wellcome

Young people's awareness and attitudes to machine learning

Science Education Tracker 2019

Wave 2

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THE ROYAL SOCIETY

KANTAR

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Executive summary

Introduction

This report presents findings from the 2019 Science Education Tracker (SET 2019) survey, the second wave of a survey series that began in 2016 (SET 2016). Both survey waves were conducted by Kantar. The survey series is commissioned by Wellcome, with additional support from the Department for Education (DfE), UK Research and Innovation (UKRI), the Royal Society and the Department for Business, Energy & Industrial Strategy (BEIS).

The SET survey series is designed to provide evidence on a range of key indicators for science engagement, education and career aspirations among young people in England and to allow changes to be tracked over time. The machine learning module, funded by the Royal Society, specifically focuses on young people's awareness of and attitudes towards machine learning applications. The same questions were asked in SET 2016 and therefore findings have been tracked over time.

The SET 2019 survey was based on a nationally representative sample of 6,409 young people in school years 7 to 13 (aged 11–18) attending state-funded schools in England. The machine learning module was addressed to a random half subsample of all those in years 10–13 (aged 14–18), a total of 2,098 young people. Within this subsample, the sample was further split and some questions were asked of a random quarter subsample (around 1,100 young people per question).

SET 2019 fieldwork was conducted online between 13 July and 2 September 2019.

Key findings

This chapter provides a high-level summary of the 2019 findings, the variation in results by key demographic subgroups and the key trends over time between SET 2016 and SET 2019.

- Awareness of machine learning applications varied. At least 80% of young people had seen or heard something about programmes which tailor web content based on browsing behaviour; voice recognition computers; facial recognition computers used in policing; and driverless vehicles. Young people were least familiar with robots used in the finance industry, robots used in medicine and robots used in a home care environment such as caring for the elderly.
- Compared with 2016, there was an increase in awareness of driverless vehicles (from 78% to 84%). However, there were declines in the level of awareness of medical diagnostic computers (from 67% to 56%) and robots used to make financial investments (from 48% to 38%).
- Males were more likely than females to say that they were aware of most of the different machine learning applications asked about in the survey. Students with a high science quiz score, which is used as a proxy for science-related knowledge[1], were more likely than students with a lower science quiz score to be aware of all applications.
- While the majority of young people (83%) were comfortable with the idea of computers recommending a movie for them to watch, there was a relatively high level of mistrust in the use of machines to provide care for the elderly or to control a car in which they are travelling; only around three in ten trusted a machine for the latter two applications.

[1] A 10-item science quiz was used to measure young people's scientific knowledge; see section 1.3 of this report.

- Between 2016 and 2019, there was a small increase in the proportion of young people who trusted driverless vehicles (from 23% to 29%). However, more generally there were declines in the proportions of young people who *distrusted* all three applications, with a corresponding rise in the proportions who answered ‘Don’t know’. This suggests that young people have become less distrustful of and more questioning about the use of these types of applications.
- Males had more trust than females in the use of machines to provide care for the elderly and in autonomous vehicles, as did students with a high quiz score compared with students with a lower quiz score.

1. Introduction

1.1. Background and context

Machine learning is a technology that enables computer systems to learn from data so that they are able to carry out specific tasks by learning from examples. As the Royal Society notes:

> **It is a form of artificial intelligence that we use every day: in internet search engines, email filters to sort out spam, websites to make personalised recommendations, banking software to detect unusual transactions, and lots of apps on our phones such as voice recognition. … Future developments could support the UK economy and will have a significant impact upon society. For example, machine learning could provide us with readily available 'personal assistants' to help manage our lives, it could dramatically improve the transport system through the use of autonomous vehicles; and the healthcare system, by improving disease diagnoses or personalising treatment[2].**

The Royal Society launched a project on machine learning in November 2015 to explore the potential of machine learning over the ensuing 5–10 years; its aims are to raise awareness of the technology and to investigate the opportunities and challenges associated with this technology.

There have been some recent studies covering the views of the adult public on machine learning and/or artificial intelligence (for example BEIS, 2019; Royal Society, 2017a). In addition, the Royal Society commissioned qualitative research among people ('digital natives') aged 18–29 which showed that young adults, compared with the general public, were generally more familiar with, and more positive about, the benefits of machine learning applications in everyday life (Royal Society, 2017b). However, there has been limited quantitative evidence concerning the views of young people.

To help address this, the Royal Society funded a short module of questions as part of the 2016 Science Education Tracker survey (SET 2016) which focused on awareness of and attitudes towards machine learning and its applications among young people aged 14–18. These questions were then repeated in the 2019 survey (SET 2019) among the same target population, which has allowed awareness of and attitudes towards machine learning applications among young people to be tracked over time.

This survey module complements a broader set of public engagement activities on the subject of machine learning, which the Royal Society has carried out as part of its machine learning project. Through a quantitative survey and a series of public dialogue sessions across the UK, the Royal Society has been exploring public attitudes towards machine learning and its applications. Engaging with the public in this way has been key in informing the findings of the machine learning project. The results of this work were published in April 2017 alongside the broader findings of the project[3], with a follow-up dialogue focused on 'digital natives' published in October 2017 (as noted above)[4]. In 2018, the Royal Society also ran a series of public events on 'You and AI' and held public lectures in London and Manchester that are available to watch online[5].

[2] https://royalsociety.org/topics-policy/projects/machine-learning/videos-and-background-information/

[3] https://royalsociety.org/topics-policy/projects/machine-learning/

[4] https://royalsociety.org/-/media/policy/projects/machine-learning/digital-natives-16-10-2017.pdf

[5] https://royalsociety.org/topics-policy/projects/machine-learning/you-and-ai/

The Science Education Tracker 2019

The Science Education Tracker 2019 (SET 2019) is the second wave of a survey series that began in 2016 (SET 2016). The SET 2019 survey was conducted by Kantar on behalf of Wellcome, with additional support from the Department for Education (DfE), UK Research and Innovation (UKRI), the Royal Society and the Department for Business, Energy & Industrial Strategy (BEIS).

While the SET 2016 survey[6], also conducted by Kantar, covered just over 4,000 students in school years 10–13 (aged 14–18) in state-funded schools across England, the SET 2019 survey sampled 6,409 young people in years 7–13 (aged 11–18) in state-funded schools across England. The survey provides evidence on key indicators for science engagement, education and career aspirations among young people in England.

The full set of findings can be found at www.wellcome.ac.uk/set2019.

The machine learning module

As an addition to the core content of the SET 2019 survey, the survey included a short supplementary module on awareness of and attitudes towards machine learning funded by the Royal Society (reported here). Although SET 2019 covers all students in years 7–13, the machine learning questions were only addressed to those in years 10–13 (as in SET 2016). The machine learning module was based on a random subsample of 2,098 out of the 6,409 respondents who completed the SET 2019 survey. Within this subsample, the sample was further split and some machine learning questions were asked of a random half of this subsample (around 1,100 young people per question).

The survey included questions on the following:

- The extent to which young people had seen or heard about machine learning applications in a variety of settings including transport, medicine, social care, finance, military and computing.
- The level of trust among young people in the use of machine learning for specific applications, including recommendation systems for online retail, care for the elderly and driverless car technology.

The same questions were asked in SET 2016, which has allowed the results to be compared over time.

1.2. SET 2019 survey methodology

Further information about the survey background and methodology, including the survey questions, can be found in the SET 2019 Technical Report, available at www.wellcome.ac.uk/set2019. Key details are as follows:

- The sample is a random sample of young people in school years 7 to 13 (aged 11–18) attending state-funded education in England. It was drawn from a combination of the National Pupil Database (NPD) and the Individualised Learner Record (ILR).
- However, the machine learning questions were only asked of a random subset of young people in years 10–13 (aged 14–18), which matches the approach used in SET 2016.
- All sampled individuals were sent a letter inviting them to take part in an online survey. The survey was branded the Pathways survey in all correspondence with young people.
- Respondents were able to complete the survey on any online device, including PCs, laptops, tablets and mobile phones.
- 6,409 respondents completed the survey between 13 July and 2 September 2019, representing an overall response rate of 49%[7].

1.3. Interpretation of the data in this report

Science quiz

The survey included a science quiz intended to measure young people's scientific knowledge. This comprised ten true-or-false questions. For young people in years 10 to 13, the quiz was identical to the version used in SET 2016, as well as in other science surveys, such as the Wellcome Monitor and Public Attitudes to Science surveys.

Respondents were classified into one of three groups based on their score from the knowledge quiz:

- Low (26% of respondents) – 0–5 correct answers;
- Medium (53% of respondents) – 6–8 correct answers;
- High (21% of respondents) – 9–10 correct answers.

[6] https://wellcome.ac.uk/what-we-do/our-work/young-peoples-views-science-education

[7] Response rate is calculated as the number of completed interviews/number of cases issued. This corresponds to Response Rate 1, as calculated by the American Research Association for Public Opinion Research (AAPOR, 2016, Survey Outcome Rate Calculator 4.0).

In this report, the knowledge quiz scores are used as a measure of scientific knowledge and as a proxy for attainment in science. For respondents in years 12 or 13 who had agreed to link NPD data to their survey answers, we were able to compare knowledge quiz scores with achieved key stage 4 science results. A moderate Pearson's correlation coefficient of 0.5 was observed between quiz score and key stage 4 results.

Reporting conventions

All differences commented on in this report are statistically significant at the 95% level of confidence[8]. All percentages reported are weighted to account for differential nonresponse.

Where percentages do not add up to 100% or to net figures, this will be due to either (i) rounding or (ii) questions which allow multiple answers.

Respondents were able to refuse to answer any question by selecting 'Prefer not to say'. 'Don't know' and 'Prefer not to say' responses are included in the base for all questions reported except where otherwise specified.

1.4. Structure of report

The report is structured as follows:

- Chapter 1 considers young people's familiarity with different machine learning applications and the variation in this across different demographic sectors.
- Chapter 2 explores young people's attitudes towards three specific areas of machine learning: recommendation engines, driverless vehicles and care of the elderly.

[8] When comparing proportions, a design effect of 1.06 was used for the 2019 study and a design effect of 1.09 was used for the 2016 study. These design effects were estimated at the overall level and were calculated as = $(1 + \text{cov}(W)^2)$ – where cov(W) is the coefficient of variation of the weights.

2. Awareness of machine learning applications

This chapter considers young people's familiarity with different machine learning applications and the variation in levels of awareness across different demographic sectors.

2.1. Overall level of awareness

Young people in years 10–13 were asked about the extent to which they had seen or heard about a number of different examples of machine learning, where machine learning was defined in the questionnaire as '*… when machines or computers are able to adapt, learn and make recommendations or decisions on their own without a human giving them ongoing instructions'.* Applications covered specific examples across the domains of home computing, policing, transport, medicine, military, finance and social care.

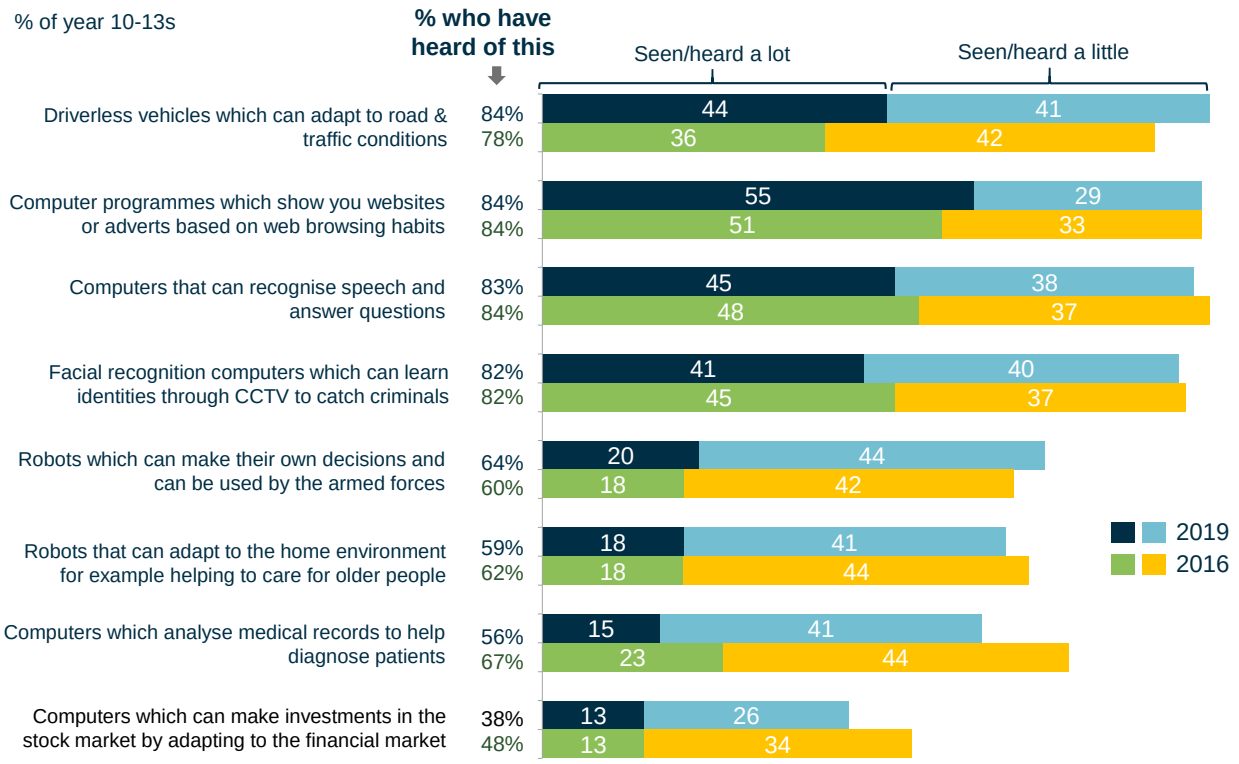
At least half of young people reported having heard something about most of these examples (Figure 2.1). The one exception was 'making investments in the stock market', which only 38% said they had seen or heard something about. However, there was substantial variability in responses to different applications. The applications which attracted the most recognition were those which concern everyday digital interactions, such as programmes that tailor web content based on browsing habits (84% had heard something about this) and computers that recognise and process speech (83% recognition level). Similar proportions had heard about driverless vehicles (84%) and facial recognition computers used in policing (82%).

Applications which were not as well known to respondents included machine learning applied in the areas of stock market investments (38%); medicine (56%); caring for the elderly (59%); and military applications (64%). It is worth noting that the question regarding the use of robots in the military did not include any mention of the term 'military drone', which has been the subject of extensive media coverage in recent years. It is possible that awareness may have increased if this potentially more familiar term had been used.

When comparing these findings with the results of the SET 2016 survey, no clear patterns are evident. In some cases, there has been little overall change in awareness: awareness has remained stable for algorithms that target web content, speech recognition tools, facial recognition computers and social care robots. However, the percentage of young people who had heard of computers analysing medical records to help diagnose patients decreased from 67% in 2016 to 56% in 2019, while the percentage who had heard of computers making investments in the stock market decreased from 48% in 2016 to 38% in 2019.

Awareness of driverless vehicles increased from 78% to 84% between 2016 and 2019. In particular, the proportion of young people who had seen or heard 'a lot' about driverless vehicles increased from 36% to 44%.

Figure 2.1: Awareness of different machine learning applications (2019 and 2016)



Q. Machine Learning is when machines or computers are able to adapt, learn and make recommendations or decisions on their own without a human giving them ongoing instructions. Have you seen or heard anything about…? (MLAware)

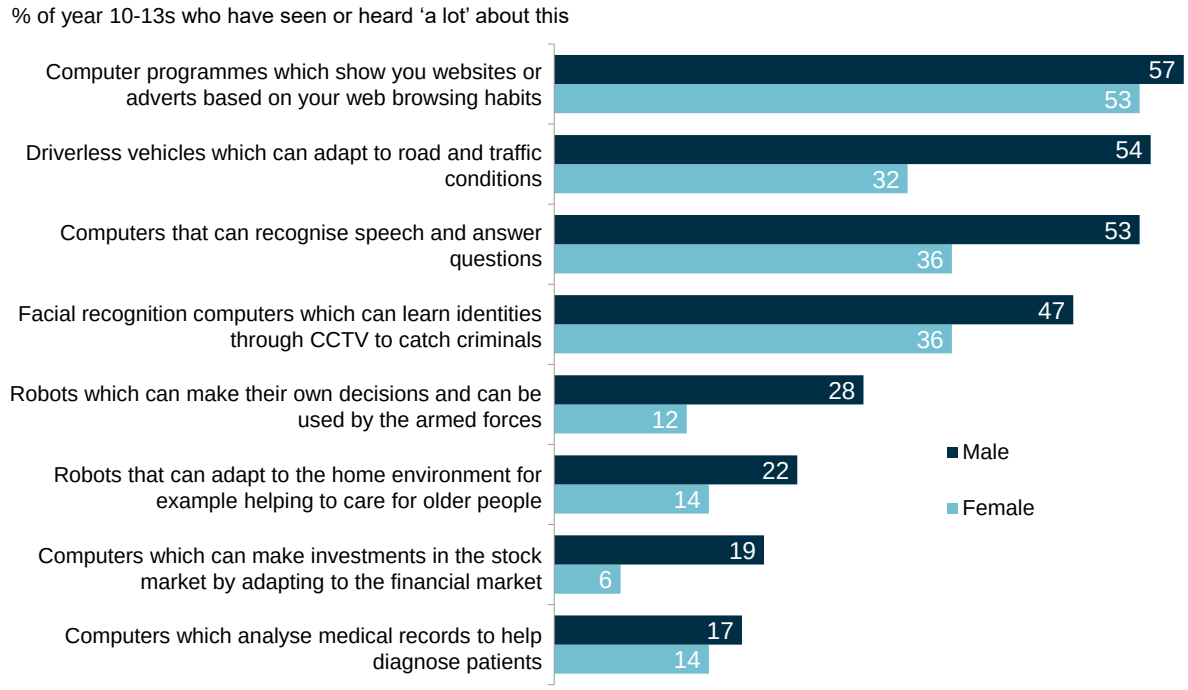
Bases (2019): Years 10–13, half sample: Base sizes vary between 1,099 and 1,106

Bases (2016): All respondents, half sample: Base sizes vary between 1,102 and 1,105

2.2. Awareness by demographic subgroups

As in SET 2016, there was a strong gender difference in young people's awareness of machine learning applications (Figure 2.2). Regarding most applications[9], males were more likely than females to report having seen or heard 'a lot'. The largest gender differences were observed in relation to awareness of computers being able to make stock market investments, where males were three times as likely to have seen or heard a lot about this (19% vs 6%), and awareness of the use of robots by the armed forces (28% vs 12%). There were also strong gender differences in relation to driverless vehicles (54% of males vs 32% of females), speech recognition applications (53% vs 36%) and facial recognition applications (47% vs 36%).

Figure 2.2: Percentage who say they have seen or heard 'a lot' about different machine learning applications by gender (2019)



Q. Machine Learning is when machines or computers are able to adapt, learn and make recommendations or decisions on their own without a human giving them ongoing instructions. Have you seen or heard anything about…? (MLAware)

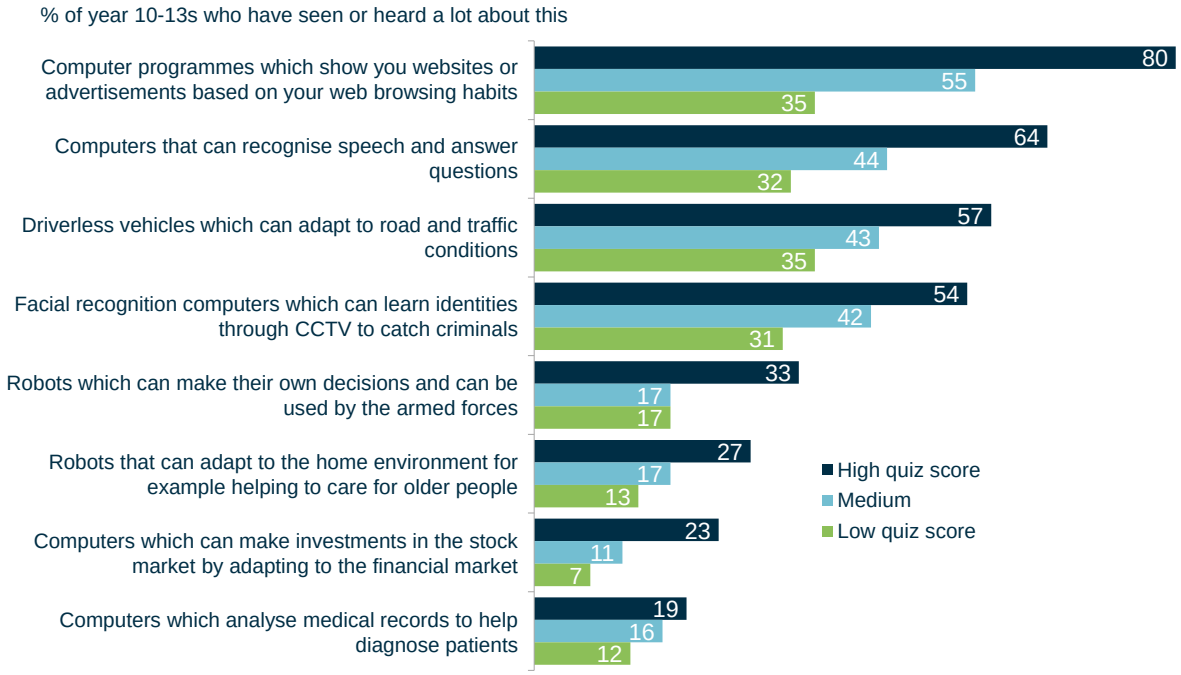
Bases (male): Years 10–13, half sample: Total: websites: 513; speech: 517; CCTV: 535; vehicles: 530; medical records: 540: elderly care: 537; armed forces: 528; investments: 521

Bases (female): Years 10–13, half sample: Total: websites: 577; speech: 566; CCTV: 555; vehicles: 561; medical records: 555; elderly care: 554; armed forces: 562; investments: 567

[9] This gender differential was observed in all applications except for web browsing and medical applications, where the difference was not significant.

Awareness of machine learning applications was related to the science knowledge quiz score, which was used in the SET 2019 survey as a proxy for science-related knowledge (Figure 2.3). Respondents with a high quiz score were more likely than those with a low quiz score to have seen or heard a lot about each type of application.

Figure 2.3: Percentage who say they have seen or heard 'a lot' about different machine learning applications by science quiz score (2019)



Q. Machine Learning is when machines or computers are able to adapt, learn and make recommendations or decisions on their own without a human giving them ongoing instructions. Have you seen or heard anything about…? (MLAware)

Bases (high quiz score): Years 10–13, sample B: Total: websites: 240; speech: 229; CCTV: 245; vehicles: 230; medical records: 230: elderly care: 245; armed forces: 236; investments: 249

Bases (medium quiz score): Years 10–13, sample B: Total: websites: 591; speech: 606; CCTV: 594; vehicles: 617; medical records: 612; elderly care: 570; armed forces: 608; investments: 596

Bases (low quiz score): Years 10–13, sample B: Total: websites: 271; speech: 264; CCTV: 263; vehicles: 254; medical records: 264; elderly care: 286; armed forces: 261; investments: 257

3. Trust in machine learning applications

This chapter explores young people's attitudes towards three specific areas of machine learning: recommendation systems used in online retail, driverless vehicles and care of older people.

3.1. Overall level of trust

There is an emerging body of literature on the level of support for different automated systems within the adult population. A Royal Society survey (Royal Society, 2017a) identified that British adults were, on balance, more positive than negative about the use of machine learning applications that recognise faces for the purposes of detecting criminals; recognise and process speech; make a diagnosis from analysing medical records; and care for older people. However, people were less supportive of driverless vehicles, robots used by the armed forces and applications which can make stock market investments.

A Eurobarometer study (European Commission, 2017) mirrored these findings, identifying that only around a fifth to a quarter of UK adults felt comfortable with the idea of having a medical operation performed on them by a robot (25%); having a robot provide services and companionship to elderly or infirm people (21%); and travelling in a driverless vehicle (18%).

In the SET 2019 survey, the level of trust varied considerably depending on the nature of specific applications (Figure 3.1). The large majority (83%) indicated that they would trust a machine or computer to recommend a movie that they would enjoy; many young people will have been exposed to and used such recommendation engines in their everyday life.

However, young people were more distrustful of other applications. On balance, more young people distrusted than trusted the use of autonomous systems based on machine learning to care for an elderly person in their own home (30% trusted this and 55% distrusted it) and the use of machine learning to control a car in which they were travelling (29% trusted this but 57% distrusted it).

While the questions cannot be directly compared with existing surveys of adults (due to differences in question wording) the findings appear to indicate a higher level of trust among younger people compared with adults. For example, the above-mentioned Eurobarometer 2017 study found that only 21% of UK adults felt comfortable with the idea of having a robot to provide services and companionship to elderly or infirm people and only 18% felt comfortable with the idea of travelling in a driverless car. The SET 2019 findings suggest that younger people are more trusting than older people, as around three in ten are trusting in these contexts.

The tendency for younger people to be more accepting of these types of machine learning applications was also found in the Eurobarometer study. Based on an EU-wide average, the level of support for robots in a social care setting was higher among young people aged 15–24 (34% feeling comfortable); this declined across the age groups (to 21% of those aged 55+), with a similar age-related pattern for travelling in a driverless car (29%, declining to 15% of those aged 55+). Across the EU in the Eurobarometer survey, support for the use of robots in medical applications was constant across all age groups (around 25%).

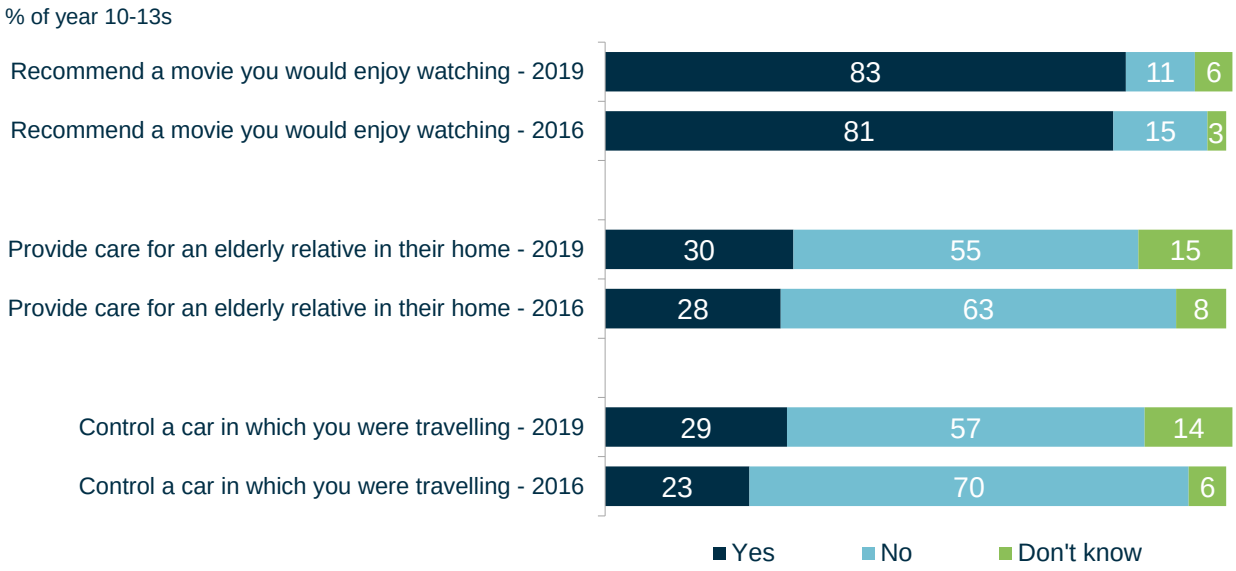
Similarly, PWC research (PWC, 2016) found that 55% of people aged 18–24 in the UK were willing to use AI for diagnosis and to recommend treatments, compared with only 33% of adults aged 55+.

When comparing these results with those of SET 2016, it can be seen that there has been very little change in the proportion of young people who trust these applications, although the proportion who would trust a driverless car increased from 23% in 2016 to 29% in 2019.

However, there has also been a decrease in the percentage of respondents who would *not* trust a machine to do each of these tasks. Between 2016 and 2019, the proportion who distrusted recommendation engines declined from 15% to 11%; the proportion who distrusted elderly care robots declined from 63% to

55%; and the proportion who distrusted driverless cars declined from 70% to 57%. These declines in the level of distrust have been accompanied by rises in the proportion who answered ‘Don’t know’. This suggests that although there has been little change in the level of trust for each of these applications, young people are becoming less distrustful of them but more questioning.

Figure 3.1: Level of trust in three different applications (2019 and 2016)



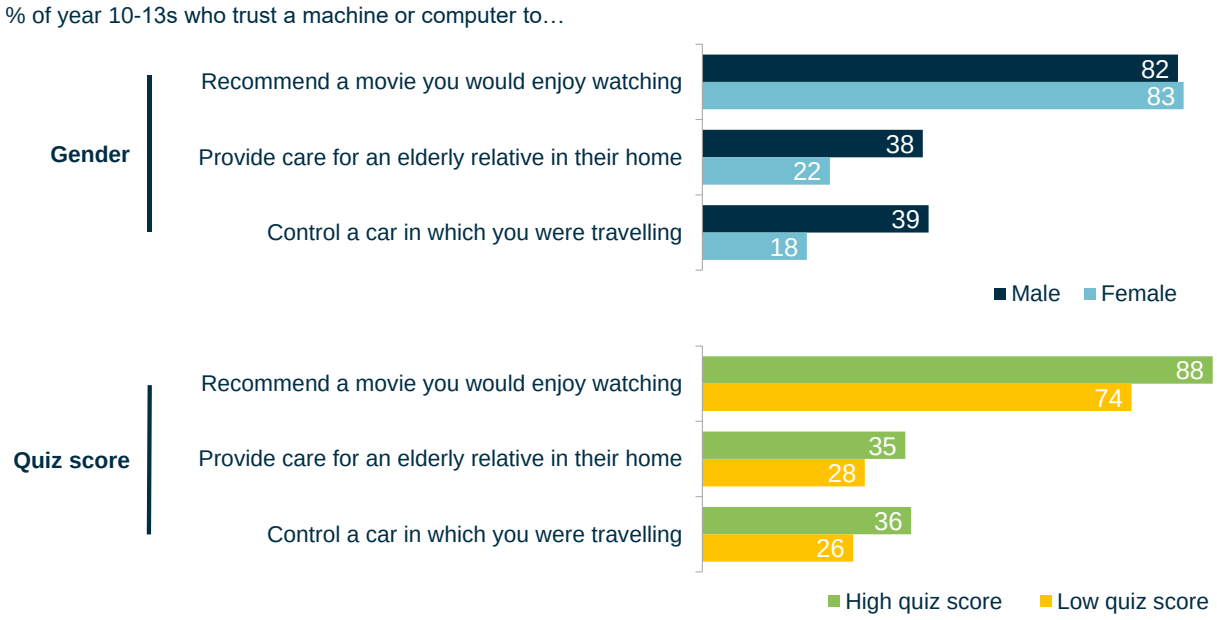
Q. Would you trust a machine or computer to…? (MLAtt)
Bases (2016): Years 10–13, half sample (2,044)
Bases (2019): Years 10–13, half sample (2,098)

3.2. Level of trust by demographic subgroups

There were some notable differences by subgroup when looking at respondents' trust in machine learning applications (Figure 3.2). Males were more likely than females to trust a machine or computer to provide care for the elderly (38% compared to 22%). Males were also more likely to trust driverless technology (39% compared to 18%).

Young people who achieved a high quiz score were also more likely than those who achieved a low score to trust all three machine learning applications.

Figure 3.2: Level of trust in three different applications by gender and quiz score (2019)



Q. Would you trust a machine or computer to…?
Bases: Years 10–13, half sample: Males (983); females (1,092); high quiz score (458); low quiz score (505)

Appendix A: Bibliography

BEIS. BEIS Public Attitudes Tracker: June 2019 (Wave 30). London: BEIS; 2019. https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/817872/BEIS_Public_Attitudes_Tracker_Wave_30_key_findings.pdf

European Commission. Special Eurobarometer 460: Attitudes towards the impact of digitisation and automation on daily life. EU: European Commission; 2017. https://ec.europa.eu/commfrontoffice/publicopinion/index.cfm/Survey/getSurveyDetail/instruments/SPECIAL/surveyKy/2160

PWC. What Doctor? Why AI and robotics will define New Health. PWC; 2017. https://www.pwc.com/gx/en/industries/healthcare/publications/ai-robotics-new-health/ai-robotics-new-health.pdf

Royal Society. Public Views of Machine Learning: Findings from public research and engagement conducted on behalf of the Royal Society. London: Royal Society; 2017a. https://royalsociety.org/-/media/policy/projects/machine-learning/publications/public-views-of-machine-learning-ipsos-mori.pdf

Royal Society. Public Views of Machine Learning: Digital natives. Supplementary research conducted on behalf of the Royal Society. London: Royal Society; 2017b. https://royalsociety.org/-/media/policy/projects/machine-learning/digital-natives-16-10-2017.pdf

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