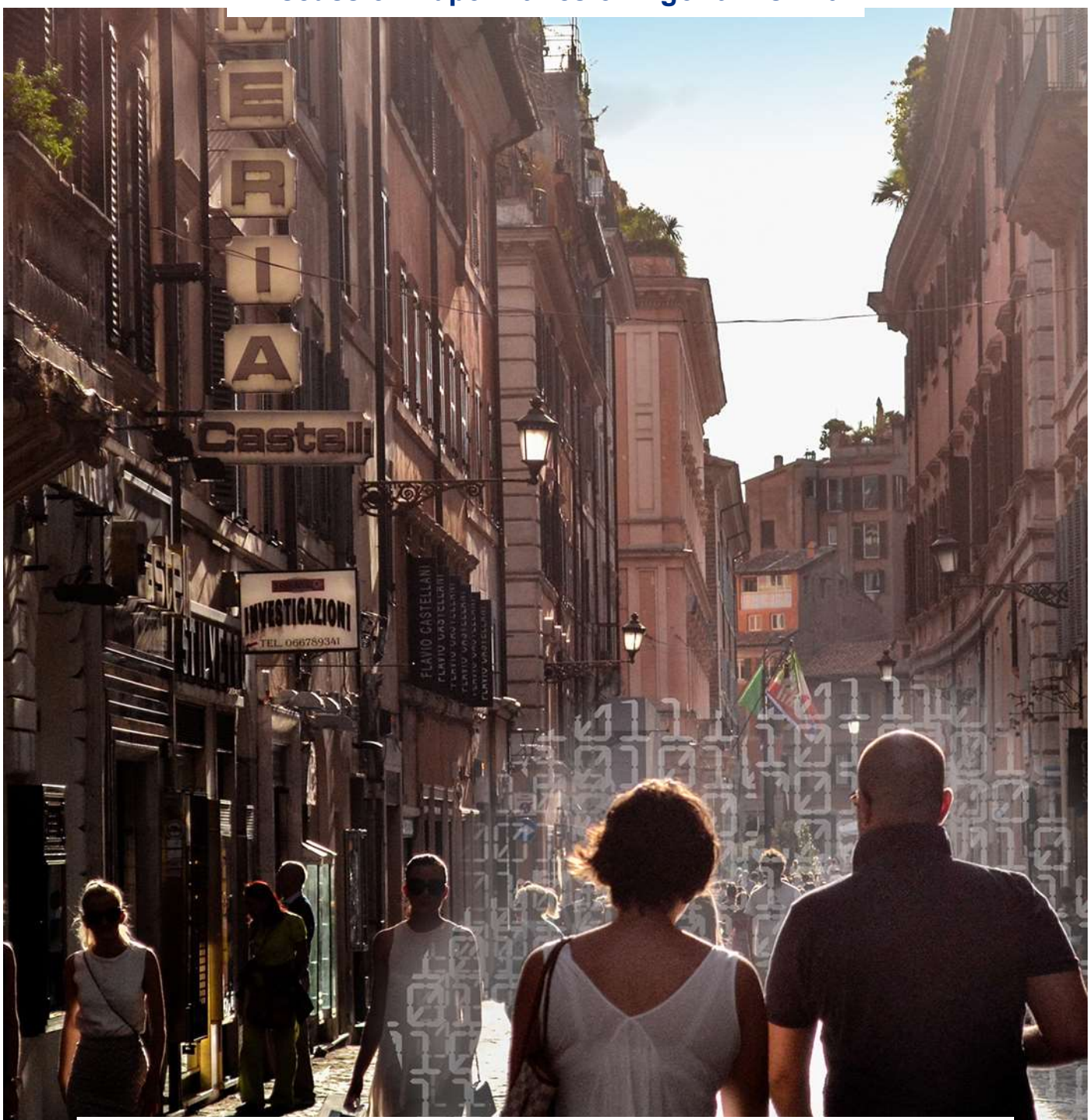
Discussion Paper Ethics of Algorithms #10



What Europe Knows and Thinks About Algorithms

Results of a Representative Survey

eupinions | what do you think?

BertelsmannStiftung

What Europe Knows and Thinks About Algorithms

Results of a Representative Survey

Viktoria Grzymek and Michael Puntschuh

Legal notice
© February 2019
Bertelsmann Stiftung
Carl-Bertelsmann-Straße 256
33311 Gütersloh
www.bertelsmann-stiftung.de

Data collection was carried out through the eupinions platform (www.eupinions.eu) by Dalia Research.

Responsible for content
Ralph Müller-Eiselt

Authors
Viktoria Grzymek and Michael Puntschuh, Bertelsmann Stiftung

German-language editing
Rudolf Jan Gajdacz, team 4media&event, Munich

English translation
Neuwasser Language Services, Berlin

License
The text of this publication is protected by copyright and licensed under the Creative Commons Attribution 3.0 International (CC BY-SA 3.0) license (Attribution – ShareAlike). You may reproduce and redistribute the material as long as you include the appropriate copyright and licensing information. You must indicate whether any changes have been made. If you change the material, you must distribute your contributions under the same license as the original. The full license text can be found at: https://creativecommons.org/licenses/by-sa/3.0/legalcode.de.

Cover photo: Stock/Snap / Pixabay, modified – Pixabay License, https://pixabay.com/de/service/license/

DOI 10.11586/2019008 https://doi.org/10.11586/2019008

Contents

Preface 5

Summary 7

Executive summary 10

1 Survey objective and procedure 12

2 What does Europe know about algorithms? 15

3 What does Europe think about algorithms? 20

4 Where and how does Europe want to see algorithms used? 27

5 Summary and conclusions 32

Literature 34

About the authors 36

Annex 37

Preface

We live in an algorithmic world. Day by day, each of us is affected by decisions that algorithms make for and about us – generally without us being aware of or consciously perceiving this. Personalized advertisements in social media, the invitation to a job interview, the assessment of our creditworthiness – in all these cases, algorithms already play a significant role – and their importance is growing, day by day.

The algorithmic revolution in our daily lives undoubtedly brings with it great opportunities. Algorithms are masters at handling complexity. They can manage huge amounts of data quickly and efficiently, processing it consistently every time. Where humans reach their cognitive limits, find themselves making decisions influenced by the day's events or feelings, or let themselves be influenced by existing prejudices, algorithmic systems can be used to benefit society. For example, according to a study by the Expert Council of German Foundations on Integration and Migration, automotive mechatronic engineers with Turkish names must submit about 50 percent more applications than candidates with German names before being invited to an in-person job interview (Schneider, Yemane and Weinmann 2014). If an algorithm were to make this decision, such discrimination could be prevented. However, automated decisions also carry significant risks: Algorithms can reproduce existing societal discrimination and reinforce social inequality, for example, if computers, using historical data as a basis, identify the male gender as a labor-market success factor, and thus systematically discard job applications from woman, as recently took place at Amazon (Nickel 2018).

"Algorithm" has become one of our era's prominent buzzwords, with hardly any political or economic debate lacking some reference. Media coverage of algorithms is also growing dramatically with the issue making front-page headlines. However – or perhaps because of this – it is worth taking a look beneath the surface of the debate and asking whether citizens are really aware of where algorithms are being used, and how algorithmic systems function.

In May 2018, we published the results of a representative survey in which Germans were asked about their knowledge and attitudes regarding the topic of algorithms. The data we collected showed the following: In Germany, there is a widespread lack of knowledge on the issue of algorithms, a great deal of incertitude regarding their opportunities and risks, and significant discomfort regarding judgments and decisions made by algorithms. The survey indicated that a broad public debate regarding the opportunities and risks associated with algorithmic decision-making had yet to commence. During the course of 2018, however, policy makers began addressing the topics of algorithms and artificial intelligence (AI). Among other factors, this was promoted by the creation of several advisory bodies, such as the federal government's Data Ethics Commission and Digital Council, or the German Bundestag's AI Commission of Inquiry, as well as the adoption of the federal government's AI strategy in November 2018.

We have taken the results of the Germany-wide survey and current political developments as an opportunity to expand our view to the European level. Ultimately, the increasing influence of algorithmic systems will respect no national borders; rather, it is a global development. The European Union (EU) itself is trying to position itself as a counterweight to pioneers such as the United States and China with regard to the social embedding of algorithms and AI. Yet what do Europeans, in fact, know about algorithms? Which areas of deployment are Europeans familiar with, and what associations do they hold with such use? Does Europe's population see algorithmic decision-making more as an advantage or a risk? Viktoria Grzymek and Michael Puntschuh investigate these and other questions in the current publication.

Drawing on a representative survey, the authors explore what people in Europe know about algorithms, what ideas and attitudes they have on this topic, and how willing they are to delegate tasks and decisions in various areas of life to algorithms. The results are once again sobering: Nearly half of Europe's population does not know what algorithms are, or that they are already in use in numerous areas of life. The results show that the debate on this issue remains in its early stages across Europe as well, even though algorithms already influence our daily lives. It noteworthy that more opportunities than risks are seen throughout Europe. At least 46 percent see more benefits

than problems associated with algorithmic decision-making, while only 20 percent see more problems than benefits. Among those who are well-informed about algorithms, the share of positive votes is still higher.

Expanding competencies within the population is, therefore, an important means of leverage with regard to promoting an informed discourse. In order to place algorithms in the service of society, however, a whole range of other measures are necessary. In this regard, Julia Krüger and Konrad Lischka (2018) recently compiled an overview of possible strategies. Establishing effective control mechanisms, in particular, should be placed high on the political agenda, a proposition that also resonated with a widely held desire on the part of the population. All necessary efforts in this regard should be made wherever it is feasible for Europe to act in concert.

This study was produced in cooperation with our colleagues in the Bertelsmann Stiftung's eupinions project as well as Dalia Research. We offer special thanks to Dalia Research for their expert support in developing the questionnaire and implementing the survey. The survey is part of the Ethics of Algorithms project, through which the Bertelsmann Stiftung is exploring the societal consequences of algorithmic decision-making systems. To date, the Ethics of Algorithms Discussion Papers series has included a collection of international case studies (Lischka and Klingel 2017), an examination of the potential impact of algorithmic decision-making on social inclusion (Vieth and Wagner 2017), an analysis of the impact of algorithmic processes on societal discourse in social media (Lischka and Stöcker 2017), a working paper on detecting problems and solutions in algorithmic decision-making processes (Zweig 2018), an expert analysis on the potential and limitations of the European General Data Protection Regulation as it applies to algorithmic systems (Dreyer and Schulz 2018), the above-mentioned panorama of approaches to ensuring algorithmic processes serve society (Krüger and Lischka 2018), as well as the survey of the German population's opinions regarding algorithms (Fischer and Petersen 2018), an analysis of existing quality criteria for algorithmic processes (Rohde 2018) and an examination of successful professional codes of ethics (Filipović, Koska and Paganini 2018). In order to facilitate discourse and debate on the results of the study, we are publishing this study under a license allowing for free distribution (CC BY-SA 3.0). We would be pleased to receive any feedback, and of course any form of constructive criticism.

Dr. Jörg Dräger
Member of the Executive Board
Bertelsmann Stiftung

Ralph Müller-Eiselt
Director, Program Megatrends
Bertelsmann Stiftung

Summary

Algorithms determine the advertising we see, make decisions regarding loan grants and university admissions, and suggest suitable partners for us on dating sites. This presents many opportunities but also poses challenges with regard to putting digital transformation at the service of society as a whole. Within this context, the question of whether and how Europeans engage with this topic takes on particular relevance. This study seeks to ascertain what Europe knows and thinks about algorithms. In so doing, it addresses three broader questions: What does Europe know about algorithms? What does Europe think about algorithms? Where and how does Europe want to see algorithms used? The results offer information at a cross-European level regarding the degree to which populations are aware of and accept the use of algorithms. The study is intended to expand upon and deepen the primarily national-level work done on this issue.

The results regarding the current state of knowledge are clear: People in Europe know little about algorithms. Fully 48 percent of Europe's population does not know what an algorithm is. In addition, less than half of Europe's population is aware that algorithms are already being used in many areas of life. In this respect, scores are particularly low regarding areas of application in which algorithmically driven decisions have potentially serious consequences for social inclusion, for example with regard to lending, the selection of job applicants, or medical diagnostic procedures. However, scores are comparatively high among men and people with a relatively high level of formal education – that is, these groups are more familiar with algorithms and their use.

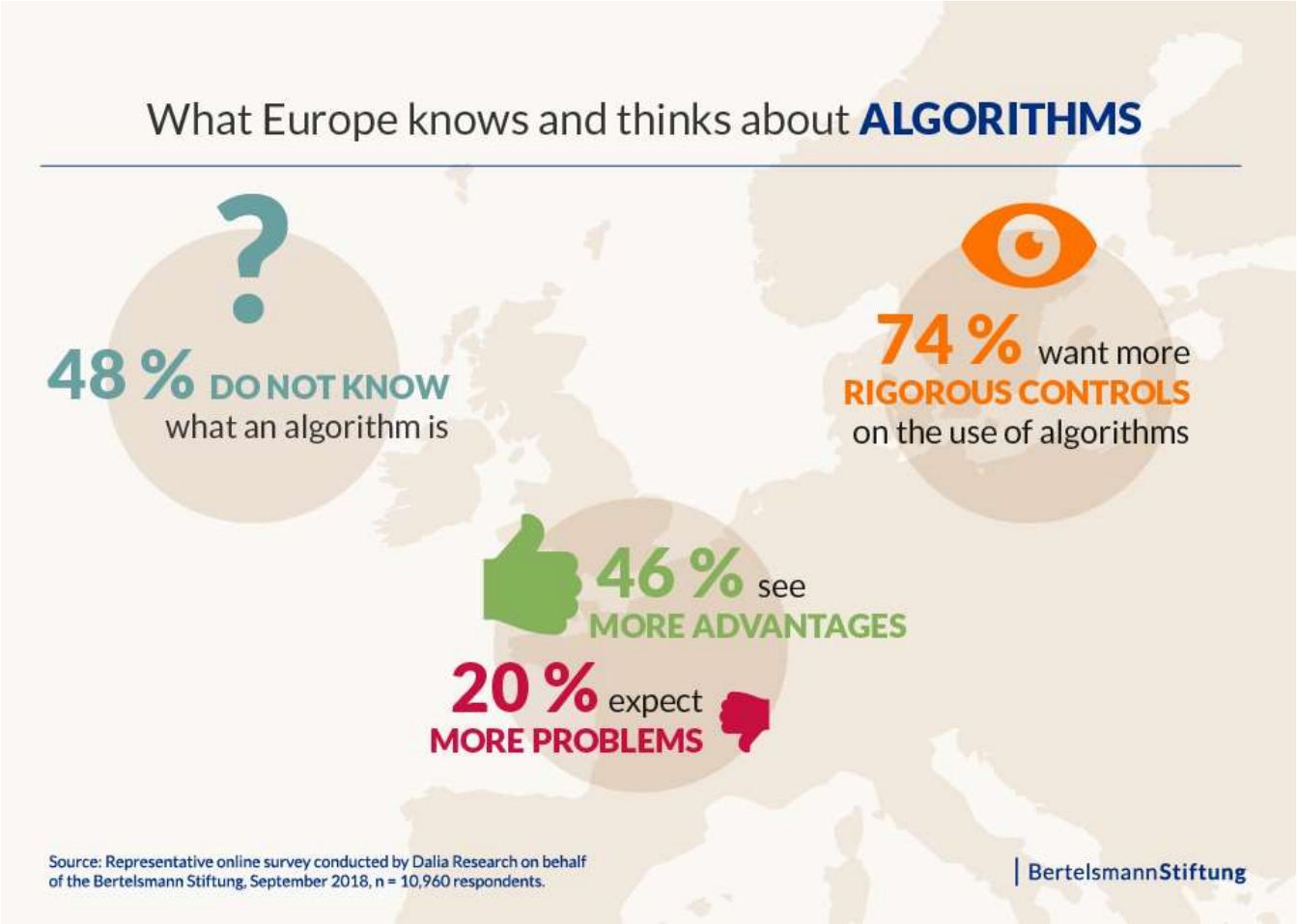
In addition, Europe's population has mixed feelings toward algorithms. For example, Europeans associate algorithms with positive factors such as efficiency and time savings, but also with negative aspects such as anxiety and the risk of manipulation. Overall, the optimistic attitude is predominant. A total of 46 percent believe that algorithmic decision-making processes have more benefits than problems, while 20 percent expect a higher share of problems. Among those who know "a lot" about algorithms, the ratio of positive votes is even higher. In addition, men and people with relatively high educational achievements place a stronger emphasis on the advantages associated with algorithmic decision-making processes.

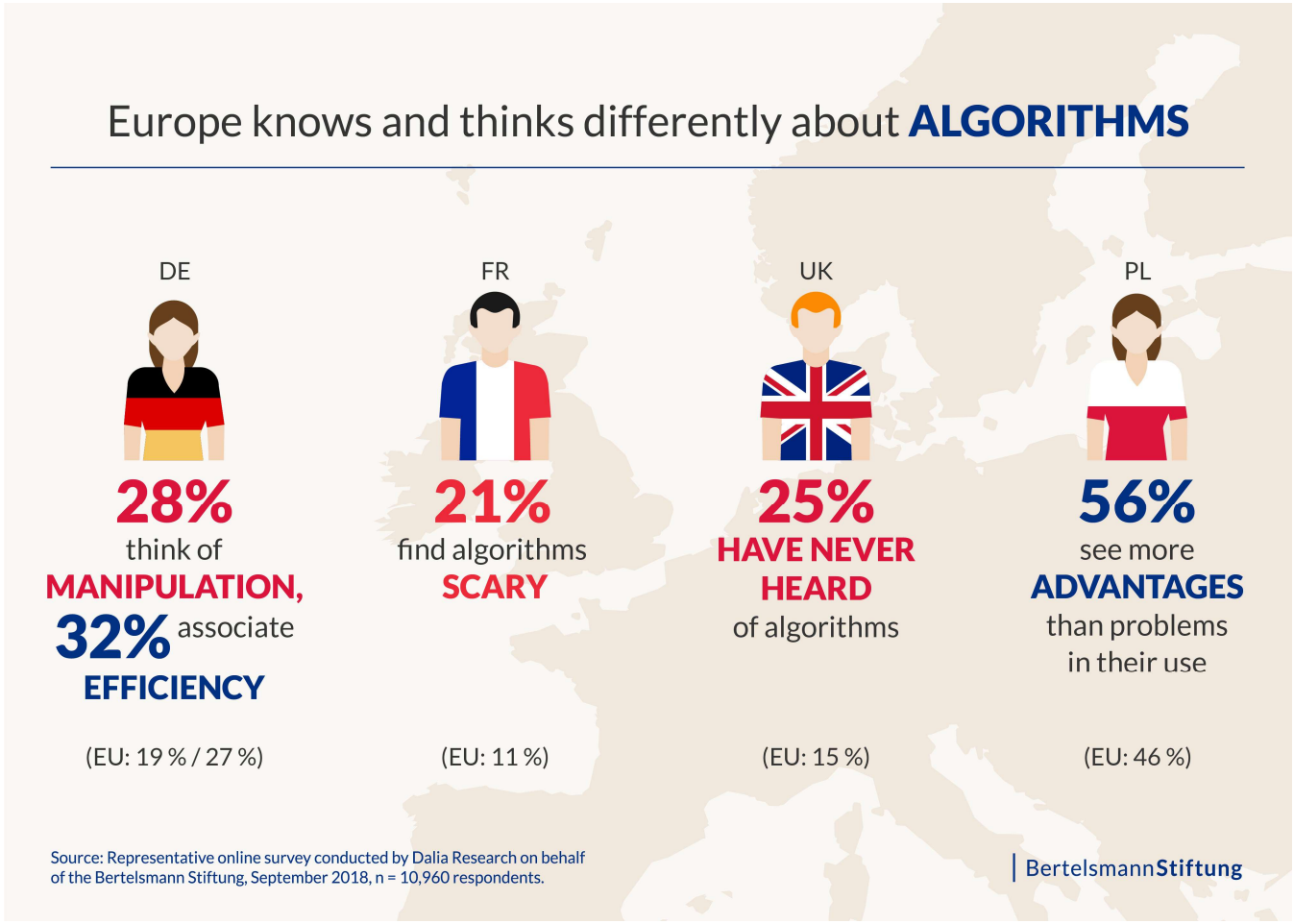
People in Europe want algorithms to be subject to oversight and do not want them to be employed in all areas of society. For example, many in the EU accept purely algorithmic decision-making in the context of technical applications that don't directly affect people, as in the case of spell-check services or the selection of travel routes. However, the balance of public opinion shifts for decisions that have a direct influence on people's lives, for instance in the labor market, in the banking sector or in a medical context. In these contexts, a clear majority wants algorithms to be used at most as a supporting element in the decision-making process, or even prefer that humans make such decisions alone. A total of 74 percent of Europeans want more rigorous controls on the use of algorithms in decision-making contexts. With regard to potential instruments of oversight, survey participants expressed particular support for the right to a second opinion, improvements in the ability to reconstruct algorithmic decisions, and a requirement that computer-based decision-making processes be identified as such.

In addition to information regarding the European Union as a whole, the survey provides representative results for Germany, France, Italy, Poland, Spain, and the United Kingdom. Thus, it allows for a comparison between the six most populous EU countries. As a rule, this tends to show that the results for the EU as a whole also apply within these countries. However, there are also some notable differences: For example, Poland's population is particularly well informed and expresses a positive attitude toward algorithms. A significant majority there is familiar with at least one area in which algorithms are employed; moreover, 56 percent see more benefits than problems in their use, making Poland the only country in which an absolute majority does so. To be sure, the United Kingdom is also relatively positively disposed toward algorithms. However, this opinion does not appear to be particularly well-founded. Presented with a list of alternatives, fully 28 percent of the UK citizens surveyed failed to identify even a single field in which algorithms were employed – even through algorithmic systems are already in use in all of these areas. In France, 21 percent indicated that they found algorithms to be "scary," a significant contrast to the mere 3 percent of Poles expressing this opinion. Perhaps because of this, a particularly large share of people in France also expressed the desire that algorithms be barred from use in certain areas, with humans instead retaining sole

decision-making authority. In comparison to the other large EU countries, Germany also appears rather skeptical of algorithms, although public opinion seems to be divided overall. People in Germany make particularly strong associations between algorithms and positive features such as efficiency and fairness, but also cite negatives such as “power for programmers” and fear of the technology’s use. Spain and Italy routinely fall into the middle of the pack, showing few significant deviations from the EU average.

At least three areas in which future action is needed can be derived from these results. First, the survey shows that the level of knowledge about algorithms is relatively low across Europe as a whole. Therefore, one goal should be a broad campaign of popular capacity-building; this would enable people to form considered opinions and debate the issue in a factually informed way. Second, the results suggest that Europeans want to see algorithms used only in certain areas. In this regard, a large majority of the population desires that algorithms be subject to stronger control measures. Effective oversight mechanisms must, therefore, be negotiated at the political level, developed and swiftly implemented. The guiding principle here must be the measures’ societal usefulness, not simply technical feasibility. Third, the comparison between the six most populous EU countries reveals quite significant differences with regard to the degree of knowledge and the character of opinions regarding algorithms. To allow us to learn from one another in Europe, discourse on this issue should be considered and conducted on a cross-European basis. After all, digitalization does not stop at national borders. The EU must, therefore, take on an active role with regard to regulation in particular.




Europe knows and thinks differently about ALGORITHMS
DE
28%
think of
MANIPULATION,
32% associate
EFFICIENCY
(EU: 19 % / 27 %)
FR
21%
find algorithms
SCARY
(EU: 11 %)
UK
25%
HAVE NEVER
HEARD
of algorithms
(EU: 15 %)
PL
56%
see more
ADVANTAGES
than problems
in their use
(EU: 46 %)
Source: Representative online survey conducted by Dalia Research on behalf of the Bertelsmann Stiftung, September 2018, n = 10,960 respondents.
BertelsmannStiftung

Executive summary

Algorithms determine the advertising we see, make decisions regarding loan grants and university admissions, and suggest suitable partners for us on dating sites. This presents many opportunities but also poses challenges with regard to putting digital transformation at the service of society as a whole. Within this context, the question of whether and how Europeans engage with this topic takes on particular relevance. This study seeks to ascertain what Europe knows and thinks about algorithms. In so doing, it addresses three overarching questions: What does Europe know about algorithms? What does Europe think about algorithms? Where and how does Europe want to see algorithms used? The results offer information at a cross-European level regarding the degree to which populations are aware of and accept the use of algorithms. The study is intended to expand upon and deepen the primarily national-level work done on this issue.

The results regarding the current state of knowledge are clear: People in Europe know little about algorithms. Fully 48 percent of Europe's population does not know what an algorithm is. In addition, less than half of Europe's population is aware that algorithms are already being used in many areas of life. In this respect, scores are particularly low regarding areas of application in which algorithmically driven decisions have potentially serious consequences for social inclusion, for example with regard to lending, the selection of job applicants, or medical diagnostic procedures. However, scores are comparatively high among men and people with a relatively high level of formal education – that is, these groups are more familiar with algorithms and their use.

In addition, Europe's population has mixed feelings toward algorithms. For example, Europeans associate algorithms with positive factors such as efficiency and time savings, but also with negative aspects such as anxiety and the risk of manipulation. Overall, the optimistic attitude is predominant. A total of 46 percent believe that algorithmic decision-making processes have more advantages than problems, while 20 percent expect a higher share of problems. Among those who know a great deal about algorithms, the ratio of positive votes is even higher. In addition, men and people with relatively high educational achievements place a stronger emphasis on the advantages associated with algorithmic decision-making processes.

People in Europe want algorithms to be subject to oversight and do not want them to be employed in all areas of society. For example, many in the EU accept purely algorithmic decision-making in the context of technical applications that do not directly affect people, as in the case of spell-check services or the selection of travel itineraries. However, the balance of public opinion shifts for decisions that have a direct influence on people's lives, for instance in the labor market, in the banking sector or in a medical context. In these contexts, a clear majority wants algorithms to be used at most as a supporting element in the decision-making process, or even prefer that humans make such decisions alone. A total of 74 percent of Europeans want more rigorous controls on the use of algorithms in decision-making contexts. With regard to potential instruments of oversight, survey participants expressed particular support for the right to a second opinion, improvements in the ability to reconstruct algorithmic decisions, and a requirement that computer-based decision-making processes be identified as such.

In addition to information regarding the European Union as a whole, the survey provides representative results for Germany, France, Italy, Poland, Spain, and the United Kingdom. Thus, it allows a comparison between the six most populous EU countries. As a rule, this tends to show that the results for the EU as a whole also apply within these countries. However, there are also some notable differences: For example, Poland's population is particularly well informed and expresses a positive attitude toward algorithms. A significant majority there is familiar with at least one area in which algorithms are employed; moreover, 56 percent see more advantages than problems in their use, making Poland the only country in which an absolute majority does so. The United Kingdom is also relatively positively disposed toward algorithms. However, this opinion does not appear to be particularly well-founded. Presented with a list of alternatives, fully 28 percent of the UK citizens surveyed failed to identify even a single field in which algorithms were employed – even though algorithmic systems are already in use in all of these areas. In France, 21 percent indicated that they found algorithms to be worrying, a significant contrast to the mere 3 percent of Poles expressing this opinion. Perhaps because of this, a particularly large share of people in France also express the desire that algorithms be barred from use in certain areas, with humans instead retaining sole decision-

making authority. Germany also appears rather skeptical in comparison to the other large EU countries, although public opinion seems to be divided overall. People in Germany make particularly strong associations between algorithms and positive aspects such as efficiency and fairness, but also cite negatives such as “power for programmers” and fear of the technology’s use. Spain and Italy routinely fall into the middle of the pack, showing few significant deviations from the EU average.

At least three areas in which future action is needed can be derived from these results. First, the survey shows that the level of knowledge about algorithms is relatively low across Europe as a whole. Therefore, one goal should be a broad campaign of popular capacity-building; this would enable people to form considered opinions and debate the issue in a factually informed way. Second, the results suggest that Europeans want to see algorithms used only in certain areas. In this regard, a large majority of the population desires that algorithms be subject to stronger control measures. Effective control mechanisms must, therefore, be negotiated at the political level, developed and swiftly implemented. The guiding principle here must be the measures’ societal usefulness, not simply technical feasibility. Third, the comparison between the six most populous EU countries reveals quite significant differences with regard to the degree of knowledge and the character of opinions regarding algorithms. To allow us to learn from one another in Europe, discourse on this issue should be considered and conducted across the EU. After all, digitalization does not stop at national borders. The EU must, therefore, take on an active role with regard to regulation in particular.

1 Survey objective and procedure

Decisions about people's lives are increasingly being made by algorithms. They are omnipresent in our daily lives. Whether in the context of loan approvals, university admissions, the preselection process for job applications, or in preventive police work, algorithms make decisions for and about us and are increasingly a part of normal existence. This presents many opportunities but also poses challenges with regard to ensuring that digital transformation takes place in a way that serves society as a whole. In this regard, the public debate is increasingly focusing on the European level. Particularly as the EU General Data Protection Regulation (EU-GDPR) has come into effect, it has become apparent that not only national governments but also Europe as a whole wants to – and indeed has the power to – shape the digital sphere. The debate on this topic is in full swing across Europe (European Commission 2018). Within the context of this discourse, especially given algorithms' great influence within peoples' lives, the question of whether and how Europeans engage with this topic takes on particular relevance. Are they at all aware of the diverse areas in which algorithmic systems are being used? Do the potential benefits associated with such use outweigh the problems, or is it the other way around? And should the use of algorithms, therefore, be subject to more rigorous oversight?

Previous surveys[1] on this issue have had a primarily national focus. For example, some surveys have addressed knowledge and opinions specifically on the issue of artificial intelligence (AI). This concept is a subject of considerable debate both in the media and the political sphere. Accordingly, a majority of Germans have at least a general impression of what AI is, and where it is used (Bitkom 2018; Bosch 2018). A majority regards the increasing use of AI in society as holding more opportunities than dangers (Kompetenzzentrum Öffentliche IT 2017) – even if there are exceptions in some areas. The use of artificial intelligence technology is opposed by a majority particularly where it would affect people directly (for example in nursing and medical care settings, as well as in education, the justice system, and policing contexts; Bitkom 2018). By contrast, another study suggests that the population sees the risks and benefits of such applications as being approximately equivalent, through the risks tend to be more vividly perceived (Inhoffen 2018). For this reason, too, a significant majority of Germans wants AI to be subject to stronger controls (Verband der TÜV e.V. 2018), with a number of potential oversight mechanisms seen as acceptable candidates in this regard (Kompetenzzentrum Öffentliche IT 2017). In early 2018, the Institut für Demoskopie Allensbach carried out a survey on behalf of the Bertelsmann Stiftung specifically on the use of algorithms (Fischer und Petersen 2018). This indicated that the German population's opinions regarding the use of algorithms were primarily characterized by a lack of knowledge, widespread indecision and discomfort.

Several studies have carried out surveys in multiple countries, seeking to draw comparisons across national borders. For example, the Vodafone Institute contrasted attitudes toward digitalization in the United States with those in various Asian and European countries (Paus et al. 2018). This showed that European countries – particularly Germany and the United Kingdom – tend to be comparatively more skeptical toward digitalization. A further comparison of attitudes within specific EU member states, respectively toward big data (Vodafone Institut für Gesellschaft und Kommunikation 2016) and digitalization in general (Ipsos Public Affairs Germany 2018), confirmed this impression of the relatively high degree of skepticism found among UK and German citizens.

The present survey expands the existing study landscape in a variety of ways. For example, it focuses primarily on the concept of "algorithm," thus following on from the Germany survey conducted by Fischer and Petersen (2018). This concept was chosen because it more accurately describes the systems that are already widely used today. In speaking of algorithmic systems, we refer to so-called weak artificial intelligence, which matches or exceeds humans' problem-solving capabilities within a narrowly defined area of use. Such systems already wield a great deal of influence within society. In addition, this survey takes Europe as a whole as its field of view. Because questions regarding the management of digitalization are increasingly being discussed at the European level, it is important to examine the opinions held by the European Union's population. To do so, representative results for

[1] Additional surveys can be found in Fischer and Petersen's (2018: 12) overview of Germany-wide surveys.

the EU as a whole are needed. In addition to considering opinions within the entire EU, this survey enables a comparison between the six most populous EU member states.

Key issues

This study seeks to ascertain what people in Europe know and think about the topic of algorithms. It aims to expand upon and deepen the primarily national-level work previously done on this issue. In this regard, three primary issues serve as the core of the survey:

1. What does Europe know about algorithms?

Two questions cover this aspect in the questionnaire. In the first, respondents indicate their familiarity with algorithms using a self-assessment mechanism. The second presents seven specific fields of application, which are used to determine the degree to which people in Europe are aware of the use of algorithms in everyday life.

2. What does Europe think about algorithms?

In this survey block, three questions explore Europeans' attitudes and opinions toward algorithms. Respondents first indicate their attitude toward the concept of "algorithm" through a question that enables them to choose between 10 possible preselected associations. Then, respondents are asked whether they see more benefits or more problems in the use of algorithms. Finally, they can either agree or disagree with a statement about their basic attitude toward algorithms.

3. Where and how does Europe want to see algorithms used?

In order to determine how people in Europe want to see algorithms used, three questions examine respondents' willingness to see certain tasks and decisions handled by algorithms. To this end, the respondents indicate whether they think decisions in 10 different fields of application should be made by algorithms alone or by algorithms jointly with humans, or whether humans alone should have the final say. This issue of the acceptance of algorithmic decision-making is closely related to the question of how and whether the use of algorithms should be subject to control measures. In order to explore this aspect, respondents are initially asked about their basic desire for more oversight of algorithms. Subsequently, they are asked to specify preferences regarding seven possible mechanisms of control.

The overall results thus provide information at a cross-European level regarding the degree to which populations are aware of and accept the use of algorithms. Such data must be taken into account if the European population is to be more effectively sensitized to the use of algorithms and their social impact. These findings also enable the status of the German debate to be assessed in comparison to that in other European countries.

Methodology

Overall, this study was based on a questionnaire composed of 10 questions requiring single- or multiple-response answers, in the context of a representative-population survey. Dalia Research carried this out on behalf of the Bertelsmann Stiftung within the framework of a regularly scheduled eupinons survey. The questionnaire can be found in an annex to the full report on the project website. Data collection took place between 18 September and 1 October 2018 in all 28 EU member states. In sum, a total of 10,960 people took part in the online survey.[2] The process took into account the current population distribution with regard to age (14 to 65 years), gender and

[2] Using an online survey naturally means reaching only those target groups that are online, and which possess a certain degree of digital competence. However, 89 percent of private households in the European Union currently have internet access, with 83 percent using this access regularly. Accordingly, the degree to which the results may be distorted by this factor is considered to be low. Additional data on internet use, including values for individual countries, can be found in the figures provided by Eurostat (2018). Similar distortions must also be considered when using other survey methods such as telephone interviews or face-to-face surveys, which also serve to reach only certain target groups.

region/country. The survey results are weighted on the basis of current Eurostat statistics regarding age, gender, education level (distinguishing between levels 0 to 2, 3 to 4, and 5 to 8, as defined by the ISCED[3] 2011) and degree of urbanization (urban and rural populations), and thus constitute a representative population for the EU-28 as a whole. At the country level, the data collection is also representative for Germany, France, Italy, Poland, Spain, and the United Kingdom,[4] all of which have a sample size of at least 1,000 respondents. A weighting procedure based on an iterative algorithm was used in order to adjust the expression of certain sample variables to reflect the actual composition of the EU population. This process involved the comparison of different combinations of the variables' expressions in order to determine the combination of weighting variables that optimally corresponded to the distribution of the sample in each country. A procedure of this kind guarantees that the collected data will be representative. An estimate of the general design effect[5] based on the distribution of weights was calculated to be 1.53. Taking this design effect into account, a random sample of this size would produce a margin of error of +/- 1.2 percent, with a confidence level of 95 percent. The results are rounded to whole percentage values for the purposes of better presentation, and due to the margin of error.

[3] International Standard Classification of Education.
[4] These countries were selected for more in-depth examination in their capacity as the most populous EU member states.
[5] The design effect describes a statistical distortion that arises if a sample is determined based on a specific selection procedure and not on the basis of purely random selection – that is, when not all elements have the same probability of becoming a part of the sample. However, the parameters of the base population can be estimated closely using appropriate estimation procedures.

2 What does Europe know about algorithms?

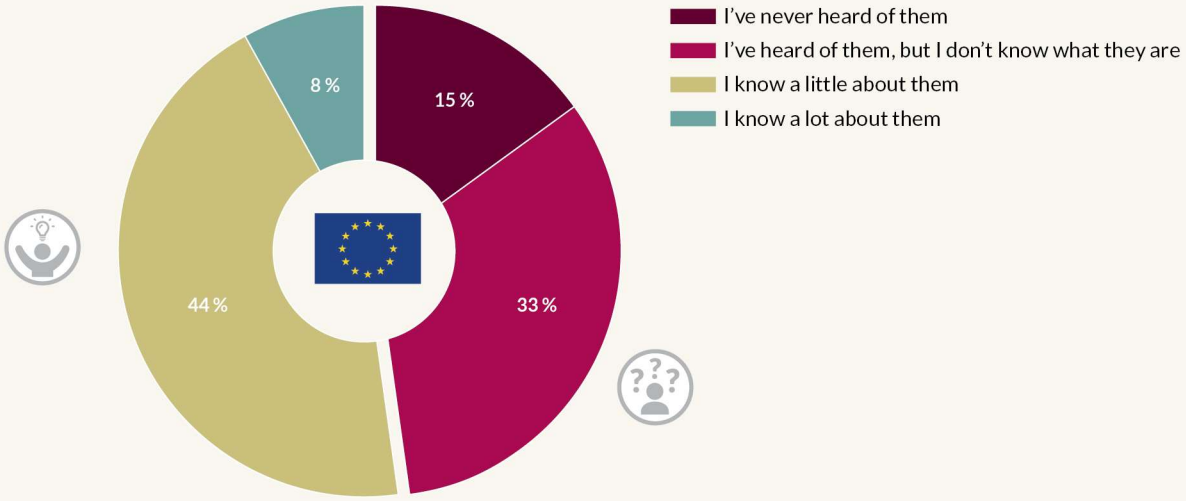
Little. Fully 48 percent of Europe's population does not know what an algorithm is. Only 8 percent said they knew "a lot" about algorithms. Knowledge in Europe is also relatively minimal with regard to specific areas in which algorithms are already being used. This finding also applies to the six most populous countries in the European Union.

"Algorithm" has become one of our era's most prominent buzzwords. Whether in the political, societal, business or media sphere, the use of algorithms is an ever-growing topic of discussion. Despite this intensifying public attention, it remains unclear whether the European population can adequately understand or evaluate the term.

Nearly half of all Europeans do not know what algorithms are

A rather sobering picture emerges when members of Europe's population are asked about their knowledge regarding algorithms. At the beginning of the survey, respondents were asked to choose which of four provided statements best described their familiarity with algorithms (Figure 1). Fully 15 percent of the respondents indicated that they had never heard of algorithms. A total of 33 percent said they had heard the term, but that they didn't know what an algorithm was. Considering these two response options together, it means that 48 percent of respondents did not know what an algorithm was, according to their own self-assessments. A total of 44 percent said of themselves that they knew "a little" about algorithms. The response "I know a lot about them," by contrast, was chosen by just 8 percent of respondents.[6]

FIGURE 1 **Familiarity with algorithms | EU**
"Which of the following best describes your familiarity with algorithms?"



Source: Representative online survey conducted by Dalia Research on behalf of the Bertelsmann Stiftung, September 2018, n = 10,960 respondents.

BertelsmannStiftung

The degree of familiarity with algorithms is associated with other demographic characteristics, particularly education level, age, and gender – a pattern that also appears for other questions within the present study. For example, in comparing answers by men and women, it emerges that men claim a greater degree of familiarity with algorithms than do women. While 11 percent of the men surveyed selected the "I know a lot" response option, this value was

[6] Even if these values represent self-assessments, they can be viewed as quite credible. Contrary to what is sometimes assumed, most people do not tend to feign knowledge they do not actually possess in surveys (other response distortions, such as adapting a response to fit an assumed social norm, are in fact more frequent; Noelle-Neumann and Petersen 2005: 86–91).

just 5 percent among women respondents.[7] Considering the results by age group, the youngest group, in particular, stands out: Among the 16- to 25-year-olds, nearly one-quarter (24 percent) indicated that they had never heard of algorithms. More broadly, the results showed that the older the respondents, the lower was the proportion that had never heard of algorithms. In the 56- to 65-year-old group, only 11 percent said they had never encountered the concept of an algorithm. Education level also appears to be a variable that positively influences knowledge about algorithms. The results generally show that the degree of familiarity with algorithms increases as the level of education[8] rises. While only 8 percent of respondents with a high level of education indicated that they had never heard of algorithms, this was true of 25 percent of those with only a low level of education. This pattern was confirmed at the other end of the spectrum: While only 4 percent of those with a low level of education knew a lot about algorithms, more than three times as many of the respondents with a high educational level (13 percent) reported this level of knowledge. The analysis also took the degree of urbanization into account as a separate demographic characteristic. However, throughout the survey as a whole, no significant differences between urban and rural population groups were evident.

In addition to providing information about the state of knowledge within the EU as a whole, the survey results also allow a comparison between the six most populous EU member countries. Here, quite significant differences emerge. For example, in the cross-European comparison, Germany has the highest share of those who know “a little” about algorithms, at 57 percent. In the United Kingdom, this group comprised 44 percent of the total. If only the share of those stating that they know “a lot” about algorithms is considered, Poland, in particular, stands out. Only there does the proportion of those who know “a lot” about algorithms exceed the 10 percent mark, if only by a small amount (11 percent in total). Among those who know almost nothing or nothing at all, there are larger country-specific differences. For example, the share of respondents in Italy (10 percent) and Poland (12 percent) who had never heard of algorithms was less than half as large as that in the United Kingdom (25 percent).

Most people in the EU are unaware of the areas in which algorithms are being used

The survey’s initial questions were aimed at determining the general level of familiarity with algorithms. However, given the already diverse and steadily increasing number of areas in which such technology is being applied, it is also interesting to know whether Europeans are aware of such areas of use, and if so, which ones. In the survey, respondents were presented with seven areas in which algorithms are already being used to support or independently make decisions. Figure 2 shows that respondents were only slightly aware of the areas in which algorithmic decision-making was taking place, with only a minority possessing such knowledge. The most well-known areas of application were those in which individuals were most likely to have noticed the consequences in their everyday lives, along with areas that had been the subject of extensive media coverage. The greatest amount of knowledge regarding the use of algorithms was in the area of advertising personalization. A total of 47 percent of respondents indicated that they were aware that computer programs create personalized advertisements on the basis of algorithms. This value may seem relatively high; however, it also means that 53 percent of the European population did not know that algorithms are used in this area. A total of 42 percent were aware of algorithms’ use in selecting partners on dating platforms. Similarly, 41 percent knew that the news and information displayed to internet users may be selected on a personalized basis with the help of algorithms. The fact that algorithms play an active role underlying spell-check programs was also known to 41 percent of Europe’s population. Around 36 percent of respondents were aware that assessments of citizens’ creditworthiness are made with the help of algorithms.

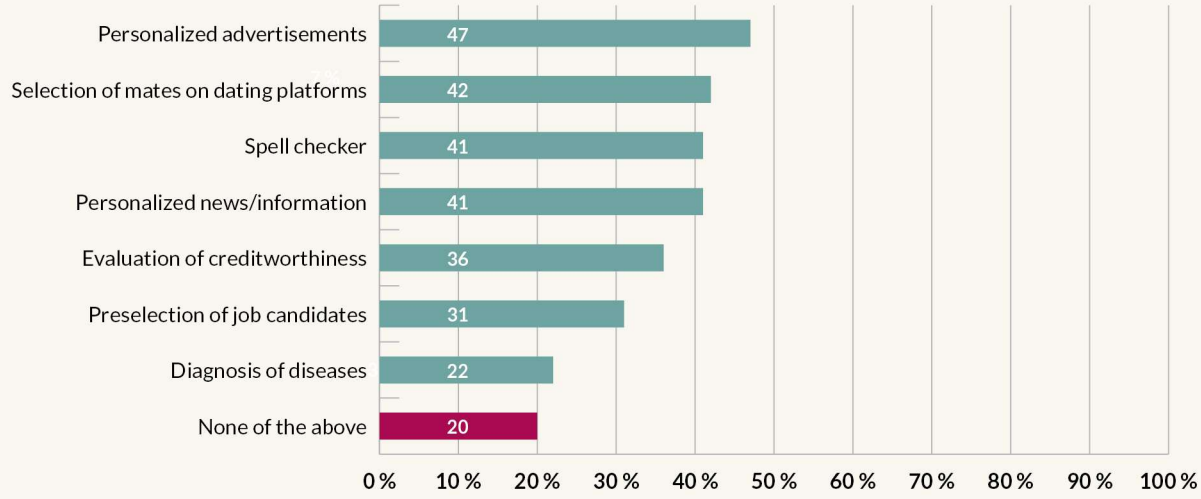
[7] Studies show that women in political-science opinion polls answer “I don’t know” more often than do men. Due to a higher level of risk aversion, women also tend less often to guess at answers to knowledge-based questions for which they are unsure (Lizotte und Sidman 2009).

[8] The survey uses the International Standard Classification of Education (ISCED) ISCED 2011 for the definition of the various education levels. Respondents with a low level of education thus correspond to levels 0 to 2 (elementary, primary, and secondary). A medium education level includes level 3 and 4 (general or vocational post-secondary but non-tertiary education). Respondents with a high level of education are those corresponding to levels 5 through 8 (short-cycle tertiary, bachelor’s degree, master’s degree or equivalent, or doctoral level).

In comparison to these fields, there was less awareness of areas of application in which algorithmic decisions have potentially greater consequences for social inclusion than it is true for personalized advertising. Only 31 percent of respondents knew that algorithms are often used to preselect candidates in hiring procedures. Similarly, only 22 percent were aware of the use of algorithms to help diagnose diseases. A striking one-fifth of respondents were unaware that algorithms were used in any of the application fields presented as options by the questionnaire.

FIGURE 2 **Awareness of areas in which algorithms are used | EU**

"In each of the following areas, computer programs currently use algorithms to make or support decisions. For which of the following areas did you already know this?"



Source: Representative online survey conducted by Dalia Research on behalf of the Bertelsmann Stiftung, September 2018, n = 10,960 respondents.

| BertelsmannStiftung

If we look at the answer to this question on the basis of demographic characteristics, the patterns described above for the initial question reappear. Men are aware of more of the areas in which algorithms are employed than are women. Similarly, a higher education level is associated with a higher degree of awareness regarding the areas in which algorithms are used. Among the respondents with the lowest level of education, 31 percent were unaware of any area in which algorithms are used, while this value was just 12 percent among the highly educated respondents. A comparison of the different age groups shows that the younger generations were particularly aware of algorithms' use in areas with which they tend to come into more frequent contact (such as personalized advertising and information, or online dating). However, the group of 16- to 25-year-olds displayed the lowest level of knowledge regarding the use of algorithmic systems for assessing creditworthiness (27 percent) or for the preselection of job candidates (29 percent). Assuming that labor-market entry typically takes place in this age group, it is striking that the group's members are relatively unfamiliar with the use of algorithms for recruiting purposes.

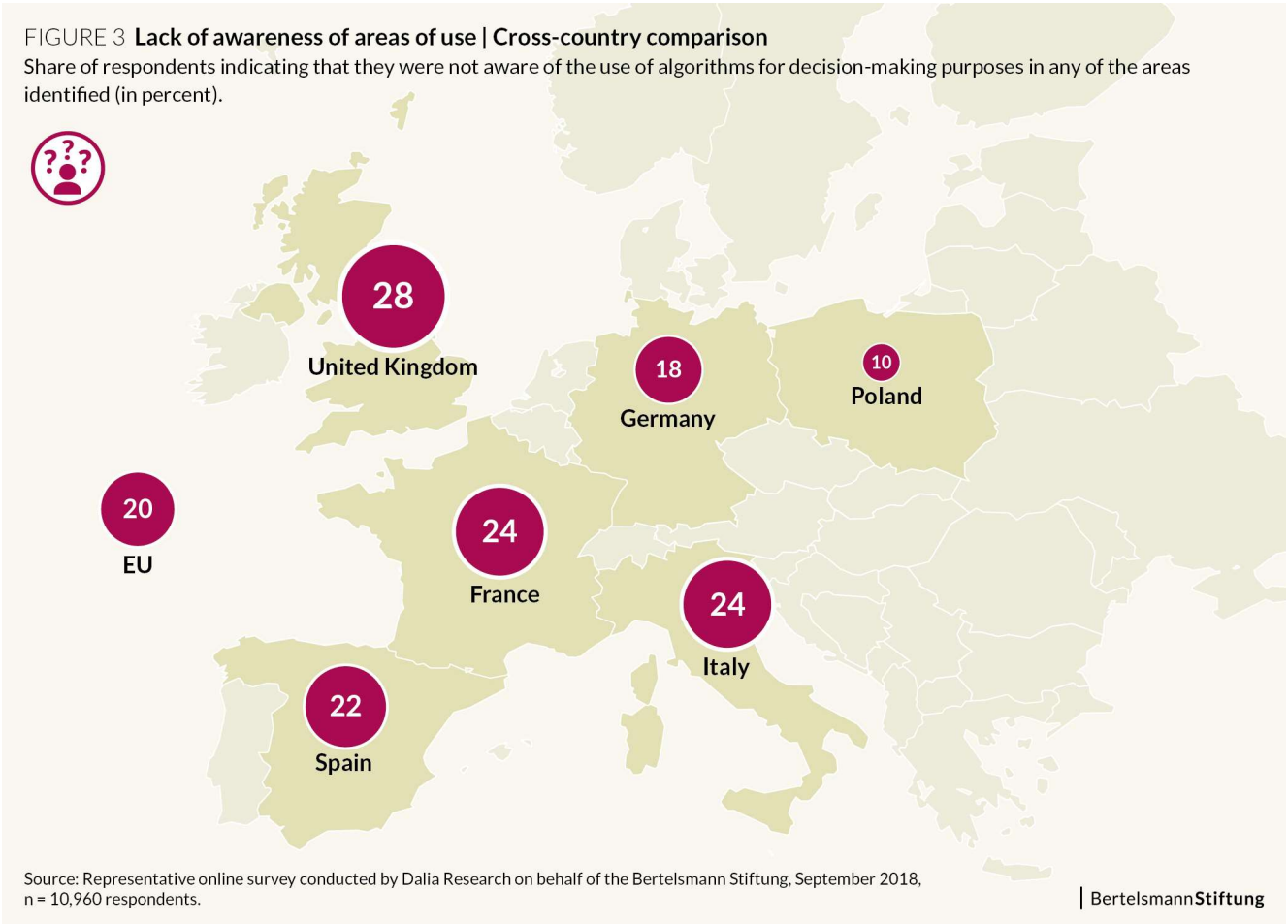
More than one-quarter of UK citizens lack familiarity with even a single area in which algorithms are used – in Poland, this share is just 10 percent

As with the knowledge-focused question, a comparison of the results in the six largest EU countries again shows deviations from the European average. However, these deviations are generally small here. Within most of the areas of use, a majority is unaware of the use of algorithms, even though algorithms are already a part of everyday life in each of these fields.

However, country-specific patterns do emerge upon closer examination. For example, Poland's population stands out with the highest level of knowledge within nearly every area of application. In addition, only Poland achieves values of more than 50 percent for multiple areas – thus, only in this country was an absolute majority aware of the use of algorithms in the areas identified. In the United Kingdom, by contrast, levels of awareness of the use of algorithms were the lowest, with values falling under the EU average in six of the seven areas.

Figure 3 illustrates significant country-to-country differences in some cases. Only 10 percent of the respondents in Poland indicated that they were unaware of the use of algorithms in any of the identified fields of application. The corresponding value in the United Kingdom was nearly three times as high. There, 28 percent had no idea that algorithms had long since become a part of everyday life in even one of the specified areas.

FIGURE 3 **Lack of awareness of areas of use | Cross-country comparison**
Share of respondents indicating that they were not aware of the use of algorithms for decision-making purposes in any of the areas identified (in percent).



Source: Representative online survey conducted by Dalia Research on behalf of the Bertelsmann Stiftung, September 2018, n = 10,960 respondents.

BertelsmannStiftung

Interim conclusion: Little knowledge and low levels of awareness regarding algorithms in Europe

Overall, the results are striking: In general, less than half of Europe's population is aware that algorithms are being used in the areas identified by the survey. Scores are particularly low for areas of application in which algorithmically driven decisions have potentially serious consequences for social inclusion, for example with regard to lending, the selection of job applicants, or medical diagnostic procedures. A comparison between the most populous countries shows that there are no exceptions to this rule and that the low levels of awareness prevail regardless of country.

Only Poland stands out with relatively high values compared to the other countries. Poland also displays the highest value on the question regarding knowledge about algorithms. For this reason, it can be concluded that the Polish – along with the Germans – know a relatively significant amount about algorithms in comparison to the rest of the European Union, and are additionally, more aware of how this technology is actually being used. The United Kingdom shows the lowest level of knowledge in relative terms. In the course of future scholarly studies, it would thus be interesting to examine the details of the national-level debates on a comparative basis, in order to identify possible causes for these differences between EU member states.

3 What does Europe think about algorithms?

The attitudes of the EU population can be summed up in the phrase "mixed feelings." Associations with the term range from efficiency and time savings to incomprehension and fear. A total of 46 percent of Europeans see more benefits than problems in algorithmic decision-making; however, a significant portion of the population shows a great amount of uncertainty around the issue. The study clearly shows that those who know a lot about algorithms have a more positive attitude in their engagement with the topic.

While we have thus far addressed general knowledge about algorithms and their areas of use, we shift now to the question of what Europe's population thinks about algorithms, and what attitudes they hold toward such technology.

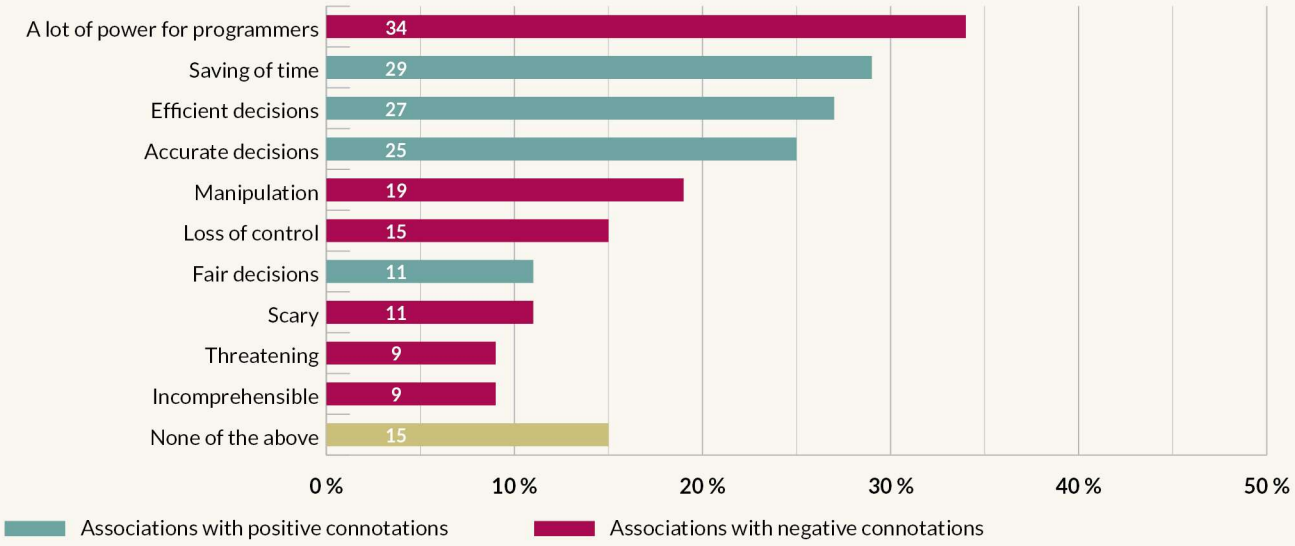
Mixed attitudes toward the concept of "algorithm"

The respondents were asked to provide information regarding their associations with the term "algorithm." In doing so, they could select from among 10 different concepts (with multiple choices possible), each of which held either a positive or negative connotation.[9] Figure 4 shows that the largest share of respondents (34 percent) associated "a lot of power for programmers" with the word algorithm, followed by "saving of time" (29 percent), "efficient decisions" (27 percent) and "accurate decisions" (25 percent). Concepts such as "threatening," "incomprehensible" and "scary" were, by contrast, less often associated with the term (9 to 11 percent). A similarly low value was seen for the association with "fair decisions" – this was linked with algorithms by just 11 percent of the respondents. This is notable given that algorithms' ostensible objectivity is typically invoked as a possible advantage over human decisions.

Some of the specified concepts were associated equally often by both men and women (each 35 percent for "a lot of power for programmers" and 15 and 16 percent respectively for "loss of control"). As a general trend, however, a greater share of male respondents selected associations with positive connotations than was true of female respondents. In addition, women again displayed greater uncertainty. Nearly one-fifth of them (18 percent) associated none of the specified concepts with algorithms, while this value was just 12 percent among male respondents. A similar pattern appears when looking more closely at education levels. While those with a high level of education had rather positive associations with regard to the pragmatic use of algorithms, respondents with lower education levels were significantly more uncertain and less positively disposed. A breakdown by age shows relatively similar patterns of association across the various groups, although younger respondents associated algorithms more strongly with concepts holding positive connotations than did the older groups. However, it is rather surprising that among the 16- to 25-year-olds, 12 percent indicated that algorithms were incomprehensible to them. This value was the highest among any age group.

[9] The differentiation between concepts with positive and negative connotations was made on the basis of their common, intuitive interpretation, as well as their typical use in everyday language.

FIGURE 4 **Associations with the term "algorithm" | EU**
"What do you have in mind when you hear the word 'algorithm'?"



Source: Representative online survey conducted by Dalia Research on behalf of the Bertelsmann Stiftung, September 2018, n = 10,960 respondents

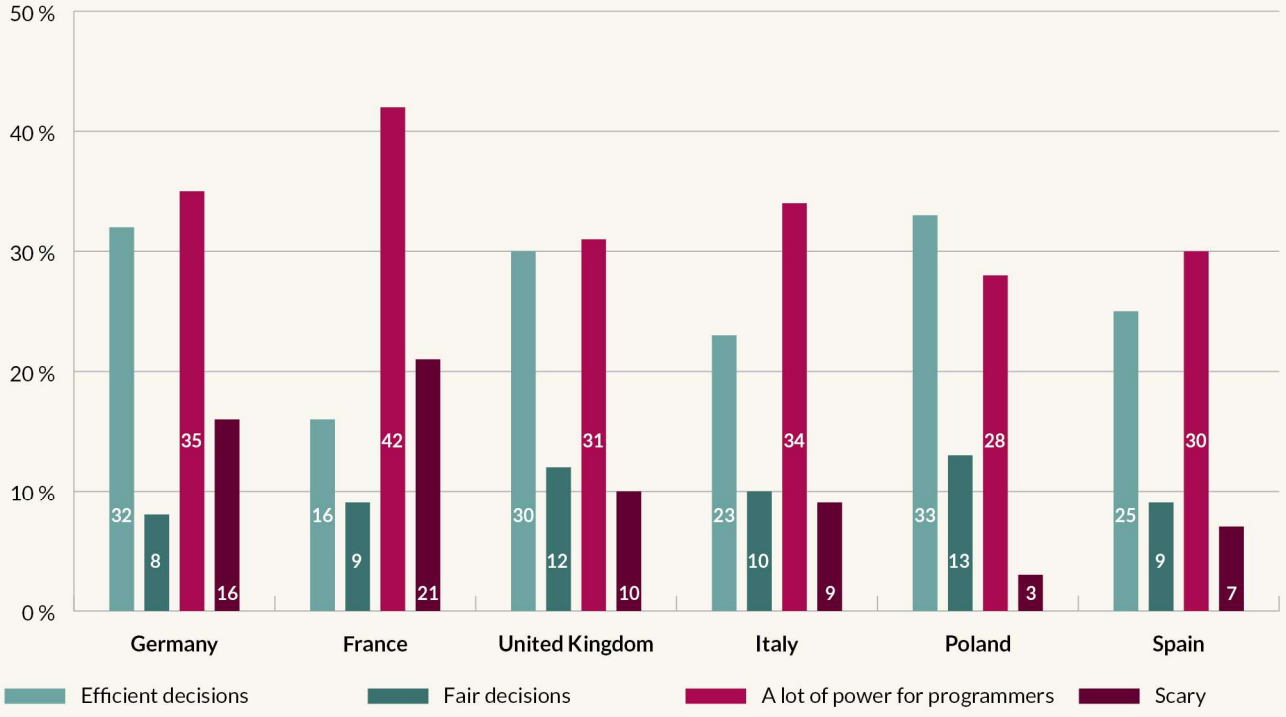
BertelsmannStiftung

In order to divide the 10 specified concepts into meaningful categories, we looked at which answers were often selected together by the respondents. This process made it clear that the intuitive distinction into associations with positive and negative connotations was also reflected in respondents' answers. For example, those who linked algorithms with "a lot of power for programmers" also tended to select the concepts of "manipulation" and "threatening." By contrast, respondents that reported associations such as "saving of time" or "efficient decisions" often chose these in conjunction with other concepts holding positive associations. Overall, Figure 4 clearly shows that respondents associate the word "algorithm" with concepts holding both positive and negative connotations – an indication that Europeans have not yet formed a clear opinion on the topic.

The French have particularly negative associations, while Polish and UK citizens see algorithms in a more positive light

A comparative look at the six largest EU countries underscores the fact that the balance of public opinion is mixed. None of the national populations regarded algorithms exclusively or even predominantly in terms of concepts with negative or positive connotations. However, there are certainly individual concepts for which the country-specific values deviate from one another strongly. Figure 5 illustrates these differences through the performance of four example concepts. The graphic depicts values for two terms with positive connotations that reflect both the practical use and the ethical advantages of algorithms. For the former, the option of "efficient decisions" was selected, as this term shows the largest variation in national percentage values. The ethical component of algorithmic decision-making is expressed using the "fair decisions" response option. Among the concepts with negative connotations, the option showing the greatest degree of fluctuation between countries – in this case, "scary" – is also depicted. In addition, the concept of "a lot of power for programmers" was chosen, as this option has the highest value across the European Union as a whole.

FIGURE 5 **Associations with the term "algorithm" | Cross-country comparison**
"What do you have in mind when you hear the word 'algorithm'?"



Source: Representative online survey conducted by Dalia Research on behalf of the Bertelsmann Stiftung, September 2018, n = 10,960 respondents.

BertelsmannStiftung

Figure 5 reveals what are at times considerable differences: While around one-third of respondents in Poland and Germany associated algorithms with efficiency, this value was only half that high (16 percent) in France. Poland also had the highest value associated with the sense that algorithms lead to fair decisions, closely followed by the United Kingdom. Among the associations with negative connotations, the picture was accordingly reversed. In comparative terms, the highest share of people associating algorithms with considerable power for programmers was in France, at 42 percent. This association was relatively common even in Poland, where it was selected by 28 percent of respondents; however, relatively speaking, this was the lowest such value. The differences were even stronger when Europeans were asked whether algorithms were frightening to them. Only 3 percent of Poles regarded algorithms as being scary; in France, this value was fully seven times as high, reflecting selection by 21 percent of the population. In Germany too, a relatively large share of the population, at 16 percent, associated algorithms with fearfulness.

A look beyond the concepts depicted in Figure 5 confirms that the highest values for associations holding negative connotations were always found either within the German or French population. Germany showed particularly strong associations between algorithms and the concepts of "manipulation" (28 percent) and "loss of control" (25 percent). These values were considerably higher than in the other countries or within the European population as a whole (respectively 19 percent and 15 percent for the EU sample overall). Along with Poland, Spain, and the United Kingdom, however, Germany also routinely has high values associated with positive concepts.

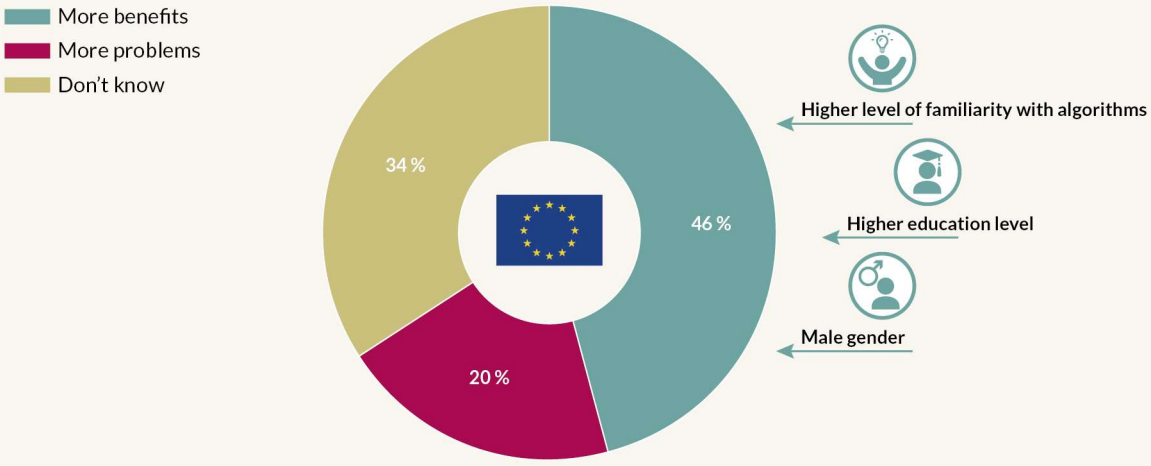
Thus, following a consideration of the four example concepts, as well as an overview of the country-specific results, it can be stated that "algorithm" as a concept fundamentally arouses more positive associations in the Polish population than it is true among the European Union as a whole, at least on an average basis. In addition, the first block of questions made it clear that Poland has a greater store both of knowledge and awareness. By contrast, France associates the use of algorithms more strongly with concepts holding negative connotations. The values for Germany are high for both positive and negative associations; however, these two currents are relatively evenly

matched. Thus, the Germans simply associate a more diverse range of concepts with algorithms, which points to an overall more balanced character to public opinion.

More than twice as many people see more benefits than problems in the use of algorithms

In addition to respondents' conceptual associations, the question of whether Europe's population has a fundamentally positive or negative attitude toward the topic of algorithms is interesting. To this end, respondents were asked to make a general judgment as to whether, in their opinion, the use of algorithms for decision-making purposes creates more benefits or more problems.

FIGURE 6 **Fundamental attitude toward algorithmic decision-making | EU**
"Overall, do you think that the use of computer algorithms for decision-making creates more benefits or problems?"



Source: Representative online survey conducted by Dalia Research on behalf of the Bertelsmann Stiftung, September 2018, n = 10,960 respondents.

BertelsmannStiftung

A total of 46 percent of Europeans indicated that decisions made with the help of algorithms resulted in more benefits, while 20 percent said they expected more problems (Figure 6). This result is striking, as it means that more than twice as many respondents see more benefits than problems. However, a distinctly high share of 34 percent answered the question with "Don't know." In the field of survey-based research more generally, an undecided share of such a magnitude is seen as a sign of a lack of orientation, with such values more usually being around 10 percent or possibly 20 percent. These results, therefore, indicate that many respondents are still unable or unwilling to render a clear judgment about algorithms.

In looking at fundamental attitudes toward algorithms on the basis of individual demographic groups, a number of interesting differences emerge. Among men, a majority (53 percent) believed that algorithms would create more benefits than problems. Among women, by contrast, this positive attitude did not command a majority. Only 39 percent of European women regarded the use of algorithmic decision-making as being associated with more benefits than problems. A still more sizable difference emerges when looking at the results on the basis of education level. Among the respondents with the highest education level, a majority of 58 percent were of the opinion that algorithms create more benefits than problems. Among the other respondent groups, this value fell to 44 percent (medium education level) and 35 percent (no or low level of education). In addition, the undecided share declined as respondents' education level increased.

Knowledge about algorithms promotes a positive attitude toward them

At the beginning of the survey, it was determined that only 8 percent of Europeans, according to their own self-assessment, knew a lot about algorithms. A comparison of the attitudes in this group and among those who knew little or nothing about algorithms offers a particularly interesting result. Among those with a lot of knowledge about

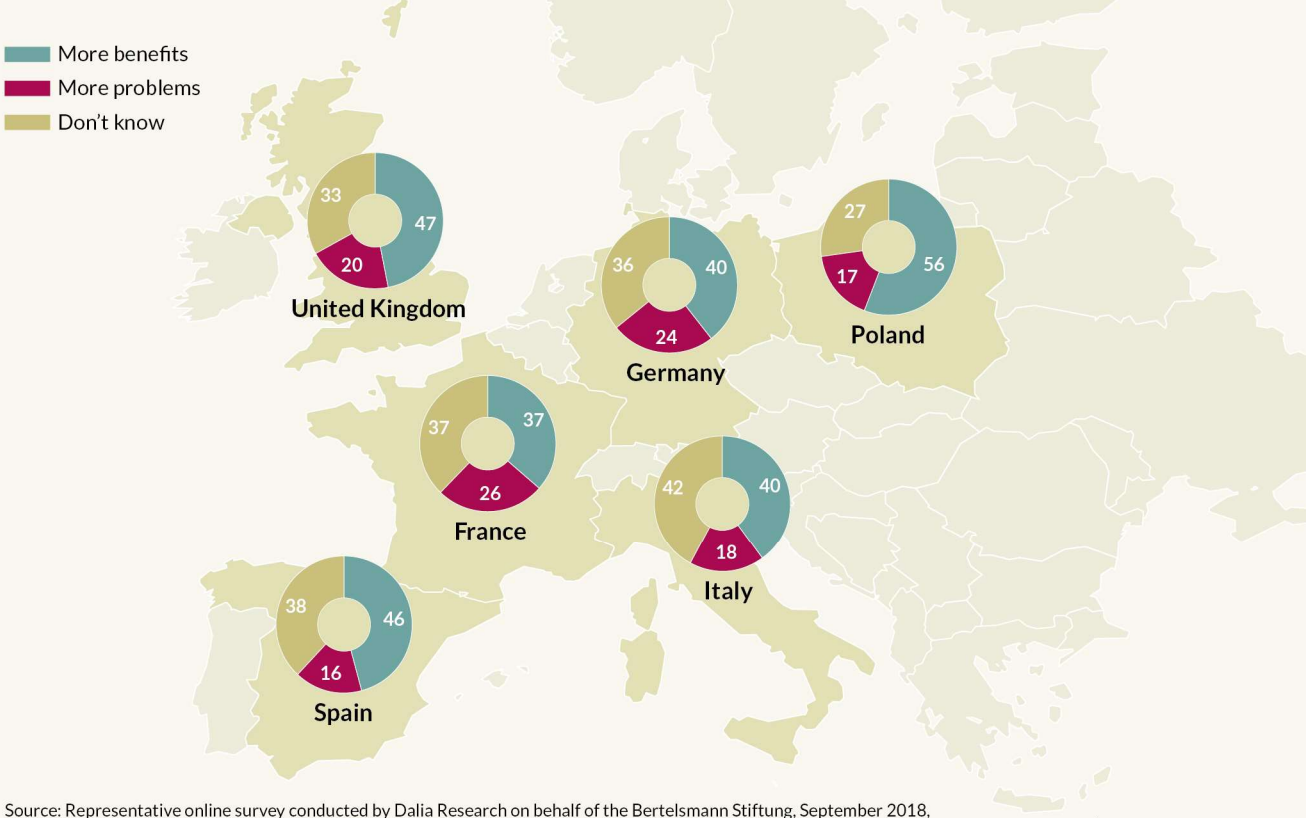
algorithms, a striking 71 percent were of the opinion that algorithmic decision-making offers more benefits. Among all the comparisons based on demographic criteria, this value is by far the highest. This result demonstrates that the possession of greater knowledge about algorithms tends to promote a positive attitude toward them.[10] Only 16 percent of those who said that they knew a lot about algorithms saw more problems than benefits associated with algorithmic decision-making. A closer look at those with a considerable store of knowledge also reveals a high degree of certainty. With only 14 percent answering this question "I don't know," this group seems to be the only one to have formed a clear opinion about algorithms. In contrast, indecision prevailed among those that previously indicated that they knew nothing or only a small amount about algorithms. Among this group, 44 percent saw more benefits and 20 percent saw more problems, with an additional 36 percent unable to decide.

Poland is the most confident country regarding the benefits of algorithms, while France is the most skeptical – overall, considerable indecision still prevails

A comparative look at the six most populous EU countries reveals a now-familiar pattern. Poland appears to be more receptive to algorithms than the other countries (Figure 7). Only in Poland did an absolute majority of the population associate more benefits than problems with the use of algorithms. At 56 percent, this value is more than three times as high as the share of those that saw more problems associated with the use of algorithms (17 percent). At the same time, the Polish seemed to be particularly confident of this judgment, as the share of undecided respondents was relatively the lowest. The Spanish and UK populations too saw considerable benefits associated with the use of algorithms, with each reaching nearly 50 percent on this measure. The most critical country again proved to be France; here, more than one-quarter of the population indicated that the use of algorithms for decision-making purposes overall creates more problems than benefits.

[10] In order to verify this relationship mathematically, we calculated whether a high degree of familiarity with algorithms was associated with a positive basic attitude toward them. The correlation value thus determined was statistically significant, but rather weak.

FIGURE 7 **Fundamental attitude toward algorithmic decision-making | Cross-country comparison**
"Overall, do you think that the use of computer algorithms for decision-making creates more benefits or problems?" (in percent)



Source: Representative online survey conducted by Dalia Research on behalf of the Bertelsmann Stiftung, September 2018, n = 10,960 respondents.

BertelsmannStiftung

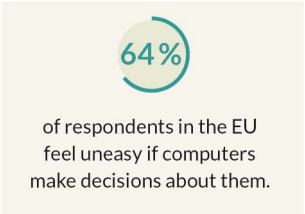
However, in addition to these differences, the following two similarities are notable. On the one hand, the share of those who were uncertain regarding the algorithms' advantages and disadvantages was unusually high in all countries. On the other hand, the share of the population seeing more benefits than problems in the use of algorithms was larger than the converse in all of the EU member countries examined here.

The answers to this question are worth emphasizing for Germany in particular, especially because the analysis that preceded the present study painted a contrary picture. In the survey conducted in January 2018, a total of 36 percent of respondents expected more risks to arise through algorithm-based decision-making, while only 18 percent saw more opportunities associated with the prospect (Fischer and Petersen 2018: 19). However, the contradiction between these figures and the values shown in Figure 6 is only apparent. For a start, the two surveys were constructed differently from a methodological perspective. The nationwide poll in Germany was based on face-to-face interviews, while the present survey the respondents were reached online. In addition, the specific questions were formulated differently. Fischer and Petersen asked about "opportunities" and "risks," while the focus here was on "benefits" and "problems." It can be assumed that a larger share of the population regards algorithms as being associated with risks that the public should be aware of, but which can also be addressed. Rather than serving as an argument against the use of algorithms in any capacity, risks could presumably be handled with an appropriate risk-management process. By contrast, the formulation "more problems" might seem both stronger and more unavoidable. If the use of algorithms indeed creates more problems, it should probably be fundamentally rejected. Accordingly, fewer people agreed with this implicitly stronger statement in the present study. However, any such possible explanation should be regarded with caution, and primarily aims to highlight the significance of the different question formulations. A direct comparison of the two sets of results is thus possible to only a limited degree.

If we assume that the two sets of results are nevertheless comparable, it would appear that the balance of public opinion regarding algorithms must have shifted since the previous survey's data-collection phase in January 2018.

Under this scenario, algorithms' increased presence in the public discourse, along with their diverse applications, may have led Germans to engage more strongly with this technological development in particular, and with digitalization in general. Thus, it could be presumed that the German population has developed an increasingly positive image of algorithms' use over the course of this process. Other surveys have also indicated a shift of opinion of this kind in Germany (Bitkom 2018). However, this thesis, too, remains only speculation; verifying it would require further investigation.

A majority of Europeans feel uncomfortable with purely computer-driven decisions



Among their other capabilities, algorithms can recognize patterns within large amounts of data. This strength makes it inevitable that algorithmic systems will support people in various tasks and decision-making functions. In order to explore the European population's attitudes toward this prospect, survey respondents were asked to choose between two statements regarding the use of algorithms to make judgments about people. The first statement read: "I prefer that algorithms judge me instead of humans. They make more objective decisions that are the same for everyone." By contrast, the second statement was formulated as follows: "Algorithms might be objective, but I feel uneasy if computers make decisions about me. I prefer humans making those decisions." Across the European Union as a whole, 64 percent of respondents decided in favor of the second statement. They felt themselves to be uneasy with the prospect of being judged by algorithms and expressed a preference for a human-rendered decision. The first statement was selected by only 16 percent of the respondents. This significant majority was present in all demographic groups (gender, age, education level, degree of urbanization). Even among those who had previously indicated that they knew a lot about algorithms, a clear majority of 60 percent selected the second statement.

A similarly uniform picture appears in the comparison between the six largest EU countries. In all national populations, a clear majority (between 54 percent and 71 percent) indicated that they were uneasy regarding the prospect of a computer making decisions about them. The lowest value in this regard was found in the United Kingdom. Correspondingly, a particularly large share of UK citizens (22 percent) indicated that they would prefer algorithm-based decisions to those made by people. In the other five countries, this share was between 13 percent and 16 percent.

Interim conclusion: Despite mixed feelings, Europeans seem to feel positively disposed toward algorithms

The question dealing with associations demonstrated that people in Europe link the concept of "algorithm" with terms holding positive and negative connotations alike. Thus, there does not yet seem to be a firm opinion on the subject. At the same time, the survey reveals that nearly half of all Europeans see more benefits than problems associated with the use of algorithms. Previous knowledge about algorithms, a high education level and being male seem to be factors that positively influence this confident basic attitude. In the cross-country comparison, France emerges as being particularly critical of algorithms. There, negative concepts were associated with algorithms with particularly high frequency, and their use was seen as producing problems. Poland, in turn, was the county in which algorithms were overall received with particularly strong enthusiasm. An absolute majority there believes that the use of computer algorithms is associated with more benefits than problems.

4 Where and how does Europe want to see algorithms used?

People in Europe want algorithms to be carefully considered and subject to oversight and don't want them to be employed in all areas of society. For example, many people in the EU say they would accept purely algorithmic decision-making particularly in the context of technical applications that don't directly affect people. By contrast, applications in the labor market, in the banking sector or for medical purposes have a direct influence on people's lives. Here, respondents believe that algorithms should be used in support of decision-making processes, or that humans alone should make the decisions. People in Europe also fundamentally want algorithms to be subject to oversight, with a range of instruments employed for this purpose.

Algorithms can be used for many different purposes. Following the survey's examination of general attitudes toward algorithms, additional questions explored Europeans' opinions toward the technology's use in specific application areas. Because a large share of the population also displayed a fundamentally critical attitude, the survey asked which instruments respondents believed should be used for the purpose of controlling algorithms.

In many areas of potential application, a majority can conceive of the use of algorithms

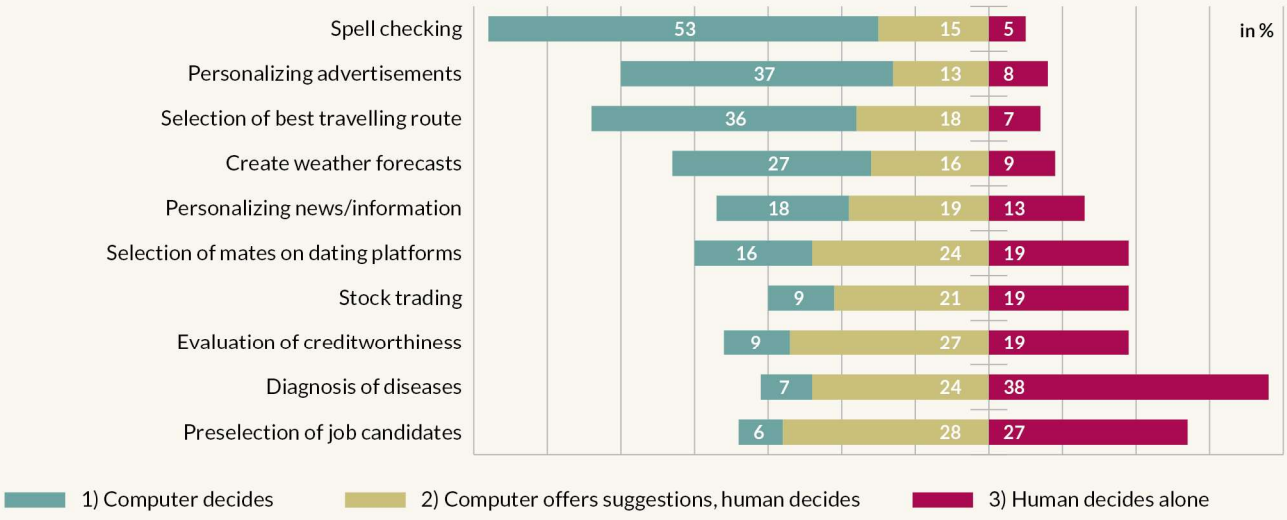
The above-mentioned areas for the application of algorithms were once again presented to respondents, but this time expanded to include three additional fields of use: the selection of the best traveling route, stock trading and the creation of weather forecasts. In conjunction with these options, three different kinds of decision-making were presented:

1. A computer makes decisions on its own.
2. A computer makes suggestions, but the final decision is made by a human.
3. A human makes the decision alone, without any computer-based suggestions.

The respondents were asked to indicate which of the various areas they view as acceptable for the use of algorithms, by selecting just one of the three decision variants for each specified area of application.

FIGURE 8 **Acceptance of algorithms | EU**

"For which of the following tasks …
1) … would you find it acceptable for a computer to make decisions on its own?
2) … would you find it acceptable for a computer to make suggestions, but only if a human makes the final decision?
3) … do you think a human should decide alone without any suggestions from a computer?"



Remaining percentage values fall into the "None of the above" category or provided no response.
Source: Representative online survey conducted by Dalia Research on behalf of the Bertelsmann Stiftung, September 2018, n = 10,960 respondents.

BertelsmannStiftung

Figure 8 shows that the acceptance of algorithmic decision-making processes depends greatly on the particular area of use. In some areas, a large share of Europe's population believes that computers can participate in decisions, either as the sole decision-maker or by supporting human-rendered decisions. For example, a majority of respondents indicated that they would find it acceptable for computers to play a role in decisions relating to the personalization of advertising, spell-checking or the selection of the best traveling route. At a basic level, the collaboration between humans and machines to make decisions met with a relatively high degree of acceptance. In most cases, the two greenish bars considered together sum to a higher value than the red bar, which represents the desire that decisions be made by humans alone.

In areas particularly relevant to social inclusion, people should have the final say

It appears that Europe's population remains uneasy when it comes to algorithms making judgments about people. Some areas that are particularly relevant to social inclusion stand out with large values associated with giving sole decision-making power to humans. With regard to diagnosing diseases, 38 percent of respondents believed that a human should decide entirely alone, without any suggestions by a computer. This response option was the only one in which the share of respondents calling for autonomous human decisions (38 percent) was higher than the share deeming decisions with some computer participation to be acceptable (overall 31 percent). The option involving the preselection of job candidates by human-resources departments also stood out, with a relatively large share of respondents (27 percent) calling for decisions to be made by humans alone. However, this desire was also relatively strong with regard to the use of algorithms for evaluations of creditworthiness, stock trading and the selection of mates on dating platforms (each 19 percent).

In general, Europe's population appears to be less critical of the use of computers in decision-making processes in some areas of use than in others. In looking for an intuitive explanation for this pattern, it seems evident that the desire for human-rendered decisions is always particularly strong with regard to assessments that may have a great deal of impact on an individual's future. The diagnosis of a disease, the invitation to a job interview, the decision whether a person is granted a loan or not – all these are judgments with significant consequences for the affected person's life. Even algorithmically assisted decisions in the context of stock trading or online dating are of a more personal nature than those regarding travel routes or weather forecasts.[11] This individual emotional involvement could be one factor behind the desire for giving humans sole decision-making power. However, any such attempt at explanation is necessarily hypothetical in nature. The results present new questions for future studies that could specifically explore respondents' underlying motivations.

This pattern, in which the use of algorithms in areas particularly relevant to social inclusion is viewed critically, also manifests in the six EU member states that were given a closer examination. In order to determine potential deviations from the EU average, we calculated the difference between the national value and the EU value. This revealed only a few significant divergences within individual countries, and even then the deviations stayed within a one-digit percentage range. One interesting observation is that in many areas of use, both the Polish and UK populations were more likely than the general EU population to accept decisions made solely by computers. The values for the use of algorithms in the advertising, credit and dating fields (in Poland), as well as for news personalization and spell-checking (in the United Kingdom), are each around five percentage points above the EU average. In comparison with the other four countries examined, these two countries appear to be more receptive to the prospect of decisions made by algorithms alone.

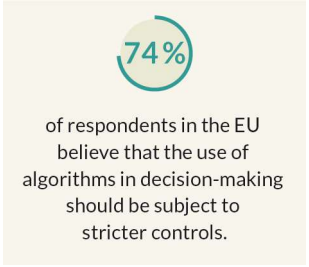
Cooperation between humans and machines in decision-making processes appears to be particularly well-regarded in Spain. Here, people advocated this form of decision-making at a rate higher than the EU average in nearly all areas, but particularly with regard to advertising, news, navigation, and weather forecasting. By contrast, France once again takes a comparatively critical stance. In areas particularly relevant to social inclusion, the share of

[11] Interestingly, similar patterns appear even in the United States, a country otherwise deemed to have a high level of digital affinity. In a survey conducted by the Pew Research Center, a majority of respondents opposed the use of algorithms in a similar range of areas (automated resume screening, automated video analysis of job interviews, criminal risk assessment, and creation of a personal finance score; Smith 2018).

people here supporting algorithmic-based decision-making was five to 10 percentage points lower than the European average. Accordingly, the population showed a stronger preference in such areas for decisions made solely by humans. For example, nearly half of the French respondents (46 percent) said that only humans should be allowed to render medical diagnoses. Similarly, 37 percent indicated that the preselection of job applications should take place entirely without the help of algorithms. However, it should again be reiterated that while these country-specific differences were striking, they were consistently small. Basically, the degree of acceptance for various algorithm usage options is relatively similar across Europe.

A three-quarters majority wants greater oversight of algorithms

In the current discussions on the use of algorithms, there have been repeated calls for intervention by policy makers and the introduction of control measures. Such demands are hardly surprising given the relatively low level of knowledge within Europe's population, and the mixed associations with the concept itself. The last two questions in the questionnaire underlying this study thus sought to collect respondents' opinions regarding oversight of the use of algorithms.



The results indicate that 74 percent of Europeans wanted more rigorous controls over the use of algorithms in decision-making contexts. This striking three-quarters majority remained constant even in the differentiated examination on the basis of demographic characteristics. The call for more oversight was equally distinct from both genders, although female respondents again showed somewhat more uncertainty; while 20 percent of women answered "Don't know" to the question about more controls, this value was 16 percent among men. The comparison on the basis of age revealed hardly any differences. Only in the group of 16- to 25-year-olds did the share of those who wanted stronger oversight (at 69 percent) fall under the 70-percent mark, which was exceeded in all other groups. Respondents also showed a considerable degree of uniformity on this question when compared across different education levels.

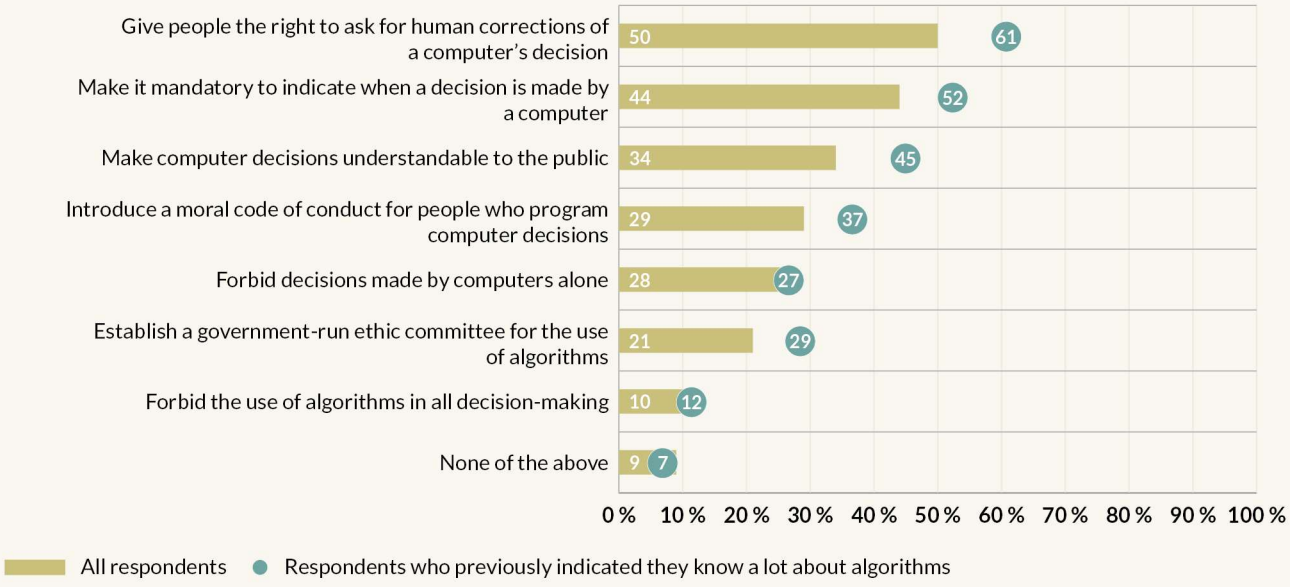
However, when looking not only at the formal level of education for the comparison, but also at the degree of familiarity with algorithms as stated earlier in the survey, the following interesting picture emerged: Among the 52 percent of the respondents that previously said they knew "a lot" or "a little" about algorithms, 79 percent called for more controls on the use of algorithms (with just 8 percent rejecting this option). In this regard, the desire for greater oversight in this group was five percentage points above the EU average. Looking more specifically only at the 8 percent of respondents who described themselves as being very familiar with algorithms, this value rose to 80 percent. By contrast, those who did not know what an algorithm was showed themselves to be more restrained with regard to calls for more oversight – and more undecided overall. Thus, it appears that respondents with a comparatively higher level of education and greater familiarity with algorithms also tend to want more oversight over algorithmic decision-making. A lack of knowledge does not foster the demand for more oversight; rather, it is reflected in a higher proportion of undecided respondents.

In almost all comparisons, the share of respondents wanting more controls was 70 percent. One of the exceptions was the United Kingdom, which stood out with a somewhat weaker desire compared to other countries. However, even here, a clear absolute majority of 63 percent advocated stronger oversight.

Respondents want algorithms to be subject to a variety of oversight instruments

In a final step, respondents were presented with seven potential measures for controlling the use of algorithms. Figure 9 shows that none of the proposed measures attracted the support of an absolute majority within the European Union as a whole. The right to a second (human-rendered) opinion to correct a decision made by a computer was supported by half of the respondents. Measures aimed at improving the intelligibility of decisions and expanding available information – for instance, the idea of creating a mandatory duty to indicate when a decision has been made by a computer – showed somewhat lower approval values. Only 28 percent of the respondents wanted to ban decisions made by computers alone.[12] However, only 10 percent of respondents called for a complete ban on the use of algorithms in any decision-making processes. Measures that focused on ethics and morals rather than on information and comprehension – for example, the creation of an ethics committee for the use of algorithms, or a moral code of conduct for programmers – were respectively supported by 21 percent and 29 percent of the European population as a whole.

FIGURE 9 **Control measures | EU**
"Which, if any, of the following control measures would you support?"



Source: Representative online survey conducted by Dalia Research on behalf of the Bertelsmann Stiftung, September 2018, n = 10,960 respondents.

BertelsmannStiftung

The main features of this ranking of control measures persist when taking a detailed look at the six most populous countries. Only with regard to the call for banning decisions made solely by computers did two countries stand out: A surprising 38 percent of Poles supported a prohibition of this kind, while in the United Kingdom only slightly over half of that (21 percent) supported such a broad-ranging measure.

Demographic characteristics appeared to make only very minor differences in this question. In the comparison between age groups, a relatively significant difference appeared for only one proposed measure: While only 25 percent in the youngest age group (16 to 25 years) supported the introduction of a moral code of conduct for programmers, this value was 37 percent in the group of 56- to 65-year-olds.

[12] At this point, it should be noted that both the EU average values and the values derived from the Germans newly surveyed here are different from the results obtained in the previous national German survey (Fischer and Petersen 2018: 31). There, 73 percent supported a ban on autonomous computer decisions. In addition, the percentage of respondents indicating support was significantly lower at the EU level than in Germany for all measures proposed in this question. The lower values can be explained by the fact that this question was answered by all respondents in the present survey, while in the previous Germany-focused survey, it was addressed only by those who had previously advocated for stronger controls. The lower percentage figure associated with support for a ban on autonomous computer decisions may be explained by the previously hypothesized shift in opinion toward a more positive basic attitude toward algorithms.

Overall, respondents with comparatively higher education levels had slightly higher values for all of the proposed measures, while respondents with lower education levels showed higher levels of indecision. A similar pattern clearly emerges in Figure 9 when considering the results among those who previously stated that they knew a lot about algorithms. This population nearly always showed a level of support for the proposed control measures that was slightly higher than that of all respondents. As with the previously posed basic question about controls, it is also true here that the desire for oversight – particularly for human corrections to computer decisions, as well as for more information, transparency, and intelligibility – coexists especially with increasing levels of knowledge about algorithms.

Interim conclusion: Use algorithms in a considered way, with sufficient oversight

At a fundamental level, people in Europe want the use of algorithms to be subject to limits and oversight. Particularly in areas with a direct effect on social inclusion or on individuals' own lives, people want humans to continue to play a decisive role in decision-making processes. This desire appears within all of the most populous EU countries, and in all demographic groups. A previously seen pattern emerges in the cross-country comparison, with Poland expressing a comparatively high level of confidence in the use of algorithms, and France showing a more pronounced skepticism. "Trust is good, control is better" – this maxim appears to apply for the use of algorithms as well, with nearly two-thirds of European respondents calling for stronger oversight of the use of algorithms. With regard to potential instruments of control, survey participants expressed particular support for the right to a second opinion, improvements in the intelligibility of algorithmic processes, and a requirement that computer-based decision-making processes be identified as such.

5 Summary and conclusions

Algorithms today have become a part of our everyday lives. They help make decisions for and about people in a variety of areas. Their influence on our society is the subject of debate across Germany, and increasingly across Europe as well. In this context, this study addresses the question of what Europe knows and thinks about algorithms.

At least three recommendations for future action can be derived from the results of the present study. A broad societal debate regarding the significance and consequences of algorithmic decision-making has begun at both the federal level in Germany and the European level but remains in its early stages. To make an informed discourse possible, the current lack of knowledge about algorithms must be addressed with competence-building measures. Moreover, if society is to take advantage of the opportunities provided by new technologies without ignoring popular concerns, effective control mechanisms are needed that will minimize the risks of potential discrimination. The European level, in particular, must focus more strongly on this regulatory aspect.

Knowledge as a foundation: Building competencies for an informed discourse

The present survey has demonstrated that populations across Europe know relatively little about algorithms. Indeed, fully 48 percent of Europe's population does not know what an algorithm is. Even with regard to specific and already existing areas of use, the level of awareness is relatively low across countries. Accordingly, Europeans have mixed feelings toward algorithmic systems. However, it should be noted that despite this lack of knowledge, people in Europe see more benefits than problems associated with the use of algorithms. The share of people holding this opinion climbs with the level of previous knowledge about algorithms. That is, those who know a lot about algorithms bring a more positive fundamental attitude to the topic, without losing sight of the associated risks.

If people know nothing about a subject, they can do no more than blindly trust or intuitively mistrust. Rather than accepting this outcome, one goal should be a broad campaign of popular capacity-building. This would enable people to form considered opinions and to debate the issue in a factually informed way. Enlightened citizens today need a basic understanding of the world of algorithms ("algorithmic literacy") in order to be able to participate autonomously in and help shape public life. In order to make the often-complex systems of algorithmic decision-making intuitively accessible and comprehensible, practical teaching tools with relevance to individuals' real lives must be developed. The creation of a Federal Agency for Algorithmic Competence, analogous to the Federal Agency for Civic Education, could help in providing information about algorithms beyond the poorly grounded speculation and horror stories that may otherwise circulate. And of course, the schools should be called on to play a role in this regard. Only in this way can the entire population reflect usefully on their daily points of contact with algorithmic systems, and conduct a societal discourse that weighs opportunities and risks in a reasonable manner. In addition, public authorities must develop considerably more expertise in this subject. Here, the need for further work is unfortunately vast. This is true for political authorities, government agencies, and the justice system. Algorithms influence public life so extensively that the state can no longer do without algorithmic know-how, either in its regulatory function or in its role as the upholder of law and public order.

Thus, systematic initiatives are urgently needed for the rapid development of competencies within both the political sphere and the population at large. This will give policy makers and the public the capacity to evaluate, oversee and regulate algorithmic systems, and to help shape them with the public interest in mind. This does not mean that we all need to learn to program. Even in a digitalized working world, this remains a job for specialists. Rather, an understanding of fundamental mechanisms is needed. Here, a look across national borders can be useful in order to learn from the strategies and discourses adopted in other countries.

Trust as the key: Establishing effective oversight mechanisms

The present survey makes it clear that Europeans do not want to see algorithms employed in an indiscriminate manner. Despite a fundamental awareness of the potential of such technologies, many associate negative concepts with their use. For example, 34 percent of Europeans see the use of algorithms linked with an increase in power for programmers. For this reason, people want humans to continue playing a central role in areas of use that are relevant to social inclusion. With this in mind, a large majority of the population wants algorithms to be subject to stronger control measures.

Ultimately, it is only effective oversight mechanisms of this kind that will allow trust in algorithmic systems to increase, in turn enabling such technologies to fully develop their benefits for society. The most-requested approaches, such as a right to a second opinion, a requirement that algorithmic processes be identified as such, and improvements in the ability to reconstruct algorithmic decisions, offer ideas of how such oversight might be concretely constituted. In this regard, only a broad spectrum of measures can ensure that algorithms will be designed to promote the public welfare. Ensuring diversity represents a particularly important approach in this regard, as algorithmic monopolies damage our society. This diversity must be actively supported. For example, more free algorithm-training data should be made available in order to facilitate the development of new algorithmic applications even for small companies and non-profit entities.

Europe as a focus: Learn from other countries, and act together

This survey is one of the first to provide a quantitative, primarily cross-European assessment of attitudes regarding algorithms. As such, it underscores how underserved the European perspective on this issue in public debates has been. Since the EU General Data Protection Regulation (EU-GDPR) has come into effect, it has become apparent that Europe as a whole – not simply national governments – has the real capacity to shape the digital sphere. At the same time, the comparison between the six most populous EU countries shows that there are some quite significant differences with regard to knowledge and opinions about algorithms.

A European perspective should, therefore, be brought into greater focus in two different respects. On the one hand, a look at other countries' actions is always worthwhile. For example, the Poles stand out with an above-average level of knowledge and a particularly high degree of receptiveness to algorithms, while the debate in Germany appears to be critical, but balanced. EU member states can learn from one another in this regard. On the other hand, the discourse regarding the use of algorithms can and must be considered and conducted across national borders throughout Europe. The European Union should engage as a strong actor seeking to shape the design of algorithms with the public interest in mind, asserting its global influence as it does so. Over the course of time, it will be important not simply to copy the strategies of other major economic powers, but rather to employ the EU's market and regulatory powers to promote the ethically responsible use of algorithms.

Literature

Bitkom (2018). “Künstliche Intelligenz: Von der Strategie zum Handeln“. 27.11.2018. http://www.bitkom.org/sites/default/files/2018-11/Bitkom%20Charts%20K%C3%BCnstliche%20Intelligenz%2027%2011%202018_final.pdf (Download 21.12.2018).

Bosch (2018). “Künstliche Intelligenz: Deutsche haben keine Scheu vor Kollege Roboter“. 19.11.2018. https://www.bosch-presse.de/pressportal/de/de/press-release-176192.html (Download 21.12.2018).

Europäische Kommission (2018). “Mitgliedstaaten und Kommission arbeiten gemeinsam an Förderung künstlicher Intelligenz ‚Made in Europe‘“. 7.12.2018. http://europa.eu/rapid/press-release_IP-18-6689_de.htm (Download 21.12.2018).

Eurostat (2018). “Digital economy and society. ICT usage in households and by individuals. Internet use.“ 20.12.2018. https://ec.europa.eu/eurostat/web/digital-economy-and-society/data/main-tables (Download 21.12.2018).

Fischer, Sarah, and Thomas Petersen (2018). “Was Deutschland über Algorithmen weiß und denkt: Ergebnisse einer repräsentativen Bevölkerungsumfrage“. Hrsg. Bertelsmann Stiftung. Gütersloh. https://doi.org/10.11586/2018022 (Download 21.12.2018).

Inhoffen, Lisa (2018). “Künstliche Intelligenz: Deutsche sehen eher die Risiken als den Nutzen“. *YouGov DE*, 11.9.2018. https://yougov.de/news/2018/09/11/kunstliche-intelligenz-deutsche-sehen-eher-die-ris/ (Download 21.12.2018).

Ipsos Public Affairs Germany (2018). ”Adoption of New Technologies: Representative Survey in Five EU Countries”. *Vodafone Institute for Society and Communications*. https://www.vodafone-institut.de/wp-content/uploads/2018/02/Ipsos_VFI_Technologieakzeptanz.pdf (Download 21.12.2018).

Kompetenzzentrum Öffentliche IT (2017). “Künstliche Intelligenz zum Nutzen aller gestalten”. https://www.oeffentliche-it.de/documents/10181/79338/Umfrage_KI_komplett.png (Download 21.12.2018).

Krüger, Julia, and Konrad Lischka (2018). “Damit Maschinen den Menschen dienen: Lösungsansätze, um algorithmische Prozesse in den Dienst der Gesellschaft zu stellen“. Hrsg. Bertelsmann Stiftung. Gütersloh. https://doi.org/10.11586/2018019 (Download 21.12.2018).

Lizotte, Mary-Kate, and Andrew H. Sidman (2009). ”Explaining the Gender Gap in Political Knowledge“. Politics & Gender (5), S. 127-151. https://doi.org/10.1017/S1743923X09000130 (Download 21.12.2018).

Nickel, Oliver (2018). “Amazon verwirft sexistisches KI-Tool für Bewerber“. *Golem*. 11.10.2018 https://www.golem.de/news/machine-learning-amazon-verwirft-sexistisches-ki-tool-fuer-bewerber-1810-137060.html (Download 21.12.2018).

Noelle-Neumann, Elisabeth, and Thomas Petersen (2005). *Alle, nicht jeder: Einführung in die Methoden der Demoskopie*. 4. Auflage. Berlin.

Paus, Inger, Alice Deißner, Friedrich Pohl, Cilia C. Kanellopoulos, Robert Grimm, Liane Stavenhagen, Janine Freudenberg and Laura Wolfs (2018). “The Tech Divide: Contrasting Attitudes Towards Digitisation in Europe, Asia and the USA“. *Vodafone Institute for Society and Communications*. https://www.vodafone-institut.de/wp-content/uploads/2018/10/The-Tech-Divide-People-and-Society.pdf (Download 21.12.2018).

Schneider, Jan, Ruta Yemane and Martin Weinmann (2014). *Diskriminierung am Ausbildungsmarkt: Ausmaß, Ursachen und Handlungsperspektiven*. Hrsg. Forschungsbereich beim Sachverständigenrat deutscher Stiftungen für Integration und Migration (SVR). Berlin. https://www.svr-migration.de/wp-content/uploads/2014/03/SVR-FB_Diskriminierung-am-Ausbildungsmarkt.pdf (Download 21.12.2018).

Smith, Aaron (2018). ”Public Attitudes Toward Computer Algorithms”. *Pew Research Center*, 16.11.2018. http://www.pewinternet.org/2018/11/16/public-attitudes-toward-computer-algorithms/ (Download 21.12.2018).

Verband der TÜV e.V. (2018). “Mehrheit der Bundesbürger für Algorithmen-Checks“. 26.11.2018. https://www.vdtuev.de/news/mehrheit-der-bundesbuerger-fuer-algorithmen-checks (Download 21.12.2018).

Vodafone Institut für Gesellschaft und Kommunikation (2016). *Big Data: Wann Menschen bereit sind, ihre Daten zu teilen*. Eine europäische Studie. Berlin. https://www.vodafone-institut.de/wp-content/uploads/2016/01/VodafoneInstitute-Survey-BigData-Highlights-de.pdf (Download 21.12.2018).

About the authors

Viktoria Grzymek is a project manager at the Bertelsmann Stiftung. As part of the Junior Professionals Program, she is involved in several projects for the Stiftung, all of which address digitalization and its associated societal issues. Previously, she served as a public-affairs consultant, and worked in the German Federal Ministry for Economic Affairs and Energy. She studied public policy at the Hertie School of Governance in Berlin, as well as European Studies at Maastricht University.

Michael Puntschuh works as a policy analyst for the independent iRights.Lab think tank. Previously, he served as project manager for the Bertelsmann Stiftung's Ethics of Algorithms project, working on the present study in the context of that activity. He wrote his master's thesis on spaces that exclude human rights in cyberspace. He studied international relations, world society and world politics at the Technical University of Dresden and the University of Lucerne, with semesters abroad in Moscow and Oslo.

Annex

Questionnaire

1. Which of the following statements best describes your familiarity with algorithms?

- I've never heard of them.
- I've heard of them, but I dont't know what they are.
- I know a little about them.
- I know a lot about them

2. What do you have in mind when you hear the word "alogrithm"?

- Efficient decisions
- Loss of control
- A lot of power for programmers
- Scary
- Fair decisions
- Saving of time
- Manipulation
- Accurate decisions
- Threatening
- Incomprehensible
- None of the above

3. In each of the following areas, computer programs currently use algorithms to make or support decisions. For which of the following areas did you already know this?

- Personalizing advertisements
- Selection of mates on dating platforms
- Personalizing news/information
- Spell checker
- Evaluation of creditworthiness
- Preselection of job candidates
- Diagnosis of diseases
- None of the above

4. For which of the following tasks would you find it acceptable for a computer to make decisions on its own?

- Personalizing advertisements
- Selection of mates on dating platforms
- Personalizing news/information
- Spell checker
- Evaluation of creditworthiness
- Preselection of job candidates
- Diagnosis of diseases
- Selection of best traveling route
- Stock trading
- Create weather forecasts
- None of the above

5. For which of the following tasks would you find it acceptable for a computer to make suggetions, but only if a human makes the final decisions?

- Personalizing advertisements
- Selection of mates on dating platforms
- Personalizing news/information
- Spell checker
- Evaluation of creditworthiness
- Preselection of job candidates
- Diagnosis of diseases
- Selection of best traveling route
- Stock trading
- Create weather forecasts
- None of the above

6. For which of the following tasks do you think a human should decide alone without any suggestions from a computer?

- Personalizing advertisements
- Selection of mates on dating platforms
- Personalizing news/information
- Spell checker
- Evaluation of creditworthiness
- Preselection of job candidates
- Diagnosis of diseases
- Selection of best traveling route
- Stock trading
- Create weather forecasts
- None of the above

7. Overall, do you think that the use of computer algorithms for decision-making creates more benefits or problems?

- More benefits
- More problems
- Don't know

8. Which of the following statements do you agree with most?

- I prefer that algorithms judge me instead of humans. They make more objective decisions that are the same for everyone.
- Algorithms might be objective, but I feel uneasy if computers make decisions about me. I prefer humans making those decisions.
- Don't know

9. Do you think that the use of algorithms in decision-making should be more controlled?

- Yes
- No
- Don't know

10. Which, if any, of the following control measures would you support?

- Give people the right to ask for human corrections of a computer's decision
- Make computer decisions understandable to the public
- Make it mandatory to indicate when a decision is made by a computer
- Forbid decisions made by computers alone
- Establish a government-run ethic committee for the use of algorithms
- Introduce a moral code of conduct for people who program computer decisions
- Forbid the use of alorithms in all decision-making
- None of the above

Addresses | Contact

Bertelsmann Stiftung
Carl-Bertelsmann-Straße 256
33311 Gütersloh
Telephone +49 5241 81-0

Ralph Müller-Eiselt
Director, Program Megatrends
Telephone +49 5241 81-81456
ralph.mueller-eiselt@bertelsmann-stiftung.de

Viktoria Grzymek
Project Manager
Telephone +49 5241 81-81247
viktoria.grzymek@bertelsmann-stiftung.de

www.bertelsmann-stiftung.de

BertelsmannStiftung