, the same logic applies in

[8] Furthermore, it is difficult to contradict the results of Big Data analyses for at least three reasons: First, equipped with the symbolic authority of data, a successful objection requires either alternative data or a well-founded critique of the available data (see for a similar argument Heintz 2010: 172). Whereas the latter requires insight into how the Big Data-analysis at hand operates, the former re-quires considerable resources to come up with data on one's own. Second, decisions based on Big Data analyses are difficult to criticize, because no reason or explanation is given that qualifies for a certain decision (Andrejevic 2014: 1679; O'Neil 2018 [2016]). Ultimately, Lessing's (1999) dictum "code is law" also applies to Big Data. Where there is no human, but a machine behind a decision, there is also no one to direct criticism or objection to.

more serious cases such as racist risk assessment.

Anti-Political Solutionism

"[T]he most important thing we at Facebook can do is develop the social infrastructure to give people the power to build a global community that works for all of us […] – for supporting us, for keeping us safe, for informing us, for civic engagement, and for inclusion of all." (Zuckerberg 2017)

Research concerned with the digital avant-garde of Silicon Valley as one important birthplace of big data describes a "solutionist ethos" as prevalent amongst Big Data evangelists (Morozov 2014; Nachtwey and Seidl 2017). The utopias, being portrayed around digital technologies, depict the world as being full of 'bugs' that need to be 'fixed'. The preferred means to do so, are technological ones, especially ICTs, digital technologies, and last but not least Big Data. The core idea of the promoted anti-political solutionism is that every problem, including social problems, can ultimately be reduced to a series of small and, therefore, manageable problems, for which technological solutions are then to be found. The optimistic belief in technological progress in combination with libertarian ideals and a deep distrust in established politics draws on the so-called "Californian ideology" that has become prominent throughout the second half of the 20th century.[9] Instead of political debate and public opinion formation, ICTs are supposed to create a virtual agora, a public space of discussion, where everyone can speak freely and equally, thereby, pathing the way for democratization, decentralization, and emancipation (Dickel and Schrape 2015).

To make this vision come true, two things are needed according to high-tech solutionist: Humans need to live up to their full potential, which is supposed to be enabled by networking, the distribution and sharing of information, and, therefore, equal access to knowledge and technology. Additionally, all institutions that hinder or restrict the free unfolding of human potential, such as bureaucracy, are to be removed and a strict meritocracy is to be established (Barbook und Cameron 1996; Dickel and Schrape 2015; Nachtwey and Seidl 2017).

At the same time, the protagonists of a Big Data-based solutionism seem to fail to recognize not only the existing inequalities in access to digital technologies, but also the reproduction of power asymmetries and social inequalities within the virtual space (e.g. Zilien and Hargittai 2009). Likewise, the well documented effect that the meritocratic ideal stabilizes existing social inequalities due to its disregard of the deeply embedded structural inequalities in society (Becker and Hadjar 2017) is not problematized any further. As Barbook and Cameron (1996: 49-50) argue, this may be due to the fact that the protagonists of the New Economy form themselves a well-educated, socio-economically privileged, mostly 'white' "virtual class" that is hardly ever affected by racism, social inequality or poverty. From a gender perspective it is to be added that with the rise of Big Data, activities and professions, such as computing, statistics or programming, gain importance that are structurally dominated by men and symbolically associated with masculinity.[10]

With its anti-political solutionism the concept of Big Data privileges a focus on allegedly anti-political, purely factual aspects of reality and social

[9] Barbook and Cameron (1996) describe the "Californian ideology", prevalent in Silicon Valley and related high-tech institutions of the US-westcoast, as a bizarre amal-gamation of "cultural bohemianism", „hippie anarchism" (56), and „anti-corporatism" (52) at the one hand and „economic liberalism" (56), „entrepreneurial zeal of the yuppies" (45), and „laissez faire ideology" (52) at the other.

[10] The recently published anti-feminist manifesto by a Google employee and the following global echo on social media (Bovensiepen 2017) suggest further that sexist work cultures are still prevailing within the work spheres surrounding and implementing Big Data.

life, thus ignoring its highly political and, therefore, inequality-relevant notions. Combined with the insensibility towards power asymmetries and social inequalities, Big Data further runs the risk of misjudging the perspective of a privileged view as universal perspective, rendering those in marginalized positions (again) invisible.

4 DISCUSSION

The discourses surrounding Big Data claim for it to establish a new regime of truth (and governance). The aim of this paper was to introduce the epistemological foundations of Big Data as they are articulated within these discourses to a feminist critique of rationality. Systematically sorting the promises made in the name of Big Data and the critique brought against them, three epistemological premises were discussed as central to understanding Big Data – namely: data fundamentalism, post-explanative anticipatory pragmatism, and anti-political solutionism. This epistemological triad has proven to be anything but (gender) neutral: The revival of the modern ideal of rationality and objectivity within the concept of Big Data links the subject of knowledge production once more to Western masculinity and threatens to marginalize modes of reasoning and aspects of reality beyond the androcentric and Eurocentric norm. The primacy of correlation over causation facilitates the misjudgment of social inequalities as expressions of positivistic truth. These tendencies are reinforced by an anti-political solutionist ethos embedded within the concept of Big Data that renders the privileged virtual class of Big Data protagonists insensitive towards gendered relations of power and inequality. In the light of these findings, the alleged biases of Big Data-based analyses prove to be less the result of random distortions or errors than the systematic consequence of the epistemological foundations of Big Data.

Consequently, this paper argues that Big Data constitutes a specific approach to the world that transports certain possibilities of knowing, and is itself not neutral, but favors the reproduction of existing social inequalities. It does so by (1) privileging phenomena that are easily transformed into (numerical) data and (distinct) categories and that are, therefore, more readily algorithmically processable; by (2) promoting the generation of (probabilistic) knowledge about what there is (or will be), instead of the critical engagement with questions of why specific phenomena have (not) come about; and by (3) favoring the presumably non-political analyses of facts over normative discussions. Future empirical research will have to examine whether this analytical argument holds true across diverse areas of Big Data applications and for different forms of data (such as non-numerical data), as well as whether similar arguments can be made with regards to other digital technologies.

In any case, a critical engagement with the concepts and premises that become materialized in the design of digital technologies is needed, if they are not to (re)produce social inequalities. When it comes to Big Data, this might include that their protagonists acknowledge their own situatedness within social relations of power and inequality and the effects this position has on the design of Big Data technologies and the truth claims that they make. This might also include to acknowledge the limitations of Big Data, for example its tendency to underrepresent already marginalized groups such as the elderly or socio-economically disadvantaged persons (Lazer and Radford 2017). Last but not least, this means to confront Big Data with questions such as: Which interests does Big Data (not) serve? Which questions can Big Data-based analyses (not) ask and answer? Which solutions do Big Data-based analyses focus on?

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CHALLENGES OF DIGITAL INEQUALITY
DIGITAL EDUCATION | DIGITAL WORK | DIGITAL LIFE

"YOU ARE TO OLD (NOT) TO LEARN" – A CRITICAL RECONSIDERATION OF "OLDER EMPLOYEES"

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ABSTRACT

Todays working environment faces the major challenges of demographical change and digitalization. Deficit-oriented stereotypes question the ability of older employees to keep pace with these technological innovations. Consequently, the elderly are perceived as less valuable for the company leading to fewer vocational training offers. Facing this dilemma, this contribution aims at uncovering the prevailing stereotypes against older employees and present a new approach of looking at older generations. Focusing existing experienced-based knowledge instead of assumed deficits as a starting point for further didactical work and research, basics of age-appropriate vocational training get pointed out in order to raise target group specific potentials in the context of the challenges of digitalization.

KEYWORDS

Older employees; vocational training; deficit hypothesis; experienced employees

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1 INTRODUCTION

Changes in pension policy conditions (e.g. less early retirement) lead to longer working life (Thieme et al. 2015). On the other hand, the increasing digitalization of working environments (the so-called „Fourth Industrial Revolution“) also influences existing well-proven working conditions by transforming existing jobs (Spath et al. 2013). Consequently, older people need to know how to act in changing working environments in order to securing their livelihood in the context of socio-political changes. In companies, stereotypes predominate against this group of employees (Pfaff and Zeike 2018) which lead to disadvantages (Billet 2011).

This contribution takes up this problem using the example of continuing vocational training in enterprises against the background of advancing digitalization. The goal of this paper is to sensitize for the consequences of a deficit-oriented perspective on older employees. Additionally, an alternative perspective on the role of older employees based on current literature is demonstrated as a starting point for further didactical work and research. First, the existing stereotypes towards older employees and the resulting consequences for vocational training are presented (Sec. 2). Decoupled from stereotypes, potentials of older employees for companies will be presented (Sec. 3). The learning behavior of older people and the prerequisites for age-appropriate vocational training get pointed out in a third step (Sec. 4). Finally, a summary is given and conclusions are drawn (Sec. 5).

2 NEW CHALLENGES! – OLD STEREOTYPES?

Work profiles will change massively due to technical innovations and digitized workplaces (Timonen and Vuori 2018). Examples are the use of mobile technologies in production that enables faster communication channels between individuals as well as the increased use of data in production environments. Therefore, the competence to deal with new technologies is required. On way to develop these competencies can be vocational training (Gronau et al. 2017). Target group-specific learning behavior of older employees demand special requirements on vocational training (e. g., Dymock et al. 2012). However, offers directly geared to the needs of older employees are rare (Bellmann et al. 2013). In companies, a deficit-oriented perspective defines the understanding towards older people. This deficit hypothesis supposes a loss of cognitive and physical abilities (Schmidt and Tippelt 2009). Consequently, companies perceive old employees as less productive, less willing to learn and less innovative (Dymock et al. 2012). This stereotypical perspective can be observed (with exceptions) throughout Europe (Bellmann et al. 2013). The real consequences of stereotypical attributions become clear taking the example of vocational training: From a business-oriented perspective, organizational parts which can contribute a great deal to the success of the company (should) get subsidized. Arguing in line with the deficit-oriented perspective, older employees are less valuable for a company. From the company's point of view, it thus seems unprofitable to support them. It can therefore be assumed that the lack of target-group-specific offerings is attributable to identified stereotypes. In summary, the predominating deficit hypothesis appears to contribute to structural disadvantages for older employees. In order to overcome these stereotypes and their consequences, an alternative perspective needs to be proposed.

3 (G)OLD EMPLOYEES

The fact that old employees have been with the company for a long time can lead to organizational advantages, e.g., higher levels of loyalty to the employer. This reduces the risk of a job change (Peeters and van Emmerik 2008). As a result, a transfer of company knowledge to competitors might become less likely. Older people also have long accumulated experience-based knowledge. Specific challenges which require

this type of knowledge (e.g., Interpretation of machine data) can be solved more efficiently by older people than by younger ones. At the same time, technical systems are becoming more complex as a result of increasing automation, which increases their susceptibility to errors due to situations that cannot be anticipated in advance (Bainbridge 1983). Among other things, employees have the task of acting as control authorities to react reflexively to errors in technical working environments. Thus, experience-based knowledge and the ability to apply this knowledge in the sense of action competence gain in importance (Gronau et al. 2017). In summary, elder have a different kind of potential compared to younger less experienced workers, especially in the context of the challenges of digitalization. Furthermore, the current literature suggests that the deficit-oriented approach is not tenable: Methodical knowledge, existing experience-based knowledge (Franken 2016), and digital assistance systems (Apt et al. 2016) can compensate a possibly existing reduced physical capacity and their consequences. It might even be interesting to consider a reciprocal relationship at this point: declining cognitive performance is partly due to one-sided and undemanding activities and lack of learning opportunities at work (Koller and Plath 2000). Consequently, the cognitive performance can be enhanced by age-appropriate vocational training and learning opportunities at work (Schmidt and Tippelt 2009). To point out the prerequisites for this, it is necessary to give a deeper understanding of the learning behavior of older people.

4 NEVER TOO OLD TO LEARN

While theory-oriented and externally controlled learning contents lose importance among older people, the connection to experience-based knowledge and one's own practical work be-comes more important. Especially in vocational training, extrinsic motivation (e.g., job promo-tion) is less important than intrinsic motivation (e.g., interests in the learning topic) (Tikkanen and Billet 2014; Thieme et al 2015). On top of that, environments and work designs which stimulate learning are also necessary to support efficient learning (Schmidt and Tippelt 2009, Tikkanen and Billet 2014). Taken together, it can be hypothesized that older people do not learn *worse* than younger people but *differently*. The following prerequisites are derivable for age-appropriate vocational training: A.) content based on experience-based knowledge and working experience and B.) opportunities to get involved in the choice of content.

To achieve this goal, older employees have to receive more attention both in society as well as the working context in order to overcome the prevailing deficit hypothesis. If, however, the biological age and social devaluation processes retained as a supposedly meaningful reference point, existing stereotypes, and the outlined consequences will remain. Searching for an alternative reference point for companies, this contribution proposes an orientation on experience-based knowledge and also a linguistic redefinition from *old* employees to *experienced* employees. Establishing this linguistic transformation, a first effort is made to separate experienced employees from existing stereotypes. Referring to this new approach, further conceptual work can be conducted in the field of vocational training.

5 CONCLUSION

All in all, the literature suggests that experienced employees incorporate much more potential than society currently acknowledges. Especially in context of increasing relevance of experience-based knowledge, experienced employees play an elementary role in the digital transformation. This paper serves as a starting point for further didactical work and research. In order to overcome stereotypes, a new approach decoupled from deficit hypothesis based on experience-based knowledge was proposed. Emphasizing the connection of this knowledge and one’s own practical work for learning, basics of age-appropriate vocational training were pointed out.

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THE FAIRWORK FOUNDATION: STRATEGIES FOR IMPROVING PLATFORM WORK

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ABSTRACT

This paper introduces the Fairwork Foundation, a research initiative that is also developing an intervention around the quality of work on digital labour platforms. Lacking the ability to collectively bargain, many of these workers have little ability to negotiate wages or working conditions with their employers who are often on the other side of the world. As a result of this new global market for work, many workers have jobs characterized by long and irregular hours, low income, and high stress. Across India and South Africa, there are challenges for workers across a range of issues, including: pay, conditions, contracts, management, and representation. The results of the fieldwork are being used to rank and compare platforms as part of the ongoing 'work in progress' of the Fairwork project, a research initiative that is developing an intervention to improve the quality of work on digital platforms.

KEYWORDS

Decent Work; Platform Economy; Digital Labour

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1 INTRODUCTION

The platform economy is growing fast with estimates that digital labour platforms[1] worldwide now earn at least US$50bn per year (Heeks, 2019): examples include platforms operating in ride hailing, food delivery, personal services, and digital content creation. There are estimated to be up to 40 million platform workers in the global South alone; some 1.5% of the total workforce (Heeks, 2019). While platform work offers income and opportunities to many, there are also numerous instances of unfair and unjust work practices. Examples of issues encountered in research are low pay, wage theft, unreasonable working hours, discrimination, precarity, unfair dismissal, lack of agency, and unsafe working conditions (Wood et al., 2019).

In most places and sectors, workers lack the ability to collectively bargain, and, because of their employment status, are not protected by relevant employment law. As a result, our research has put together a multi-year programme of action research designed to foster more transparency about working conditions in the platform economy, and ultimately to encourage fairer working conditions. This paper introduces the ongoing work in progress of the Fairwork project. We have brought together a diverse set of platform economy stakeholders (workers, unions, platforms, labour lawyers, academic, and third sector organisations) to co-develop a set of Fairwork Principles that are meaningful and achievable in the contemporary gig economy. We have then used those principles to assess work processes and conditions in most large platforms operating in Bangalore, India and in South Africa.[2]

This paper will review the theoretical underpinnings of our fair work principles, our theory of change and the thresholds of fairness deployed in the project. It then outlines the methods and the advantages and challenges of collecting data about fair work from empirical research with platforms and workers, and though desk research. Finally, even though our first league tables are not released until later in the year, the paper shares some preliminary results and impacts from the research.

2 THEORETICAL UNDERPINNINGS OF THE FAIRWORK PRINCIPLES

Fairness at work is a complex issue. At a basic level, fairness involves an equitable exchange of labour-time for a wage. However, fair pay remains an ongoing challenge, both in more traditional forms of employment and online work. From the exchange of time for a wage flow many complicated relationships, situated within particular economic, social, political, and cultural histories. The factors involved differ based on the kind of work and its technical composition. These include the labour process, the activities involved, the way it is managed, the use of technology, and so on.

By 2025, a third of all labour transactions will be mediated by digital platforms (Standing, 2016). While platform work undoubtedly offers opportunities and income to many (D'Cruz and Noronha, 2016), emerging evidence of the quality of work on labour platforms points towards numerous problems (Bergvall-Kåreborn and

[1] A digital labour platform may be defined as a set of digital resources - including services and content - that enable value-creating interactions between consumers and individual service-providing workers (adapted from Constantinides et al 2018).

[2] Our pilots began in South Africa and India because of the relatively large size of the platform economy and the significant potentials to improve platform work in both places. In both countries, much platform work is relatively unregulated. Because of the enormous economic, political, and cultural differences within India, our work is currently limited to the city of Bangalore. While our research in South Africa has been limited to Johannesburg and Cape Town, we would argue that are results are applicable to all large cities in the country.

Howcroft, 2014; Berg, 2016; CIPD, 2017; Huws et al., 2016; Lee et al., 2015; Rosenblat and Stark, 2016). A major problem, and one that has held back research, is that work platforms have successfully used the 'spectacle of innovation to conceal the worker' (Scholz, 2015). One example of this is the rise of 'commercial content moderation', involving workers in the global south checking content for large platforms like YouTube (Roberts, 2016). This work involves new harmful practices, of which many are currently unaware.

Platforms involve more than just a change in labour processes, but are also seeking to transform other existing practices. As De Stefano (2016) has argued, platforms are undermining the standard employment relationship, creating increased casualisation. This has a corrosive effect on working standards, changing existing and accepted standards. For some types of platform work, workers are in competition globally for the same jobs. This is particularly significant as people from low-income countries in the global South are able to access the internet, resulting in accelerated competition (Graham et al., 2017a). There are currently no agreements for collective bargaining with these kinds of work, leaving workers unable to collectively negotiate improved working conditions or wages. Many platforms make it very difficult for workers to communicate with one another, let alone organise. There is often the risk of being "deactivated" which can make workers reluctant to express voice. Furthermore, most platforms position themselves as intermediaries rather than employers, which means it is less clear who workers can negotiate with. Unsurprisingly, this has resulted in low wages, irregular hours, and high stress (Graham et al., 2017b). This is aggravated by the fact that many platform workers are characterized as 'self-employed' and therefore do not benefit from employment rights guaranteed for 'employed workers' in local labour legislation.

These examples provide the context from which we have proposed the establishment of the Fairwork project. It is a response to the particular challenges faced by platform workers that seeks to draw on ongoing empirical research to develop effective strategies for change. Given the difficulty in finding appropriate legal regulation or achieving change through collective action, the Fair Work Foundation instead draws on the influence of publicity, reputation and consumer power to achieve decent work for platform workers. Building on the model of Fair Trade and the highly successful Living Wage initiative in London, the Fair Work Foundation uses a rating scheme to determine the extent to which platforms are providing decent work for those who carry out platform-mediated tasks. This in turn requires us to determine rating scales, which on the one hand underpin fair work standards in the complex world of platform working and on the other hand give meaningful incentives to platforms to bring their practices into compliance. This paper describes the process of determining those ratings and the outcome.

While all platforms are engaged in the supply and demand of labour, the specific functions differ. This can involve becoming a new intermediary for some kind of existing service, creating new jobs and skills (Drahokoupil and Fabo, 2016), or forging new economic geographies of work (Graham and Anwar, 2018). In order to consider the differences in fairness – or what fairness means – in the contexts of platform work, we have attempted to deploy broad principles of fairness that can incorporate different labour processes, kinds of organisation, and other specificities that have important ramifications for certification. To do that, our goal has been to establish principles of fair platform work that can be meaningful across places and sectors. But then establish thresholds of measurements that can adapt to spatial and sectoral specificities.

After a review of related job quality literature and related standards, The Fairwork Foundation developed eight themes that were to be included in our ratings. This involved comparing the six different standards in Table 1. These included the Ethical Initiative Base Code (ETI, 2014) which is an internationally recognised code of labour practice, building on the Conventions of the ILO; The SA8000 certification scheme, developed by Social Accountability International (SAI, 2014), also based on ILO decent work; Richard Heeks (2017) 'Decent Work and the Digital Gig Economy', which summarises a range of contemporary literature in the field; The Frankfurt Declaration on Platform-Based Work (FairCrowdWork, 2016) signed by North American and European Trade Unions; FairCrowdWork (2017) which is a collaboration between IG Metall, the Austrian Chamber of Labor, the Austrian Trade Union Confederation, and Unionen; and the voluntary guidelines for crowdwork set by the German crowdsourcing platform Testbirds (2017) and supported by Deutscher Crowdsourcing Verband e.V. The different approaches for standards have been synthesised into Table 1. summarising the differences. We added our own standards based on the literature review (see column "Fairwork") and then grouped these into themes. For example, where there were multiple standards relating to pay (see the two for Faircrowd.work), these have been synthesised into a single row for the theme "pay." The result is a revised set of "Fairwork Principles" in the final column.

3 WEIGHTING THE PRINCIPLES

In workshops in Berlin, Geneva, Bangalore, and Johannesburg, we asked stakeholders to discuss priorities for the principles. The discussions were synthesized, and participants were asked to rate the importance of different principles. Along with drawing on the findings of previous empirical research, this led us to apply the following weightings to end up with the following five principles. The other three principles featured in Table 1, along with equity which was added at this later stage, have been included within the revised "Governance" principle, as each had a lower weighting with stakeholders.

Pay: Fairness relating to pay includes levels of pay as well as fair pay terms, including ensuring that workers costs are met.

Conditions: Fair conditions cover the way in which the work is carried out, either mitigating the risks of the work, or actively improving health and safety.

Contracts: The key issue with fairness of contracts is whether employment status attributed to the worker by the contractual documents reflects the actual employment relationship. Contracts should be transparent, concise, and provided to workers in an accessible form.

Governance: Fair governance involves how the platform operates across five dimensions. First, management, involving fairness in relation to the work process, including disciplinary practices. Second, communication, with clear lines of contact between workers and a representative of the platform. Third, accountability, involving transparency in relation to decision-making processes. Fourth, use of data, which should be justified with a clear purpose and only with explicit informed consent. Fifth, equity, which is cross-cutting and ensures no discrimination.

Representation: Fair representation requires that workers have a voice on the platform. Workers should have the right to be heard by a platform representative and there should be a clear process by which workers can lodge complaints, receive a response, and access a dispute resolution process. The platform observes the ILO right to free association, not linked to worker status, but as a universal right. Similarly, the platform accepts collective representation of workers and collective bargaining.

ETI	SA8000	Heeks	Frankfurt	Faircrowd work	Testbird	Fairwork	Fairwork Principles
Living Wages	Living wage	Adequate Earnings	Minimum wage	Pay and non-payment	Fair payment	Minimum wage; Regulation of non-payment; Pay terms	Pay
Employment feely chosen; Working hours are not excessive; Working conditions are safe and hygienic	No child, forced, or compulsory labour; Limits on working hours/days; Safe and healthy working environment	Employment Opportunities; Career Development; Work Process; Working Hours; Health & Safety		Experiences with technology; Quality and availability of tasks	Motivating and good work; Clear tasks and reasonable timing; Freedom and Flexibility	Information about work; Psychologically stressful or damaging tasks	Conditions
Regular employment is provided		Social Protections; Other Legislation and Rights; Stability of Work; Employment Status	Comply with laws; Clarify employment status; Social protection	Changes to Terms and Conditions; Warranty	Tasks in conformance with the law; Clarification on legal situations	Compliance with relevant laws; Non-competition agreements; Non-disclosure agreements	Contracts
				Contact with employers; Contact with workers; Communication	Constructive feedback and open communication	Communication	Communication
No discrimination is practiced; No harsh or inhuman treatment is allowed	No discrimination; No abusive disciplinary practices	Discrimination; Respect, Privacy and Dispute Resolution	Dispute resolution	Reviews, ratings, and evaluations	Respectful interaction; Regulated approval process and rework	Contestation of work evaluations or qualifications; Account deactivation; review of task instructions	Management
Code through supply chain, reporting	SA8000 management system	Platform Governance; Accountability	transparency				Governance
					Data protection and privacy	Access to collected data	Use of Data
Freedom of association and right to collective bargaining	Freedom of association and right to collective bargaining	Freedom of Association; Social Dialogue/ Collective Bargaining	Collective bargaining			Collective representation and bargaining	Representation

Table 1 Different Approaches to Standards in Digital Work

	Pay	Conditions	Contracts	Governance	Representation
Initial Threshold	1.1 Earnings are above the local minimum wage	2.1 Task-specific risk mitigation	3.1 Clear terms and conditions are available	4.1 Provides due process for decisions affecting workers	5.1 Includes freedom of association and worker voice mechanism
Secondary Threshold	1.2 Earnings are above the local minimum wage after costs.	2.2 Actively improves working conditions	3.2 Terms and conditions genuinely reflect the nature of the relationship	4.2 Pro-equity policies and informed consent for data collection	5.2 Recognises collective body for representation and bargaining

Table 2 The Fairwork Principles 1

4 THRESHOLDS AND METHODS

Within those five principles, we developed two thresholds of fairness (see Table 2) for the first year. Our project used those thresholds to assign every platform a score out of ten. The thresholds used allow us to both operationalise an initial threshold of fairness for each principle (in other words, a floor underneath which working conditions should not fall) and a more aspirational target as the second threshold.

The mechanism through which this project seeks to enact change (comparing fairness of work across platforms) necessitates scoring not just platforms who opt-in, but rather all major platforms in a city. As such, faced with a context in which some platforms may not wish to supply supporting evidence, Fairwork's scoring strategy stipulates that scores should only ever be given if there is clear empirical evidence to demonstrate that a platform surpasses any threshold. In other words, the lack of a point can either represent the fact that a principle is not met or that there is insufficient evidence to judge compliance.

Three overlapping methods are used to gather data used for the scoring. First, interview invitations are sent to all large platforms in a city. In those interviews, platforms are given the opportunity to discuss the scoring criteria and provide evidence for how they meet the threshold. In those interviews, some platforms have also asked for suggestions on changes to policies that might be needed in order to receive more points.

Second, interviews with a random selection of platform workers from each platform are set up.[3] Interviews ask workers about not just their own jobs, but also experiences from anyone in their networks. These interviews are mostly used to understand how platform policies play out in practice and to gather evidence that can be used for continuing discussions with platform representatives. The nature of the platform economy means it will never be fully possible to create a representative sample of workers on a platform. For that reason, we are careful to use this data in a context-sensitive way. For a principle like Fair Pay, worker interviews can only be used to take points away from a platform. In other words, we could never establish if a platform can ensure that all workers earn above the local minimum wage from an unrepresentative sample of

[3] We use the term "platform worker" here to refer to someone who works for the platform providing the service. This is regardless of their contractual status. For example, a driver on Uber.

workers. We could, however, establish that some workers do not earn above the local minimum wage. In contrast, for a principle like Fair Conditions, we can quickly establish through worker interviews if specific policies exist to mitigate risk or improve working conditions.

Third, desk research is used to uncover information about platform policies that can be used to assign scores. A significant amount of information useful for scoring can be found on the platform websites and apps. This content can be supplemented with news stories, investor reports, and other third-party content.

The first year's rankings for Fairwork were released on the 25th of March 2019. The league tables for South Africa and India (Bangalore) are now available on the Fairwork website.[4] These league tables will then be updated on a yearly basis. Because of the fast-changing nature of the platform economy, this will help us to ensure that no scores are more than one year old.

5 IMPACTS AND NEXT STEPS

The Fairwork Foundation has so far successfully engaged directly with eight platforms in South Africa (representing over 45,000 workers) and four in India (representing over 450,000 workers). A few of these platforms have already agreed to implement changes to improve the fairness of work based on the Fairwork principles. One platform is a delivery platform that was keen to engage with the project and demonstrate that their company is a good place to work. While the platform already scored relatively well on the ranking, we entered into discussions about further improvements that could be made. The platform owner wanted to experiment with encouraging worker voice on the platform (thresholds 5.1 and 5.2) and so has agreed to publicise a statement go written with the Fairwork Foundation to facilitate collective representation and bargaining. Another example is a freelance platform that places workers on-site. They are in the process of undergoing significant changes to their business practices and have decided to integrate the Fairwork principles into their new operations, ensuring that thresholds around fairness are met in relation to each of the five principles.

Our goal will be to produce yearly rankings and league tables for South Africa and India, as well as expanding to include London and Berlin. We expect our principles, thresholds, and rankings to evolve through ongoing discussions with partners and stakeholders. By carrying out this regular programme of action research, our hope is that we can ultimately encourage a movement towards fairer working practices.

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[4] See: https://fair.work/ratings

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CHALLENGES OF DIGITAL INEQUALITY
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WHEN DO COMPANIES TRAIN LOW SKILLED WORKERS? THE ROLE OF TECHNOLOGICAL CHANGE, HUMAN RESOURCES PRACTICES, AND INSTITUTIONAL ARRANGEMENTS

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ABSTRACT

The article investigates the role of technological change, HR practices, and institutional organizational differences in training participation of low skilled workers in Germany. By building on institutional theories four hypotheses are derived and tested. Regression analysis based on the IAB Establishment Survey (wave 2011 and 2013) show evidence that the training participation of low skilled workers is shaped by organizational characteristics in terms of advanced production technology, investments in EDP, organizational or technological innovation, institutionalized arrangements and HR policies. While the effects of technology and innovations are of short-term nature, institutionalized arrangements in terms of employee representations and formalized HR practices have an enduring effect: They are positively associated with both a higher likelihood of training investments in low skilled workers and higher rates of continuing training participation among low skilled workers in 2011 and 2013.

KEYWORDS

Continuing training; Organizations; Social Inequality; Technological Change, Regulation

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1 INTRODUCTION

In all European societies low skilled workers face particular labor market risks in terms of unemployment, bad working conditions, or low pay (Eurofound 2009). These risks will further increase with ongoing changes in the world of work, often leading to higher skill requirements and a shrinking demand for unskilled work.

According to calculations of the German Institute for Employment Research (IAB) 45% of the tasks that are recently performed by low skilled workers are routine tasks, which could technically be substituted by computers or computer driven machines (Dengler & Matthes 2015). Though the actual effects of the digital transformation on low skilled jobs are still subject of debates and research (Hirsch-Kreinsen 2016) there is at the same time wide consensus that continuing training forms a key measure to respond to these developments by improving digital skills, labor market opportunities, and career prospects for low skilled workers (Martin & Rüber 2016; Mohr et al. 2016: 553). It is the crucial question of the paper how low skilled workers can be better integrated in employer-provided continuing training in Germany.

According to representative establishment data only one out of two companies in Germany has devoted (working) time or money to continuing training in 2017 (IAB 2017). While 40% of the skilled workers took part in continuing training, the share among the low-skilled workers (doing work that does not require a vocational education) was only 20% (IAB 2017; see also Janssen and Leber 2015: 6).

The low training participation of low-skilled workers raises questions for both the underlying obstacles as well as possible pathways to overcome them. While there is a relative broad literature on training participation in general few studies have focused on the particular group of low skilled workers (see Bellmann et al. 2015; Mohr et al. 2016; Martin and Rüber 2016). Moreover, the role of the institutional company context did not receive much attention, so far. Studies addressing the training participation of low skilled workers have been mainly concerned with determinants like labor shortages (Bellmann et al. 2015) or task characteristics (Mohr et al. 2016). The role of institutional differences between organizations, in terms of collective bargaining coverage, employee representation, or HR practices, have neither been explored systematically nor addressed theoretically in previous research on training participation of low skilled workers.

A qualitative study based on firm-level case studies in Germany could identify a number of favorable institutional influences and mechanisms at the sectoral and company level (Wotschack & Solga 2014). Besides the (well-known) factors that increase in-company training in general (such as a labor shortages, technological change, or an existing educational infrastructure) social and institutional embeddedness of the company proved to be an essential prerequisite for the integration of low-skilled workers through training programs. This includes diverse company agreements and collective regulations, long-term employment relations, worker representation, strong norms of solidarity, as well as tight cooperation between the corporate actors. Moreover, the high proportion of low-skilled workers that participate in further training could not be explained by a single characteristic. In fact, several factors worked together in specific constellations. The integration of such social and institutional determinants and constellations remains a gap in the quantitative research on further training.

This article wants to close this gap in existing research by addressing the question, how institutional arrangements and HR strategies at the organizational level shape the training participation of low skilled workers, in addition to technological change, and labor shortages. The data base is the representative German IAB Establishment Survey provided by the German Institute for Employment research (IAB). Theoretically, the study builds on insights from

institutional organizational theory (Beckert 1996; Granovetter 1985; Steinback et al. 2010).

2 THEORY AND HYPOTHESES

Theoretically, differences in training participation are usually explained by processes of selection (by employers) and self-selection (by employees) (Ramos and Harris 2012; Wozny et al. 2016). Barriers at the individual level, such as the missing subjective perception of existing continuing education needs, lack of interest in continuing education, subjective learning barriers or external constraints (such as family demands) can prevent training participation – even when there are good opportunities at the organizational level (Martin and Rüber 2016). Many of these factors most frequently apply to low skilled workers (Mohr et al. 2016). Regarding the side of the employers, the willingness to train workers tends to decrease when time or financial resources are scarce, when the expected returns to training are low, or if no need for training is perceived (Abramovsky et al. 2011).

A common explanation for low training activities at the company level refers to problems of uncertainty (Osterbeek 1998). Transaction cost theory stresses the risk of opportunistic behavior (Neubäumer et al. 2006; Williamson 1985). From the workers perspective, desired returns to training (such as financial benefits, job security or promotion) can be denied by the employer. Employers, in contrast, bear the risk that training investments do not lead to the desired gains in productivity. Moreover, returns to training are jeopardized by career interruptions or employer change ("poaching"). In order to cope with these risks organizations can introduce contractual arrangements (governance structures). Since it is costly to establish such arrangements, transaction costs are increasing and make continuing training more costly.

Alternative theoretical approaches such as filter theory explain the lower training participation of low skilled workers by the (mis)attribution of low and/or uncertain returns to training (Arrow 1973). According to this view, employers tend to ascribe lower returns and greater risk of loss of training investments to low skilled workers. Since they are not able to predict actual gains in productivity (due to training), they focus primarily on groups of people, where returns to training seem high and safe. Certain personal characteristics like the educational degree (measured in certificates), gender, age, or employment relationship serve as an (indirect) indicator signaling lower risk and more gains in productivity. As a consequence, high skilled, young, male, full-time employed workers are more likely to receive continuing training (Asplund 2005).

Given the outlined theories, I expect that low skilled workers are more often included in continuing training when the company faces technological or organizational change (see Bellmann et al. 2015; Hirsch-Kreinsen 2016). Under these conditions, organizations are forced to invest in training of low skilled workers (despite negative attributions). Advanced production technology, the introduction of new technology, digitization, and organizational change will increase the pressure to invest in training also for low skilled workers in order to enable them to adapt to new or advanced technology, work organization, or production processes (hypothesis H1).

When we follow filter theory there is good reason to be pessimistic about the chances and long-term prospects of low skilled workers to participate in continuing training. In the case of labor shortages or technological change, organizations adapt to situational restrictions and do not follow a substantial long-term strategy. So I would expect that the positive effect on training participation of low skilled workers is rather weak and not enduring (hypothesis H2). As long as mechanisms of statistical discrimination are at work, the negative signal of a low or missing qualification (as an indicator of low or uncertain returns to training) will counteract

training participation, in the long run even. So the question arises how mechanisms of statistical discrimination can be canceled out or at least reduced for low skilled workers in the long run.

Institutional theories emphasize the importance of the social context for (solving) problems of uncertainty in economic exchange relations (Abraham 2001; Granovetter 1985; Beckert 1996: 142). When we apply insights from these theories to the question of (overcoming) unequal training participation, we can derive the following hypotheses.

At the organizational level, institutionalized regulations and structures of employee representation can counteract the discrimination of low skilled workers by establishing alternative criteria for the distribution of training investments. I would expect a favorable influence of employee representations (works councils or other types of employee organization) and collective agreements. When training investments are not (solely) driven by the economic criterion of efficient returns but codetermined by employee representations (that are formally obliged to represent the entire work force also regarding issues of continuing training) or collective agreements mechanisms of statistical discrimination should lose their power (hypothesis H3).

Following organizational theory (Steinback et al. 2010) workplace inequalities are also determined by formal organizational practices (like institutionalized regulations or HR policies) that stabilize (or change) status hierarchies within workplaces. Training participation of low skilled workers should vary with the type and shape of HR strategies, ranging from more market and cost driven strategies to institutionalized and employee-oriented practices. I expect that low skilled workers are better off when training investments are governed by formalized, or employee-oriented HR policies (H4). When HR policies are concerned with issues of employability low skilled workers should receive more training due to their poorer employability. When the performance of low skilled workers is evaluated on a regular base by formalized measures, decisions on training participation should be based on (more) actual information on the real productivity of workers, and less on (negative) signals and ascribed attributions by single managers. I expect a similar effect, when long-term employment relationships provide more information on the performance of low skilled workers.

3 RESEARCH DESIGN

The IAB Establishment Panel (Fischer et al. 2009), waves 2011 and 2013, are used in order to test the outlined hypotheses. Data access was provided via on-site use at the Research Data Centre (FDZ) of the German Federal Employment Agency (BA) at the Institute for Employment Research (IAB) and subsequently remote data access. The IAB Establishment Panel provides elaborated information on company characteristics of about 12.000 German companies per year, including a detailed measure of (employer-provided) continuing training participation for different groups of employees. The Panel is based on a random sample selected from all German companies registered at the German Federal Employment Agency's (BA). The data collection was done via oral interviews with employers or employer representatives based on a standardized questionnaire. The following analyses refer to the wave 2011 because of its particular thematic focus on institutionalized HR practices. Information on training participation in 2011 and 2013 is used in order to observe short- und long-term effects of the selected organizational and sectoral characteristics.

Following the definition of the Institute for Employment Research (IAB) the focus is on employer-sponsored continuing training only. Thus, only training activities, which were (at least partly) funded by the employer in terms of investments of time and/or money are taken into account.

All analyses are based on a sample of 6824 establishments from wave 2011 with at least one low skilled worker and on a subsample of 4016 establishments that participated in wave 2011 and 2013. According to the IAB questionnaire low skilled workers are "workers doing jobs that require no professional qualification". This definition is based on the current job and not on the level of qualification of the employees.

Dependent variables: The first dependent (dummy) variables are training investments (yes/ no) in low skilled workers in the first half of 2011 and the first half of 2013. It refers to the question: 'was your establishment active in continuing vocational training in the first half of the year?' When the answer was 'Yes, working hours and/or financial resources were provided for continuing training", and "low skilled workers" (at least one) participated in continuing training (in 2011, respectively 2013) the establishment was considered to support training of low skilled workers. The second dependent (metric) variable is the training participation rate of low skilled workers defined as the share of low skilled workers that received training in 2011, respectively 2013.

Explanatory variables: To capture a possible *demand for innovation-related upskilling*, a dummy variable was created. It is based on the question if the company has improved an existing service or product, developed a new service or new product, or introduced (new) processes for the improvement of production or services in 2010. *Investment in EDP*: A dummy variable indicates whether there were investments in 'computers, information and communication technology' in 2010.

Whether or not the *HR policies* are institutionalized is measured by the question: 'Does your establishment work with': (a) 'written plans for staff development?', (b) 'formally laid down procedures for appointments?', (c) 'job descriptions for the majority of jobs?', (d) 'written target agreements with employees?', (e) 'written evaluations of job performance?'. A factor analysis (main components analysis) confirms that one factor explains 62% of the total variance. The dummy variable for formalization of HR policies is encoded with a value of 1 for all companies that exhibit a positive factor charge, otherwise with the value 0.

Differences in the *orientation of HR policies* are measured by the following indicator: 'How important are the following strategies for your establishment to meet future needs for skilled workers?' HR policies are classified as employee oriented (versus cost-cutting and outsourcing strategies) when they conform highly to the following strategies: 'keeping older workers longer in the company', 'long-term personal development of employees', 'improving the reconciliation of family and working life', or 'creating attractive work conditions'. A factor analysis confirms that one factor explained the four items of 47% of the total variance. The dummy variable for an employee-oriented HR policy has a value of 1 for all establishments with a positive factor charge.

Long-term employment relationships: When the company reports that all employees of the company have permanent employment contracts longer employment periods are assumed.

Tow dummy variables were created indicating whether or not there is a *works council or other form of employee representation* in the company and whether or not the company is covered by a *collective agreement*.

4 RESULTS

In a first step, logistic and OLS regression analyses have been carried out in order to study the role of technology, labor shortages, innovation, institutional arrangements, and HR strategies on continuing training participation of low skilled workers (Table 1). Most company characteristics have been observed in 2011. Only for the business situation, labor shortages, investments in EDP, and recent innovations (regarding work organization, products, services, or the production process) retro perspective

information referring to 2010 was used. Dependent variables are investments (yes/no) in continuing training of low skilled workers (in terms of time or money) and training participation rates of low skilled workers in 2011 and 2013.

	Continuing training for low skilled workers (yes/no)	
Model	**M1 (2011)**	**M2 (2013)**
Explanatory variables (wave 2011)		
Investments in EDP (2010)	0.03** (0.01)	0.03* (0.01)
Recent innovation (2010)	0.04** (0.01)	0.02(*) 0.01)
Modern production technology	0.03** (0.01)	0.02(*) (0.01)
Collective agreement	0.02(*) (0.01)	0.01 (0.01)
Formalized HR practices	0.08** (0.01)	0.09** (0.02)
Employee-oriented HR policies	0.04** (0.01)	0.04** (0.01)
Long-term contracts	-0.04**(0.01)	-0.04* (0.02)
Employee representation	0.03* (0.01)	0.05** (0.02)
Pseudo R^2	0.19	0.18
n (establishments)	6824	4016

(*) significant 10% level; * significant 5% level; * significant 1% level;

Control variables: Company size, compound operation, business situation, employment development, work force composition, infrastructure for training, region (East-/West-Germany), sectors (15 dummy variables)

Source: IAB establishment Panel, waves 2011, 2013; own calculations, only companies with low skilled workers

Table 1: Determinants of training investments in low skilled workers: Logistic regression analysis (average marginal effects; standard errors in parentheses)

In line with hypotheses H1 and H2 the analyses confirm (see Table 1, Table 2) that modern production technology and investments in EDP have a significant positive effect on training investments (in 2011 and 2013) but not on training participation rates of low skilled workers. Recent technological or organizational innovations (in 2010) have a positive effect on training investments for low skilled workers in 2011 and 2013, but training participation rates of low skilled workers are only affected in 2011. With other words (and in line with H2), the included technological determinants do not significantly affect training participation rates of low skilled workers. If they do so (in case of recent innovations) their effect is not enduring.

Regarding the role of the institutional organizational context (H3), the analyses confirms the positive impact of employee representations on both the chance of training investments in low skilled workers (Table 1) as well as their training participation rate in the short (2011) and in the long run (2013). In line with the theoretical expectations we find evidence that employee representations contribute significantly and continuously to higher levels of training participation among low skilled workers.

	Training participation rate low skilled workers	
Model	**M3 (2011)**	**M4 (2013)**
Explanatory variables (wave 2011)		
Investments in EDP (2010)	0.02 (0.01)	0.07 (0.05)
Recent innovation (2010)	0.03* (0.01)	-0.07 (0.01)
Modern production technology	0.02 (0.01)	0.00 (0.05)
Collective agreement	0.01 (0.02)	-0.01 (0.05)
Formalized HR practices	0.03* (0.02)	0.11(*) (0.02)
Employee-oriented HR policies	0.04** (0.01)	0.00 (0.04)
Long-term contracts	0.00 (0.02)	-0.05 (0.05)
Employee representation	0.06** (0.02)	0.11(*) (0.06)
Adjusted R^2	0.04	0.01
n (establishments)	6824	4016

(*) significant 10% level; * significant 5% level; * significant 1% level; same control variables as listed in Table 1

Source: IAB establishment Panel, waves 2011, 2013; own calculations, only companies with low skilled workers

Table 2: Determinants of training participation rates of low skilled workers: OLS regression analysis (standardized coefficients; standard errors in parentheses)

Regarding the role of collective bargaining coverage empirical evidence is rather weak. Collective agreements are positively related to the chance that the company has invested in continuing training for low skilled workers in 2011 (though this effect is only significant at the 10%-level), but not in 2013 (presumably due to the smaller number of cases). For both years, there is no significant effect of collective agreements on the training participation rate of low skilled workers.

With regard to the role of HR strategies (H4), the analysis confirms that the likelihood of training investments was significantly higher for low skilled workers (in 2011 and 2013) when the company was characterized by formalized HR practices. Regarding the effects of

employee-oriented HR policies empirical evidence is less clear. In line with hypothesis H4, they are related to a higher likelihood of short (2011) and long-term (2013) investments in training of low skilled workers (see Table 1). Regarding (higher) participation rates of low skilled workers (see Table 2) there is only evidence for a significant effect in 2011 but not in 2013 (presumably caused by changes in the management). The positive impact of long-term employment relationships is not confirmed by the data. We even find evidence for an opposite effect: Companies with (exclusively) permanent employment contracts are less likely to invest in training of low skilled workers.

The explained variance of models M3 and M4 (Table 2) is low (4%) indicating that the overall impact of company characteristics on training participation of low skilled workers is limited. One possible explanation are mechanisms of self-selection: while the decision of employers to invest in training for low skilled workers depends strongly on the company context, the share of workers who take up training opportunities is largely affected by other determinants (Frazis et al. 2000).

Apart from the outlined institutional influences, training participation of low skilled workers varies with a number of control variables. In line with findings from previous studies (Bellmann et al. 2015), labor shortages, infrastructure and staff for training have a positive impact on training participation of low skilled workers in 2011 (but not in 2013). Smaller companies are less likely to invest time or money in continuing training of low skilled workers. In establishments with a large share of low skilled workers training investments and training participation of low skilled workers are significantly higher.

Furthermore, the likelihood of training investments for low skilled workers is positively related to compound operation, work force composition, (higher) turnover rates, regional, and sectoral differences.

5 CONCLUSIONS

This article addressed a major dilemma of low skilled workers in Europe: Though continuing training forms a key measure to improve their labor market position and to cope with fundamental changes in the world of work (like the digitalization), their participation in continuing training remains very low.

Since particularly low and uncertain returns to training are often attributed to low skilled workers this group is included less often in continuing training. Against this background, the article explored the role of technological change, HR strategies, and institutional organizational arrangements to overcome this problem. To my best knowledge, previous research has not addressed this issue so far.

The article derived from the idea that institutional arrangements are able to prevent the discrimination of low skilled workers substantially. By either providing more information on the actual productivity of low skilled workers, or establishing non-economic criteria for training investments they increase the chance that firms continuously integrate (more) low skilled workers in continuing training. The effect of technological change and innovation, in contrast, is rather limited for this group of workers as long as mechanisms of discrimination are at work.

Analyses of data of the IAB establishment Panel (wave 2011, 2013) confirmed this expectation widely. While there is clear evidence that recent innovations, modern production technology, or investments in EDP have a direct positive effect on the likelihood of training investments for low skilled workers, empirical evidence regarding substantial and enduring effects is weak. Institutionalized arrangements in terms of employee representations and formalized HR policies, in contrast, are related to continuously higher levels of training participation among low skilled workers. Additional analysis (not reported here) show evidence that low skilled workers benefit most in organiza-

tional clusters that are characterized by structures of employee representation, formalized HR practices, and employee-oriented HR policies.

The results of this study underline the importance of institutional arrangements and HR practices at the organizational level. A major role is played by structures of employee representation and formalized HR practices, such as written plans for staff development, formally laid down procedures for vacant appointments, job descriptions, written target agreements, or written evaluations of job performance. For the large number of enterprises without employee representations and formalized HR policies substitute regulations and initiatives at the collective bargaining and state level are needed. Collective agreements might play an important role, too. Yet, their overall impact on the training participation of low skilled workers is still weak. This underlines the need to incorporate more binding regulations on continuing training in order to commit companies to take care of their workers' long-term employability.

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CHALLENGES OF DIGITAL INEQUALITY
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AN INTERDISCIPLINARY EXPLORATION OF DATA CULTURE AND VOCATIONAL TRAINING

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ABSTRACT

In this interdisciplinary paper we discuss the intersection of organizational data culture and vocational education and training (VET). Building on a preliminary definition of data culture and an explorative analysis of data-related value propositions in the German VET market, we analyze how VET providers address organizational challenges in the wake of big data and digitization that affect many of today's organizations, regardless of their traditional industry. We argue that if organizations want to implement a data culture, their employees have to receive appropriate trainings that convey relevant skills and competencies.

KEYWORDS

Data culture; Organizational culture; Vocational training and education; VET, Data strategy

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1 INTRODUCTION

As they adapt to the challenges and possibilities of big data, today's organizations go through a lot of crucial changes. In their attempts to extract value from data not only do organizations explore new technologies (Ebner et al. 2014) but also business models (Hilbig et al. 2018), organizational structures (Wilberg et al. 2017) and cultures (Marr 2017; Vayghan et al. 2007).

In an ideal setting, these changes follow well-defined data strategies that eventually generate competitive advantages. Although there is no unified understanding of the data strategy concept, some authors underline its interdependence with the skills and mindsets of organizational members. Common notions revolve around the idea that new skills and mindsets, both technical and non-technical, must be adapted by organizational members in order to implement value-driven data analytics (Katal et al. 2013; Wilberg et al. 2017; Wilberg et al. 2018), embedded in an *organizational culture that supports the sharing and use of data* (Connors & Malloy 2007; Vayghan et al. 2007). However, these discussions often fail to include descriptions of the needed skills. Moreover, they lack a model of a supporting culture and its relation to changes with regard to employee skills and mindsets. In order to address these shortcomings and to better understand the interplay of employee skills and organizational culture in the wake of big data, we propose the following steps for an initial interdisciplinary exploration. First, we provide a preliminary definition of a concept that we call data culture. We derive this definition from a brief analysis of a real data-strategic transition that took place at IBM and was first documented in 2007. The analysis will be carried out using a model for organizational culture that has its roots in sociological systems theory and allows us to reflect on the interplay of organizational culture and the skill sets of employees in a structured manner. Building on that, we discuss vocational education and training (VET) as an enabling element for the implementation of big data skills in a given organization and the creation of data culture. We then proceed to combine our previous theoretical discussions with a brief exploration of the VET market in order to gain first insights about which employee skills are actually promoted. Here, we integrate a business model perspective and desk research with a focus on the value offerings of three German VET providers. In a last step, we synthesize our findings and provide an outlook for future research tasks in the field.

2 DATA CULTURE

In 2007 members of IBM's Enterprise Business Information Center of Excellence (EBI CoE) published a data strategy framework that they used for an internal transformation process regarding the enterprise-wide usage of data. At this point in time, IBM aimed to make important parts of their data available for reuse throughout the organization and it turned out that one of their main challenges was to tackle preconceived ideas and practices with regard to internal information silos. In order to overcome these practices, they focused on the elimination of mentalities and visions that were contrary to their goal, thus creating an organizational culture that was supportive of their new ideas (Vayghan et al. 2007). The framework comprises of 6 key elements that, according to the CoE's point of view, complement a successful implementation of an enterprise data strategy, two of which are organizational culture and employee skills (see Figure 1). However, while the authors

The 6 Key Elements of IBM's Internal Enterprise Architecture Program
1. Maturity Model for Data
2. Enterprise Program for Technical Data Architecture
3. Process Design for Creation and Maintenance of Data
4. Data Governance
5. Organizational Culture
6. Employee Skills

Figure 1. 6 Key Elements of IBM's Internal Enterprise Architecture Program according to Vayghan et al. (2007).

discuss the first 4 key elements of their framework at length, their discussion of organizational culture and employee skills does not provide the same depth. By not providing at least a simple definition or model for organizational culture and its data-strategic impact or any information on relevant employee skills with regard to big data, they leave questions unanswered that have become increasingly relevant in the time passed. In terms of a data culture model, we propose to analyze the IBM data strategy framework from the point of view of systemic organization theory. From this perspective, most of the key elements of the IBM framework refer to what is understood as the formal side of an organization as they represent what a given organization formally expects from its members in terms of programs, communications channels and people (Kühl 2018). Then there is the right side or rather visible side of an organization[1]. It represents the façade (Kühl 2018), showing what is supposed to be seen in terms of a curated public image. *Organizational culture, however, is not a formal structure or a façade but represents the informal side of an organization*. It includes emergent practices that build on implicit expectations towards the behavior of organizational members. These practices don't follow any kind of formal agreement, and sometimes even don't comply with them (Kühl 2018). In a way, an organization's culture thus seems intangible. And yet, it can evolve because the model states that there is an underlying recursive process at work, where changes on the formal side impact the informal side that again supports the consistency of the formal design. Now, if the aim of an organization that handles big data is to extract value from it (Hilbig et al. 2018), for our preliminary definition we might envision data culture as a special form of organizational culture in data-driven organizations. It is thus a set of informal practices and corresponding mindsets (expectations) that facilitate the extraction of value from big data. Since data culture itself is intangible, it cannot genuinely be controlled but only affected by the redesign of formal structures within an organization[2].

Organization	**Programs**	**People**	**Communication Channels**
Visible Side			
Formal Side	• Maturity Model for Data • Enterprise Program for Technical Data Architecture • Process Design for Creation and Maintenance of Data • Data Governance	• Employee Skills	
Informal Side	• Organizational (Data) Culture		

Figure 2. The 6 Key Elements of IBM's Internal Enterprise Architecture Program transferred to a Data Culture Model leaning on Kühl (2018).

[1] This side is called "Schauseite" in original German sources.

[2] Given this intangible nature it might be advisable to refrain from concepts such as data-driven culture which implicate one-sidedness and thus might evoke the notion of direct steerability.

Going back to IBMs enterprise data strategy framework, all but two of its key elements belong in the programs section on the formal side (see Figure 2). The maturity model, the technical data architecture program, process design and data governance policies first and foremost aim to provide and implement predefined decision criteria for internal stakeholders and can therefore be classified as programs. None of the key element directly addresses communication channels and only one of them refers to the third structural type (people), namely the 6th key element, called employee skills. While all of these elements have an impact on data strategy in the IBM framework, in related publications some authors especially emphasize the importance of formal changes with regard to an organization's personnel, their respective skills and mindsets. For example, Ebner et al. (2014) emphasize the role of key organizational members for the implementation of big data strategies whose absorptive capacity can be a key driver for innovation. They further state that if employees don't understand the value of an IT system, they will rarely make use of it. Wilberg et al. (2017) state that organizations need to train their employees, including new skills that enable the organization to extract value form big data. Vayghan et al. (2007) as well as Connors & Malloy (2007), who documented data initiatives in major institutions, both stress the importance of new mindsets when it comes to data management in organizations. Building on our previous definition of data culture and these statements, we assume that a data culture can only be developed in a company if employees generate an understanding of the new digital technologies in use and build an awareness for possibilities of using data. *Data culture thus provides a direct link between an organization's capability to provide employee training and development and its transition towards a data-driven future.* According to our model, organizations that keep developing their employee's skills, create a change on the formal side that impacts the informal side where data culture is located. To provide a better understanding of the skills and mindsets in question, in the following section we discuss the concept of VET in companies and analyze the value propositions of three external VET providers who offer employee trainings for companies that strive to implement data awareness and analytics.

3 VOCATIONAL EDUCATION AND TRAINING

Vocational education and trainings are defined as knowledge-intensive services that follow the characteristics of services itself: intangible, immaterial, integration of an external factor, uno-actu principle – production and consumption at the same time (Schlutz 2006; Rippien 2012). On an operational level, VET is part of the human resources department of an organization and aims to qualify all employees for current and future tasks (Oechsler 2000). Depending on the needs, various vocational trainings – also known as on-the-job-trainings – can be implemented in organizations on two distinctive levels. Either as an individual training of the employee or the collective training of a whole company which directly effects corporate and organizational development (Hilbig 2019). In line with a growing body of research, we argue that in order for organizations to implement a data culture as a facilitating element for value extraction from big data, their employees have to receive appropriate trainings that convey relevant skills and competencies. Because of that, vocational education and training of employees becomes a key task for organizations that aim to stay competitive in a dynamic, globalized and digitized world. In order to provide a first understanding of the skills in question, we analyzed the value propositions within the business models of three VET providers as a first impulse for future research.

4 VALUE OFFERINGS IN THE GERMAN VET MARKET

To collect initial insights on how VET providers address the needs of today's organizations with regard to big data, we conducted an initial desk-research to analyze their value propositions. Desk research is an important instrument of qualitative research and makes material accessible that is not primarily collected but draws on secondary sources such as on- and offline texts, films, audio files or objects (Mayring 2010). A lot of information about companies is available through websites, databases, social media channels or press articles, allowing an initial description of new training approaches through document analysis.

VET provider A is a classic training and consulting company that offers full-service for qualification processes, training logistics and seminars. The company is active in the fields of HR, organizational development and information technology. Their training modules are divided into 4 traditional subject areas: IT governance, IT applications, IT operations, IT development and personal and professional development. For each main subject area different seminars with optional certifications are offered. VET provider A focuses on classical information technology topics such as IT security, network technology, database systems or business intelligence. In addition, certifications are offered for products from private providers of information technology such as Microsoft, IBM, SAP, Oracle or Adobe. In the field of digital transformation, training courses on data engineering and data science are also provided.

VET provider B primarily focuses on digitization and industry 4.0. Competencies and profound methods in these fields are conveyed by focus training courses e.g. on the data-driven company or by coaching sessions on all aspects of agile project and innovation management or corporate culture in the digital age. VET provider B also offers consulting services in order to transfer the skills that were acquired in the training courses to real life scenarios in the company itself. By combining online workshop methods with on-site analysis, a roadmap for sustainable digitization strategies, innovative business models and the necessary change management will be provided. Topics in additional e-learning courses range from the basics of industry 4.0 to enablers such as big data, data mining, machine learning and artificial intelligence to blockchain and quantum computing. According to VET provider B, it is primarily a question of corporate culture to successfully overcome the challenges of digitization. This might explain why there is an almost equal number of e-learning courses covering topics such as mindset, new work, leadership and corporate culture in the digital age. Another module block deals with strategies and business models of digitization such as digital business models, digital ecosystems and platforms, or corporate start-ups. Moreover, VET provider B also offers the development of individual learning management systems, e.g. based on Moodle. The individual development and production of video tutorials, interviews, webinars, interactive graphics or animation can also be purchased. Furthermore, VET provider B also offers delegation trips for a cross-national and cross-industry knowledge transfer in terms of industry 4.0.

Unlike the VET providers that were discussed before, VET provider C focuses solely on online trainings. Aiming to increase data awareness for their customer's organizations, they focus on a small selection of data-related technologies as well as the basics of data-driven work and decision making with descriptions that align with existing job assignments in the market. On the one hand, VET provider C offers trainings for would-be data analysts. Here, the focus is on the application-oriented teaching of Python for the preparation, analysis and visualization of business data as well as basics in statistics. On the

other hand, VET provider C offers trainings on a more advanced level for would-be data scientists. Here, they teach machine learning with business data and provide advanced knowledge of big data technology frameworks such as Spark and Hadoop.
Among their customers are digital agencies, start-ups and larger enterprises: from automobile manufacturers to telecommunications providers and pharmaceutical companies.

5 ANALYSIS

Building on the discussion of only 3 VET providers and their value propositions, we can already state that there is a big amount of VET offerings in the current market that address a vast number of skills revolving around the broader challenges of big data for today's organization. In our sample, every VET provider has its own focus, for example, VET provider B and C put data awareness and data engineering competencies much more in the spotlight while the significantly larger VET provider A relies more on traditional information technology trainings. Moreover, all VET providers in this study have in common that they address a whole range of different organizational members in a B2B-setting, including managers, project managers, IT personnel and other internal stakeholders. Thus, the contents of the VET services do not just address technically trained stakeholders such as IT personnel. While some of them focus on teaching additional technical skills to non-technicians, others avoid technical concepts altogether and rather focus on business aspects or organizational development in the context of big data. Moreover, even though all analyzed VET providers offer classical learning content for organizational members in IT positions, offerings such as data awareness (VET C) and corporate culture in the digital age (VET B) indicate an awareness for the importance of new data-related skills for a wider range of organizational members. These value propositions aim to include all organizational members, thus creating an impact that goes beyond formalized role assignments within an organization. Referring to our initial discussion of data culture in this paper, it is interesting so see how at least one VET provider (B) emphasizes the potential impact of organizational cultures on digital change. And yet, their understanding of how to transform organizational culture remains unclear. In general, it is hard to state which of the new competencies discussed above correspond to the ones that were mentioned by Ebner et al. (2014), Wilberg et al (2017) or Vayghan et al. (2007). Moreover, further research will be needed in order to clarify how and under which exact circumstances the offerings discussed above have an impact on data culture. For future research it might thus be advisable to focus on individual organizations, their specific data challenges and the respective subset of relevant internal stakeholders. The same approach would also allow for an empirical testing and in-depth discussion of the initial data culture model that we presented in this paper.

6 CONCLUSION

This paper provides first thoughts on how data culture can be a facilitating element for organizational data initiatives and data-driven transformation. Based on a sociological model of organizational culture, we introduced a preliminary definition of data culture, describing it as a set of informal practices and corresponding mindsets that facilitate the extraction of value from big data within an organization. Building on statements from academic literature, we discussed how vocational education and training provides a possible impact for the development of a data culture. Finally, we conducted an initial desk research to analyze how value offerings in the VET market currently address this situation. Our preliminary results indicate that while we can provide an initial theoretical framework and definition of data culture and its connection to VET services as an enabling element, additional research has to be conducted on how these

services support the evolution of organizational data culture on an operational level.

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PROCEEDINGS OF THE WEIZENBAUM CONFERENCE 2019
CHALLENGES OF DIGITAL INEQUALITY
DIGITAL EDUCATION | DIGITAL WORK | DIGITAL LIFE

SIGNALING STIGMA. HOW SUPPORT TECHNOLOGY INDUCES BODILY INEQUALITIES IN INTERACTION

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ABSTRACT

This paper contends that support technologies and their relevant artifacts recast bodily relations and thereby produce differing bodies in situations. In this vein, it sketches three main forms of physical human-machine relations (substitution, augmentation, support) and then introduces the concept of signaling stigma that allows to observe the situated management of new technological markers of difference. It concludes with suggestions for further research building on this approach to uncover the interactional foundations for what might grow into manifest inequalities—beyond the still important issues of personal data rights and access to technology.

KEYWORDS

Support Technology; Physical Support; Human-Machine Interaction; Stigma Management

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1 INTRODUCTION

Public discussions and research about "digital" inequality are preoccupied with problems of quantified selves, culturally biased algorithms, or access to digital contents and infrastructure. In the meantime, technical support devices (from detached robots to intimate implants) proliferate and affect our lives in various forms. This paper contends that support technologies and their relevant artifacts recast bodily relations thereby producing differing bodies in situations. It starts by outlining three types of relations between support devices and human bodies and then introduces the concept of *signaling stigma* as a form of describing and researching relevant situations. Further inquiry regarding interactional cues of potential inequalities is sketched in the conclusion.

2 SUPPORTING THE BODY

Turning to devices designed to support everyday activities emphasizes the bio-physical dimension of digitization. This concerns human bodies in particular. It is obvious that many gadgets have come closer to our bodies. This is not only true for wearables, implants, or "smart" assistive devices built into cars and homes but also for robots that have become "collaborative" in factories or clean the floor in our flats.

This approaching to the human body is due to the continual miniaturization of technology (Featherstone 1999; Mills 2011) in combination with increasing computing power, connectivity, and sensor performance. Computing is not only ubiquitous and tangible, it has now even become "intimate" (Lupton 2015). Robots of all kinds are now imagined and built as companions (Biundo et al. 2016). The idea of support technology is both an immediate offspring and a driver of these transformations.

Close bodily relationships between humans and machines are mainly considered and designed in three ways: as substitution, augmentation, and support (Viseu 2003; Markoff 2015; Karafillidis and Weidner 2018). *Substitution* corresponds to the idea of automation which defines a specific form of relation rather than its absence (Seyfert 2018). Here, issues of technical feasibility are of primary concern and the body is mostly conceived as an integrated whole. The idea of human *augmentation* construes relations from the perspective of a somewhat deficient human being in need of enhancement. To this end, the body is decomposed into different (mostly cognitive) functionalities that can be subject to augmentation. The body's informational capabilities for knowledge acquisition and sensory perception become pivotal.

Considering human-machine relations as *support* additionally focuses on the motor capacities of bodies and on the interaction itself. Decomposition is now extended and encompasses biophysical aspects (e.g. gripping, walking, lifting) and social situations. Both are broken down into different micro-activities and recombined—interfaced—for realizing support.

Since the idea of support proliferated, engineers started to take social situations and their materiality into account from the outset. To be sure, in most cases their image of the "social" remains simple (Bischof 2017). Yet there is a growing sense that bodies, artifacts, and situations form an integrated assemblage. In conclusion, support devices entail a shift from human-machine interaction to human-machine *integration* and bring forth sensorimotor hybrids that will also generate new perceivable markers of difference.

3 SIGNALING STIGMA

Currently, the most salient and widespread support devices in closest distance to human bodies are smart phones, smart watches/trackers, prostheses, and maybe hearing aids. But the development of smart clothes and various exoskeletal structures for work (industrial assembly, health care), rehabilitation, and everyday activities (e.g. grippers, gaming) has advanced considerably. Such artifacts decorate and permeate our bodies in more or less perceptible ways to

support activities in alignment with situational affordances (i.e. other people as well as objects). As soon as the integration of *physical* support devices comes to be seen as the normal state of affairs, they start to serve as prominent markers of potential inequality. That is, there are not only detrimental inequalities concerning social inclusion (Warschauer 2003; Park 2014) but also new deliberate markers of corporeal difference that bear the potential, though not the necessity, to grow into social inequalities. I contend that they will take on the form of *signaling stigma*.

My own field observations in plane assembly and nursing homes might illustrate the direction of this idea. The visibility of devices worn to support the body (here: soft and hard exoskeletons) evokes equivocal interactional responses. On the one hand there is a clear refusal or reluctance to wear it, causing discomfort either for wearers or other situated participants (or both). On the other hand, there is a sense of distinctiveness. Nursing staff reported general interest, but also concern ("are you ill?") and spiteful remarks by residents as well as colleagues. In the industrial setting people felt "cool" wearing futuristic gear for work and displayed their hybridity but were mocked, too.

To examine such situations in which bodies are recast due to support technology I propose to construe them as stigma (Goffman 1963). Originally, the term referred to bodily signs that were intentionally cut or burnt into the body to signal people to be avoided. However, Goffman has shown that stigma is a relational concept, that is, what is treated as stigma is contingent on context and timing. Hence, every*body* is concerned with stigma management in one way or another.

Conspicuous body-worn gadgetry decreases attempts to control information regarding the "discreditable" supported body and *encourages to display the technological stigma*: designing the hearing aid, making the prosthesis look cool and fashion-like, wearing the soft exoskeleton above the clothing even though it could be hidden beneath. These are forms of an inverted stigma management, as it were: deliberate new—and in contrast to body modifications adaptable—ways of signaling bodily differences.

It could be argued that e.g. smart phones cannot qualify as stigma because they are widely used and accepted. Yet even this assessment is dependent on relational context. It also makes a methodological difference: alienating the obvious helps to discover the micro-logics of sociotechnical processes. However, the main argument refers to gadgets for *physical* support.

4 CONCLUSION

Whether a signaling of artifactual stigmata will grow into manifest inequalities by social closure or control in peer groups and families is a crucial question for further inquiry. Research could start with ethnographies and interviews in contexts where bodily support is currently most salient (e.g. exoskeletons and prostheses).

Technical support is also going to alter expectations and demands with respect to the capacities of human bodies and possible compensations of disabilities. In general, organizations might pick up on such expectations to set new standards that reinforce the production of differing (and differentially exploitable) bodies. Governments and insurance companies are certainly interested in relevant bodily data thus generated.

Discussing inequality from this angle is of great importance for technology development. The challenge is to build support technologies that are affordable and attentive to the political issues of control and inequality. Engineers and other developers involved in such processes, must be aware of these connections—not only for ethical, "social", and legal reasons but also for the very success of the project and the invented technology. Also, acceptability and control cannot be confined to psychological factors. It is rather worthwhile to analyze processes of signaling stigma in situated interactions.

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CHALLENGES OF DIGITAL INEQUALITY
DIGITAL EDUCATION | DIGITAL WORK | DIGITAL LIFE

UNEQUAL TRAINING PARTICIPATION AND TRAINING EXPERIENCE AT THE DIGITAL WORK PLACE - AN INTERDISCIPLINARY STUDY

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ABSTRACT

Despite technological progress and the resulting changes, the human actor remains the decisive critical factor for the economic success of companies. This paper presents an interdisciplinary approach and research design to examine issues of unequal access to training in the new digital workplace. The research project combines an in-depth state-of-the-art study with an experimental design that tests in a lab environment how learning barriers can be tackled by manipulating the educational situation. In a final step, the methods developed and the results of the experiment are implemented and evaluated in the real situation using the example of one or more companies. The aim of the study is to identify possibilities for different actors in companies to better design working and learning conditions.

KEYWORDS

Learning Factory; Digitalization; Training; Experiment; Low-skilled workers

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1 INTRODUCTION

Industry 4.0 creates considerable opportunities for companies of all industries and sizes, which at the same time require, the training and further education of employees. Despite technological progress and the resulting changes, the human actor remains the decisive critical factor for the economic success of companies. However, the human capacity for change is influenced by individual competencies and qualifications. The employees in production in particular, have to cope with changes and adapt to new roles, technologies and tasks.

For low skilled workers – the focus of this study – four different pathways of the digital transformation have been derived: deskilling, upskilling, substitution, or persistence of given tasks and jobs (Hirsch-Kreinsen 2016).

Though scholars have repeatedly argued against technological determinism (Pfeiffer 2018) or focused on the consequences of technological change (Acemoglu & David 2011; Brynjolfsson & McAfee 2016), few studies investigate how the shape and use of new technology is influenced by the company's setting in terms of labor relations and institutional arrangements (Noble 1979). Our study suggests an interdisciplinary approach to this question: First, we want to study how the introduction and use of new digital technology is shaped by labor relations, corporate actors, and institutional arrangements at the company level. The aim is to understand why digital technology was applied in a certain way that rather limits than extends workers' skills and autonomy and restricts training and job opportunities. Second, we want to use an experimental design in order to study alternative pathways to introduce and apply this technology in a way that increases skills and work autonomy of low skilled workers but did not come into being due to the given company setting. This will extend our knowledge on the possible role and outcomes of an alternative use of digital technology for low skilled jobs that fosters upskilling.

2 RESEARCH OBJECTIVE

In a study planned for 2019, our interdisciplinary team will investigate the prerequisites for and the design of education and training measures using digital technologies.

We focus on manufacturing companies that apply so called digital assistance system in order to meet new qualification and training requirements for low skilled workers. By providing visual information on tasks and work process, these systems enable workers to optimize their work performance and to perform a broader variety of tasks. However, there is evidence that the use of digital assistance systems for low skilled jobs can be related to losses of work autonomy, devaluation of experience based knowledge and higher stress levels (Warnhoff & de Paiva Lareiro 2019). Our study investigates how the application of digital assistance systems is shaped and influenced by existing and targeted organizational processes and by the organizational framework. Moreover, it sheds light on the role and possible outcomes of alternative ways to use digital assistance systems and to contribute to the better skill development and higher job satisfaction of low skilled workers.

3 INITIAL SITUATION

Companies are dependent on changes in the social environment, especially with regard to personnel requirements. An example are the actual changes in an age structure and the risk of labor shortages (Gesamtmetall 2015). Another example are the challenges in the context of the refugee debate, where companies depend to a large extent on the labor force of refugees, but should first invest in their training and adapt the enterprise technological infrastructure and processes.

While around 40% of the skilled workers took part in continuing training in 2017, the share

among the low-skilled workers (doing work that does not require a vocational degree) was only 20% (IAB 2017; Janssen and Leber 2015). The low training participation of low-skilled workers raises questions for both, the underlying obstacles as well as for measures and arrangements at the company level to overcome these obstacles.

New technologies such as digital assistance systems can be used to train these workers on the job, to enable them to perform a broader variety of different tasks and to adapt quickly to changing work demands.

Recent social developments such as labor shortages, the need to better integrate refugees, or low skilled workers in the labor market, challenge the world of work and organizations. At the same time, the ability to master these challenges strongly depends on the adaptability and innovative power of companies.

This mutual relationship is the starting point of our research.

4 DESCRIPTION OF THE STUDY

We combine an in-depth, state-of-the-art study with an experimental design that tests the success of training and qualification measures by manipulating the educational situation. We proceed in two steps by using insights from interdisciplinary theoretical or applied research.

Step 1: We will conduct a firm-level case study in a real Industry 4.0 company that has recently introduced a digital assistance system for low skilled jobs. We will examine how this system impacts on work autonomy, skill requirements, and job satisfaction of low skilled workers. Moreover, we will identify organizational characteristics (like labor relations, work organization, corporate actors, and learning environment conditions) that have shaped the given application of the digital assistance systems for training low skilled workers.

At the end of this step, we will be able to develop the experimental design and our hypothesis on restrictions at the company level that prevent alternative ways to use digital assistance systems for increasing work autonomy, skills, and job satisfaction.

Step 2: The experimental part of the study will be conducted an Industry 4.0 application center, where a realistic working environment will be investigated using a simulated production task and a simulated organizational context. Here the test persons learn to carry out a business process-oriented activity. We plan to manipulate the learning environment in different ways and examine the learning process and outcomes at the individual level. We will develop two specific learning scenarios: 1) with a direct response of the assistance system to the current action (right or wrong) and with continuous support from the assistance system and 2) with extensive training (paper-based) at the beginning of "production" and a summarized feedback on performance only at the end.

At the end of this step we will be able to identify the best learning environment conditions and formulate recommendations for personalized competence identification and qualification as well as the structuring of team building and learning processes.

5 CONCLUSION

This paper presents an interdisciplinary approach and research design to study issues of unequal access to education and training in the new digital workplace. It extends our knowledge on the determinants that help to prevent processes of deskilling for low skilled workers. The paper focuses on the role of digital assistance systems in companies' training policies. It emphasizes the role of labor relations, organizational arrangements, training situations, and learning environments and brings together the perspectives of sociology of work and organization and the perspective of business informatics and education.

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PROCEEDINGS OF THE WEIZENBAUM CONFERENCE 2019
CHALLENGES OF DIGITAL INEQUALITY
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SOURCES OF INDIVIDUAL DIFFERENCES IN ADULTS' DIGITAL SKILLS

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ABSTRACT

We develop an integrative conceptual framework that seeks to explain individual differences in digital skills. Building on practice engagement theory, this framework views the continued usage of digital technologies at work and in everyday life (ICT use) as the key prerequisite for the acquisition of digital skills. At the same time, the framework highlights that ICT use is itself contingent upon individual and contextual preconditions, most notably literacy skills. We apply this framework to data from two recent German large-scale studies (total N 5,281) that offer objective measures of adults' digital skills. Findings support our framework's view of ICT use as a key prerequisite for digital skills. Moreover, they demonstrate that literacy skills have strong associations with digital skills, largely by virtue of their indirect associations through ICT use. By comparison, regional digital cultures evince only limited explanatory power for individual differences in digital skills.

KEYWORDS

Digital skills; Digital divide; ICT; Literacy; Practice engagement; Skill use

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1 Digital Skills in the Information Age

Across the past two decades, digital skills—that is, the ability to use information and communication technologies (ICT for short; International ICT Literacy Panel 2007)—have gained currency for individuals and societies alike. As a consequence of this digital transformation, digital skills have become a fault line along which new social inequalities emerge (e.g. Falck et al. 2016).

Given the growing importance of digital skills, it is an important question how individual differences in digital skills arise. However, as yet, evidence on adults' digital skills is sparse, scattered, and lacks theoretical integration. In the present study, we develop a conceptual framework that aims at a better understanding of how individual differences in adults' digital skills arise. Furthermore, we bring this framework to an empirical test by using data from two German large-scale studies offering high-quality objectively assessed measures of adults' digital skills: the "Programme for the International Assessment of Adult Competencies" (PIAAC, see Rammstedt 2012) and the "National Educational Panel Study" (NEPS, see Blossfeld et al. 2011). As yet, only a few studies exist that drew on such objective, standardized measures of adults' digital skills to pinpoint these skills' potential determinants (e.g. Desjardins Ederer, 2015; Hämäläinen et al., 2015).

2 Integrative Conceptual Framework

Dominant theories of skill acquisition such as practice engagement theory (Reder 2009) assign a key role to social practices, that is, ICT use in settings such as the workplace or everyday life. ICT use is likely to be of particular relevance to the acquisition of digital skills because current cohorts of adults typically received little or no formal training in digital skills but had to acquire them through non-formal and especially informal learning processes, that is, through "learning by doing" (Wicht et al., 2018). However, ICT use does not operate in a vacuum and itself depends critically on a number of prerequisites. Chief among them are the opportunities and encouragements to engage with ICT offered by the multi-layered contexts in which individuals' live (Brynner et al. 2008) on the one hand, and individuals' endowment with literacy skills (van Deursen and van Dijk 2016), which are indispensable in order to engage with (heavily text-based) digital technologies on the other.

Our unified conceptual framework, shown in figure 1, summarizes these key ideas and distinguishes between three levels relevant for adults' ICT use and digital skills based on the findings of previous research: the individual level (particularly represented by individuals' literacy skills (van Deursen & van Dijk 2016, but also other sociodemographic characteristics, see e.g. Desjardins and Ederer 2015), the level of micro-contexts (represented by the workplace and in everyday settings in which ICT use takes place, see e.g. Reder 2015), and the level of more distal macro-contexts (represented by digital culture at the regional level, see e.g. Salemink et al. 2017). It is mainly through their influences on ICT use that factors on the individual, micro-contextual and macro-contextual level are thought to influence the acquisition of digital skills.

3 Results

We present the results of our analyses based on PIAAC and NEPS in figure 2. In all models, we control for traditional socio-demographic variables, including gender, age, and migration status, which are not reported. All in all, the results for both kinds of data sources give a similar picture: While the association between digital culture (measured by internet registrations per capita at the level of German districts) and individuals' digital skills is only moderate (Models 1) ICT use on the job and in everyday

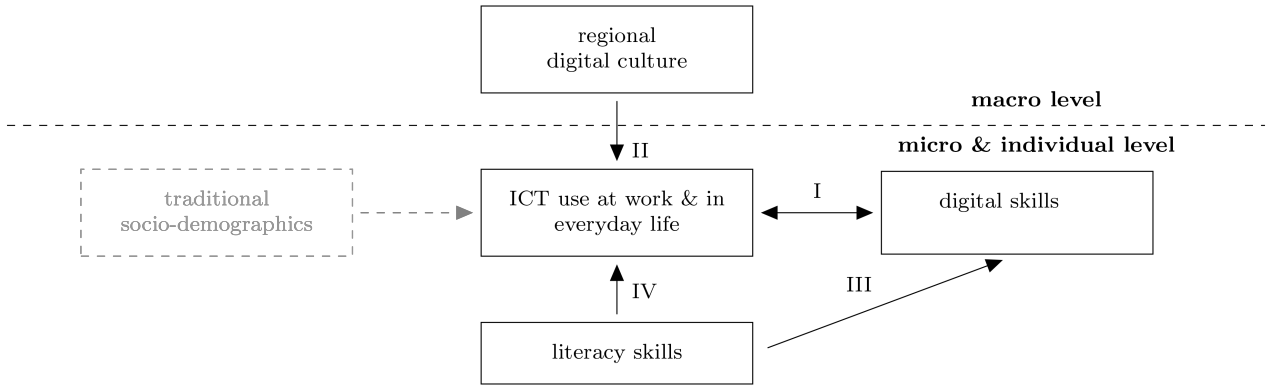

Figure 1. Conceptual framework identifying ICT use as a key prerequisite for acquiring digital skills.

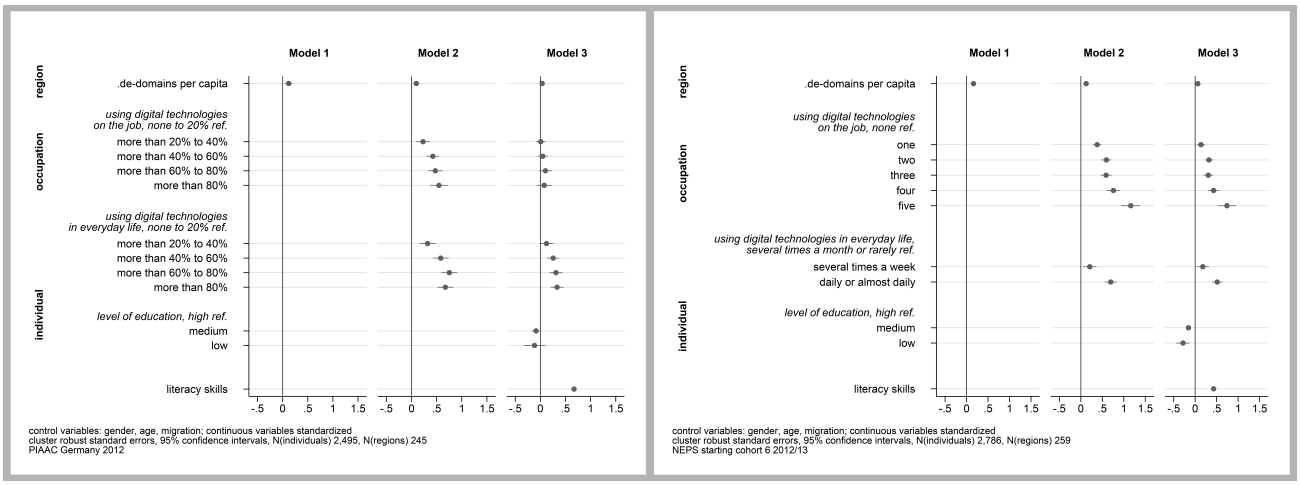

Figure 2. Digital skills regressed on individual and contextual factors, stepwise regression results form PIAAC (left-hand side) and NEPS (right-hand side).

life are strongly related to individuals' digital skills and in part mediates the association between digital culture and digital skills (Model 2; paths II and I).

The sources of the association between ICT use and digital skills can be revealed after taking into account individuals' literacy skills (Models 3); in addition, we control for the level of formal education. Introducing theses variables leads to a decline of ½ of the initially large regression coefficients for ICT use. Thus, the positive association between literacy and digital skills is largely mediated by individuals' ICT use (paths IV and I). However, both ICT use variables (i.e. at work and in everyday life) are still incrementally related with digital skills.

4 CONCLUSION

Our study contributes to research on the origins of individual difference in adults' digital skills in several ways. In line with our framework, our findings highlight that digital skills do not emerge in a vacuum but are strongly contingent on individuals' ICT use at work and in everyday life. That is, adults acquire digital skills largely through "learning by doing". At the same time, our findings direct attention to the preconditions of ICT use. Above and beyond well-established socio-demographic characteristics, we identify individuals' literacy skills as a key precondition for both ICT use and digital skills.

5 ACKNOWLEDGMENTS

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EXPLORATION INTO QUALIFICATION TRANFORMATION OF EMPLOYEES WORKING WITH DECISION-SUPPORT-SYSTEMS

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ABSTRACT

The introduction of new information and communication technology (ICT) in the company is often associated with the need for new qualifications and skills as well as different fields of activity and responsibility for the employees. Studies have shown a skill-biased digital divide in certain fields of ICT. In this study, trend scenarios of qualification requirements of workers using decision-support-systems (DSS) were evaluated in four different sectors: civil protection, energy management, plant maintenance, hospital- and operating room management. The results show either an increase in complex tasks or a shift to distinctively different areas of activity for workers affected by the use of DSS, especially in cases where management decisions lead to the reorganization of workers.

KEYWORDS

Qualification requirements; decision-support-systems; human-machine-interaction

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1 INTRODUCTION

Evidence from scientific studies has shown that with the implementation of new information- and communication technology (ICT) in companies and institutions areas of activity and responsibility of employees can change and consequently transform qualification requirements (Hecklau et al. 2016; Dengler and Matthes 2015). Consequently, this research aimed to investigate this proposition by exploring possible qualification changes of workers as a result of the use of decision-support-systems (DSS) as an example of ICT, and additionally evaluate possible developmental perspectives for qualifications of these workers. DSS exploiting Big Data offer companies and institutions profitable opportunities by linking already existing and new information pools to optimize and accelerate processes and, as a result, achieve greater efficiency-gains in the quality or quantity of their output (Jelinek and Bergey 2013).

2 METHODOLOGY

The study was conducted as a set of qualitative interviews using standardized questionnaires with experts from four different sectors: civil protection, energy management, plant maintenance, hospital- and operating room management, that were selected due to their involvement in different research projects aiming to develop innovative DSS exploiting Big Data.[1] The in total five interviewees were either using the DSS themselves or supervising workers using the system and thus had been the first users. As the projects were still ongoing at the time of the interviews, the DSS were in their developing-state and being tested. Although, the data sources, design-process and interface of each project-DSS differed, the projects all aimed to develop platforms designed for the workers who initially handled the data analysis up to then (often manually). Key research questions examined in the study were: (A) How are qualification requirements of workers changing as DSS are used? (B) How will the allocation of complex activities between the workforce and the DSS develop prospectively? Qualification requirements were classified into four categories according to the catalogue of the Federal Employment Agency (Bundesagentur für Arbeit 2010). To get closer to the first research question, an assumption from Social and Economic Science was taken into account: the digitalization of work leads to skills-biased effects on the labor market (Fernández-Macías and Hurley 2017; Sparreboom and Tarvid 2016). Researchers observed two prominent phenomena concerning the development of qualification requirements that will be evaluated in this study: Upgrading and Polarization of qualifications (Hirsch-Kreinsen 2016). Upgrading is the revaluation of work that accompanies either an all-encompassing increase in the qualifications of all workers or a devaluation of the low-skilled (Huchler 2016). Polarization describes an opposing divide of qualification requirements: an increasing relevance of low-skilled and highly-qualified and a decreasing importance of medium-skilled workers (Goos, Manning, and Salomons 2014). For the second question, a closer look was taken at recent research concerning human-machine-interaction, finding two possible trend scenarios of human-machine-interaction: tool scenario and automation-scenario (Dworschak and Zaiser 2014; Windelband and Spöttl 2012). In my study, the two scenarios were evaluated for its application in the context of DSS and its impact on qualification requirements of workers. In the first scenario, the deployed technology is used to rapidly process information necessary for the workers to make and support decisions. In the automation-scenario, the DSS provides either workers with precast decisions concerning steps within a process based on its analyzed data

[1] Further information about the projects can be found via: www.smart-data-programm.de

set or executes the necessary tasks itself. Workers perform more assistive activities and inspect the quality of the DSS outcome.(Windelband 2014) The experts were introduced to the scenarios and compared them with the current state of affair concerning the human-DSS-interaction within their institution.

3 RESULTS

In two of the four cases, energy management and plant maintenance, the DSS was used to conduct analytical processes autonomously and based on that automatize decisions and activities. The management decided to split the affected workers into two groups: the first group was now appointed to watch over the deployed system in order to inspect the quality of its outcome and manage to alter the system or intervene in its working. The group needed to focus on the complex not automatized processes and activities. The other group was now occupied with less analytical and complex work involving the communication of the DSS' outcome and its implications with colleagues and business partners. In contrast, in the other two cases, civil protection and hospital- and operation room management, the DSS was solemnly used as an information tool. Information that would have formerly been gained manually could now be collected and structured less time depriving. The workers had a more profound data set to base their decisions on and could focus on using the DSS' outcome to fulfill the more complex tasks. Advanced training was only necessary to test the usage of the deployed system.

4 DISCUSSION

The first two cases, energy management and plant maintenance, can be considered as examples of the automation-scenario. Furthermore, the cases show indications for polarization of qualification requirements, as with the deployment of the new system the workforce divided into two different groups with dissimilar qualification requirements. However, this divide was due to a managerial decision and did not occur as the result of a gradual change of qualifications over time. The first group needed a greater analysis- and methodological competence to get a deeper understanding of all processes and working of the DSS. For these more complex activities, additional professional education was necessary. A distinct shift towards a higher qualification requirement was visible. Whereas for the second group the area of work changed completely to a more manual and communicative and less complex and analytical activities. Workers in this group received retraining. A partial shift towards lower qualification requirements could be observed. For the last two cases the results indicated that the shown human-machine-interaction can be viewed as an example of the tool-scenario. The system was deployed to process more time-consuming activities (e.g. data collection), whereas the workers could focus on more complex tasks, resulting in a work-sharing human-machine-interaction. Despite the worker's focus on more complex tasks, there was no change concerning the qualification requirements of the workers that would lead to a higher qualification level. Thus, the cases can be classified to neither upgrading nor polarization of qualification requirements. Ultimately, the clear-cut concepts might not be able to depict the full scale of qualification transformations due to the use of ICT.

5 CONCLUSION

The results show that tasks of workers affected by the use of DSS might increase in complexity or shift to another area of activity. The greatest changes concerning the qualification requirements of workers and their interaction with DSS were found in areas where pre-arranged management decisions lead to the reorganization of workers and their fields of tasks and skills. Future research may possibly increase sample size, use other forms of data-collection or focus on more diverse scenarios that can be applied to different types of ICT.

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PLATFORM LABOUR AND THE MOBILE UNDERCLASS: BARRIERS TO PARTICIPATION IN THE UNITED STATES AND INDIA

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ABSTRACT

Online crowdwork platforms have been praised as powerful vehicles for economic development, particularly for workers traditionally excluded from the labor market. However, there has been insufficient scrutiny as to the feasibility of crowdwork as an income-source among socio-economically deprived populations. This paper examines device requirements and differential access to digital infrastructure, both of which act as potential barriers to not only basic participation but also to economic success. Given the increasing prevalence of mobile-first and mobile-only populations, research on this topic aids in understanding the crowdwork ecosystem among differing socio-economic sectors. Based on a survey of 606 crowd workers in the United States and India, this paper uses both quantitative and qualitative data to explore whether reliance on mobile devices is detrimental for the economic outcomes of crowdwork. The results point to substantial inequalities in device use and received benefits from crowdwork, within each country and between the two contexts.

KEYWORDS

Crowdwork; Mobile; Mobile Underclass; Digital Inequalities; Amazon Mechanical Turk

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A recent typology by Howcroft and Bergvall-Kåreborn (2019) distinguishes four types of crowdwork. One type, namely online task crowdwork or 'microwork', has become the focus of increasing academic attention in recent years, both as a source of data and as a research context (Irani, 2015; Kittur et al., 2013; Martin et al., 2014). Crowdwork platforms have also attracted interest for their potential to provide economic development opportunities among excluded populations (Alkhatib et al., 2017; Bucher & Fieseler, 2017; Kittur et al., 2013; Paolacci et al., 2010). For example, participation on the leading crowdwork platform Amazon Mechanical Turk (AMT) has been presented as an option for mass job creation and income generation in the Palestinian territories (Kuek et al., 2013) and among female Syrian refugees in Jordan (Hunt et al., 2017). In the human-computer interaction (HCI) literature, an increasing amount of research is dedicated to mobile crowdsourcing and the quest to develop user-friendly mobile applications for crowdwork in a global context (Chi et al., 2018; Goncalves et al., 2017; Vaish et al., 2014).

As a countermeasure to these often optimistic accounts, scholars have begun to critique crowdwork from different angles, pointing to power asymmetries, exploitation (Bergvall-Kåreborn & Howcroft, 2014), and access barriers, such as in terms of disability and age (Brewer et al., 2016; Zyskowski et al., 2015).

Adopting a focus on the every-day materialities of work, this article discusses one specific access barrier, namely the device used to participate on crowdwork platforms. Despite the notion of crowdwork being digital and remote, with implications for how it is viewed as a form of disembodied artificial intelligence (Irani, 2015), crowdworkers still require certain infrastructure to carry out such work. Crowdworkers need a laptop, PC, tablet, or smartphone, as well as a stable Internet connection. While seemingly basic, such requirements currently exclude half of the global population and thus the negotiated interplay between worker, device, and platform demand greater academic attention (GSMA, 2018; ITU, 2017).

We are particularly interested in the role of smartphones and tablets in constraining or encouraging participation on crowdworking platforms, thus offering a voice in the discussion around whether crowdwork can be an effective economic opportunity for the mobile-only and mobile-first underclass. To assess the impact of device on crowdworking, we therefore conducted a survey of 606 crowd workers in the United States and India, generating both quantitative and qualitative input around the experiences, materialities of crowdwork, and economic outcomes of crowdwork. The two surveys aim at answering the central research questions of the article: *How mobile-friendly is crowdwork? Does mobile crowdwork result in tangible advantages or disadvantages for workers?*

Our findings indicate that crowdworkers face both opportunities and barriers when using mobile devices, but that using mobile devices overwhelmingly constitutes a minority activity undertaken as a last resort or for their particular mobile affordances such as portability. In particular, mobile devices act as a valuable complement, aiding workflow and for additional task-access. The practice of second screening, in particular, became apparent as a mode of use among the India-based sample. Mobile-first or mobile-only approaches to Internet use, while increasingly common for entertainment and social purposes, are thus not reflected in crowdworking practices where preferences remain firmly attuned towards traditional PC or laptop devices. The function-al constraints of mobile devices acted as significant barriers to adoption. Since efficiency and speed are central to income-generation on crowdworking platforms such as AMT, even minor differentials in speed and efficiency between device choices could result in reduced income over time. Indeed, for the US-based sample, we were able to

show a negative but weak device effect for smartphone use for carrying out HITs, showing that relying on mobile devices too heavily might result in being financially penalized.

One of the most striking factors was the role of the requester as a restricting force. While crowdwork has a connotation of flexibility and mobility, by restricting tasks to a specific device due to requester preference, the flexibility of workers is severely reduced. Without mobile-accessible tasks, discussion around mobile-readiness of crowdworkers is rendered moot.

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FRAMING COMPUTATIONAL THINKING FOR COMPUTATIONAL LITERACIES IN K-12 EDUCATION

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ABSTRACT

The last decade has seen an increased interest in promoting computing education for all, focused on the idea of "computational thinking." Currently, three framings for promoting computational thinking in K-12 education have been proposed, emphasizing either (1) skill and competency building, (2) creative expression and participation, or (3) social justice and reflection. While each of these emphases is valuable and needed, their narrow focus can obscure important issues and miss critical transformational opportunities for empowering students as competent, creative, and critical agents. We argue that these computational framings should be seen as literacies, thereby historicizing and situating computer science with respect to broader educational concerns and providing new directions for how schools can help students to actively participate in designing their digital futures.

KEYWORDS

Computational thinking; literacy; critical pedagogy; programming

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1 INTRODUCTION

The growing pervasiveness of digital technologies has promoted a global interest in computer science education for all. In addition to expanding access to specialized coursework in computer science, there has been an effort to define a core set of computational skills that every child should learn and use across the curriculum, as well as in everyday life. Efforts to define such a broadly-applicable yet distinct skillset have coalesced around *computational thinking*, a term promoted by Wing (2006) naming the foundational skills and thought processes of computer science. Learning computational thinking is being equated in many cases with learning the language of computers for digital literacy in the 21st century.

Since Wing's publication, numerous papers and books (e.g., Rich & Hodges, 2017), and hundreds of studies (e.g., Florez et al., 2017) have been dedicated to investigating student learning, teaching approaches, and assessments of computational thinking for K-12 education. While there is no agreed upon definition of computational thinking (National Research Council, 2010), it is nonetheless being proposed as a foundation for new sets of 'literacies' focused on computational understanding and skill (diSessa, 2001; Guzdial, 2019; Vee, 2017).

In this paper, we describe three different framings for how computational thinking has been conceptualized and review their strengths and weaknesses. We then address missing aspects in each of these framings and discuss how our analysis of computational thinking can provide a rationale for a broader conception of computational literacies in K-12 CS education.

material.

2 THREE FRAMINGS OF COMPUTATIONAL THINKING

Wing (2006) defined computational thinking most generally as "taking an approach to solving problems, designing systems and understanding human behavior that draws on concepts fundamental to computing" (p. 33). Early efforts in the 1980s of bringing computers and programming into schools most often presented it as a standalone activity, while today's focus on computational thinking is an interdisciplinary practice, particularly relevant to STEM fields (Weintrop, Beheshti, Horn, Orton, Jona, Trouille & Wilensky, 2016). We have identified three directions that have framed computational thinking from different learning perspectives.

The first, and most prominent, direction under which computational thinking has been framed comes from a functional, cognitive perspective, which supports the pragmatic goals of skill and competence building. This direction draws from cognitive research traditions that already dominated efforts to introduce programming in the 1980s (Soloway & Spohrer, 1989) which place computational thinking as a form of complex problem solving that is primarily performed by individuals (Grover & Pea, 2013). Here, emphasis is placed on student learning of computational concepts such as loops, recursion, conditionals, and data structures, and practices such as iteration and abstraction, which are in turn connected to future opportunities for work and career advancement. The cognitive framing is most prevalent in current national frameworks and curricula such as Code.org's *CS Discoveries* and *Explorations* that outline learning pathways for K-12 students.

Another direction emphasizes how students can develop computational thinking through designing and programming shareable digital artifacts. This direction draws from constructionist learning theory (Papert, 1980), which emphasizes interest-driven and peer-supported activities and thus sees computational thinking as a vehicle for personal expression and participation (Kafai & Burke, 2014). Learning key computational concepts and practices are thus situated within acts of designing complex applications that are shared on social networks. Much work following this direction has studied youth' engagement with computer science activities within

informal, non-school, education environments such as community technology centers and online communities. However, there have also been several efforts aimed at developing school curriculum using this situated approach, including the *Creative Computing Guide* that highlights game design and storytelling activities (Brennan, Balch & Chung, 2019) and the *Stitching the Loop* activities that engage students in crafting and coding personalized electronic textiles (Kafai & Fields, 2018).

Finally, a third direction places students' computational thinking into the context of social justice-oriented production in order to engage them with existing socio-political issues. This framing draws heavily from the traditions of critical pedagogy, which emphasizes both an examination of and resistance to oppressive power structures (Freire, 1993) as well as production-oriented media literacy, which develops youth agency through the process of creating and disseminating media content (Buckingham, 2003). Efforts following this direction place computational thinking as a platform through which to address existing real-world challenges by creating original multimedia artifacts. Student-generated projects include, for example, digital mapping visualizations that highlight local issues with gentrification occurring (Lee & Soep, 2016), and mobile apps that challenge existing narratives about 'low-resource' neighborhoods through highlighting accessible extracurricular activities that students have catalogued for their peers (Vakil, 2018).

One striking commonality in all three approaches is that today's computational thinking is situated in the design and production of authentic, real-world digital applications, very much in contrast to the short, isolated programming activities that dominated CS teaching in the 1980s (Palumbo, 1980). In the skill and competency building approach, students engage in the production of digital objects such as video games and robots for the purposes of supporting understanding of fundamental CS concepts such as rule-based behaviors and abstraction (Grover & Pea, 2013). Approaches that favor personal and creative expression explicitly connect to learners' interests in digital media by privileging personalized artifacts that can be shared with others, often referencing popular culture themes (Richard & Kafai, 2016). Finally, in social justice-oriented design students consider design applications to address and critique existing inequities and oppressions through their designs (Lee & Soep, 2016).

Not surprisingly these three framings differ in how they balance explicit efforts to build individual skill and disciplinary knowledge with efforts to engage students in applying these for personally meaningful purposes, whether creative or political. We know from studies of Scratch online community that creative expressions and participation alone are not sufficient to make computational concepts and practices accessible to novice programmers (Kafai & Burke, 2014). Relatedly, it is not clear from project descriptions in social justice-focused projects (Soep & Lee, 2016) what students actually learned in terms of computational concepts and practices (one exception is Lee & Garcia, 2015), something which highlights a greater focus on content creation, rather than understanding the actual mechanisms of computational infrastructures, which are often themselves a source of oppression and inequality (Vakil, 2018).

3 TOWARDS COMPUTATIONAL LITERACIES

While oftentimes these framings are cast against one another (see Vakil, 2018), we argue that they are indeed complementary and necessary to support students' development as computationally engaged agents in the complex, digital world in which they participate. For that reason, we propose that all three framings of computational thinking become the foundation for computational literacies (diSessa, 2001; Guzdial, 2019; Vee, 2017). The functional framing recognizes the infrastructural role of computers in literacy practices (diSessa, 2001) and

emphasizes their skillful use. The situated framing recognizes how computers mediate social identities and meaning-making (Vee, 2017). The critical framing continues the historical analysis of the relationship between media and power (Vakil, 2018).

Integrating these three framings in a pragmatic, situated, and critical vision of computational literacies is useful as a design heuristic, surfacing missed opportunities in existing curricular initiatives. Functionally-oriented curricula are at risk of (ironically) rendering computational thinking as a form of 'book learning' disconnected from students' identities and lived experience. Situated framings sometimes emphasize creativity and self-expression without substantially developing students' skills or understanding of the computational media they use. Additionally, situated framings rarely consider how the actual mechanics of how popularity is measured online or the digital infrastructures through which content circulation occurs.

On the surface, social justice-oriented framings of computational thinking claim to move from an individualistic perspective that only examines personal choice to understanding the larger socio-political issues that frame problematic uses of technology including data mining and tracking, targeted marketing, and privacy issues around surveillance and citizen's rights. But a closer examination of actual implementations in this area reveals an orientation toward developing production-oriented skill building and emphasis on content creation, rather than deep analysis of the structures of computation itself. From this perspective, students are missing out on developing a critical understanding of what computation is in our world today.

The recent emergence of critical issues around the circulation of fake news, privacy violations, and algorithmic bias make clear that students need to know not only how to use and design digital media—promoted in the current framings of computational thinking—but also to question the design, infrastructures, and histories of digital technologies themselves. Individually, the proposed application designs in the distinct framings of computational thinking fall short of not only getting youth to review and understand the existing computational mechanisms that underlie digital engagement, but also in considering the role of computation can play in both supporting and suppressing individual and social self-determination online. While others (Vakil, 2018) have already outlined the necessity of engaging youth in the critical engagement of computational infrastructure, we additionally highlight the need to combine this view (which views computation as something which can take away power and agency) with the situated, constructionist framing (which emphasizes computation as something that can also grant power and agency). In other words, any emphasis on computational literacies should equally consider not only what competencies students can acquire, but also how to create awareness of the ways the use and design of computational media can simultaneous oppress and inspire.

We close this section with an example that promotes such an integrated and situated approach toward computational literacies. One important idea to consider here are *where* and *how* the actual intersections between these frameworks occur (e.g., skills building, creative expression, and social justice) and how we can further push the integration between these perspectives, while also highlighting how they are situated in existing contexts. The example of visualizing and questioning computational participation in Scratch illustrates how computational thinking can be reframed as integrated, situated computational literacies. Scratch is an online programming community, which has attracted over ten million of kids in the creation of programming projects that are shared online. Studies have been conducted to understand what computational concepts and practices Scratch users engage with, the variety of creative projects, and the progression of computational participation for different types of users (Kafai & Burke, 2014).

However, more recently, researchers have added new programming features, special "community blocks" that let Scratch users not just create projects but also help them understand how participation data is collected, used and disseminated on the site, and also within many existing online communities (Dasgupta & Hill, 2017). By giving users opportunity to creatively play and develop personalized projects with these blocks, students became more cognizant of numerous issues surrounding big data today, whether a realization of the privacy implication of data collection and retention, possible avenues for exclusion through data-driven algorithms, or possible biases and assumptions hidden within supposedly neutral data claims. While the users only expressed these perspectives on the closed system of Scratch (Hautea, Dasgupta & Hill, 2017), one can see how an understanding of these ideas can help promote a larger understanding of our wider digital environment today, where algorithms and data structures are rarely shared. Here, learning computational concepts is not just an instrumental goal but pushes youth towards considering the larger socio-political implications of data collection, analysis and use, thereby working to bring together the more cognitive, functional framing of CT with approaches that favor critical engagement and action.

This is one example of how the different framings of computational thinking could be integrated in computational literacies. As Scribner (1984) argued, literacy is not just about the pragmatics of reading and writing text but also about understanding their personal and political dimensions of texts. From this vantage point, computational literacies point towards three important dimensions of relationships that computational thinking needs to help realize: a pragmatic view about interacting with computational artifacts, programming and understanding code, a personal view about authoring one's identities and a political view about using, understanding, and transforming sense-making processes and subject positions. If computational literacies are to be included in the canon of K-12 literacies, then we need to move any single framing that only either emphasizes skill building or contextual uses, toward a larger view that embraces a need to combine these perspectives in order to highlight the values, biases, and histories embedded in the digital technologies.

4 CONCLUSIONS

In this paper, we outlined different framings for computational thinking and discussed their strengths and weaknesses. We proposed a new direction to reframe computational thinking as situated, critical literacies that not only encompasses functional skills, but also the socio-political and personal contexts that inherently accompany youth's use and production of digital media. Advancing computational literacies which situate learning and teaching of computer science education aligns with other efforts in K-12 education have as its overarching goal to educate students as responsible citizens—consumers, producers and critics—in the digital publics they all participate in and contribute to.

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HUMAN/MACHINE LEARNING: BECOMING RESPONSIBLE FOR LEARNING CULTURES OF DIGITAL TECHNOLOGIES.

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ABSTRACT

This paper centrally asks for the ways in which ubiquitous, ever new digital technologies of 'our' everyday lives transform learning at the digital human-machine interface from the perspective of feminist science and technology studies. How to account for emerging forms of interwoven human and machine learning? Suggesting the term of learning cultures in approaching this question, the paper emphasizes an understanding of learning not as a proficiency of an entity embodying either natural or artificial intelligence, but rather as a culturally situated and materially enacted process. In so doing, the paper brings together recent impulses that suggest a re-conceptualization of learning, e.g. through the notion of "machine learners" (Mackenzie 2017) or that of "posthuman learning (Hasse 2018)". Reading these insights together, I will finally suggest an account of becoming responsible for learning cultures of digital technologies through a reconsidered notion of interwoven human/machine learning.

KEYWORDS

Learning; Digital Human-Machine Relations; Feminist STS

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1 INTRODUCTION

There is no consensus on the relevance of digitisation for culture and society.
Gertraud Koch, 2017

Ubiquitous, ever new digital technologies seem to become of increasing importance to‘our’ everyday lives, ranging from the apparently long-established smart phone, robot lawn mowner and vacuum cleaner to smart home assistants, all distributed by the leading technology companies of the Global North. The core technology of what can be framed as constituting “the internet of things” (Greengard, 2015) are smart miniaturized computers. The IoT then stands for a technologization of ‘our’ human existence that is characterized by the massive evolution of computing capacity that allows connecting things and persons, or connecting to others in new ways.

This paper is interested in the human-machine interfaces emerging through technologies of the IoT. Even though there might not exist a consensus on the relevance of digitization, it argues that digital interfaces are not only constitutive of new forms of how humans and ‘smart things’ relate. Rather, from these new relations also evolve new forms of learning between humans and those digital technologies of connecting. Therefore, it suggests to research digitization as a ressource for reconsidering how humans learn. By acknowledging the impact of emerging digital human-machine interfaces on ‘our’ learning processes, this paper moreover suggests to reconsider the conceptual foundations of the very notion of learning itself from the perspective of first feminist learning theory and second feminist studies of science and technology (FSTS). Background for this reconsideration is a notion of learning that understands the latter not as a purely cognitive capacity, but rather as the result of experience and as closely tight to ‘our’ being-in-the world (cf. Meyer-Drawe 2012 [2008]).

From such a phenomenological perspective, digital devices in their infrastructural dimensions also require posing the following questions: How to account for emerging forms of interwoven human and machine learning? And: How does such an account of interwoven learning challenge the notion of responsibility?

In the following sections, the paper will first present its approach to such a conceptual reconsideration of learning at the interface between humans and digital technologies to then bring insights of critical FSTS scholarship on digital learning together with (post-)phenomenological learnig theory in order to establish the notion of human/machine learning. Finally, this will serve as a point of departure to generate impulses for re-adjusting what it means to become responsible for human-machine relations of interwoven digital learning.

2 THE IOT: CONCEPTUAL CLARIFICATIONS

The IoT appears at the same time ubiquitous as intangible. It might figure in a device like the smart home assistant, but it also encompasses the very infrastructure that makes it possible to connect. Therefore, it seems to be important to first enhance the graspability of the phenomenon ‘IoT’. I suggest doing so by reconstructing a selected historical aspect of this complex phenomenon. This, as I will continue to argue in the following subsections, means to trace a trajectory of miniaturized computers that suppsosedly blend in to ‘our’ everyday environments. Mapping aspects of this trajectory then becomes the point of departure to make the quality of connection of digital devices more tangible and therefore also the seemingly diffuse nature of human-machine relations that the IoT implements. Through this, I will also begin to tackle the question of learning at the emerging interfaces.

Further, I argue that the proposed approach means to *situate* the IoT, that is, approaching the IoT through the feminist epistemological lens of

"situated knowledges" (Haraway 1991). This includes to situate knowledge claims, e.g. through tracing aspects of the IoT's trajectories as well as the emerging technical infrastructure and devices within the complex and interwoven power and spatiotemporal relations as constitutive frame of the IoT. Situating the IoT, I will in the following subsections reconstruct briefly 1.) the historical aspect of ubiquitous computing and 2.) the discursive-material properties of the emerging digital interface to then 3.) generate an understanding of the nature of connecting implemented by the IoT and ask how this new mode of connecting also challenges 'our' concept of learning at the digital human-technology interface.

2.1 THE IOT AND UBICOMP – HISTORICAL INSIGHTS

The IoT can be regarded as pertaining to longstanding imaginations of a "calm technology which receeds into the background of our lives" (Weiser 1991) – an imagination which emerged from the effort to evolve personal computers into an ubiquitous, but calm machinery of our everyday lives. Mark Weiser popularly coined the term of ubiquitous computing (ubicomp). He envisioned computational futures by asserting that "personal computing had not gone far enough" (Dourish and Bell 2011, 2). Instead, he worked on making computational technologies the fabric of 'our' political, economical and social lives. As Paul Dourish and Genevieve Bell (2011) put it, Weiser's highly influential "technomyth" was based on his anticipation of "a world suffused with information technology, in which daily life might bring some people into contact with many, interconnected devices, large and small" (3). However, and as they also underline, the technomyth of ubicomp operates on the technical and imaginative level. That means to acknowledge the ways in which imaginations not only set the limits of how 'we' think about technologies, but also how 'we' develop technology – in short, which kind of technology can be, is and will be developed.

Ubicomp as a concept might have moved into the background of computational interests, however, the very principles of it that can be framed as realizing a suffuse of our world with information technology, have moved to the fore of contemporary technology development. Butwhat exactly does that mean? The IoT as pertaining to the larger category of calm technology is fundamentally based on realizing a world in which "every 'thing' either is a computer, has one attached to it, or at least in some way is connected to the Internet" (Kinder-Kurlanda and Boos 2017, 197).

In the following subsection, I will reconstruct the importance of situating the IoT within the context of ubicomp for grappling with the quality of connection between humans and digital technologies as well as its impact on human learning.

2.2 MAKING THE INFRASTRUCTURE & INTERFACE OF THE IOT TANGIBLE

Prerequisite to the ability to connect digitally is the capacity not only to compute, but importantly, to constantly collect (sensory) data. The latter allows "to identify and localise objects in time and space (ibd.). However, this also means that the person, using connected, digital devices, turns into the producer of a vast amount of data, e.g. data that tracks and monitors how I move to the city, what I eat and how I sleep. These aspects have been discussed, for instance, prominently by Deborah Lupton (2016) coining the term "the quantified self". Lupton provides an important figure for the analysis of digitization with which she maps the regulative aspects of monitoring and tracking that highlight the dimensions of control over as well as optimization of subjects implemented to the constant collection of data through digital, networked devices.

With this, Lupton not only provides an account of datasized self-embodiment and the concomitant concept of the self as regulated through quantifiable data, but also points towards the problem of ownership over data.

For the porpuse of this article, I underline that the aspect of an increasing datafication of 'our' lives and bodies inherent to the IoT makes palbable the ways in which digital connectivity is not an abstract phenomenon happening in the relam of numbers. Rather, it displays that digital connectivity is a socio-cultural and, importantly, material transformation of the very grounds of 'our' living. In turn, it requires to be analyzed through a perspective of FSTS which asks for the ways in which binary oppositions are reworked or redrawn through digital connectivity as world-making phenomenon.

However, and as I would like to emphsize, the latter is not exclusive to newly evolving forms of relation between humans and digital, networked devices and the concomitant digital infrastructure. Rather, it can be argued that the entanglement of the socio-cultural and material grounds of 'our' existence is a quality inherent to computational culture at large.

Kathrine N. Hayles (2012) describes in "How we think" the impact it has on her working when the computer breaks down or the Internet is disconnected: "I feel lost, disoriented, unable to work—in fact, I feel as if my hands have been amputated" (21). Being cut off from the Internet for several days just recently, I can only confirm Hayles' description – though I felt not like my hands have been amputated, it nevertheless had a tremendous effect on my ability to work as an academic. Hayles further continues that the inability to work, especially when thinking and writing is your work, is not only a psychological effect of the computer as a networked device. Rather, she points out the following:

"[R]esearch indicates that the small habitual actions associated with web interactions—clicking the mouse, moving a cursor, etc.—may be extraordinarily effective in retraining (or more accurately, repurposing) our neural circuitry, so that the changes are not only psychological but physical as well. Learning to read has been shown to result in significant changes in brain functioning; so has learning to read differently, for example by performing Google searches" (ibd.).

I regard Hayles argument as vital for making the IoT in its effects on our lives more tangible. If the calm technology is becoming a part of our existence, we will have to understand the ways in which connecting to the IoT is not only about producing data, but is also an embodied process that involves the capacity to alter 'our' physical structures. In addition, this also implies to take into account the ways in which learning is an embodied process and that acquiring a capacity such as reading is highly dependant on the medium we learn to read with. Learning to read a book or learning to read a google search on my computer or digital gadget thus make not only a difference in 'our' capacities to read, but also in 'our' embodiments of that capacity.

Furthermore, embodiment and physical contextualization appear to be key in realizing calm technology. This can be traced back to the fact that the idea of ubicomp evolved from "the perceived failure of the personal computer to deliver meaningful value to human beings" (Dourisch and Bell 2011, 10). Notably, Weiser and his colleagues were confronted with the critique of anthropoligsts such as Lucy Suchman, who were working at XEROX in Palo Alta around the time when Weiser (1991) began with his work on the "computer for the 21st century". As Dourish and Bell point out, the influence of the work of Suchman and others "critical of the traditional conceptions of computation, interaction, and practice embedded in computer system design" (ibd.) cannot be underestimated.

In consequence, calm technology that moves into the background can be regarded as an attempt to increase the value of computers for humans. This attempt involves embedding digital technologies in the already existing infrastructures of our everyday lives and thereby also making digital technology a part of our material

daily environments – in a manner that "moved away from the desktop and [...] was distributed across a range of devices, each specialized to particular sorts of tasks" (ibd., 11).

In what follows, I will turn to the question of learning with regard to the IoT from the perspective of one selected phenomenological feminist learning theory that I will bring into conversation with selected findings in (F)STS on human-machine relations of learning. My focus in this is to avoid an either technooptimistisc or technopessimistic perspective in grappling with the nature of connectivity provided by the IoT. Rather, I suggest to shift from a binary opposition between subject and digital technology towards a co-constitutive account of connectivity and its implications for learning in a phenomenological sense.

3 On Human Learning with digital devices

In which ways does embedded and distributed, digital technology impact processes of human learning? To address this question, it is necessary to briefly outline my understanding of human learning. Differentiating between specific educational practices and methods of learning on the one hand as well as on the other the question of how to understand the very nature of learning, I follow Meyer-Drawes (2012 [2008]) work on conceiving of the latter in terms of the capacity of being-in-the-world where learning is experience. This means to draw on a phenomenological account of learning that, in short, centrally focuses on (embodied) experience and thereby brings the sensual over the cognitive aspects of learning to the fore. A phenomenological account of learning understands the latter as my involvedness in the world and happens when I am confronted with the new that challenges me to act (differently). This, furthermore is thought of as a specific human capacity (cf. ibd.).

The focus of this paper is to understand the meaning of digital technologies of the IoT as co-constitutive for human learning conceived of as experience in such a phenomenological manner. Hayles (2012) understands the digital interface as constitutive of new forms of experience, when she writes:

"The more one works with digital technologies, the more one comes to appreciate the capacity of networked and programmable machines to carry out sophisticated cognitive tasks, and the more the keyboard comes to seem an extension of one's thoughts rather than an external device on which one types. Embodiment then takes the form of extended cognition, in which human agency and thought are enmeshed within larger networks that extend beyond the desktop computer into the environment" (23).

With Hayles, I consider distributed and embedded digital technologies to be constitutive of relations between humans and those technologies that are characterized by an embodied extended cognition. Especially the idea of the human becoming physically enmeshed within larger networks of distributed cognition appears promising for developping a notion of learning specific to the process of experiencing the IoT.[1]

In addition, Hayles makes palbale the ways in which digital connectivity means to become part of the embedded and embodied digital infrastructure – a status that challenges the division between human and technological entity, internal and external as well as human and technological (cognitive) capacities. This then, can be regarded as the point of departure to ask for the ways in which human learning as experience and machine learning as computational capacity also become enmeshed in new ways through, e.g., the IoT (1) and how 'we' could conceptualize the emerging forms of enmeshment.

1 There exists a large corpus on embodied cognition from varying disciplinary backgrounds with equally varying foci, discussing, e.g., how cognitive capacities are always interrelated to the physical and social world as well as how we have to understand them as öprocessual capacities. I have discussed aspects of this corpus with regard to digitl technologies elsewhere, see Treusch 2018 a, b and for an overview: Fingerhut et al. 2013

In what follows, I will present two recent approaches towards the interwovenness, but also differences between human and machine learning.

3.1 MACHINE LEARNERS

Adrian Mackenzie (2017) explores machine learning as a capacity of our contemporary digital devices that moves beyond 'pure programmability' of the machine. This means that 'our' devices start to learn – whereas learning here means a statistical process based on constantly collecting sensory data which is then quantified through classification. However, Mackenzie also contests an understanding of machine learning as purely based on statistical models of learning that can be reduced to amounting to a positivist, capitalist knowledge economy. Rather, he understands machine learning as a knowledge practice which assembles "accumulation of forms, techniques, practices, propositions, and referential relations" (30). With this, he expands the critical analytical toolkit for researching machine learning as the basical principle behind digitsation and quantification emerging from the digital connectivity of the IoT.

Nevertheless, he acknowledges that "machine learning is a convoluted but nevertheless concrete and historically specific form of calculation" (7) that constitutes a "form of knowledge production and a strategy of power" (9). In this way, knowledge production through machine learning can be understood as an execution of power in a Foucaudian sense (cf. ibid.). At the same time, Mackenzie also moves beyond a critical account of the (powerful) workings of machine learning "without preemptively ascribing potency to mathematics or algorithms" (ibd.).

Furthermore, he develops an account of data practice or the process of practicing data for researching machine learning. It allows to map the archeology of machine learning in terms of a foundational transformation of (human) knowledge production or in Mackenzie's words that of "'brainwork'" (13). This means to map the conditions and practices through which data practice becomes 'our' truth: "data practice […] reconfigures local centers of power and knowledge by redrawing human-machine relations" (9).

Mackenzie is specifically interested in machine learning's potential to challenge and change already established forms of data practice. This potential arises from the processes of reconfiguration implied to practicing data as the latter is exceeding "the coming together of algorithm, calculation, and technique" as a "coherent or complete" (17) process. The reconfigurative nature of data practice insists on the possibility to "articulate their diversity, loose couplings, and mutability" (ibid.). In short, Mackenzie argues for a close reading of data practice as a pre-requisite for enhancing the possibilities of non-hegemonic standardizations. This "would function as a mode of experimentation on operations" (209).

3.2 ON POSTHUMAN LEARNING

Cathrine Hasse (2018) differentiates between human, posthuman, and machine learning. With this, she basically problematizes 'the human' as a powerful modern figure: "the human is not a stand-alone individual engaging with a world of discrete objects, as has been the belief since the enlightenment, but a posthuman 'coming-into-being' with socio-cultural materiality" (1-2).

In this regard, she dismantles the idea of autonomy and agency as capacities of the 'human' subject in order to expand the human and human learning with an account of his or her constitutive embeddedness in a physical, socio-cultural environment. As Hasse emphasizes, "machine learning in AI builds on an outdated paradigm of the detached, rational human" (ibid.). In consequence, Hasse offers an account of learning as "becoming skillful in an evolving process of collective socio-cultural material epistemology" (ibid.).

The detached rational human is a figure of a computational culture that can be framed under the term of cognitivism. Through this vein, human cognitive capacities are described, e.g. as based on following fixed rules, or following a serial step-by-step path. Such conceptualizations have been analyzed as being Cartesian in nature, and thus, centrally perpetuating the mind/body split (e.g. Wheeler 2005). Though since the early 1990s new strands of an embodied and embedded AI (e.g. Brooks 1991) have been emerging, cognitive theories that are rooted in a Carteisan thinking appear to remain one of the bastions of AI (cg. Wheeler 2005). Against this backdrop, Hasse brings diverging strands of contemporary thinking that insists on the material nature of every aspect of 'our' existence. Based on that, she points out that "knowing is not reducible to a mental process; knowing is rather a physical practice of engagement" (4). Furthermore, she also emphasizes that this physical practice of engagement is a collective practice that "entangles humans and non-humans" (8). The term posthuman then marks the physical embeddedness and the entanglement of humans and non-humans – both as foundational for re-conceptualizing learning.

"Experience is thus not just subjective in an individualist way, but to some extent collectively shared through our socio-cultural learning processes that merge words, meanings and materials in ways that make social communication possible" (6). With this, Hasse proposes an account of posthuman learning as collective, socio-cultural experience that strongly differs from machine learning. She understands the latter as the context-free practice of, in short, manipulating numbers.

4 Reading Insights together: Impulses for becoming responsible for the IoT

In this paper, I situated the IoT by reconstructing briefly selected aspects of the historical lineage between ubicomp and the IoT. With this, I propose to make the the IoT graspable and work against the tendency that this ubiquitous phenomenon becomes intangible.

As a result, I argue that the IoT as embedded and distributed calm technology cannot be reduced to a purely abstract, number crunching means of collecting data through connecting things and persons. Rather, it can be situated within a critique on the computational culture from which the personal computer emerged. In addition, the impact on 'our' being-in-the-world are, with Hayles, of psychological as well as physiological nature. In short, calm technology conditions 'human experience', that is, learning.

How to grapple with learning at the age of the IoT? MachKenzie and Hasse both expand 'our' analytical framework for engaging with and conzeptualizing the transformations of learning. With Mackenzie, I furthermore suggest understanding the use of calm technology for controling and monitoring every aspect of human existence as not inherent to the idea and realization of distributed, but connected minituarized computers. Rather, the convergence of the IoT and (self-)quantification can be considered to be a historically specific configuration of human-machine relations – while reconfigurations are possible. With Hasse, I take learning as collective, sociomateiral, that is, posthuman experience as the point of departure for such reconfigurations.

Finally, I suggest an account of becoming responsible for digital connectivity at the age of the IoT that assesses at the possibility of, but maybe also the need for reconfigurations of the relation between human and technology. This

means to reconsider the relation between machine and posthuman learning – as interwoven forms of human/machine learning – while taking into account the power workings as much as the potential of data practice for either limiting or expanding 'our' posthuman capacity to experience.

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SKILL DEVELOPMENT ON THE SHOP FLOOR— HEADING TO A DIGITAL DIVIDE?

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ABSTRACT

In recent years, there has been a huge debate on how modern sensor technology and the increasing connectivity of production systems have changed industrial production processes and working conditions. This article contributes to the discussion on how digitalization affects skill development under different working conditions and asks the following question: How has learning within work processes changed with the introduction of data-based technologies?
To examine the interaction between digital assistance systems and organizational parameters on informal learning, we analyzed the implementation of digital assistance systems in two different groups: low-skilled assembly workers and high-skilled shop floor supervisors. Our findings suggest that a lack of autonomy in workplaces has negative impacts on informal learning and thus on skill development. When the design of assistance systems perpetuates preexisting inequalities in working conditions, their use can contribute to a polarization of skills and a digital divide within the workforce.

KEYWORDS

Industry 4.0; Digitalization; Assistance Systems; Informal Learning; Skill Development; Digital Divide

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1 INTRODUCTION

This article contributes to the broader discussion on the relation between skill development and digitization in German industry. We examine how the interaction between the implementation of digital assistance systems and organizational parameters on informal learning affects employees in industrial production.

The aim is to illustrate the areas of tension in the process of implementing new assistance systems within employees' everyday working lives on the shop floor. For this purpose, we analyzed the implementation of two similar digital assistance systems at different hierarchical levels in a German electrical engineering company based on workplace observations and qualitative interviews.

With our empirical findings, we will show that new technologies and working conditions influence skill development among industrial workers. We found that employees have an increased need for learning and show a high willingness to learn. Skill development is not primarily determined by the technologies used but is highly linked to the organizational parameters, such as hierarchical structures, the distribution of work, and types of workstation.

In contrast, organizational structures favor higher work intensification, especially for low-skilled workers, who work at in a highly standardized and takted process and have few opportunities for self-directed learning at their workplaces. The following sections describe and discuss the adverse effects of using assistance systems at different hierarchical levels.

2 STATE OF THE ART: DIGITALIZATION AND SKILL DEVELOPMENT

The role of skills has been highlighted on several occasions since the beginning of the public debate on digitization and Industry 4.0 in Germany (BMAS 2017; Plattform Industry 4.0 2014; Becker 2015). Scholarly debates on how skills will develop due to the ongoing digitalization of work fall into two categories: the upskilling hypothesis and the polarization hypothesis.

Upskilling can be understood both as automation, and thus as a substitution of simple jobs, and as a general process in which skills increase in all employee groups. Following Zuboff, the growing availability of data and the resulting increase in demand for intellectual skills will lead to "better jobs – jobs that at every level will be enriched by an informating technology" (Zuboff 1988: 159). The upskilling hypothesis is still prominent in the current Industry 4.0 discussion (Pfeiffer et al. 2017). Other authors argue that a polarization of skills is more likely than a general upgrading due to informatization or a complete substitution of low-skilled work (Hirsch-Kreinsen 2016, 2018).

While there is no clear answer to the question of whether workers' skill levels will rise or fall, the history of automation has shown that implementing new technologies has always affected the distribution of labor and therefore the task profiles and skill requirements.

Assistance systems are widely used in production to provide information in real time. Research has shown that unskilled workers, semi-skilled workers, and experienced workers with new tasks perform faster when supported by digital assistance systems (Apt et al. 2018). In the background, this information is automatically merged and filtered as needed in order to optimize production (Spath/Ganschar 2013). There are numerous examples, such as portable data-controlled glasses, gloves or clothing, but also visualizations or simulations on screens or projection screens (Evers et al. 2018; Niehaus 2018; Dombrowski/Wagner 2014).

Digital assistance systems are highly relevant for learning in practice, as they structure large amounts of data or provide clear visualizations (Niehaus 2018; Hirsch-Kreinsen 2016). This enables orientation in increasingly complex work processes. Assistance systems can also be

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very helpful for learning processes, as occurs when retraining an ageing workforce. This offers new potential for humanization in the world of work (Botthoff/Hartmann 2015).

In the transition to a more digitalized world of work, actors in German industrial enterprises often tend towards various types of informal learning in their concepts. According to relevant studies about skill development, 60–70% of skilled workers' professional competences are based on varieties of informal learning (IAB 2017b; Dehnbostel 2018, 2016 and Dehnbostel et al. 2003; Dohmen 2001).

In contrast to formal learning, informal learning means learning processes that take place directly "on-the-job." The term includes experience-based knowledge building as well as self-directed learning processes supported by colleagues, team leaders, plant specialists, etc. Moreover, this includes somewhat formalized components such as informal training in new software applications (Dehnbostel 2018; Walker 2017).

Compared to high-skilled workers, only half as many low-skilled workers take part in formal further training (IAB 2017), which makes informal learning particularly important for this group. Often, such workers do not have formal credentials and acquire experience "on-the-job." This is possible with simple applications with visual support in their workflow (Niehaus 2018).

As a tool, data-based assistance systems are intended to support human-technology interactions. They are expected to help workers to develop new skills within work processes just by using. In addition, they can support new employees in the induction phase. These systems are considered part of the development of skills, especially for those with limited access to formal learning opportunities (Plattform Industry 4.0 2014: 14; BITKOM and Fraunhofer IAO 2014).

A study observing the application of an assistance system for manufacturing shows that they can relieve workers' stress and enable them to perform a higher variety of tasks (Kuhlmann et al. 2018). This could help to counter deskilling. The same study showed that the constant shift in attention between the actual task and the assistance system also caused stress, which was criticized by more experienced workers. Such employees relied more on their experience than on the information provided by the assistance system (ibid: 186).

Furthermore, previous research has shown that co-determination in skill development processes leads to more satisfaction (Bellmann et al. 2018). Regarding the use of assistance systems under less autonomous working conditions (Niehaus 2018; Krzywdzinski 2018; Butollo et al. 2018), we assume a growing digital divide that is currently at an early stage of development.

Several studies have shown that access to further training differs according to occupational status and that further training is linked to technical and organizational parameters (Wotschack 2017; Bäumer 1999; Düll/ Bellmann 1998; Block 1991). Low-skilled workers in particular have less good learning conditions in their work processes when new technologies are implemented (Warnhoff/Krzywdzinski 2018).

There is no clear answer to the question of whether companies are willing to reject Taylorist work organization entirely and offer continuous learning for all employees. The question remains of whether upskilling is limited to a minority of key employees who are continuously being upskilled and retrained. The problematic tendencies of deskilling only become apparent when conducting a precise and long-term analysis of the use of technology in the everyday work of employees (Apt et al. 2018).

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3 DATA AND METHODS

The following results were obtained in an ongoing in-depth case study[1]. The analyzed case concerns a typical production plant of a company in Germany. Given that the company is a traditional manufacturer of electronic products, its plant is part of a global production network. The company has a stable market position and is one of the innovation leaders in its industrial sector. The plant employs around 1000 workers. Despite the introduction of agile working methods in some areas, it has a hierarchical structure that is typical for the industry, with separate functional areas such as assembly, maintenance, and logistics. The employees are predominantly male, with long years of service and an average age of over 46.

Reflecting the Industry 4.0 concepts promoted by the German government, the plant is in the middle of an extensive change process, with multiple digitalization projects seeking to secure market leadership. Many actors are concerned with the introduction of new technologies in manufacturing and see an increased need for learning through new digital systems at all levels, as the adaptation strategies of the past have only limited compatibility with new technology generations.

In this article we focus on the subjective perspectives of employees regarding the implementation of Industry 4.0 and skill development with different learning processes. For this purpose, we use case study approach (Yin 2009), with a special combination of four different survey methods (Pongratz/Trinczek 2010). This approach brings together data from different survey methods. The first of these involves semi-structured interviews, which were conducted on a quarterly basis with a fixed sample. The interviews lasted one and a half to two hours and were transcribed and evaluated using qualitative content analysis according to Mayring (2010). Additionally, insights from workplace observations (5–6 hours per person) were incorporated. Using a theory-based category system based on the concept of socio-technical systems (Hirsch-Kreinsen 2014; Sydow 1985) and developed based on the empirical material, we systematically categorized and refined the material according to learning in different hierarchical levels.

The preliminary results presented in this article refer to the study period January to June 2018 and focus on the functional area of assembly. The results outlined in the following section focus on the implementation of digital assistance systems at two different hierarchical levels: low-skilled assembly workers and high-skilled supervisors on the shop floor.

4 RESULTS

Our empirical findings emphasize the role of informal learning for skill development. In the analyzed case, formal training does not dominate the process of skill development; in fact, the dominant processes are individual and collective learning processes that take place in the working process with little or even no formalization. In order to investigate how different working conditions, affect informal learning, we compared the use of different digital assistance systems on the shop floor.

4.1 APPLICATIONS FOR SUPERVISORS ON THE SHOP FLOOR

For supervisors on the shop floor, the plant implemented a digital assistance system in the form of a mobile information tool. For example, it is used by group leaders, who are in charge of assembly workers' skill development

[1] The empirical material is part of an ongoing PhD project by Kathleen Warnhoff: "The digitization of industrial work: Continuous learning and challenges for Good Work." In this project, she examines different learning processes with an extended perspective in a period of two years (2018-2019). At the end, she intends to compare different functional areas in industrial companies, which should enable scholars to gain a better understanding of the implementation of digital technologies and of the role of strategies in shaping continuing learning in employees' work processes.

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and by team leaders, who distribute the tasks. The assistance system is a combination of artificial intelligence (AI) as a language support with semantic analysis and a visualization of relevant machine and process data. By receiving information in real time, the supervisors, e.g. team and group leaders can control production processes more effectively. The digital assistance system collects the feedback from the machines, automatically converts it into tasks, including solution descriptions, and distributes these to smartphones and tablets used by the employees with the appropriate skills.

Within these applications, shop floor supervisors have a lot of leeway to decide whether and how they will use this instrument when making decisions. This autonomy in how they use the system is a source of informal learning. The increase in the available information also poses a new challenge for learning and has the potential to lead to information overload. A shop floor supervisor describes the changes in work organization due to the use of the assistance system as follows:

"It's an additional tool that will enable people to do a completely different job. At the end it follows a lean idea. […] I don't need local experts like the technologists who spend half a day on the shop floor and take a close look at the process. Nowadays, we have an automatic export of machine data, we can analyze the data in real time, and we even have sustainable transparency. […] Today, even a team leader can evaluate this and determine indicators."

Before the assistance system was implemented, expert knowledge was bound to specific individuals; now it is pooled in the system and available for all executives on the shop floor level. The availability of data, and hence information, enables the supervisors at the shop floor level to engage in a variety of new tasks and at the same time calls into question the established division of labor between different experts.

By automating time-consuming routine tasks, the assistance systems create the leeway for informal learning that is needed to handle the increased complexity and scope of information.

4.2 Applications for Low-skilled workers

In the observed manufacturing processes, most workers have no formal vocational training but have many years of experience by learning "on-the-job." While shop floor supervisors' jobs are characterized by a high degree of autonomy in terms of time management and work organization, assembly workers' jobs are often characterized by a strict time schedule and predetermined work processes. The work is structured by tightly timed activities and restrictive performance targets. Job rotation between the different workstations is organized by the workers themselves.

Unlike the applications for supervisors on the shop floor as outlined above, the low-skilled workers use static assistance systems that are directly integrated into their workstation. Because these systems are linked to other applications on the shop floor, production workers cannot decide whether they want to use the digital assistance system and when. Regardless of their usage preferences, the system keeps running all the time. This is contrary to the self-determined way supervisors use their assistance system. One worker describes the assistance system, which is a combination of pick-by-light systems to select the parts and an on-screen manual, as follows:

"You see everything on the screen here in the middle, every step of the way. I know it inside out. The light flashes now and shows you which material you need and where it will go. Here you have the numbers and the computer shows you where you can find the material. […] the other screen automatically calls up the instructions, you don't have to think or follow anything."

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	Shop Floor Supervisor	Assembly Worker
Skill Level	high-skilled	low-skilled
Characteristics of the Assistance Systems	mobile systems/information about production processes in real time	stationary systems implemented in the workplace/digitized real time manual
Degree of Autonomy	high degree of autonomy/voluntary use of the system	low degree of autonomy/mandatory use of the system
Informal Learning with Assistance Systems	easy access to more information enables self-directed learning processes	the system substitutes for experience knowledge/few possibilities for informal learning
Challenges for the employees	informational overflow	lack of autonomy for self-directed learning/devaluation of the workplace

Table 1 Skill Development on the Shop Floor

At first sight, it may seem as if the assistance system is hardly changing work processes: The movements for producing the components and the variety of tasks remain the same for production workers. But the use of the assistance system changes the organization of work and therefore the required knowledge: While it neglects the experience of workers in their field by showing them manuals for tasks they have been doing for years, it also leads to new learning demands on the part of the workers.

"I also need PC knowledge, so not like a professional, but basics, which programs do I have to start when I get to my workplace. There is SAP and three other programs, […]. If your computer crashes, you also need to know how to reactivate everything. The new ones will learn that by getting it shown, otherwise they won't be able to start working at all."

The assistance system, which can be described as a visualized work manual, gives the employees precise step-by-step instructions. Hence, it is also seen as an aid by workers, especially when they haven't been performing a specific task for a long time. While knowledge about the working steps seemingly becomes redundant due to the assistance system, the need for basic digital skills grows, and in the analyzed case, these skills are transmitted via informal learning processes among coworkers.

Finally, the workplace observations and interviews with assembly workers show that many of them want to participate more in the digital transformation of their workplace. But participation and informal learning is often limited by their highly structured work regimes. Assembly workers often do not lack motivation, as some supervisors indicate; they lack opportunities to actively take part in skill development.

5 DISCUSSION

Our primary question was how the introduction of data-based technologies has changed learning within work processes. We analyzed the relevance of digital assistance systems for the skill development of employees under various working conditions. Our empirical findings for two groups of employees show that assistance systems take different forms and are adapted to the differing requirements of the respective work processes. This path dependency results in fundamental differences in learning conditions for different groups of employees. Our most important findings are summarized in Table 1.

Assistance systems can support industrial employees in their everyday working lives. On the operational level, the usage of the applications differs in terms of the degree of mobility that is possible and whether the use is voluntary or mandatory. This difference is crucial when we

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consider their influence on skill development and autonomy. The introduction of assistance systems means employees are experiencing work intensification due to the combination of the learning processes required for the use of the system and the day-to-day requirements of the work processes. This is a challenge because the time windows for informal learning during the work processes in manufacturing are extremely limited. As the speed of new technological developments increases, this has a direct impact on the future needs for learning in the workplace.

The in-depth analysis of the two different employment segments shows that, for shop floor supervisors, the role of experiential knowledge has increased, since this knowledge is necessary for interpreting the increasing volume of data and information. The use of the systems reduces information complexity, and, in combination with experiential knowledge, it enables complex decision-making.

Due to limited resources and the increasing speed of technological change, we found that formal training strategies only play a limited role for industrial companies with regard to the skill development of their workforces. While only a few employees are involved in formal upskilling, the majority of skill development takes place informally and is embedded in daily work routines. For informal learning processes, data-based assistance systems can reduce the burden of complexity. Depending on the area of application, the extent to which experiential knowledge is being replaced is still unclear.

There are distinct differences in informal learning between the two groups observed. The working conditions that allow more or less autonomy to act and make decisions also shape learning in different ways: While shop floor supervisors learn in a self-determined manner and only rely on support systems for decision-making, assembly workers lack autonomy of action in predetermined work processes and thus also the resources necessary for informal learning processes. While an increasing devaluation of experiential knowledge is occurring due to the use of assistance systems for experienced workers, such systems could also assist learning processes for new employees and broaden the variety of tasks they can undertake by enabling them to perform new tasks without long periods of training.

For low-skilled workers, the role of experiential knowledge decreased dramatically, as it was made obsolete by the detailed instructions provided by the assistance system. Here the need for learning arises due to the use of the systems themselves, as they require skills in the use of the software that were not previously needed in these positions. By neglecting low-skilled assembly workers' experiential knowledge, the assistance system used in this area may lead to an overall devaluation of the affected positions.

To summarize: By adopting this exploratory approach, we have been able to show that learning conditions in the organization are primarily structurally determined. Existing inequalities in autonomy and skills between shop floor supervisors and shop floor employees are manifested in the way technologies are designed and used. Yet the design of the assistance systems perpetuates existing inequalities. While digital assistance systems can be a lever for empowering employees to engage in informal learning under the right conditions, the technical skills their use requires can also lead to work intensification if the employees are not given the leeway to adapt to new skill requirements. Industry 4.0 concepts are therefore a huge challenge for production employees.

6 CONCLUSION

In the transition to a more digitized world of work, actors in German industrial enterprises have often tended to adopt approaches centering on work-integrated informal learning. The increased need for informal learning due to the use of assistance systems fosters a – concentration of work for low-skilled workers.

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In contrast to shop floor supervisors, this is due to the tightly timed activities they must perform and their lack of autonomy to engage in self-directed learning. Within a company, this growing gap in the significance of existing skills and in leeway to learn may lead to a growing "digital divide" within the workforce (van Deursen/van Dijk 2014).

This article has pointed out challenges in the implementation of assistance systems and discussed the lack of autonomy in employees' work processes and thus in work-integrated learning. Our results are limited to the specific workstations observed and the respective organizational context. Considering the high variety of existing systems and the different functional areas—such as maintenance and logistics—more research is needed to evaluate how digital assistance systems affect skill development and working conditions under various circumstances in the industrial sector.

To adapt to technological changes, companies need concepts and structures for skill development. Since employees with formal qualifications are underrepresented in the field of simple work, informal learning processes are all the more important for these employees as they otherwise risk being left behind in such complex change processes. Without the necessary autonomy to engage in informal learning, the existing gap in skills will be retained or enlarged. Since the application of digital assistance systems is embedded in existing organization structures, it seems reasonable to conclude that these systems will likely perpetuate existing inequalities instead of reversing them.

There is a need for discussions about further consequences regarding the existing tendencies towards inequality to avoid a digital divide. Employees in low-skilled work are disadvantaged not only in their daily work processes due to a lack of autonomy but also in how they learn the process of work. A lack of learning opportunities for low-skilled workers may risk increasing the division in the employee structure within industrial companies.

While digitalization is not a new phenomenon, the degree of connectivity within the company and the associated complexity has increased. These changes are often barely visible in the workplace. However, what we know so far is that more and more data is converging in the background and that this data can be obtained in detail in work processes and evaluated by all levels of management in real time.

In this context, there are labor policy implications that do not solely relate to the use of individual assistance systems. Instead, there is a need for regulation with regard to the protection of personal data, working hours, and performance requirements. In addition to negotiations and participation-based design approaches at the company level, there is also a public debate in which the increased learning requirements and the increased productivity pressures are addressed in order to find overarching solutions.

The implementation of assistance systems could be used to enable employees to perform a broader variety of tasks, which, in turn, could lead to a more diversified workplace design. In order to benefit from the strengths of digital assistance systems and compensate for the negative consequences, strong co-determination and robust organizational and political concepts are necessary in the era of Industry 4.0. There is a need for regulations to expand the scope of action, especially for low-skilled workers.

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PROCEEDINGS OF THE WEIZENBAUM CONFERENCE 2019
CHALLENGES OF DIGITAL INEQUALITY
DIGITAL EDUCATION | DIGITAL WORK | DIGITAL LIFE

INEQUALITIES OF PROFESSIONAL LEARNING ON SOCIAL MEDIA PLATFORMS

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ABSTRACT

Professional learning on social media is generally framed as unproblematic, but the transition to these platforms marks a change as professionals' work is conditioned by their logic and economy. In this paper, our focus is how problematic inequalities of teachers' professional learning around access, participation and resources are produced as their professional exchanges is formed by social media participation. Three aspects of inequality have been examined. First, the performance of teachers' (un)equal professional opportunities; second, (un)equal access to resources; and third, (un)equal existential opportunities for professional development. We draw on examination of three-years of API data from a large teacher Facebook-group asking, who can participate (gender, location), what voices are heard (status, language), and how does the social media platform condition professional exchange and participation? Our results consider the opportunities and costs for teachers as individuals, professionals and intellectuals. They reveal problematic temporal aspects such as work intensification, and limited professional exchange, partly conditioned by the platform functionality.

KEYWORDS

Professional learning inequalities; Social media platforms; Facebook data

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1 INTRODUCTION

The advent of social media platforms has provided opportunities for large-scale networks of professionals to share experiences and resources on a daily basis, and professional learning on such platforms has tended to be framed as relatively straightforward and unproblematic. Yet the transition to these platforms marks a change as professionals' work are conditioned by the logics and economy of social media platforms. These global internet platforms economically rely on massive amounts of user-generated content and data production. Technically, the platforms work as "online content-hosting intermediaries" (Williamson 2017, p. 62), and they have a profound political and economic impact on educational sector by introducing it to the business model and political economy of platform capitalism (Srnicek 2016). Different platform domains on a micro-level shape the communication and function of user interaction and accessibility. As essential parts of schools and teachers' professional lives are formed by online professional exchange within these emerging platform contexts, problematic inequalities around access, participation and resources (co-)produced by social media platforms have become evident.

2 FOCUS AND QUESTIONS

In this paper, our focus is how problematic inequalities of professional learning are produced, in the transition to social media platforms and in the regulatory powers of social media participation. The approach is based on a critical sociological engagement with the domain studied. Our aim is to problematize the construct of social media participation as an equally assessible and democratic space by conceptualizing it as a place where different forms of inequalities are produced and intersect. Educational inequalities are highly problematic for a democratic society and currently, professional development opportunities for public sector teaching are undergoing large transformations. A key transformation is the emergence of large professionally oriented social media groups where teachers discuss their practice. We seek to identify and unpack the forms of inequalities for professional learning that are produced through teachers' participation and interaction in such large-scale profession-oriented social media groups.

Three aspects of equality have been explored, widely focusing on "the capability of functioning fully as human being" (Therborn 2013, p. 41), including "freedom and knowledge (education) to choose one's lifepath, and resources to pursue it" (p. 43), in this exemplified by teaching professionals working online. Firstly, it concerns the performance of teacher professional's opportunities of (un)equal professional/life chances, secondly, (un)equal access to resources e.g. materially-infrastructurally and lastly, (un)equal existential opportunities of professional development, autonomy and respect in relation to norms of social media participation. In this sense, classical aspects of distributional and categorical inequalities have been used, that is, how educational resources are distributed to and among teachers as public sector professionals, and how categories like gender, location, language and 'voice' relate to these aspects.

We draw on a research project based on a 3-year 'big data' corpus of activity in a large thematic profession-based Facebook group as an empirical case collected in 2016. Questions raised are, who can participate (based on gender, location), what 'voices are heard' (status, language), how is the social media platform conditioning a professional exchange and participation?

3 METHODOLOGY

The methodological choice of a 'big data' approach follows from analyses of current research within educational science which largely has been limited to small-scale studies using self-reports or traditional interviews on how teacher professionals use social media for professional learning and networking (Macià & García 2016). The project mainly draws on a big data corpus covering all of the group activity of 13,000 members including all posts, comments, and likes from the group's three first and most active years. The data was accessed by the Facebook Graph Application Programming Interface (API) and collected through the Facepy library (Gorset 2015) for the Python programming language. The project has used a combination of methods, mainly starting from computational content analysis and participant observation methods followed-up by surveys, interviews and in-depth interaction analysis. The data set has been aggregated and visualized in a variety of ways to examine different aspects of the group's activities over time including group size, core members, temporal aspects like activity distribution, discussion topics, shared resources, norms and repertoires in the group (e.g. Lantz-Andersson, Peterson, Hillman, Lundin & Bergviken Rensfeldt 2017; Bergviken Rensfeldt, Hillman & Selwyn 2018).

4 ACCESSIBILITY AND RESOURCES AS (UN)EQUAL PROFESSIONAL OPPORTUNITIES

We base our empirical case on a Swedish example, a country that has undergone a distinct decentralisation and marketization of its school system since the 1990s. The decentralisation has resulted in a differentiated and municipalized situation where local conditions mainly determine what types of resources and digital infrastructures are accessible for teachers and schools. The decentralised school system has led to devolved responsibility for teacher professional development (Parding, Berg-Jansson, Sehlstedt, McGrath-Champ & Fitzgerald 2017). Compared to other OECD countries, the allocation of work hours for teacher professional development in Sweden is around half of the average (OECD 2013). This situation has to a large extent left teachers' individually responsible for dealing their professional development through distributed market choice and 'forced freedoms'. The current situation also can explain why social media platforms constitute such an important and popular option for teacher professionals. Facebook in particular also has been a very popular social media platform in Sweden which make this a convenient and 'equal' choice for teachers in their professional life. The marketization of Swedish schooling has made the private digital platform sector highly visible and the internationally popular Google and Apple based one-laptop-per-individual movement has been a part of this, at least in regions with strong economic resources such as the bigger city regions. Interestingly, this may serve as a background to how our Facebook teacher participants are geographically distributed, where the majority live in urban and suburban areas. However, our analysis based on distinctions between urban/suburban and rural municipalities made in official statistics produced by the Swedish Association of Local Authorities and Regions/SALAR (2017) shows that the geographic distribution of top contributors in the group reflects the overall geographical distribution in Sweden (see Table 1).

Population	Urban/sub-urban	Rural
Top 50 contributors	37 (74%)	13 (26%)
Sweden (Statistics Sweden, 2017)	7,577,848 (75%)	2,542,394 (25%)

Table 1. Distribution of contributors with most posts and comments by municipality type (SALAR, 2017).

The geographic distribution of group members may reflect Sweden overall, but this may mask inequalities on local levels such as the differences within schools and between schools and teachers in the same municipality or school forms. In an interview with the group's moderator, she expressed that what characterized the group of teachers was, "this need for professional development we have, for further learning, but always on our own terms and as a part of our everyday work, not because someone says, 'this is what everyone should do now'". The grassroots-driven, but also individually and self-regulated population of teachers gathered around a shared pedagogical theme forming a shared space that fit well with the logic of social media platforms. In particular, activity in the group followed the model of constant engagement, but also took advantage of the intermediary function and 'free use' of the digital platform that are such key aspects of the business model of platform capitalism (Srnicek 2016). With platform capitalism, platforms like Facebook elicit social interaction and encourage users to engage in activity such as pressing like buttons and sharing photos to promote further activity and data production. While internet platform industries make use of teachers' labour and data production, putting them in a constant loop of desirable engagement and feedback from algorithmic powers in much the same way they do with any other user, there are particular concerns in relation to inequalities of professional opportunity. Examining our corpus in more detail, it is evident that on a daily basis, teachers engaged in the Facebook group as a form of extension of work, taking place during breaks, evenings, and holidays. As Figure 1 shows, 43% (6,945) of posts and comments on work days were made during the early morning or evening hours (before 08:00 or after 17:00) and only 32% (5,180) were made during working hours. Outside the hours depicted in Figure 1, 25% (4,038) of posts and comments were made on weekends and while peak months for contributions were at the beginning or middle of school terms, 11.5% (1,852) of contributions were made during the months of June and July, when schools are not generally in session in Sweden. Compensation for a lack of formal professional development opportunities with social media groups of the kind we have studied means that teachers are reliant on platforms that not only turn their digital work outside of work hours into a boundless professional assignment, but also into labour for large internet conglomerates. In this situation, differences in life situations and willingness to sacrifice leisure time and recreation lead to significant participation inequalities that influence different teachers' possibilities for professional learning.

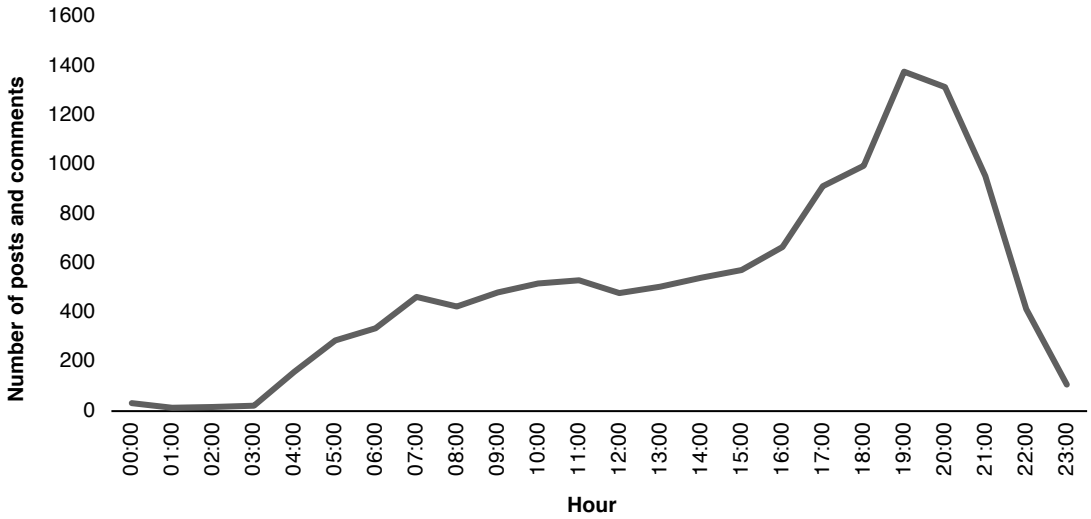

Figure 1. Posts and comments on weekdays during the school term by hour.

5 PARTICIPATION IN/EQUALITIES

One way to understand possible participation inequalities produced in the Facebook group, has been to analyse aspects of status and language, including the gender distribution of male and female active voices. Based on a comparison of the first names of group members with data from Statistics Sweden (2017), we assigned a gender to each activity within the corpus. Our analysis of the average length for posts and comments showed that women used 23.5 words while men used 37.1 words, that is, men took nearly the double amount of the active voice space (see Table 2).

Gender	Posts and comments	Top 50 contributors	Average word count
Women	10,948 (65.5%)	30 (61.2%)	23.5
Men	5773 (34.5%)	20 (38.8%)	37.1

Table 2. Comparison of posts and comments in the group by women and men.

In this way, there seems to be little difference in gender inequalities on the digital platform compared to the offline world, however, based on calculations of who claims most space, a different pattern can be seen, however with regard to the top contributors in the group. The number of women and men among the top 50 contributors is proportionally similar to the overall number of posts and comments contributed by women and men respectively (see Table 2), but this distribution is skewed with all the top 10 contributors being women.

To some extent this is visible in the gendered nature of the content of members posts and comments. Performing emotional work in a teacher Facebook group is also to perform one's profession. This norm, performed by the teacher professionals further adds to the powerful features of the social network effects of the digital platform as moderators and other top contributors are encouraged by the platform functionality to conduct more social and emotional labour (Arcy 2016).While contributions of all kinds can be found by both women and men, at an aggregate level, those of women tend to be shorter and less critical or explanatory than those of men. Our analysis shows that supportive comments in particular tend to be much shorter than those offering critique or explanation (see Figure 2).

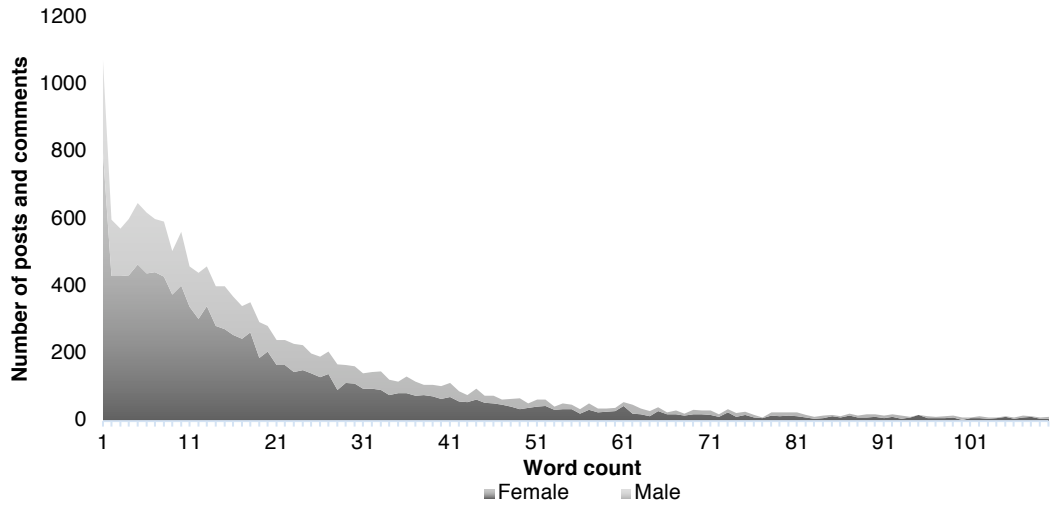

Figure 2. Distribution of posts and comments by word count and gender of contributor.

Furthermore, and that despite women making up more than 70% of group members, posts and comments of 80 words or more are posted in roughly equal numbers by the two genders. As education is such as crucial part of a society's development and the democratic opportunities and life chances of people, it is problematic that gender inequalities in educational contexts are continuously reproduced. An equal access to digital platforms should also include equal access to a communicative space. Social media participation, however, does not seem disrupt or change the gender distribution of voices being heard in our example. This suggests that teacher professional's engagement and self-organization on social media platforms should be problematized by teachers and moderators themselves beyond the polite norms of the profession and social media 'netiquette'. Equal distribution of opportunity to speak is of vital importance for all teacher professionals as is encouragement to conduct intellectual work in spaces such as large-scale Facebook groups. While there are clear gender differences in the character and length of posts and comments visible in our corpus, we should make the point that such data extracted through APIs are always biased towards active users who actually like, post and comment. 'Lurkers' and other 'silent reactions' are not represented and, in this way, our corpus is not an exhaustive record of the activity or interactions of group members who may very well react and interact in a multitude of ways that go unrecorded.

One indicator of activity taking place outside the platform that is visible in the corpus is hyperlinks to other online resources. Since the language of the group is Swedish but the topic of the group is international, it is possible to see which resources are in that language versus others. This gives some indication of the relevant discourse outside the group that is conducted by group members and professional associates and the relevant discourse produced by or with an orientation to the international topic space.

Our analysis shows that Swedish dominates as the language of 84% of the blog posts linked to in the group (See Table 3).

Resource type	Swedish	Other
YouTube video	55 (58%)	40 (42%)
Blog post	185 (84%)	34 (16%)

Table 3. Indicators of language of posted resources.

This indicates a local discussion that extends beyond the group. Further analysis of the blog posts themselves reveals that a great

many are written as longer reflective pieces of writing or reports of classroom practice by the members who posted them. Similarly, in terms of videos linked to or posted in the group there is a preference for Swedish language content with Swedish indicated as the audio language in the YouTube database for 58% of the videos. Further analysis of the videos themselves reveals that like the blog posts, those in the Swedish language are often produced by the posting member and consist of content used by that teacher in their professional practice.

However, with only a few exceptions of videos in Norwegian and Danish, the remaining 42% of YouTube videos posted are in English and generally take the form of instructional or inspirational content aimed at teachers with an interest in the topic of the group. In this way, many of the voices heard through the resource linked to in the group are those of the teachers themselves sharing their practices and perspectives. However, a significant amount of discursive space is taken by international voices contributing with less practice-oriented perspectives on the topic. Generally, these posts also receive less attention in terms of discussion perhaps because of a perceived distance to the language space and voices of other professional contexts.

Our results from analysing overall group participation show that members generally reacted with appreciation to posting of resources such as blog posts and videos. In many ways, the social platform enabled a professional exchange which otherwise would not be available in other forms for teachers in Sweden. However, the platform only supports certain forms of participation that can be most often characterised in contrast to more traditional professional development activities as relatively passive consumption of content. For example, of the more than 13,000 members in the group during the three years that we studied it, only 7.5% ever included a link to an external resource in a post or comment. There were also few deeper reciprocal exchanges with only very few discussion threads lasting over several days or consisting of more than 100 comments. Here, a number of concerns arise from our data relating to the restricted ways that teachers were able to work as skilled, engaged and intellectual professionals online. For instance, while teachers were 'free' to engage with the group in any way they pleased, rather than being an accessible repository of accumulated expertise, Facebook presented a narrow selection of content to teachers who often made efforts to disrupt the platform's logic by creating markers such as 'follow' and '.' in comments so that they would be alerted to ongoing conversations of interest. The group was characterised by users' passive interaction with the online content determined (to a large extent) by the platform's algorithms and regulatory powers rather than teacher expertise.

6 DISCUSSION

What are the implications of social-media based professional learning in terms of inequalities of accessibility, and for professional and existential opportunity? Are there likely longer-term implications of how these emerging digital platform spaces are enabling or restricting professional self-development, freedoms, and intellectual exchange? The activity levels in the group we have analysed are high, but from an intellectual and existential opportunity perspective on the professional development, the general character of discussion is notably superficial, social-emotional, and often gendered in favour of men's dominance as active voices. Even if womens' social interaction labour makes the social media based professional learning productive, this labour is also profited on by platform business logic, in that sense the inequalities of "gendered labor is extended in the digital media economy" (Arcy 2016, p. 366). The status of

teachers in relation to the platform is also problematic with Facebook offering the platform, but profiting from the work associated with public sector state funded professional teachers' active participation. As platform industries like Facebook are "becoming owners of the infrastructures of society" (Srnicek 2016, p. 96), Williamson (2017, p. 62) warns that, "platforms designed in the commercial sector may in future years increasingly intervene in and rework public education at massive scale, both within and beyond state control".

As researchers, we also profit from publicly available large-scale Facebook data collected at a time before such data collection was questioned. The corpus is based on a single and limited case where the group moderator could grant access. Other contexts or circumstances associated with conducting social media research on teacher professional's Facebook participation may lead to different conclusions. Comparing the context we have examined to other similar European or non-European contexts of teacher professional learning, offers an opportunity to understand teachers' multi-sited activities across different digital platforms.

Social media platforms are often discussed as an opportunity to replace 'traditional' professional learning and as a way to reduce spending on formal courses or time for workplace learning in the underfunded public sector. However, these possibilities come with realities of distributional and categorical inequalities. Access, participation and resources in relation to digital platforms raise the spectre of problematic inequalities for the profession. Added to this, there is also the cost of 'free' often gendered labour on the part of teachers as they engage and perform the ideal professional learner. These changing conditions for teacher's professional learning result in problematic temporal aspects such as work intensification, resulting in a competitive individualized neoliberal performativity. Similarly, extended dialogue, listening-and-responding, democratic exchange and genuinely public and intellectual debate amongst professionals and of both sexes are rare. There are also risks for isolated and instrumental professional development for teachers as individuals, and less focus on their position as professional colleagues and 'public intellectuals' within society more broadly. The context reported on here relies on trust in teachers' will to develop and network as professionals, stakeholders like school management, politicians and parents have reduced insight into teachers' voices and professional commitments. Similarly, a move away from traditional professional development to informal and often ad hoc online groups also makes it hard for teachers to influence and change their current situation on a collective organized professional level or on a workplace basis. In that sense, social media platforms may function as 'sites for the cultivation and deployment of neoliberal subjectivities that prioritize entrepreneurialism, self-sufficiency, a willingness to work anytime and anywhere, and instrumental relationships towards institutions and other human beings' (Bengtsson 2016, p. 222-223). While some participants might consider these to be desirable characteristics, they are certainly counter to the senses of obligation and reciprocity that one would commonly associate with notions of 'community' and 'solidarity' within professional groups drawing on trust and mutuality.

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Media Bias towards African-Americans before and after the Charlottesville Rally

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Abstract

African-Americans are still experiencing racial discrimination rooted in structural bias in US American society. Research has shown that this behaviour can be reduced if individuals are made conscious of their bias, but little is known about these mechanisms on a societal level. Envisaging the white-supremacist Charlottesville rally in 2017 as an event that rendered American society conscious of its racism, we scrutinise whether racial bias in the digital media has changed, comparing levels of pre- and post-Charlottesville bias. We fit word embedding models to a broad sample of largely US media and quantify bias by calculating cosine similarities between terms for black or white actors and positive or negative character traits. We find no differences in positive character traits after Charlottesville. However, African-Americans are associated substantially less with negative character traits post-Charlottesville, while white actors are semantically closer to negative traits.

Keywords

Media bias; Ethnic studies; Automated text analysis; Word embeddings; Charlottesville

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1 Introduction

The African-American population is still confronted with racial discrimination, which originates from a negative structural bias of American society towards black people. A recent and extreme example of the discriminatory behaviour, with which African-Americans are confronted, is the high number of fatal shootings of unarmed black men by white police officers across the United States. Digital media, online news and blogs play a central role in the persistent phenomenon of racial discrimination, as they serve as a primary source of important information on current events but also, more generally, inform and shape the attitude and worldview held by the population. Due to its crucial role in opinion formation and updating, the implicit (as well as explicit) positive or negative bias towards minority groups spread by online media can reinforce biases in individuals, which can lead to discriminatory behaviour. In this sense, biases spread by media sources across the political spectrum of broadsheets, tabloids and blogs can be regarded as a proxy for public bias. In this study, we provide evidence in support of the idea that biases can be found across a broad spectrum of news sources and that these biases are likely to shift over time. We particularly focus on online media as a proxy for public opinion as well as the public's strength and direction of bias. Related to this issue we also ask how the biases that persist in digital societies emerge from the individual level.

Several studies have shown that making people conscious of their racial bias can pave the way to a significant reduction in discriminatory behaviour (Devine et al. 2012, Amodio, Devine, and Harmon-Jones 2007). Yet, can an intervention that reduces bias in individuals under laboratory conditions also work on digital societies in the real world? Setting out to scrutinise the external validity of previous findings, we envisage the white-supremacist rally in Charlottesville in 2017 as such a stark reminder of existent racism, which rendered American society conscious of its structural discrimination. More specifically, we test whether there are any substantial changes in implicit racial bias in a broad sample of US and UK online media by comparing the levels of pre- and post-Charlottesville bias. The sample we use contains 97,542 articles from 47 media outlets, combines tabloid and broadsheets, online bogs and satirical magazines, and spans from the extreme right to the left of the political spectrum. To operationalise racial bias we resort to the literature on the logic of Implicit Association Tests (IAT) that were developed to empirically test racial bias via word group associations. Drawing on this idea, we measure the association between specific word groups in written media. We fit word embedding models to pre- and post Charlottesville media samples and calculate cosine similarities between lists of words denoting black or white actors as well as positive and negative adjectives for character traits. This allows us to quantify the change in media bias towards African-Americans before and after the rally, compared to the bias towards white actors. We find that after the rally, there is no considerable change in positive bias towards white or black actors, while post-Charlottesville African-Americans are associated considerably less with negative character traits. Our findings suggest that media bias towards marginalized groups can temporarily shift after exogenous shocks such as the Charlottesville rally.

2 Interventions to Reduce Racial Bias

In spite of a general empirical tendency showing that racial bias is gradually dwindling since the 1960s (Gaertner and Dovidio 1986, Schuman et al. 1997), African-Americans are still suffering from structurally unequal treatment, such as poor quality interactions (McConnell and Leibold 2001), limited employment opportunities (Bertrand and Mullainathan 2004) or smaller chances of receiving life-saving medical treatment (Green et al. 2007). Racially prejudiced behaviour is believed to originate from implicit biases (Devine 1989, Gaertner and Dovidio 1986), which produces discriminatory behaviour (McConnell and Leibold 2001). These biases are reproduced in inter-personal interactions but also in collective means of communication, such as newspaper articles, fake news or blog entries. Past research has shown that media content produces negative dispositions towards such minority groups (Boomgarden and Vliegenthart 2009) and can be amplified by respective exogenous shocks (Czymara and Schmidt-Catran 2017). Results from earlier studies also indicate that racist bias is not static, but can be reduced temporarily or even in the long-term (Galinsky and Moskowitz 2000, Devine et al. 2012). For an individual to reduce their racial biases, the first step is to grow conscious of their bias, which is linked to the evocation of concern and guilt (Devine 1989), which motivates self-regulation to discontinue biased behaviour (Amodio, Devine, and Harmon-Jones 2007). Long-term de-biasing effects were achieved if this was coupled with bias education programmes designed to evoke general concern about implicit biases (Devine et al. 2012). Presenting an individual with feedback of their racial bias, thereby rendering them conscious of their bias and evoking concern about the racist biases held, can thus pave a way into decreasing racial prejudice.
Implicit association tests (IAT) is a method developed to lay bare socially significant associative structures and can be used to measuring evaluative associations that underlie implicit, e.g. racially biased, attitudes (Greenwald, McGhee, and Schwartz 1998). In these IAT, in essence, participants are made to answer to certain words with other words, e.g. names perceived to be typically *white* or *black* have to be replied to with words that fall under the category *pleasant* or *unpleasant*. If for instance an association between an example of each of the categories *white* and *pleasant* is stronger, this indicates an underlying positive bias towards the category white. The logic of IAT has been used in the application of word embeddings to text to track stereotypes on gender and minorities (Garg et al. 2018). We make use of this application of word embeddings to quantify negative and positive sentiment towards African-Americans and white Americans.

3 Media Bias Pre- and Post Charlottesville

Our example looks at the case of persistent racism by the US population towards African-Americans. In this example, we gauge public opinion by a broad range of media sources and compare the implicit bias towards the black and white population before and after a march of white-supremacists who expressed their overtly racist stances. Doing this, we use the Charlottesville rally as an event that serves like a nation-wide intervention of conscious-rendering. In this argument we draw on the mechanisms from the social psychology literature, which is focused on the effects of de-biasing on indi-

viduals. Analogously to social psychologists, which examine the effects on a group of participants, we examine a potential effect of collective conscious-rendering on public opinion, for which we use a large sample of media outlets and popular news blogs as proxy. Although the consumption of biased news can inform racially biased or racist believes, our focus in this research preliminary lies on the media as a proxy for public opinion and debate in society.

On 11 August 2017 the *Unite the Right* rally took place in Charlottesville, Virginia. The march consisted largely of white men, who self-identified as alt-right, neo-Confederates, neo-fascists, neo-Nazis, white nationalists and supremacists. The marchers chanted racist and anti-Semitic slogans, carried swastika and torches. Although the Charlottesville rally was previously announced, the level of racist slander, violence and the homicide committed by a rally member on the early morning of 12 August came as an as-good-as external shock, laying bare the perilous racism and its violent potential existing in US society. The intensity of overt racism and violence must have also evoked general concern among (at least a large part) of the public and caused a nation-wide debate. The Charlottesville rally serves as a treatment of collective feedback and evocation of general concern. If the bias-breaking mechanisms put forward by the psychological literature were to hold in the US case, we would expect a neutralisation of biases towards black actors. Indicators of such a neutralisation would entail that we would find neither a substantially more positive nor a substantially more negative bias towards black people in the post-Charlottesville media. We could also expect a new biasing effect, in which in a post-Charlottesville world, there would be more negative bias towards Caucasians.

4 Data and Method

Our media sample uses 97,542 online newspaper articles and blog entries from a variety of US and UK sources, spanning the period of 10 May to 11 November 2017. The sample includes mainstream and well-established newspapers such as CNN or The Guardian, fake news blogs and newspapers and satire sources as well as hyper-partisan political outlets such as Breitbart (Horne et al. 2018). The British media was included into the sample as the UK also has a large population, which faces structural negative bias, but also to increase article numbers. We removed sources with a very low publication output and processed articles by common methods of automated text analysis (Grimmer and Stewart 2012). In this process, we also removed short articles with fewer than 50 terms. This eventually resulted in a news sample of predominantly right-wing media, which will only allow us to infer shifts in bias in more conservative-oriented public opinion. Future research should use a more diversified sample across the political spectrum. The sources and number of articles for our final sample can be found in Table 1.

Figure 1 further displays the term frequency of the most frequent words of all articles that stem from the post-rally sample and include the term *Charlottesville*. While terms related to political actors and the rally itself appear very frequently, it is also apparent that the post-Charlottesville reports frequently discuss racism and violence. For this reason, we should unsurprisingly find an increased association between ethnicity of actors and terms such as *violence*, such that Caucasians are more closely associated with these terms after the rally.

Source	No. of articles
True Pundit	7313
Washington Examiner	6382
Breitbart	5964
BBC	5183
Drudge Report	4427
CNN	3391
New York Post	2920
The Huffington Post	2705
National Review	2610
Salon	2485
The Daily Beast	2321
RedState	2310
Politicus USA	2226
CBS News	2071
Daily Mail	2035
The Gateway Pundit	2017
Bipartisan Report	2011
CNBC	1870
TheBlaze	1757
Freedom Daily	1756
Vox	1711
The New York Times	1706
New York Daily News	1671
NPR	1589
RT	1585
The Political Insider	1523
NewsBusters	1498
ThinkProgress	1342
The Guardian	1332
USA Today	1294
Conservative Tribune	1286
Infowars	1282
Natural News	1259
The Duran	1211
The Atlantic	1208
The Daily Caller	1205
CNS News	1151
Counter Current News	1133
Fox News	1061
Media Matters for America	1050
The D.C. Clothesline	1036
PBS	1033
Talking Points Memo	1030
Yahoo News	1012
Daily Kos	997
The Right Scoop	925
The Conservative Tree House	658

Table 1. News sources and report counts.

However, in this work, we instead scrutinize whether the Charlottesville rally affected differences between ethnic groups not for terms directly related to racism and violence, but instead for positive and negative character traits. This allows us to examine racial bias for terms that are not directly related to the rally. We argue that we should only see an increased association between positive or negative character traits and ethnic actors post-Charlottesville if the rally affected the racial bias.

Thus, a stronger association of e.g. *black* and the word *friendly* after the rally would denote an increase of positive racial bias towards Africa-Americans. To operationalise both ethnic groups, we compile two sets of dictionaries, i.e. list of terms. We compile this list drawing on previous work that uses terms related to either African-Americans (black) or Caucasians (white) (Kozlowski, Taddy, and Evans 2018).

We then select terms that occur in our corpus using pre-existing dictionaries for character traits commonly perceived as positive (e.g. friendly) and negative (e.g. unreliable) (Gunkel 2019).

We examine bias towards African Americans with an automated text analysis approach relying on *doc2vec*, a recent variant of word embeddings (Mikolov et al. 2013, Le and Mikolov 2014). In comparison to bag of words approaches, which do not take into account the syntax of language (Grimmer and Stewart 2012), word embeddings can capture more complex semantic relations. Given enough training data this allows word embedding models to solve analogy tasks. For instance, the analogy problem *man is to woman as king is to ?* can be solved with the arithmetic operation *king - man + woman* applied to vectors learned from an embedding model, which would return the result *queen* (Kozlowski, Taddy, and Evans 2018). This powerful method is increasingly acknowledged by scholars and is, for instance, utilised to study the development of societal stereotypes (Garg et al. 2018) that are captured by algorithms trained on textual data (Bolukbasi

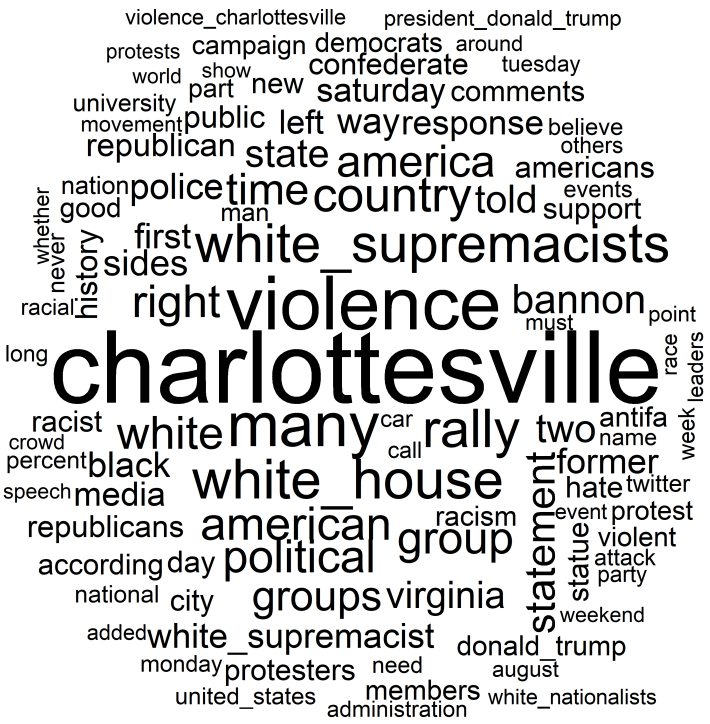

Figure 1. Word cloud of term frequency of all post-Charlottesville articles on the rally.

et al. 2016). In our paper, we instead focus on short- and mid-term developments of bias rather than stereotypes. We begin by training separate *doc2vec* models on articles published in two time periods, one three months before and three months after the rally. For each period, we train 20 models on bootstrapped samples of articles from the respective periods. The articles used to train each model are drawn at random with replacement. This allows us to not only examine biases before and after the Charlottesville rally but also to quantify uncertainty in our estimates (Kozlowski, Taddy, and Evans 2018). For each model, we project ethnicity on a polarity scale (Caucasian vs. African-American dimension) based on the ethnic dictionary. We then compute cosine similarities between ethnicity and positive as well as negative traits. This enables us to analyse the change in media bias towards African-Americans in comparison to Caucasians, as well as before and after the rally. In terms of research design, we are aware of the limitations of the causal claims we can make. We cannot randomly assign the *treatment* of the rally to a subset of the news outlets and therefore cannot control for possible confounders. However, our design still allows us to determine shifts in semantic associations between ethnicity and character traits before and after the rally.

5 Results

To examine whether the Charlottesville rally could have affected biases towards African-Americans, we visualise the results of the word embedding models using cosine similarities in Figure 2 (negative traits) and Figure 3 (positive traits). Due to space constraints we only visualise ten terms for each figure although the findings for negative and positive traits also apply to the remaining terms in our more comprehensive dictionaries.

Both Figures include the ethnicity dimension, where the left-hand side (negative values) is associated with Caucasian and the right-

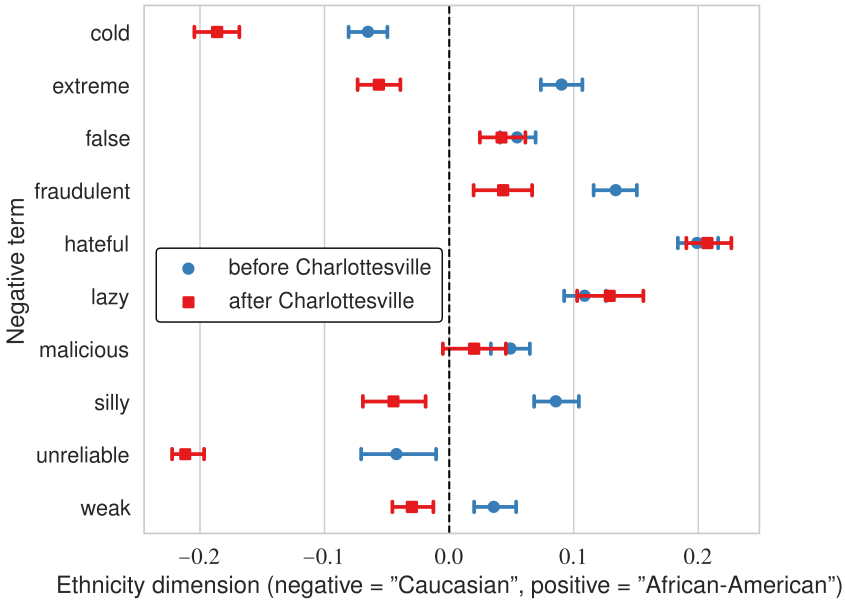

Figure 2. Cosine similarities with bootstrapped 90% intervals between ethnicity dimension and negative character traits.

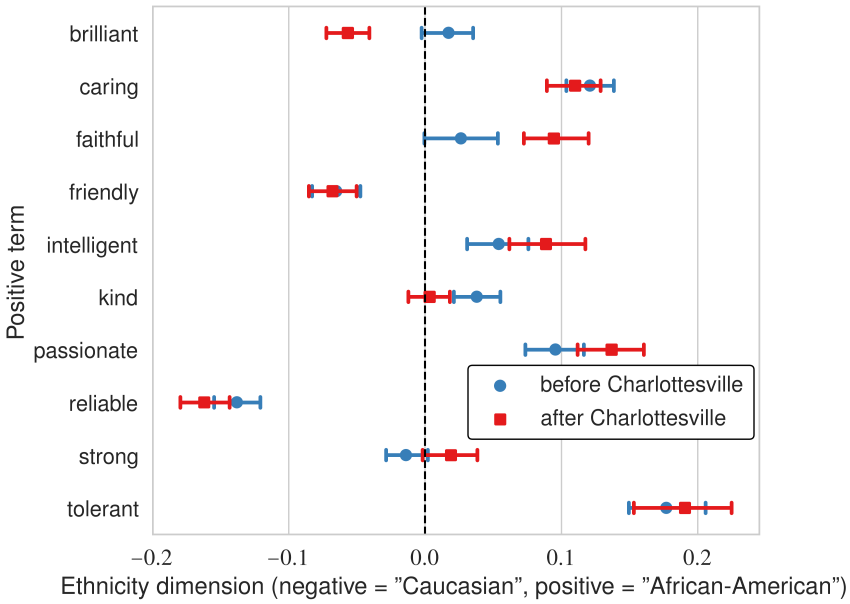

Figure 3. Cosine similarities with bootstrapped 90% intervals between ethnicity dimension and positive character traits.

hand side (positive values) is associated with African-American. Values for each term denote cosine similarities between the ethnicity dimension and the character trait. To give an example for the interpretation of the results, Figure 2 includes cosine similarities between the ethnicity dimension and negative term *silly*, both before and after the Charlottesville rally. Before Charlottesville *silly* was semantically closer to African-Americans. After the rally, the negative racial bias shifts, so that also the term *silly* is more closely related to Caucasians. This change in overall negative bias towards white actors in the post-rally

sample can also be observed with regards to the character traits in our dictionary that are not displayed in Figure 2. Unlike the negative character traits, the shift in positive bias between pre- and post-rally media reporting is minor, as can be seen in Figure 3. Bootstrapped intervals for the positive trait *intelligent* and other terms before and after the rally overlap, indicating minor or no differences.

Altogether, our findings do not suggest that there are any meaningful changes for associations between ethnicity and positive character traits. The similarities for positive terms in articles published after the Charlottesville rally are mostly in line with the similarities from articles published before the rally. However, the change in bias for negative terms is substantially larger. African-Americans are associated substantially less with negative character traits post-Charlottesville, while white actors are semantically closer to negative traits. These results suggest that at least for a short time period after the Charlottesville rally, articles in the digital media contained fewer associations between negative traits and African-Americans, i.e. a decrease in negative bias towards black people.

6 Conclusion

In this paper we set out to scrutinise whether the white-supremacist rally in Charlottesville in 2017 could have brought about any shift of positive and negative racial biases towards black and white Americans in the media. This research draws on social psychological concepts and mechanisms, such as IATs and bias-breaking interventions, and tests them on the aggregate level of American media. Theoretically, we could expect a de-biasing effect after the rally, meaning that there would be no notable difference between positive and negative associations of white and black people. Such a neutralisation could be the result of a successful bias-breaking intervention that renders individuals, or in our case the media, conscious of their previously held negative bias towards African-Americans and positive bias towards white Americans. To measure racial bias we compare the pre- and post-rally similarities of associations between ethnic terms and words for character traits. We find that there is no difference in pre- and post-rally media samples for positive associations, meaning Charlottesville did not seem to have had an effect of positive bias towards whites and blacks. However, we can observe a substantive overall shift in negative media bias towards black and white people after the rally. After the march, black people are associated less with negative terms than prior to the rally, while white actors are associated more with negative character traits post-rally. This holds despite of the fact that our sample comprises more right-wing than left-wing or centrist sources, so that we would expect to see similar but stronger effects in a more balanced sample of American news. Future research could build upon our work by looking into how and whether different segments of news outlets across the political spectrum adapt their implicit bias after such politically disrupting events. Scholars could also use the application of word embeddings in an experimental or quasi-experimental framework to isolate clear causal effects and test the theory of bias-breaking on the aggregate level of societies. Despite the shortcomings of our work, we seek to contribute to the literature on marginalized groups in digital societies, showing that media biases towards marginalized groups can temporarily decrease in the light of exogenous shocks.

7 Acknowledgments

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PROCEEDINGS OF THE WEIZENBAUM CONFERENCE 2019
CHALLENGES OF DIGITAL INEQUALITY
DIGITAL EDUCATION | DIGITAL WORK | DIGITAL LIFE

GROWING OPEN SCIENCE WITH THE COMBINED POTENTIAL OF CITIZEN SCIENCE AND AUTO SCIENCE

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Abstract

In this paper, we present our ideas on how to best support researchers in every phase of the research process when dealing with their research data.
We propose a *Research Data Portal* as the central data infrastructure. With the help of this portal, a researcher can easily manage and update his or her research data, share it with collaborators, and reach out to the public.
We further propose a *Citizen Science Portal*, which includes some new and innovative concepts and methods. In this portal, Citizen Science and Auto Science concepts are applied, and support to bring together the best of both worlds is provided. *Citizen Science* promises to entail the individual (scientists and hobby scientists) to help with research. *Auto Science* is meant to help analyze research data, e.g., to help publish the data and to help improve its quality, by applying methods from artificial intelligence.

Keywords

Research Data; Open Science; Citizen Science; Auto Science

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1 Introduction

The Weizenbaum Institute is an interdisciplinary research institute committed to Open Science. In the current start-up phase of the institute, we try to gain an understanding of a researcher's daily life and try to actively support it: (i) We need to understand how the researchers' individual research processes look like, what tools they use, and what research data they produce. (ii) In parallel, we try to design an Open Science-friendly environment, and try to motivate and support the researchers when working in this environment.

Our goal is to achieve *Open Science* sign, namely to install Open Scienc integral part of our institute's culture This has to be done on an organizat well as on a technical level. In this we will concentrate on the latter. As in Figure 1, we will focus on the sup

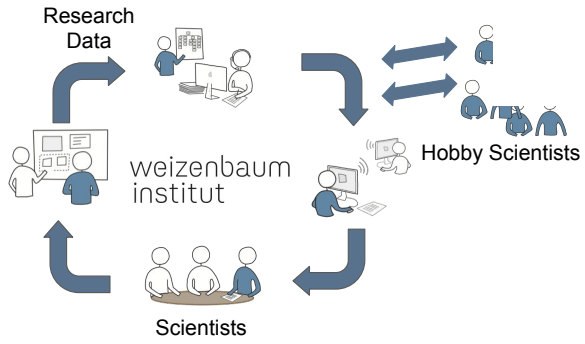

Figure 1: Scientists & Hobby Scientists

2 Vision

Our idea is to create an *Open Science Portal* (see Figure 2), which is tailored to the needs of the Weizenbaum Institute. The key idea is that we design and use this portal in our daily research. It mainly consists of two parts – a *Research Data Portal* and a *Citizen Science Portal*.

2.1 Research Data Portal

We see a *Research Data Portal* as the central point of a researcher's daily life. With the help of the portal, a researcher can easily manage and update his or her research data, share it with collaborators, and reach out to the public.

One essential feature is that it will provide a simple way of exchanging data with other tools, the scientist uses. One of our key design decisions is that a researcher will have a *Researcher's Identity*, and all of his or her research output is tied to this identity, in order

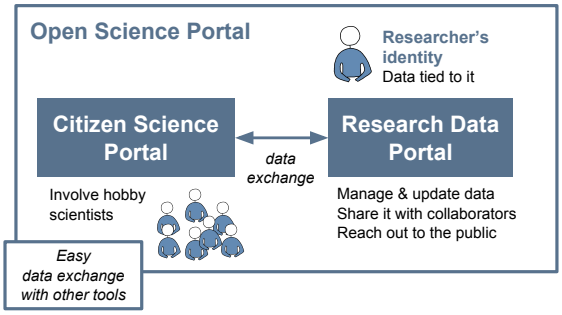

Figure 2: Open Science Portal for the Weizenbaum Institute

Challenges (i) While most research data platforms are tailored to a specific discipline, the platform is planned for an interdisciplinary environment. The main challenge here will be to find a good balance between generality and specificality.

Current Status In a first step, we have analyzed different open source research data platforms (cf. Wilkinson et al. 2016; Amorim et al. 2017) and evaluated three promising candidates in more detail: DSpace[1], Zenodo[2] and CKAN[3]. Based on this evaluation, we decided to use DSpace (Smith et al. 2003), as it

[1] duraspace.org/dspace
[2] zenodo.org
[3] ckan.org

matches most of our requirements, and as it is widely used among our partner institutions.
Following this first step, we have started to tailor this open source research data portal to our specific needs. We can base this on our experience in developing open data platforms, e.g., the European Open Data Portal[4], which was launched 3 years ago, has about 30.000 visitors a month, and encompasses over 860.000 data sets.
In parallel, in order to tackle challenge (i), we will stay in close contact with the different research groups and the different protagonists of the Weizenbaum Institute.

2.2 Citizen Science Portal

To further support researchers when dealing with their data, we want to apply new and innovative concepts and methods, which are integrated in a *Citizen Science Portal*. Our main idea is to apply Citizen Science and Auto Science concepts, and to bring together the best of both worlds. *Citizen Science* promises to entail the individual (scientists and hobby scientists) to help with research. *Auto Science* (Weber 2017) is meant to help analyze research data, e.g., to help publish the data and to help improve its quality, by applying methods from artificial intelligence.

Challenges (i) At the moment, many Citizen Science projects face the challenge that neither a critical mass of hobby scientists, nor people with the "right" background are attracted. (ii) Furthermore, hobby scientists are mostly involved in a crowdsourcing-fashion, namely to collect and clean data. Prominent examples from the USA are Galaxy Zoo (astronomy), Foldit (biochemistry) and Polymath (mathematics) (Franzoni and Sauermann 2014). (iii) Last but not least, new and innovative concepts and methods are needed in order to realize our *Citizen Science Portal* as envisioned.

Current Status To this point, we have completed our first proof-of-concept implementation of the Citizen Science Portal. In order to address challenge (i), the main idea is that large interactive screens will be placed in public, and that the Citizen Science projects will be executed in this environment. There exist similar ideas from the crowdsourcing-domain, e.g., (Goncalves et al. 2013).
As next steps, we will try to address challenges (ii) and (iii) by experimenting with some new and innovative interaction techniques as well as with Citizen Science and Auto Science concepts. In order to gain first insights, we plan to perform 2-3 Citizen Science projects from the research agenda of the Weizenbaum Institute.

3 Conclusions

In this paper, we have presented our ideas on how to best support researchers in every phase of the research process when dealing with their research data.
From our point of view, the most innovative potential of our proposal lies in the in-depth integration of *Research Data Portal* and *Citizen Science Portal*, and in the combination of Citizen Science and Auto Science concepts.

[4] www.europeandataportal.eu

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CHALLENGES OF DIGITAL INEQUALITY
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INCLUSIVE INNOVATION AND ENTREPRENEURSHIP IN THE NEW DIGITAL ERA

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ABSTRACT

The intensive digitization of society has coincided with rising economic inequality across the developed economies. Missing from the standard list of policy responses to rising inequality is the role of innovation and entrepreneurship. This paper argues that new digital business models, that capture value differently and share the wealth created more broadly, will be a necessary part of addressing technology-based inequality. This in turn will require more support for inclusive innovation and entrepreneurship, which will allow novel, alternative value models to emerge, and be given a chance to compete and succeed. Using a three-part model of the main modes of performance in the digital era—datafication, algorithms, and platforms—the paper will discuss skills and intervention that might help in making digital innovation and entrepreneurship more inclusive.

KEYWORDS

Technology-based inequality; Inclusive innovation; Inclusive entrepreneurship; Digital business models

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1 INTRODUCTION

The intensive digitization of society has coincided with rising economic inequality across the developed economies. The standard list of proposed responses to technology-based inequality include: education for new job skills; regulatory changes such as taxation, antitrust enforcement, and intellectual property reform; and technology inclusion initiatives for under-represented groups (Allen, 2017).

While these proposals are welcome, what is missing from the standard list of responses is the role of innovation and entrepreneurship in addressing technology-based inequality. The share of GDP paid in wages to labor is shrinking across developed economies, which, combined with the hollowing out of middle skill jobs (Autor, Dorn, Katz, Patterson, & Van Reenen, 2017), places limits on how much labor market upskilling alone can remedy inequality. On the business side, the ability of new entrants to challenge established digital platforms and ecosystems for the large profits created by digital transformation appears to be under pressure.

This paper argues that new digital business models, capturing value differently and sharing the wealth created more broadly, will be a necessary part of addressing technology-based inequality. This in turn will require more support for inclusive innovation and entrepreneurship, which will allow novel, alternative value models to emerge, and be given a chance to compete and succeed. Using a three-part model of the main modes of performance in the digital era—datafication, algorithms, and platforms—the paper will discuss skills and interventions (Allen, 2019) that might assist in making digital innovation and entrepreneurship more inclusive.

2 INNOVATION, ENTREPRENEURSHIP, AND TECHNOLOGY-BASED INEQUALITY

The intensive digitization of societies and economies has created tremendous economic value (Allen, 2017) which, when captured by a specific business or organization, becomes economic wealth. Studies of business strategy and entrepreneurship have long distinguished between value creation and value capture (Bowman & Ambrosini, 2000)—the inventor who creates a brilliant new device may or may not profit from their invention, depending on the mechanisms they use to capture part of the value they have created.

Private sector wealth in the past four decades has shifted from primary economic sectors (such as energy, commodities, and materials) to the more virtualized sectors of digital technology and finance, as measured by stock market capitalization. A challenge for increasingly unequal economies is to make digital wealth creation more inclusive. Despite the scarcity of digital job skills, labor markets alone have not been successful in sharing digital wealth more broadly. It is likely that the ways that businesses create, capture, and share economic value—their *business models*—will need to evolve and change. New business models, guided by different values, are more likely to emerge if innovation and entrepreneurship in the business sector is more inclusive of people with different values and goals.

While the past 40 years of intensive digitization has not led to self-corrections in economic inequality, digitization may be entering a new chapter where the pressures toward wealth concentration may be even more intensified—our new era of ‘data science’.

3 THE NEW DIGITAL ERA

The digital era we have known of the past 40-50 years can be summarized by three key value creation processes, or *modes of performance*: Information, Automation, and Communication. Information is the capture of representations of the world, and the relationships between them, that allow things to be processed and stored digitally. Automation is the replacement of a real-world process by its digital equivalent. Communication is the error-free transfer of information from a sender to a receiver. Each of these processes creates economic value by exchanging 'bits for atoms', making activities potentially millions of times faster and cheaper.

These traditional digitization processes can be thought of as laying the groundwork for a new digital era of 'data science'. The analogous modes of performance in this new era can be characterized as Datafication, Algorithms, and Platforms. Rather than explicitly capture and model (somewhat scarce) information, the datafication process creates an abundance of data, composed of the data traces left behind by all digital activity, human and non-human. Value is created by finding unique insights across this vast and growing data landscape. Algorithms, rather than being step-by-step replacements of previous processes, are prediction engines that, with enough data, are able to train themselves through machine learning techniques. And platforms, rather than focusing on point-to-point communications, provide a digital space to connect people and technology through digital mediation (Allen, 2017).

A quick example to illustrate the difference between the previous and new digital era: the Amazon 'Echo Dot' home smart speaker. In terms of the original information era, the Echo Dot creates value by assembling an impressively cheap processor, memory, audio processor chip, and WiFi radio for connecting with fast home networks in turn connected to the Internet. Sophisticated voice recognition in the home comes courtesy of the Amazon Lex cloud-based service that offers natural language translation for less than one US cent a request. This allows home entertainment tasks and purchases to be automated through voice, using a device costing less than $40 US. Viewed as a new digital era device, however, the Echo Dot depends on the use of natural language algorithms, trained through massive conversational and written data sets. This encourages the constant collection of new data, along with the mining of existing data sources collected for completely different purposes, as seen in the recent case of Alexa training using reddit.com conversations, leading to a recommendation to 'kill your foster parents' (Durkin, 2018). The Echo Dot is connected to the Amazon commerce platform, which has complete control over which products consumers see for sale. Voice commands make the mediation effect even stronger, as consumers are usually only presented with a single choice through an audio interface. The value created and shared depends greatly on the datafication, algorithms, and the platforms used.

Key to the economics of this new digital era is its enthusiastic embrace by businesses. The transition to the first digital era took place over decades, slowed by return-on-investment calculations that juxtaposed the value of digitization with the massive time and money investments required to create data stores, capture processes, and build a communications infrastructure. Now that these investments are in place, business is engaging in a thorough embrace of digitization that is not only economic, but even cultural. Far from being fearful or anxious of new technology, the business world is embracing the opportunity to turn a resource they now have in abundance (data), and little idea of what to do with it, into a seemingly miraculous source of value through prediction. Based on technology that feels a bit like a magical black box because, at least in the case of neural networks with hidden layers of 'deep learning', it kind of is. The new algorithms then become an occasion to restructure and reconfigure their own internal processes, based on the 'reality' of data.

In the next three sections, we offer brief examples of how these main performance modes of the new digital era might affect economic inclusion.

4 Datafication and Economic Inclusion

The data traces left by datafication are being used for new kinds of predictions throughout society and the economy. For inclusion via labor markets, datafication might reinforce existing trends towards the 'hollowing-out' of middle skill jobs, leaving behind only a small number of highly skilled quantitative jobs, together with a mass of low-skilled jobs that fill in the gaps of what can be performed automatically. In spite of this predicted trend, we should be on the lookout for new emerging job roles in our increasingly datafied world. For example, both Google (through their YouTube subsidiary) and Facebook will be hiring almost as many content reviewers and curators as engineers over the next few years, according to their hiring plans (Iyengar, 2017).

Another interesting example comes from the world of predictive policing, one of the great data science success stories of recent decades. While predictive policing opens up many questions of bias and reinforcement of the societal status quo, at the level of work it highlights potential new job roles.

A study of policing in the Netherlands has investigated a new job role that stands between the data scientists creating predictive models, and the day-to-day work of police on the streets (Waardenburg, Sergeeva, & Huysman, 2018). This new role, called an 'intelligence officer', interprets the output of the predictive model, and assembles a daily briefing for patrol cops that highlights certain information, and combines it with their own unique local knowledge. Wherever gaps appear between prediction models and action, there is the potential for both skilled labor, and for new entrepreneurs to find productive niches.

5 Algorithms and Economic Inclusion

The modern notion of algorithm, taken from the world of computer science and mathematics, promises greater objectivity and predictive power in a realm of pure mathematical problem solving, while at the same time re-opening classic questions about the control and accountability of technology (Smith & Marx, 1994). Within its calculations are embedded specific choices about the selection of problems ('requirements'), the definition of desirable outcomes, and selection of data ('training sets'), each of which reflect the value of the people controlling the algorithm.

One example of entrepreneurship using algorithms is the recent story of Predictim, a startup using social media data to predict whether a potential baby sitter might harm a child (Patterson, 2018). The data engineers founding the startup saw an opportunity to opportunistically scrape pre-existing data (social media posts on Facebook and Twitter) and apply machine learning techniques to create scores predicting potential harmful behavior, drug use, and 'disrespect' from potential teenage baby sitters. Unlike in laboratory examples of machine learning, it is unclear that these data science entrepreneurs had any special expertise in human behavior, or any reliable data on whether potential babysitters actually engaged in any of these behaviors. If these tools became widespread, how might it exclude certain classes of baby sitters based on the language of their posts made for entirely different reasons? In the end, the startup was put on hold after being blocked by Facebook and Twitter, illustrating the challenges of relying on the giant technology platforms for value creation.

Another kind of algorithmic example comes from the fashion startup Stitch Fix. Starting as a fully digital company in this new era, it prides itself on being a completely "data-driven clothing company using AI at virtually every aspect

of its business, with its own algorithms department staffed by 100 data scientists." (Johnson, 2018) As described by its 'Chief Algorithms Officer', Stitch Fix uses algorithms to drive every aspect of its business: "Algorithms help pick out clothes sent to customers in the mail, choose the clothes kept in inventory, assist with client communications, and have even started to design clothes. A computer vision algorithm ingests the Pinterest Pin boards to keep track of things customers found online that they love." To the extent to which this vision correctly describes a new entrepreneurial opportunity, the only way to participate in value capture and sharing will be to be involved in the creation of these new ventures, not through a middle- or low-skilled labor market.

6 Platforms and Economic Inclusion

In the new digital era, many economic and personal interactions are mediated through platforms run by large technology companies. These platforms are able to amass uniquely detailed data sets, and use algorithms to decide what will be communicated, and who will be connected. The algorithms themselves can be set to optimize outcomes favoring whatever business model they choose. For advertising driven business models, for example, the algorithms can optimize on 'engagement', or time on site. Anyone seeking to innovate in these spaces has to navigate between these giant pre-existing platforms.

One recent example is the 'Up Next' recommender algorithm for videos used by YouTube. The videos recommended by YouTube can favor those that lead to highest time on site, not necessarily the highest quality or even mildly accurate videos. For example, one study of YouTube searches during the 2016 US presidential elections revealed that when searching the names of the candidates, there was a high incidence of "anti-Clinton conspiracy videos" being recommended by the algorithm, rather than official information from the campaigns or high quality news outlets. "There were dozens of clips stating Clinton had had a mental breakdown, reporting she had syphilis or Parkinson's disease, accusing her of having secret sexual relationships, including with Yoko Ono. Many were even darker, fabricating the contents of WikiLeaks disclosures to make unfounded claims, accusing Clinton of involvement in murders or connecting her to satanic and paedophilic cults." (Lewis, 2018). Similar investigations also claim that searches for information on topics such as evolution, climate change, and vaccination tend to favor extreme points of view and conspiracy theories. These platforms have created and captured tremendous wealth through advertising, but has concentrated this wealth in relatively few hands.

Another recent example: the challenge that Amazon sellers will face getting visibility through the Alexa voice interface, as mentioned above. "The first problem for businesses is figuring out how to survive in a world where algorithms are starting to take more and more decisions away from consumers. For example, if I order something through my Alexa, rather than giving me every option on Amazon, Alexa's algorithms will present me with at best one or two choices." (Ravindran, 2018) Trying to navigate a world dominated by large platforms will be a major inclusion challenge.

7 New Entrepreneurial Skills

What are the new skills that will allow entrepreneurs to thrive in a world of datafication, algorithms, and platforms to create new digital business models? One answer is to train more entrepreneurs to be coders and data scientists. However, this does not solve the inclusion problem—it arguably makes it worse.

There are other ways for entrepreneurs to take advantage of the platforms, data, and algorithmic capabilities discussed above. Allen (2019) offers a definition of digital entrepreneurship that includes a set of core skills, and a set of higher level capabilities that present new opportunities. The core skills start with choosing a business model, and positioning relative to existing competition. Many of the new digital models, such as content-based businesses, community-based businesses, or promotion, do not require extensive coding or math skills to start. Even more traditional models, such as an online store, are easy to launch from a technical point of view.

Other essential digital entrepreneurship skills include customer acquisition and digital marketing, prototype building, analytics, and user experience design and testing. Online services are available that allow the non-technical entrepreneur to being acting in each of these skill areas, with the possibility of increasing their effectiveness as they engage more intensely. The higher-level entrepreneurial capabilities include the ability to create or get access to better data than current solutions, and the ability to experiment with different products, customers, and business models.

Breaking down the digital entrepreneurship challenge into specific skill paths, whether using this scheme or others still to be proposed, will be one of our best tools for managing the complexity of this new digital era, and inviting and including people of many backgrounds to be digital innovators and entrepreneurs.

8 Conclusion: New Digital Value Sharing

How open is this new digital economy to new entrants, and the kind of innovation that would change how the value created by digitization is shared? Accountability to society at large comes in many different forms. In the world of private business, it comes from accountability to regulators, to investors, to competitive labor markets, and above all to competitive consumer markets. In terms of introducing new business models, business accountability comes largely from new entrants, namely entrepreneurs, competing for profits. There is some evidence of increased market concentration in most industries, as well as pressure on new firm formation rates. Without new innovators and entrepreneurs, economic and social accountability will suffer.

One aspect of the inclusion problem pointed to by this diverse set of examples is the problem of introducing new business model innovations that will share value more widely. A business model describes at an abstract level how value is created for all parties, but more typically and specifically refers to how a business makes money by fulfilling a customer value proposition. Entrepreneurs search for a viable business model in their startup phase, later entering a period of optimizing an existing business model that already works to some degree (Ries, 2011). Increasing the ability of a broader set of entrepreneurs to search for viable new digital business models will be crucial. This goes beyond teaching the mechanics of coding and machine learning.

While keeping an eye out for emerging job roles that will rise in the inevitable disconnects between algorithms and reality, our main proposal is to radically increase societal ability to engage in digital entrepreneurship (Allen, 2019). Digital entrepreneurs can be taught to quickly prototype their business ideas online, create and/or access unique data sets, perform rapid experimentation, and be ready to shift between different business models as they learn more about their business ideas. Any content, discussion, existing business, or group can be turned into a small-scale business at first through multiple revenue models such as advertisements and referrals, sponsorships, transactions, sales, or even donations. At least part of the solution to inclusion should involve more entrepreneurial skill building in

the context of the new digital era, with entrepreneurs who are able to navigate and take advantage of giant platforms, complex and opaque algorithms, and unique data sets.

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CHALLENGES OF DIGITAL INEQUALITY
DIGITAL EDUCATION | DIGITAL WORK | DIGITAL LIFE

CITIZEN SCIENCE AND THE DISSOLUTION OF INEQUALITIES IN SCIENTIFIC KNOWLEDGE PRODUCTION

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ABSTRACT

Recently, a larger public has started to critically discuss scientific knowledge and its role in political decision making. In this discussion, scientific and civic epistemologies are put into connection with each other. Just as post-democratic theory argues in relation to political decisions, the production of scientific knowledge is criticized as a non-inclusive process, too. The Citizen Science movement tries to resolve this deficit by involving citizens into research. In this paper, we introduce agency as an analytical category into the discussion, focussing on how participants are represented in Citizen Science. We highlight the interdependencies between the degree of agency granted to the participants in Citizen Science projects and the degree of their representation in knowledge production.

KEYWORDS

Citizen Science; Civic Epistemologies; Post-Democracy; Digital Knowledge Practices; Representation

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1 INTRODUCTION

The relevance of scientific knowledge and expertise in political decision-making processes is commonly acknowledged. Politicians and political bodies legitimise their decisions and arguments referring to scientific knowledge or expert committees that deliberate questions at hand. These negotiations between political stakeholders and experts are central in the process of how societies come to know and have been referred to as civic epistemologies (Jasanoff 2007).

Interestingly, this epistemic dimension of politics has recently become contested in two ways: (i) Political parties and movements increasingly criticize democratic institutions for strong biases and elitist structures, arguing that the governance of stakeholders and experts undermines democratic values, thereby fostering inequalities (Crouch 2004). This critique finds its preliminary climax in the discussions about "fake news" and "alternative facts", focusing on a lack of representation in the construction of commonly shared social realities (Beck 1992).

(ii) At the same time, not only the democratic institutions but also academia and the practices of scientific knowledge production are problematized. Evaluation processes with their specific logics have become central for academic careers (Espeland and Sauder 2007), undermining ideal scientific values (Merton 1973). For instance, more than half of 1,500 surveyed scientists assumed a significant reproducibility crisis (Baker 2016). As a result, a lager public is questioning scientific authority and expertise.

The critique of expert governance and reliability of scientific knowledge is the starting point of our argument. In this argument, we want to show that both phenomena are expressions of a more general problem that politics faces: a lack of public **representation in civic and scientific epistemologies (Section 2)**. We will introduce Citizen Science as a means of **(digital) participatory knowledge practices (Section 3)**, promising to resolve representative deficits. Furthermore, we will introduce **agency as an analytical category to distinguish two major participatory practices, which are both labelled as Citizen Science (Section 4),** but are also fundamentally distinct in how they address the issue of (digital) equality.

2 REPRESENTATION IN CIVIC AND SCIENTIFIC EPISTEMOLOGIES

In order to understand the commonalities of civic and scientific epistemologies, we draw on insights of science and technology studies. With Thomas Kuhn (1964), the perspective on science shifted from a process of knowledge accumulation, resulting in objective truth, to practices of contingent negotiations of what truth, reality or facts are. The social and material aspects of knowledge production were investigated by Collins (1975), Latour and Woolgar (1979), and Knorr-Cetina (1981), showing multitude logics, values and valuations inscribed in knowledge and technology genesis.

From these investigations, two major insights can be drawn: Scientific knowledge production has its own politics and, more importantly, there are many ways of knowledge production, accompanied by various forms of expertise (Collins and Evans 2004). In conclusion, civic and scientific epistemologies have to negotiate the same constituting decisions: They need to decide whom they consider as speakers and which politics they follow. From this perspective, the critique on scientific knowledge production becomes structurally similar to arguments of post-democratic theory: democratic (and scientific) institutions diminish their representation due to technocratic or scientific governance.

Accordingly, in the discourse of scientific epistemologies, scientific governance is associated with an absence of representation and participation. This perception also aligns itself with feminist STS scholars, who have raised longstanding criticisms against the exclusiveness of scientific knowledge production (Keller 1995).

3 DIGITAL, PARTICIPATORY KNOWLEDGE PRACTICES

The Open Science movement tries to resolve the exclusiveness of science by making research results and data publicly available and by involving citizens into research practices. The latter is referred to as *Citizen Science* and focuses specifically on the social dimension of openness in scientific knowledge production (addressed in section 2). Citizen Science aims to integrate scientists and non-scientists into the research process and therefore offers the opportunity to represent a broader public in scientific knowledge production. Similar to online participation in governance, Citizen Science is an evolving digital practice, mostly utilizing online participation to facilitate research projects. Prominent examples in the US are Galaxy Zoo, Foldit and Polymath (Franzoni and Sauermann 2014). However, there is no definition or theory what Citizen Science is or should be, subsuming a variety of practices, such as crowdsourcing of data analysis (Galaxy Zoo), public participation in policymaking (Irwin 1995, Haklay 2013, Eitzel et al. 2017) or data collection through game play (Foldit).

4 AGENCY AS ANALYTICAL CATEGORY

Since Citizen Science aims to be a democratic way of knowledge production, the symmetry between civic and scientific epistemologies offers the means to distinguish between democratic and post-democratic practices in science (Latour 2004). To understand this difference, we take equality as one of the core values of democracy into account (Dewey 1888). Therefore, we introduce agency as central category to analyse Citizen Science practices. As Bogner (2012) has criticised, participation can be a formal act, without any consequences for the actual political process of deliberation. It is therefore important to not only enable participation, but to distribute power between the participants. That means, to give them agency. Democratic knowledge production in that sense takes the perspective and expertise of the participating citizens as serious as the expertise of the participating scientists. The central point is the inclusion of all participants equally, without predefined hierarchies and with their individual expertise.

By considering these two elements, we find differences in Citizen Science projects. If citizen scientists act as sensors or data collectors by counting birds (Bonny 1996), the participation is utilized in a predefined hierarchy and without inclusion of individual expertise. In contrast, citizen scientists who analyse and interpret texts (Benoit et al. 2016), bring their own perspective into the analysis – thus their individual social reality is represented. Therefore, the degree of agency given to the participants in Citizen Science projects becomes crucial for their representation in knowledge production.

Taking this perspective, there are currently participatory practices, labelled as Citizen Science but distinct in how they promote the democratic norm of (digital) equality: On the one end, crowdsourcing scientific work, using citizens as sensors or data collectors, and on the other end, empowering citizens by involving their perspectives and expertise into knowledge production. From our point of view, only the latter should be called Citizen Science.

5 CONCLUSION

In our contribution, we highlighted that civic and scientific epistemologies are both contested concerning their structures of representation and knowledge politics. Citizen Science aims to include citizens into knowledge production, increasing representation through participation. We argued that it is crucial that citizen scientists gain agency, meaning that all participants are included equally without predefined hierarchies and with their individual expertise, in order to be involved as scientists. In conclusion, only knowledge practices that give agency to their participants should be called Citizen Science.

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INFLUENCE OF INFORMATIZATION ON WORKING ACTIVITES IN THE INFORMATION TECHNOLOGY BUSINESS – AN APPROACH FOR AN ANALYSIS FRAMEWORK OF LABOR CAPACITY

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ABSTRACT

The effects of the digitization of the work provide companies and educational institutions uncertainty. Therefore new future working skills of employees will be necessary. This applies in particular to those employees in the field of information technology who are particularly affected by digitization and who mostly perform on the technologically cutting edge of information technology.
The practical part of this article aims to present an analysis model which explores the work activities of IT specialists through quantitative and qualitative analysis methods and shows which informal skills are placed in the work activities of the employees. A methodological triangulation should enable a multi-layered view of work activity. The developed framework will be discussed during the conference contribution in order to enable reflection and improvement of the approach with the aim of enabling a good practice for other researchers.

KEYWORDS

Informatization; Digitalization of work; Labor Capacity; Working Assets; Agile Work;

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1 Introduction

Information has become a pillar for value creation in this time of digital capitalism (Schiller 1999) within the structural change of the society from industrialism to informatization (Castells 2001; 2003) in which value is created digitally and globally. For the future education of employees, it is mandatory to understand which (informal) personal skills need to be developed to work in companies, which fulfil agile or hybrid working strategies.

The research project OPEN IT (Städler et al. 2018) analyses those skills within the working world of IT workers. The focus of the research project is to construct, test and evaluate IT study programs. Those take IT workers' competencies from the field of IHK education (DIHK 2010; Rogalla and Witt-Schleuer 2004) into account to reduce academic workload.

2 Informatization and Labor Capacity

Informatization describes the process of generating and using information (Schmiede 1996: 27) for value creation. In capitalist production, a shift from material to immaterial products has taken place. The informatization of the working world (e.g. Schmiede 1996; 2006; Boes and Pfeiffer 2006) means that services and production processes are decentralized continuously, virtualized as well as offered and provided internationally (Boes and Kämpf 2006). In the context of this change, information technology allows the globally organized production capital a smooth, distributed production and exercise of services (Boes and Kämpf 2011) as well as the realization of global and virtual project work (Will-Zocholl 2016). The progress of the computerization of work is favored by the information space created by computerization (Boes and Kämpf 2011: 56-63), especially on the Internet (Boes et al. 2014). The central assumption of informatization is that services and production processes are increasingly digitized and distributed in a global context within decentralized and virtualized work. For the future development of capitalism, it is essential to expect how capital can generate further value. It is essential to reflect the Marxism terms of real and formal subsumption (Marx 1979: 431-440). Real subsumption is the classification of living labor into the production process through standardization and formalization (Schmiede 1981). In formal subsumption, capital, its benefit solely through the formal subordination of a production process into a capitalist system. The production itself, in the information space and of application and IT products, is already following standardized *patterns* to organize development processes (Böhle et al. 2008: 93).

The necessary qualification for the development of products is beyond conventional formalization and categorization, and soft skills such as communication skills, the ability to work in a team, or creativity and the ability to improvise are gaining importance. In addition to the classical qualifications that workers must bring, various skills are difficult to formalize. They concern cognition as well as informal *soft skills* that play a role in agile organizations. The concept of work capabilities tries to make this informal knowledge and skills empirically tangible (Pfeiffer 2004).

Labor capacity can be a key aspect of the computerized economy: „The qualitative and social essence of work is displayed in laboring capacity;… The comprehensive forming and application of the senses, living working knowledge with its objectified (but not yet objectified) and non-objectified shares of experiential knowledge and, finally, capabilities of the situational concretizing application of theoretically-grounded knowledge or theoretically-grounded procedures and methods." (Pfeiffer 2014: 610-611). The subjectivation of labor action as a phenomenon of living labor ability understands experience not as a static accumulation of routines, but as a particular way of dealing with things, people, and situations (Pfeiffer and Suphan

2015). For some time, employers themselves have been expecting virtues and qualities from employees in addition to technical skills (Opaschowski 2006). Those requirements go in line with analysis, which examines job descriptions (Kanning 2007: 13-19). Since the end of the 1990s, those descriptions have shown an increase in the requirements for social competences in job advertisements.

Suphan and Pfeiffer (2015) propose an analysis of labor capabilities (AV index) and the associated capacity to work. Their analysis focuses on the questions of a German labor analysis conducted by the Professional Institute for Education and the Federal Institute for Occupational Safety and Health in 2012 (Rohrbach-Schmidt and Hall, 2013). They different the selection of 18 questions into three separate divisions: Situational handling of complexity, Situational imponderables and Increase in structural complexity. The results of the three sections are multiplied by the relevance of experiential learning for the job.

3 Research and Data Analysis

In order to meet the demands of work in a computerized world, the following question arises: *Which working competences and working abilities must employees have - especially in the area of IT workers, who are particularly affected by digitalization?*

Based on the theory of informatization and the approaches of working asset analysis a triangulated research design is performed to understand the working worlds of IT workers. A contrast between traditional and agile working assets in the IT departments will be the result of the analysis.

In the first research step, the questions of the AV index (Pfeiffer and Suphan 2015), extended by quantitative questions on work activity, and are used to gain an impression of the group structures and hierarchical levels in companies.

Based on the results of the first research step, interviews with different roles within IT and IT projects will be conducted in the second step. This second step is planned as a set of intensive interviews based on narrative depth controlled by impulse questions. The qualitative data collected will be used to support the quantitative statements on roles and for the formation of inductive categories (Berger-Grabner 2016) for work activities. The interviews will be accompanied by a description of the respective workplace and working environment.

The information collected in the second step is used for the third and final analysis for inductive category formation. In the observation in the third step, employed persons in companies will be observed in group discussions (Kauffeld 2005: 290) and structured within interactions (Lamnek 2010: 509-510; Kauffeld 2005: 275).

The focus in this last step is on the differentiation of the interaction in project sprints and process steps, customer interaction and administrative management.

4 Conclusion

The results will provide information about those kinds of skills, which are necessary for self-determined work and display how different approaches result in several types of outcomes.

The results should display the inequality in the analyzed workforce regarding work behavior, working assets, labor capacity and the dedicated requirements to fulfil within an agile and traditional working place. The results will be used to define a framework for scientific education offers as well as for the participation of employees and the necessary participation of companies.

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PROCEEDINGS OF THE WEIZENBAUM CONFERENCE 2019
CHALLENGES OF DIGITAL INEQUALITY
DIGITAL EDUCATION | DIGITAL WORK | DIGITAL LIFE

THE RIGHT TO WORK AND FINDING WORK: THE INACCESSIBILITY OF PRIVATE AND PUBLIC SECTOR CAREER PORTALS

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ABSTRACT

The right to participation in society for people with disabilities is relatively well established in national and international law and convention (UNCRPD), and increasingly in social norms. These rights include the right to work.

The majority of job opportunities today are advertised and applied for almost exclusively online in digital form. In late 2017 we performed both automated testing of career sites against WCAG 2.0 and BITV standards and a multi-day detailed laboratory observation of visually impaired and blind testers applying for jobs across 10 German organisations in the public and private sectors. The tests note significant problems with the accessibility of the career sites, both in terms of standards compliance and practical use testing. This study illustrates the barriers that digital technologies can create for people with disabilities. This paper will highlight and classify these issues, explore their causes, and briefly suggest improvements for software developers, employers and regulators.

KEYWORDS

Accessibility; Recruitment; Software; Web; BITV

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1 Accessibility Study Of German Corporate Career

Various laws, treaties and regulations aim to address discrimination of people with disabilities. Today, the internet is the dominant channel for employers to advertise vacancies, and to engage with candidates. Recruiting software is now highly sophisticated.

This study examines the accessibility of the career sites of 7 large German multinationals and 3 Public Sector organizations, using both automated testing tools, and blind and visually impaired users using the websites.

2 The Right To Work

Article 27 of UNCRPD[1] obliges states to recognize the right of persons with disabilities to work, on an equal basis with others. (Fasciglione, 2015). Similar rights are created by EU Directive[2] and in national law, for example the AGG[3] and the BGG[4] in Germany. Additionally Article 3 of the German Constitution states that no person shall be disfavoured because of disability and Article 12 establishes occupational freedom. Social law in Germany aims to protect the rights of workers and those seeking work, and also specifically attempts to encourage employers to provide work for people with disabilities[5]. We examine whether technology supports or hinders that right to work.

3 Earlier Studies

While there have been various studies of website accessibility (Kuzma, 2010; Wentz *et al.*, 2014; Acosta-Vargas, Lujan-Mora and Salvador-Ullauri, 2016) and some on career sites, we were unable to locate any study of German corporate career sites. A study in the US investigated the accessibility and usability of job application websites for the blind (Lazar, Olalere and Wentz, 2012). This study did not just test for standards compliance, but it tested real world usability by having blind users conduct hands on applications. The results showed that less than 1/3 of the application attempts could be done without assistance.

4 Approach To Testing, Test Subjects And Test Design

Automated testing, while it is useful in picking up many accessibility errors, has many limitations. The most effective way to test for accessibility is to have testers who have the disability you wish to test against. In order to assess the websites as completely as possible, and to explore the gap between automated testing assessment and actual user feedback, automated testing, screen recordings, a user survey, video interviews and direct observation were deployed.

4.1 LAB ASSESSMENT AND OBSERVATION

The SZS[6] at the Karlsruhe Institute of Technology provides assistance to visually impaired and blind students, and researches assistive technologies, and the testing took place in the SZS lab. 4 students volunteered for the testing. The testing was run over the course of 4 days in Nov./ Dec. 2017, with two students per session.

All screen activity and computer voice were recorded, and the authors attended all the sessions, took notes, asked questions and made video of the testers in action, and interviewed them at the end of the assessment.

[1] United Nations Convention on the Rights of Persons with Disabilities

[2] Council Directive 2000/78/EC of 27 November 2000 establishing a general framework for equal treatment in employment and occupation

[3] Allgemeines Gleichbehandlungsgesetz. General Act on Equal Treatment.

[4] Behindertengleichstellungsgesetz. Equality for Persons with Disabilities Act.

[5] SGB IX: Rehabilitation und Teilhabe behinderter Menschen (Rehabilitation and Participation of Disabled People)

[6] www.szs.kit.edu Study centre for the visually impaired.

Name	Disability level	Assistive technology	Academic field	Academic degree
User 1	<5% view left	NVDA (screen reader)	Chemistry	Masters
User 2	15% view left	Zoomtext (magnifer)	Computer Science (FH)	Bachelors
User 3	Blind	NVDA/Braille	Computer Science (FH)	Bachelors
User 4	Blind	NVDA/Braille	Computer Science	Bachelors

Table 1. Background of users for lab test.

The choice of organizations was based organizations that the testers were curious to test, taken from a longer list of large German companies. For the public sector, a mix of large and smaller organizations were chosen. For the purposes of this publication, we have withheld the organization names.

The testers were asked to find a role that they would be potentially interested in applying for, for instance, student placement in the IT department, thesis assignment, or first level job.

4.1.1 KEY FINDING

None of the sites were completely accessible without some assistance. In some cases, the assistance was minimal, in others it involved actually taking control of the computer. Most of the private sector sites had many basic accessibility errors. Public sector sites were somewhat more compliant in terms of accessibility navigation and controls, but were sometimes overly complex from a generic usability perspective.

The descriptions below are based on the real time perceptions, frustrations and successes of the users, and a detailed analysis of the screen recordings. The high level WCAG 2.0 principles influenced the analysis (Perceivable, Operable, Understandable, and Robust).

4.1.2 FINDING THE CAREER AND JOB SITE

Rather than going to the corporate home page, and then searching through the menu for the ca-reer or jobs section, all the testers went to Google and searched on company name / jobs. In almost all cases this brought up the correct site as the first link on the google search, although in one case the user clicked onto an external job board which had bought the advert listing at the top of search result. The test users commented that they found Google search easier to navigate than trying guess menu names and navigation paths on the corporate website. No one used the website's own search bar to find the career page starting point.

4.1.3 SEARCH NAVIGATION

All sites had some navigational issues, but searching /narrowing down the selection was often very problematic. Several sites used maps for search navigation (fig. 1), these were generally inaccessible. For example, this high-level selection of the type of role was overly ornate (fig. 2), and without alt-text. To navigate this, the tester required sighted user assistance.

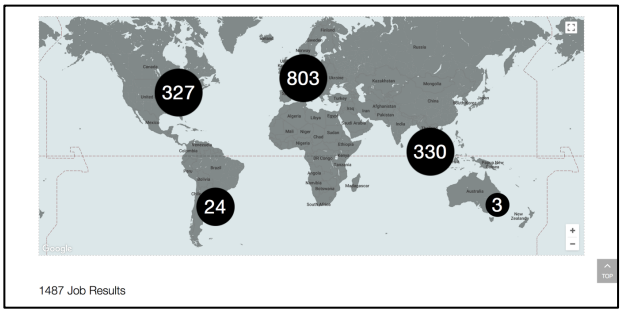

Figure 1. Map inaccessible for screen reader.

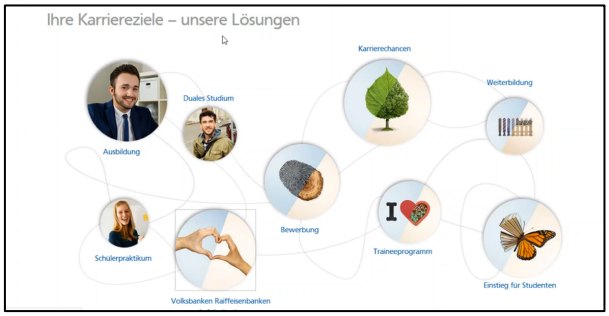

Figure 2. Pretty but awkward navigational metaphor.

4.1.4 PDFS FOR HELP, ETC.

When the test users realized that they needed to open a PDF, they all mentioned that PDFs are often a major accessibility challenge. This mirrors other research on PDF experience (Wild

and Craddock, 2016). A document describing the application process and flow was completely inaccessible to the screen reader. It read every letter out. All other PDFs they encountered were also difficult to read, as they were not formatted to be accessible. Typically, this meant that the whole document needed to be clicked through word by word, or even letter by letter. Most images in the PDFs lacked alt-text. For long documents such as privacy statements requiring acknowledgement, this was particularly problematic, and without sighted assistance, PDFs were a showstopper on several sites.

4.1.5 VERBOSITY OF TEXT AND IMAGES

Most of the career sites had a lot of marketing text/images, which a sighted person would skim over. Screen reader users don't have that opportunity to skim text, and when the text is both verbose and awkward to navigate past, frustration levels rise. Users who have to listen to sound of the screen reader appreciate concise marketing.

4.1.6 DIFFERING RESPONSES BY USER

The lab test illustrated every user is different; there is no standard blind user. The challenges, successes, frustrations were not precisely the same for the 4 users. Perceived factors influencing this included the nature and level of disability itself, knowledge of the recruitment process and corporate websites more generally, and choice of assistive technology and even browser. One user was particularly adept at working around navigation issues that other users were not able to solve quite so easily.

For example, in the case below (fig. 3) website navigation was seen as difficult by the blind users because of poor labelling and awkward tab sequence, but one user with visual impairment found the black and white contrast buttons easier to use with the screen magnifier.

On the other side blind users found the screen in fig. 4 easy to complete, as field names were directly noted in the field itself, making for simple and rapid navigation, however for partially sighted users, the light colouring made the screen illegible, even with strong magnification.

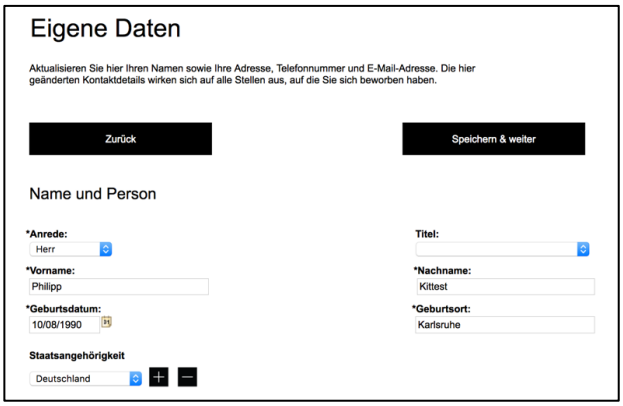

Figure 3. Good contrast example for visually impaired users, but blind users found the navigation awkward.

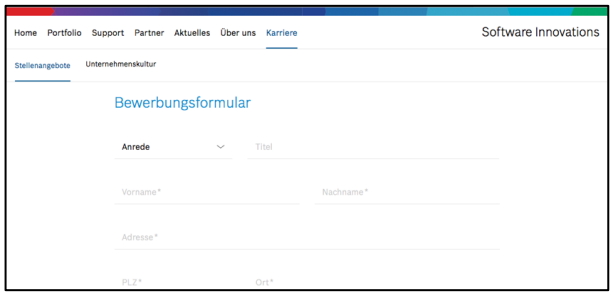

Figure 4. Screen contrast poor but good field navigation.

4.1.7 DIVERSITY STATEMENTS, OR CERTIFICATIONS

We were not able to find any career site that advertised compliance with WCAG, either in the website impressum, or on the career site itself. Some career sites discussed accessibility in the context of their diversity behaviours, and highlighted their diversity credentials.

While most corporate sites have an extensive section on diversity, people with disabilities generally receive little or no mention. Public sector organizations were significantly better in providing information about accessibility obligations and also in terms of capturing disability information about the applicant.

4.1.8 STRUCTURED DATA AND EXCESSIVE COLLECTION

While there may be justification for some of the fields, others are clearly excessive. Several sites have very lengthy drop-down lists. This one caused a problem for the students, as the screen was labelled *Zeugnis* (reference), so they were expecting to upload their CV and degree type information, instead it was asking for industry specific certificate information. Without sighted assistance, the test subjects were not able to progress beyond this point (fig. 5). One public sector site the forms were overly complex, with excessive use of drop-down entries and somewhat cryptic codes. The relevance of the nobility table is highly questionable (fig. 6).

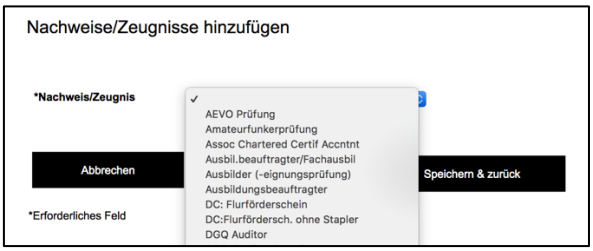

Figure 5. Lengthy drop-down list.

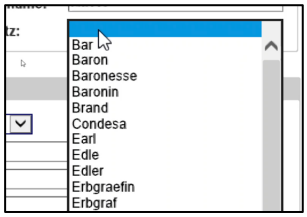

Figure 6. Nobility titles on the recruitment form.

This was even more problematic with job and education information, where the pull-down lists were long, and lacking intuitive search (fig. 7). While highly structured data makes for easy categorization by the recruiter, the effort for a disabled user was such that it required the help of sighted user to complete the fields. There were at least 10 such fields, some had several 100 items. The list of subjects was a pull down, meaning scrolling through 100s of entries.

Figure 7. List of study subjects.

4.1.9 EMBEDDED VIDEO

Embedding video, often using YouTube, is widely used, especially in the career portal stage. While these videos are an excellent way to inform and excite sighted applicants and candidates, clearly they are very little use to visually impaired or blind users. When video replaces other forms of communication, then it is actually a hindrance. All sites were haphazard in labelling videos with meaningful labels. In some cases the video played sound and music on opening the site, and in the background. This was very confusing and in one case discomforting for the tester. Additionally, most videos didn't have captions, which is not helpful for deaf or hearing-impaired users.

4.1.10 CAPTCHAS

Captcha made it very difficult for those not using a mouse to conclude the process without sighted assistance. The audio captcha is very difficult to follow, and provides limited feedback. It also scrambled languages.

4.1.11 FORM AND PROCESS NAVIGATION

On several sites tab order is not well thought through, and when combined with poorly labeled data fields, it makes data entry very laborious, error prone and frustrating. Some of the screens are very long with poor framing. On one site for instance, the tab order included the long list of subcompanies and images. In the course of the application, one user went through that list at least 10 times.

4.1.12 ERROR MESSAGES, POP UPS, AND DATE ENTRY

Several sites use pop ups to display new data entry screens, this is awkward navigationally, as the screen reader doesn't always know about the pop up. Pop up error messages are especially problematic if they are not accessible, as the user is then unaware of the error and how to address it. Several sites did not properly document radio buttons, so it was hard to figure out what one had clicked yes or no for.

Date handling is often problematic, with rich control calendars often requiring sighted intervention. Date fields require careful attention. In the case below (fig. 8), it was impossible for any of the testers to move beyond the calendar pop up without sighted assistance. At least 3 other sites had similar issues with date handling.

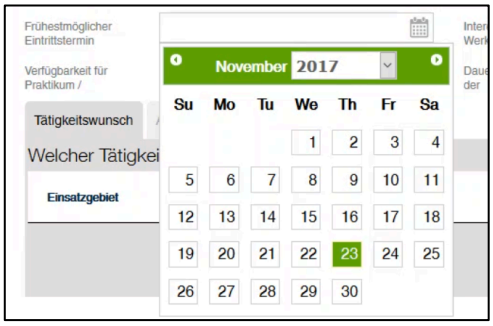

Figure 8. Calendar freezes screen reader.

4.2 AUTOMATED TESTING OF SITES

As well as the observational test with the users, the study tested the first page of career sites with an automated testing tool for BITV[7] and WCAG 2.0. The tool used was AChecker, as this is used regularly by the SZS for its testing. It's an open source tool, developed by the Adaptive Technology Research Centre at University of Toronto (Gay and Li, 2010). It is widely used, especially in the more recent testing research. See Vigo for a detailed benchmark of testing tools (Vigo, Brown and Conway, 2013). AChecker tests for multiple standards, for instance WCAG 1.0, WCAG 2.0, Section 508, BITV 1.0, and the Italian Stanca Act. AChecker identifies three types of problems (Sohaib and Kang, 2017).

- **Known Problems:** These are problems that must be fixed and have been identified as accessibility barriers.
- **Likely Problems:** These are problems that are likely to be fixed and have been identified as probable barriers.
- **Potential Problems**: These are problems that require a human decision for modifying or not to modify your webpage.

Rather than simply giving a pass or fail score, the tool provides a detailed explanation of the issue, suggesting fixes. The vast majority of errors were graphical images that were not labelled. Many of the images on these websites don't serve a particular critical purpose, but nevertheless, they should be labelled, and also avoided in navigation, when appropriate. The landing page with highest error count, had a relatively minor error, (e. g. use of italics) repeated in the background on many elements. This may impact text resizing for visually impaired users. On a bank site, there are a number of images used for navigation, and these are identified by the tool as being without alt text. These are more severe. In the lab test, this lack of alt text was a major navigation challenge for the testers, as these images were the springboard to other important parts of the site. For this research, we only tested the first page of the career site, not the complete process flow. Just testing the first page obviously does not give visibility into the complete process, but it is a useful start. The authors surmise that the further into the process the worse the accessibility standards compliance would be, given the greater complexity of the input screens, and the "Potemkin village" tendency of corporate and government websites. The automated test should not be seen as a

[7] BITV: Barrierefreie Informationstechnik-Verordnung. German Accessibility regulation, Established by BGG.

substitute for user testing, but they should be a key part of the website readiness assessment. At the very least, recruitment managers can use these tools themselves to ask questions of those responsible for website testing. Using the number of errors to rank sites is not accurate, as the severity of the errors is not assessed. It is clear that the testing of career sites for accessibility is haphazard at best. Most of the errors that the tool finds are very simple to repair. The tool is not able to pass judgement on broader usability, but it is effective at highlighting failing based on the standards.

4.2.1 AUTOMATED PDF TESTING

Several of the career sites we examined make use of PDFs, for the reasons discussed above. Several PDF files were selected from the test organizations. They were tested against the ISO-14289:2008 standard, otherwise known as PDF / UA-1. The tool used to do the testing is an open source tool called PAC3.[8] The tool provides a detailed report, defining and describing the errors in the documents. All PDFs that the testers engaged with in the lab were either inaccessible or awkward to access. On viewing the automated test results, it illustrates little effort is given to PDF accessibility design or testing before posting on the career sites. While not all career sites made use of PDF's, most did, and none were easily accessible. Today it is simple to create accessible PDF's, there are tools with templates to guide content writers to develop accessible content, and there is a growing array of tools to test and correct accessibility errors. The failing on PDF accessibility is hard to justify, and the author suspects that the PDF's are written by HR, and not checked against standards when saving. This is a relatively trivial process with content tools today.

5 FIXING THE PROBLEM

Significantly improving accessibility requires action from multiple stakeholders.

Developer knowledge and attitude: Software developers and product management require accessibility training (Ladner and May, 2017)

Design methods: Mainstream universal design into software. For instance, Design Thinking is currently not inclusive. Accessibility by design and default (Abascal *et al.*, 2016).

Tooling: Improving development tools, methodologies (Sánchez-Gordón and Moreno, 2014) and the standards themselves[9].

Inclusive hiring: Encourage more inclusive hiring in software development. Designing with, rather than merely for people with disabilities.

Buyer behaviour. Organizations that procure and commission career sites could place more pressure on software developers to provide up to date VPATs[10] and hold them to them (DeLancey, 2015).

Applying technology to the challenge. AI to improve accessibility. For instance, image recognition software can create meaningful alt-text descriptions (Wu *et al.*, 2017).

Regulatory clarity and the threat of sanction. European accessibility law is fragmented, and only sporadically enforced (Easton, 2012). In the US, ADA[11] claims have forced many organizations to improve web accessibility.

6 SUMMARY

Employers and software are failing to deliver Accessible recruitment.

Firstly, this research showed how this set of organizations have largely failed to deliver accessible recruitment for people with disabilities. The frustrating experiences of the testers highlights clearly the problem. Code can discriminate. The private sector organizations were

[8] http://www.access-for-all.ch/en/ *Schweizerische Stiftung zur behindertengerechten Technologienutzug.*

[9] It is beyond the scope of this paper to discuss the strengths and weaknesses of the WCAG standards.

[10] The Voluntary Product Accessibility Template.

[11] ADA. Am Americans with Disabilities Act of 1990 (42 U.S.C. § 12101)

typically poor, with limited regard for accessibility standards compliance. The public-sector websites were somewhat better, due in part to demands of German *Barrierefreiheit* (Accessibility) regulations. Secondly, many of the usability issues that made things very difficult for the testers, would also have been frustrating for the sighted user. Overly complex passwords, excessive use of structured data fields, awkward attachment handling, verbose marketing texts, for instance, would be irritating for any user. Fixing usability would help all users. Thirdly, fixing the many of these issues is not particularly difficult. The accessibility of the career sites would be improved with a more disciplined approach to Alt Text field labelling and tab navigation flow. Fundamentally improving accessibility in recruitment will require effort from software developers, employers, and regulators. It is not merely a software problem, but a reflection of broader societal failings of inclusion. While employers talk extensively of diversity, the reality of their corporate career sites illustrates the large gap between rhetoric and practice.

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PROCEEDINGS OF THE WEIZENBAUM CONFERENCE 2019
CHALLENGES OF DIGITAL INEQUALITY
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VISUALIZATION OF LEARNING PROCESS AND LEARNER'S EMOTIONS: CURRENT STATE, LIMITATIONS AND FUTURE WORK

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ABSTRACT

In a context of learning, visualization of learners' processes and states can provide an intuitive understanding of learning processes and learning states. As a result, learners and teachers are able to take appropriate steps to improve learning.
Physiological data such as electrodermal activity and cardiac response are adopted as a non-invasive method to detect stress and emotion, providing awareness and feedback to learners. However, there is little research on sensor data visualization considering human-computer interfaces and user experience.
This paper summarizes the state of emotion visualization in a learning context and discusses limitations of previous studies on learners' experience. Design considerations based on emotion visualization are compared to design principles for user interfaces and user experience, which shows the shortcomings of current approaches to emotion visualization. We show the importance of combining design and learning considerations for emotion visualization and intervention. The paper concludes with remarks on future work.

KEYWORDS

Information visualization; Physiological sensors; Emotion; User experience; HCI

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1 INTRODUCTION

With an effective visualization of learning process and learners' emotions, learners and teacher could apprehend the learning progress directly, in addition to getting a deeper insight into the occurrence (Rushmeier et al., 1997). In a learning context, various visualizations are explored in Massive Open Online Courses (MOOCs). Most visualizations are designed mainly for teachers (Figure 1, left) and the visualizations developed for learners focus on directing learners to what to learn next (Jivet, 2016). Jivet (2016) presented the Learning Tracker which displays learners with the current learning status (Figure 1, right) by using a traditional visualization method (radial chart).

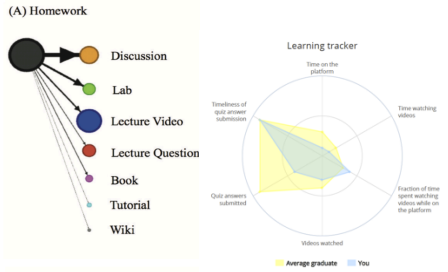

Figure 1. Visualizations in MOOCs (left: resource use (Breslow, 2013), right: learn tracker (Jivet, 2016)

Similarly, visualization methods using a learning context stem from traditional information visualizations.

However, as a visualization and a visual intervention for learners should be meaningful, easy to recognize and supportive, the traditional visualization methods widely used by researchers and analysts may not be appropriate or even effective. For example, MoodWings (MacLean et al., 2013) utilizes wearable sensors to detect stress and mirror the stress level back to users. Colorful butterflies with flappable wings were used and tested in a simulated task. The interviews with users revealed that the intervention itself was the stressor for the task. This indicates that the emotional visual and physical intervention should be ruminated to reflect user's voice and experience. As emotion visualization for learning support has not yet been investigated, this paper surveys recent studies in emotional support focusing on visualization. The aim of this survey paper is to highlight the importance of emotion visualization in a learning context and proposes future work in this topic.

2 CURRENT STATE OF EMOTION VISUALIZATION AND LIMITATIONS

Emotional states of users are generally reported by users through self-report. Using wearable sensors, emotional states of users can be derived using sensor data. When users are prompted to report their emotional state, facial images such as SAM (Self Assessment Manikin) (Bradley and Lang, 1999) are used. Similar to SAM, in Huisman and colleagues (2013), the cartoonist images with body posture are used to indicate their emotion.

Figure 2. Images used in LEMtool (Huisman et al., 2013)

However, when emotion is visualized back to users, facial images are rarely used. For example, AffectAura is designed to show users' emotional state throughout the day by using the timeline visualization with series of "hot/cold" metaphor-based bubbles (McDuff et al, 2012). Carnea and colleagues (2015) presented the metaphor-based visualization of emotion using a colored halo and outlines which is designed to interact with users.

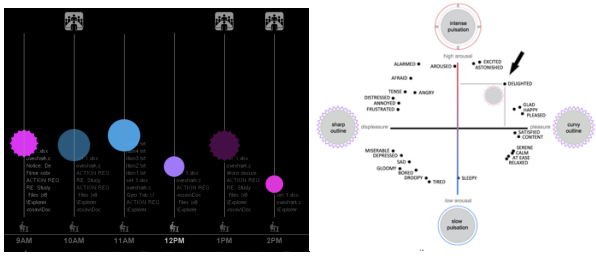

Figure 3. Visualization using metaphor (left: AffectAura (adapted from McDuff et al, 2012), right: Emotion-Prints (Carnea et al,. 2015))

In the mobile agent EMMA (Figure 2) learners are asked to input their current emotional state using the pictorial scale and the agent responds learners with appropriate facial images (emojis) and empathetic messages (Ghandeharioun et al., 2018).

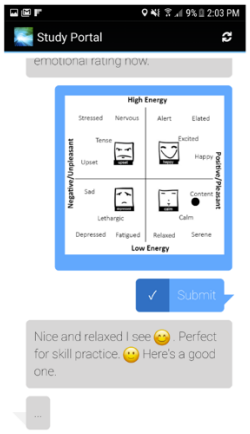

Figure 4. EMMA-Emotionally Intelligent Personal Assistant) (Ghandeharioun et al., 2018).

Most approaches to visualize emotions stem from the traditional methods of visualization including user interface and user experience design. However, the design considerations for emotional support are distinctive from the traditional user interface and from user experience design. For example, Nielsen's 10 usability heuristics (Nielsen, 1995) include mainly the pragmatic qualities which emphasize on design without errors and consistent interaction. The user experience questionnaire (Schreppe, 2018) extends the pragmatic quality by hedonic quality and proposes the attractiveness as the core area of user experience.

The design considerations of emotional visualization proposed by Carne and colleagues (2015) include pragmatic qualities such as generality, simplicity, distinguishability and intuitive visuals. However, context appropriateness, correspondence to users and emotional support areas are not easy to fit under the umbrella of neither design principles nor scales.

Furthermore, Yun and colleagues (2017) proposed the design consideration of a learning companion as 1) human fellow learner, 2) positive learning experience, 3) instructional benefits, 4) task and non-task-oriented messages, 5) simple and stylish visuals, 6) correspondence to learners, 7) dialogue initiation and 8) force reflection, which may fit under the hedonic quality of a user experience scale, yet with immense reduction.

3 DISCUSSIONS

Visualization provides useful information intuitively along with an opportunity to look deeper into the phenomena. As emotions play an important role in learning, visualization of emotional state not only provides learners with awareness of their states but also supports them to regulate their emotion.

Our study focused on a few studies that attempted to visualize emotional states using a metaphor-based visualization and traditional methods. We have found that the studies which investigate emotion visualization are not prominent in a learning context. Furthermore, when comparing the design considerations rooted from a learning perspective with the ones from a design perspective, it was observable to see the difference in principles and also in details.

Affordable wearable sensors have been investigated rigorously for emotion detection, but there is a lack of guidelines for visualization and interventions which communicate and interact with learners.

Based on our study, we remark a few important aspects to account when designing a visual intervention as a learning support.

First, design considerations for emotion support for learners should not start from the traditional design principles or scales yet, it should stem from learners' perspectives and experiences. To do this, understanding learners in various contexts should be considered and reflected in the design process.

Second, design and pedagogical support should be combined in design considerations for emotion visualization. As both approaches have strengths in different areas and both have their stronghold, not only the design aspects but learning aspects should be considered and an iterative user-centric approach should be taken.

4 CONCLUSION

As previous studies on emotion visualization for learning support have not been explored extensively, to authors' knowledge, we have only considered few studies in emotion visualization for this short paper. However, we analyzed previous visualization methods in emotion and derived the implications for future directions of visualization of emotion which can reflect learners' needs and experience emphasizing on both design and pedagogical approaches.

Our future study will entail extensive reviews of user-centered emotion visualization as a learning support from 1) design approach, 2) pedagogical approach and 3) data visualization approach.

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