D1.2 Benchmark of factors affecting use of digital products and services across Europe

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Executive summary

This deliverable presents the methodology and results from five surveys from the DIGNITY project. The surveys examined key factors that affect the use of digital mobility services, covering technology access, technology use (both in general and for transport), attitudes towards technology and competence with basic digital interface patterns, as well as sensory, motor and cognitive capabilities. The surveys were conducted in five European countries or regions: Germany, Italy, Barcelona Metropolitan Area, Flanders and the Netherlands, and were designed to be compatible with a previous survey carried out in the UK.

The survey results provide important information for understanding how many and what types of people are likely to be excluded from using specific digital mobility services or products because they lack access to the required technology, would struggle to use the interface or find it daunting to use new technology. This is particularly important because those who struggle with digital interfaces are often already disadvantaged due to issues such as poverty, low education, disability or age. Care is needed in the design of digital mobility services to prevent exacerbating existing structural disadvantages and societal divides.

This deliverable presents general results from the surveys and some initial indication of how the factors affecting digital mobility exclusion vary between subgroups of the population. Further analysis is out of scope of this deliverable but will be explored in further work. In addition, the survey datasets will be made available open access on the UPC repository for other researchers who would like to explore the data further.

The results from the surveys indicate that substantial numbers of people in all the countries surveyed lack access to or do not use digital technology. For example, those without internet access ranged from 7% in Barcelona to 24% in Italy. Digital mobility services requiring the installation of a new app on a smartphone are likely to be particularly exclusionary because the user needs to know how to install an app as well as have access to a smartphone. Furthermore, substantial numbers of people have low levels of basic digital interface competence, ranging from 18% in Flanders to 33% in Italy. These figures indicate that there are large numbers of people who have access to technology but are still likely to struggle with using basic smartphone interfaces.

The surveys also examined attitudes towards technology, finding that those with low affinity for technology interaction (Franke et al, 2018) range from 28% in Barcelona to 50% in Flanders. These people are likely to be more hesitant about using new technology and may have a tendency to avoid it.

There were also high levels of travel limitations: the proportions of those reporting being very limited in their regular travel in the region ranged from 27% in the Netherlands to 45% in Germany. Furthermore, substantial numbers of these respondents reported limitations because digital skills were needed to plan the travel or use the transport.

The use of digital mobility services such as car sharing, digital taxi services and mobile phone parking payment was low. Between 35% in Flanders and 87% in Italy had never used any of the services examined in the survey. These findings indicate that there is a long way to go before these services truly become mainstream, especially in Italy.

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The final module of the surveys examined physical, sensory and cognitive capabilities. These results can be useful in determining what proportions of the population are likely to be able to interact with interface elements, e.g., see the text and graphics comfortably or activate small touchscreen controls reliably. The findings indicate that the numbers of people with capability limitations are high, and that many people experience limitations in more than one capability at the same time. For example, 36% of the German sample reported limitations in their daily activities because of issues with more than one capability.

Examining different subgroups of the population, initial results from the German survey indicate that older people, those with disabilities and (to a lesser extent) those with low levels of education had the lowest levels of technology variables, including digital technology access, use, competence and attitudes. These same groups also experience the most travel limitations, both in general and for reasons to do with digital skills. These results highlight the extra importance of inclusive design when designing for older people, those with disabilities and those with low education. This includes the design of transport services that are intended for use by the population as a whole because this includes many people in these groups. It is sobering to realise that these are the same groups experiencing the highest levels of mobility poverty. This presents a key challenge to develop more inclusive mobility systems and not inadvertently further exclude these vulnerable groups in the move to digitalisation.

Document History

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List of Figures and Tables

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1. Introduction

1.1 Dignity Project Summary

The overarching goal of DIGNITY is to foster a sustainable, integrated and user-friendly digital travel eco-system that improves accessibility and social inclusion, along with the travel experience and daily life of all citizens. The project delves into the digital transport eco-system to grasp the full range of factors that might lead to disparities in the uptake of digitalised mobility solutions by different user groups in Europe. Analysing the digital transition from both a user and provider's perspective, DIGNITY looks at the challenges brought about by digitalisation, to then design, test and validate the DIGNITY approach, a novel concept that seeks to become the 'ABCs for a digital inclusive travel system'. The approach combines proven inclusive design methodologies with the principles of foresight analysis to examine how a structured involvement of all actors - local institutions, market players, interest groups and end users - can help to bridge the digital gap by co-creating more inclusive mobility solutions and by formulating user-centred policy frameworks.

The idea is to support public and private mobility providers in conceiving mainstream digital products or services that are accessible to and usable by as many people as possible, regardless of their income, location, social or health situation or age; and to help policy makers formulate long-term strategies that promote innovation in transport while responding to global social, demographic and economic changes, including the challenges of poverty and migration.

By focusing on and involving end-users throughout the process of designing policies, products, or services, it is possible to reduce social exclusion while boosting new business models and social innovation. The aim of DIGNITY is to provide an innovative decision support tool that can help local and regional decision-makers formulate digitally inclusive policies and strategies, and digital providers design more inclusive products and services.

1.2 Objectives of Deliverable 1.2

Deliverable 1.2 summarises the results of task 1.2 where national or regional surveys were carried out in five European countries to gather population level data on user factors that affect people's use of digital products and services. These factors include technology access, technology use (both in general and for transport), attitudes towards technology and competence with basic digital interface patterns, as well as sensory, motor and cognitive capabilities. The surveys provide an indication of how these factors are spread across the population. The countries surveyed were Belgium, Germany, Italy, Spain and The Netherlands, corresponding to the partners in the DIGNITY project. Data was already available for the remaining partner (University of Cambridge, UK) from an earlier version of the survey conducted in 2019 (Goodman-Deane et al, 2021a).

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The objectives of this deliverable are to:

- provide detailed information on the questionnaire used in the surveys so that others could conduct similar surveys to gather data on the user factors that affect digital mobility exclusion;
- describe the sampling and methods used in the survey in each country to aid in the interpretation of the survey results;
- describe the general results in each country, showing how the factors affecting digital mobility exclusion are spread in the population of each country as a whole;
- provide some insights from this data into digital mobility exclusion;
- provide an initial indication of how the factors affecting digital mobility exclusion vary between different subgroups of the population.

Please note that this deliverable presents only an initial description and analysis of the survey results. We plan to conduct fuller analyses in the future but it is beyond the scope of the current deliverable.

1.3 Outline of this deliverable

This deliverable consists of six sections, including this introduction. Section 2 provides some background to the surveys and why they were conducted. In Section 3 the survey methodology, sampling and questionnaire are described in detail, including differences between the surveys in different countries. Section 4 contains results from the survey in each of the countries in turn, reporting these for each of the samples as a whole. Section 5 then examines how key variables vary between different groups that may be vulnerable to digital mobility exclusion. Finally, Section 6 concludes and describes some key possibilities for further work.

2. Background: Factors affecting the use of digital mobility services

Technological advances in the transport and mobility sector, such as digitalization, smart applications and local digital services, offer a range of mobility innovations with great potential to improve passengers' transportation options and experiences. These digital mobility services can, for example, provide better access to information and support, combine multiple transport modes more seamlessly and provide on-demand public transport, as well as offering new business models.

However, many of these services require the end user to use a digital interface in order to access them. Users who cannot use this interface for one reason or another may end up being excluded from using the service. This is a particular issue for digital mobility services because some of those who could benefit the most from improved access to transport are also at higher risk of digital exclusion. For example, the European Commission (2020) found lower levels of digital technology use among people with low education, older people and those who are retired or inactive. As Vandycke (2018) pointed out, "new transport technologies have, for the most part, benefited a specific demographic: urban, young, tech-savvy, and pretty wealthy".

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As a result, care needs to be taken in the design of digital mobility services to ensure that they are inclusive and can be used by a wide range of groups across society. To do this, it is important to understand how the factors that affect digital mobility exclusion are spread across the population. The DIGNITY surveys presented in this report aim to do this.

In order to measure the factors that affect mobility exclusion, it is first important to understand what these factors are. In fact, there are many factors that affect whether a person can use a digital product or service effectively. These include attributes of the product or service itself, characteristics of the user and features of the context of use. Figure 1 summarises how these interact to cause digital interface exclusion when the product demands are incompatible with the user characteristics within the particular context.

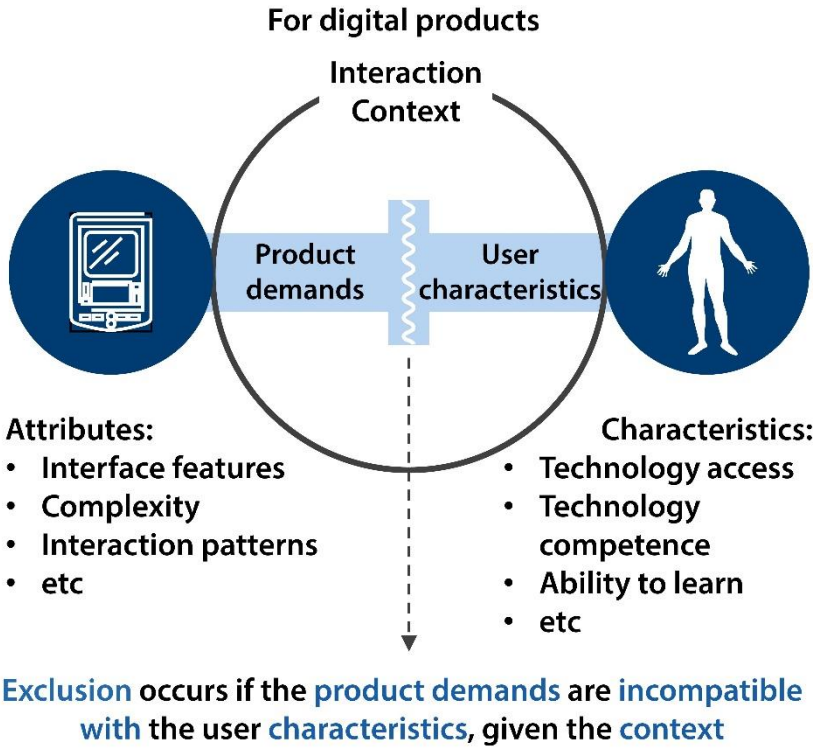

Figure 1: Model of digital interface exclusion (from Goodman-Deane et al, 2020)

The surveys described in this report aim to increase the understanding of user characteristics and how these vary across the population in the surveyed countries. The results can help to inform policy makers and other stakeholders in their decisions, for example about whether and what digital platforms should be used, how the interfaces should be designed and whether non-digital alternatives are needed. The results could also be used examine individual digital mobility products and services or larger groups of similar products to identify who is likely to find them difficult to use and why. This can identify ways in which the services can be improved and made more inclusive.

There are many user characteristics that impact on the use of digital mobility products and services. Some of the key characteristics are summarised in Figure 2. This figure is taken from (Goodman-Deane et al, 2020) and was developed based on a literature review, with

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particular reference to Barnard et al (2013) and Wagner et al (2010). Note that technology competence also depends on various factors including technology prior experience.

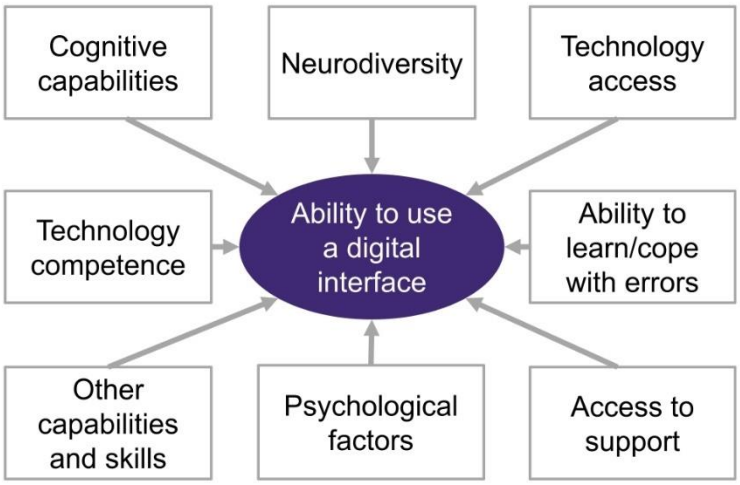

Figure 2: Key user characteristics that affect a person's ability to use a digital interface (from Goodman-Deane et al, 2020)

It is impossible to cover all of these user characteristics in adequate depth in a 20 to 30 minute interview. A subset was selected to cover key characteristics that are useful for informing estimates of exclusion and can be measured adequately in this format: technology access, technology use/experience, basic technology competence, attitudes towards technology (psychological factors), ability to cope with errors and other capabilities.

3. Method

3.1 Overall methodology

The survey was conducted in five separate countries (Belgium, Germany, Italy, the Netherlands and Spain) in 2020 and 2021. The survey in each country was conducted by a local market research/survey company, under the direction of the Dignity research partner in that country. The process was co-ordinated and managed by the Dignity partners at the University of Cambridge (UCAM). Ethical approval for the surveys was obtained from the University of Cambridge Engineering Department ethics committee.

The surveys in Germany, Italy and the Netherlands examined the whole country. The ones in Spain and Belgium focused on smaller regions within these countries as explained in Sections 3.2.3 and 3.2.4 below. They are thus referred to as Barcelona Metropolitan Area and Flanders respectively in the rest of this report.

All of the questionnaires were administered in face-to-face interviews. An online survey was not appropriate because it was important to obtain data from people with all levels of digital experience and competence, including those with no internet connection. Phone interviews were not also appropriate because the technology competence questions required the interviewers to be able to see how participants interact with paper mock-ups of smartphone interfaces.

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As the surveys had t/o be conducted face-to-face, they were affected by the COVID-19 pandemic and consequent social distancing and lockdown restrictions. In particular, they had to be postponed from their original dates (summer 2020) and were conducted at different dates in different countries, as was possible under local COVID-19 restrictions. The dates for each country are shown in Table 1. In the remainder of this report, the surveys are reported in the order shown in this table (chronological order of survey completion). Note that the survey in the Netherlands was conducted in multiple phases because additional COVID-19 restrictions were imposed in that country part-way through data collection. A third phase was required to obtain additional interviews to better match the quotas in the quota sampling.

Table 1: Dates when the Dignity survey was conducted in each country

Country	Date of survey
Germany	July – Sep 2020
Italy	Nov 2020
Barcelona Metropolitan Area (Spain)	Nov-Dec 2020
Flanders (Belgium)	June-Sep 2021
The Netherlands	First phase: Sep 2020 Second phase: July-Sep 2021 Third phase: Nov 2021

All of the surveys were conducted in a manner compliant with local COVID-19 restrictions, maintaining social distancing and wearing face coverings as appropriate. The methodology for the digital competence tests was adapted to enable it to be conducted at a distance of 2m from the participant if required (see Section 3.3.5).

3.2 Sampling and Recruitment

The aim was to get a good representation of the adult population (age 16+) in each country or region. The specific sampling and recruitment procedures varied from country to country. Initially the survey was intended to be conducted with 300-500 participants in each country, using quota sampling on age, gender, location (urban or rural), technology use and either social grade or education. The quotas were to be set based on the spread in each country or region.

However, in some countries, it was possible to obtain a larger sample, large enough to be population-representative. In other countries, it proved difficult to do quota sampling on so many variables and this had to be reduced to a smaller number.

The sampling and recruitment procedures are therefore detailed for each country separately below. Figures are presented for each country comparing the sample distribution with population data. Sample percentages are reported as percentages of valid responses, so the total number of responses varies slightly between variables.

Note that there are some differences in the variables used in different countries due to differences in the population data available and in the demographic questions in the Dignity

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survey in different countries (see Section 3.4 for details on how the survey questions vary between countries).

In addition, the population figures for technology use vary depending on the particular measures was used and how and when the population data was gathered. In some cases, there was also some difficulty in matching population education figures with the education categories used in the Dignity surveys. Some estimates had to be made about whether particular education categories were similar enough to allow comparison. These mean that the comparisons for technology use and education are rougher than for age, gender and urbanisation.

3.2.1 Germany

The survey in Germany was conducted by forsa (www.forsa.de), a German independent market and opinion research institute. The ADM face-to-face sampling system (https://www.adm-ev.de/) was used to obtain a population-representative sample of 1010 adults. This method provides an area sample covering all populated areas in Germany. It was used because there is no generally accessible directory of all private households or persons in Germany. After the selection of sample locations, the private households to be surveyed and target persons within these households were selected at random using a random route procedure. At least four contact attempts were made for each target household or person. No incentives were offered to participants.

A total of 1010 people took part in the German survey, sampled from the total German adult population of 72 million in 2020 (US Census Bureau, undated). The resultant sample distribution is shown in Table 2. A weighting variable was calculated taking age, gender and region into account. The final column of Table 2 and all results presented in this document for Germany use this weighting.

Table 2: Distribution of the survey sample in Germany.

Variable	Value	% in German population[1]	% in unweighted sample	% in sample with weighting on age, gender and region
Age[2]	16-39	33.3%	35.9%	33.4%
	40-64	41.2%	44.4%	41.3%
	65-74	12.0%	12.7%	15.1%
	75+	13.5%	7.0%	10.1%

[1] Note that population figures for gender and urbanization cover the whole population (age 0 up), those for technology use cover age 14 and over, those for education cover 15 and over.
[2] Population figures are for 2020 and were taken from the German federal statistical office via Statista (https://de.statista.com/statistik/daten/studie/1351/umfrage/altersstruktur-der-bevoelkerung-deutschlands/)

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Gender[3]	Male	49.3%	48.4%	49.0%
	Female	50.7%	51.6%	51.0%
Location[4]	Urban	77.4%	71.0%	70.7%
	Rural	22.6%	29.0%	29.3%
Technology use[5]	Use smartphone[6]	81.7%	85.8%	81.9%
	Do not use smartphone	18.3%	14.2%	18.1%
Education[7]	Currently attending school	3.5%	1.5%	2.6%
	No school leaving certificate	4.0%	1.7%	2.0%
	School leaving certificate (intermediate or secondary general)	58.6%	71.2%	62.5%
	University entrance qualifications or higher	33.5%	25.7%	33.0%

3.2.2 Italy

The survey in Italy was conducted by BVA DOXA (https://www.bva-doxa.com/), an Italian independent market research company. Adults aged 18 and over were selected on a random basis from the electoral lists of about 140 municipalities located throughout Italy. Young people aged 15-17 (who were under voting age and thus not on the electoral lists), were selected using quotas of age and gender. Only those aged 16 and over were included in the survey dataset. Interviews were conducted in participants' homes. No incentives were offered to participants.

A total of 1002 people took part in the Italian survey, sampled from the total Italian adult population of 53 million in 2020 (US Census Bureau, undated). The resultant sample distribution is shown in Table 3. It was not possible to ascertain the urban/rural split for this survey as the Italian questionnaire only asked about the size of the commune (region) of residence (see Section 3.4.2) and many communes include a mix of rural and urban locations.

A weighting variable was calculated taking age, gender and region into account. The final column of Table 3 and all results presented in this document for Italy use this weighting.

[3] Population figures are for 2020 and were taken from German census data via Statista (https://de.statista.com/statistik/daten/studie/161868/umfrage/entwicklung-der-gesamtbevoelkerung-nach-geschlecht-seit-1995/). The proportions for gender include the whole population, including those under 16.
[4] Population figures are for 2020 and were taken from the World Bank, UN DESA via Statista (https://de.statista.com/statistik/daten/studie/662560/umfrage/urbanisierung-in-deutschland/)
[5] Population figures were taken from Vuma Touchpoints (https://www.vuma.de/vuma-praxis/die-studie/ via https://de.statista.com/statistik/daten/studie/585883/umfrage/anteil-der-smartphone-nutzer-in-deutschland/)
[6] Smartphone use in the survey refers to those who used a smartphone at least once a week.
[7] Population figures for education are for 2019 and were taken from the German federal Statistical Office: (https://www.destatis.de/EN/Themes/Society-Environment/Education-Research-Culture/Educational-Level/Tables/educational-attainment-population-germany.html)

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Table 3: Distribution of the survey sample in Italy.

Variable	Value	% in Italian population[8]	% in unweighted sample	% in sample with weighting on age, gender and region
Age[9]	18-44	36.5%	33.6%	37.2%
	45-64	36.0%	41.9%	35.6%
	65-74	13.5%	14.7%	17.2%
	75+	14.0%	9.8%	10.0%
Gender	Male	48.7%	48.7%	48.2%
	Female	51.3%	51.3%	51.8%
Technology use[10]	Used the internet in the last 3 months	78%	80.9%	79.5%
	Not used the internet in the last 3 months	22%	19.1%	20.5%
Education[11]	Elementary school or no schooling	16.2%	9.4%	11.3%
	Junior/middle school	32.4%	27.7%	26.2%
	Senior high school or equivalent	36.4%	48.0%	47.4%
	University degree or higher	15.0%	14.9%	15.1%

3.2.3 Barcelona Metropolitan Area (Spain)

The Spanish survey focused on the Barcelona metropolitan area because this was the area of interest to the Spanish pilot and there was concern that a survey attempting to cover the whole country with around 300 people would not provide useful information for them.

The survey in Spain was conducted by GESOP (https://gesop.net), a Spanish research institute specialising in social research and public opinion. Two subsamples were defined: Barcelona city and the rest of the Metropolitan Area. In Barcelona city, the sample was stratified by district. In the rest of the Metropolitan Area, the sample was stratified based on location and the size of the municipality. Within each stratum, municipalities were randomly selected.

[8] Population figures for age, gender and education are for 2019 and were taken from Statista (https://www.statista.com/).

[9] Age figures are given as a proportion of the population/sample aged 18+ because population figures for 16-17 year olds were not available.

[10] Population figures for technology use are for 2020 and were taken from Eurostat from the dataset for Digital economy and society (https://ec.europa.eu/eurostat/databrowser/view/isoc_ci_ifp_iu/default/table?lang=en). Figures were available to the nearest whole number.

[11] Population figures for education are for 2019 and were taken from Statista (https://www.statista.com/statistics/1088273/population-aged-15-years-and-older-by-educational-level-in-italy/). Figures for vocational qualifications were included in "senior high school or equivalent" to give an estimate for this category. The population figures are for the population aged 15+.

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In each district or municipality, individuals were recruited on street. The third person to pass the interviewer from the moment they were free was approached (with the caveat that two people from the same group were never interviewed). Quotas were used to ensure a good representation across the population. In Barcelona city, quotas were set on age, gender and nationality (Spanish or other). In the rest of the Metropolitan Area, quotes were set on age, gender, nationality and type of location (level of urbanisation). The interviews were conducted on street. No incentives were offered to participants.

A total of 601 people took part in the Barcelona survey, sampled from the total adult population of the region of around 2.5 to 3 million[12]. The resultant sample distribution is shown in Table 4. As the quota match was good, no weighting variable was calculated, and all results presented in this document for the Barcelona Metropolitan Area are unweighted. A breakdown for urban/rural is not given for this survey because the area is almost entirely urban. Some of the population figures are for Barcelona City rather than the whole of the Barcelona Metropolitan Area, so an exact match is not expected.

Table 4: Distribution of the survey sample in Barcelona.

Variable	Value	% in population[13]	% in unweighted sample[14]
Age	16-39	34.7%	35.4%
	40-64	42.4%	42.1%
	65-74	11.5%	11.1%
	75+	11.7%	11.3%
Gender	Male	47.5%	47.9%
	Female	52.5%	51.9%
	Prefer to self-describe		0.2%
Technology use[15]	Used a smartphone to access the internet in the last three months	86.5%	84.1%
	Not used a smartphone to access the internet in the last three months	13.5%	15.9%
Education[16]	Primary and lower secondary education (or similar) or lower	45.1%	30.8%
	Higher secondary education	23.2%	15.7%
	Higher education	31.8%	53.5%[17]

[12] Calculated from a total population of 3.2 million (https://www.amb.cat/). Note that population figures vary between sources, possibly due to different definitions of what is included in the region.
[13] The population percentages for age and gender are for the Barcelona Metropolitan Area in 2020 and are taken from IDESCAT (https://www.idescat.cat).
[14] All survey results for Barcelona are unweighted
[15] Population percentages for technology use are for Barcelona City and are taken from the 2019 municipal services survey of Barcelona City Council (https://ajuntament.barcelona.cat/ca/informacio-administrativa/registre-enquestes-i-estudis-opinio). The Dignity survey results for this variable in this table are also reported as a percentage of the participants in Barcelona City (rather than all the participants in the survey).
[16] Population percentages for education are those aged 15+ in the whole of Catalonia and are taken from IDESCAT (https://www.idescat.cat).
[17] Post-compulsory professional training was included in this category for the Dignity survey results. It is unclear whether these were included in the population figures or not.

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3.2.4 Flanders (Belgium)

The Belgian survey focused on the region of Flanders because of significant cultural, language and other differences between Flanders and Wallonia (the other main region in Belgium), and because of organizational and practical reasons.

The survey was conducted by Data Synergy, a Belgian independent market research company. Quota sampling was used with quotas on age, gender, location (urban or rural), technology use (smartphone use) and education. Participants were recruited from interviewers' networks following these quotas. Interviews were conducted in participants' homes and an incentive was offered in the form of a pen in a special case.

A total of 418 people took part in the Flemish survey, sampled from the total adult Flanders population of around 5.5 to 6 million[18]. The resultant sample distribution is shown in Table 5. A weighting variable was calculated taking age, gender and region into account. The final column of Table 5 and all results presented in this document for Italy use this weighting.

Table 5: Distribution of the survey sample in Flanders.

Variable	Value	% in Flanders population[19]	% in unweighted sample	% in sample with weighting on age, gender and region
Age	16-39	35%	42.0%	31.2%
	40-64	40%	36.1%	43.8%
	65-74	13%	12.0%	13.0%
	75+	12%	10.0%	12.0%
Gender	Male	49%	48.9%	48.9%
	Female	51%	50.8%	50.9%
	Prefer to self-describe		0.2%	0.1%
Location	Urban	45.3%	44.5%	51.0%
	Rural	54.7%	55.5%	49.0%
Technology use	I don't have a smartphone	7.0%	6.3%	7.7%
	I use my smartphone less than one hour/day	18.0%	18.3%	21.7%
	I use my smartphone more than one hour/day	75.0%	75.5%	70.6%
Education	Primary education and lower secondary education	20.7%	27.2%	24.9%
	Higher secondary education	46.0%	36.3%	36.7%
	Higher non-university and higher university education	33.3%	36.5%	38.4%

[18] Calculated from a total population of 6.6 million (www.statistiekvlaanderen.be/en/population-size-and-growth-0).
[19] Figures for the Flanders were taken from CIM (Centre for Information about the Media)

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3.2.5 The Netherlands

The survey in the Netherlands was conducted by DTV Consultants (https://dtvconsultants.nl/) a Dutch independent traffic consultancy with expertise in data collection. Participants were recruited on street at a railway station and in shopping malls with quotas set on age, gender, education and technology use. Interviews took place at a mobile test centre. Participants were offered an incentive of a 10-euro gift card for taking part.

Table 6: Distribution of the survey sample in the Netherlands.

Variable	Value	% in Dutch population[20]	% in unweighted sample	% in sample with weighting on age and gender
Age	16-39	36.1%	37.5%	35.9%
	40-64	40.2%	37.2%	40.2%
	65-79	18.0%	16.3%	13.9%
	80+	5.8%	9.0%	9.9%
Gender	Male	49.4%	49.2%	49.2%
	Female	50.6%	50.8%	50.8%
Location[21]	Urban	91.9%	82.0%	81.5%
	Rural	8.2%	18.0%	18.5%
Technology use[22]	Used a smartphone to access the internet[23]	88%	91.2%	91.0%
	Not used a smartphone to access the internet	12%	8.8%	9.0%
Education[24]	Primary or prevocational secondary education (LBO, VMBO, MAVO, etc) or below	29%	20.2%	20.0%
	Secondary education (HAVO, VWO, MBO 2-4)	40%	45.9%	46.1%
	Higher or university education (HCO) or above	30%	33.8%	34.0%

[20] Age and gender population data are for 2021 and were taken from CBS(https://www.cbs.nl/nl-nl/visualisaties/dashboard-bevolking/bevolkingspiramide)

[21] Population figures for urbanization are for 2019 and were taken from Statista (https://www.statista.com/statistics/276724/urbanization-in-the-netherlands/)

[22] Population figures for technology use are for 2019 and were taken from Eurostat https://ec.europa.eu/eurostat/databrowser/view/isoc_ci_im_i/default/table?lang=en from the dataset for Digital economy and society, 2019. Figures were available to the nearest whole number.

[23] In the Dignity survey dataset, this refers to those who used a smartphone to access the internet at least once a week.

[24] Population figures for education are for 2017 and were taken from https://longreads.cbs.nl/trends18-eng/society/figures/education/. Acronyms such as LBO refer to Dutch education levels. The education levels in the population and Dignity survey were matched as closely as possible, but this may not be exact.

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A total of 423 people took part in the Dutch survey, sampled from the total Dutch adult population of 14 million in 2021 (US Census Bureau, undated). The resultant sample distribution is shown in Table 6. A weighting variable was calculated taking age and gender into account. The final column of Table 6 and all results presented in this document for the Netherlands use this weighting.

3.3 *Questionnaire*

The survey questionnaire was adapted from a previous survey created by the Dignity partners at the University of Cambridge (UCAM) and conducted in the UK in 2019 (Goodman-Deane et al, 2021a). This means that the majority of questions had already been piloted and tested, and allows some of the results to be compared with results from the UK. Some questions were omitted or modified based on the experiences in the UK survey and subsequent validation test. The questionnaire was also adapted for use in the transport sector, in particular by the addition of Module B1 (see Section 3.3.2) which focuses on the use of technology for transport.

The questionnaire was developed in English and then translated into the local languages (German, Italian, Catalan/Spanish and Dutch) by professional translators. The local partner was also asked to adjust the examples of services and products in the questionnaire to ones commonly used in that country. The translated versions were then translated back into English and checked by the survey creators before adjustments were made and the translations were finalised.

The questionnaire took around 20 to 30 minutes to administer. It was kept short to encourage participation from a wide range of participants. It comprised modules on technology access and use, technology for public transport, general technology activities, attitudes towards technology, digital competence, sensory, motor and cognitive capabilities and demographics, as described in the following subsections. To correspond to good ethical practice, participants could decline to answer any or all of the questions if they wished.

The full English versions of the questionnaire and showcards are given in Appendices 1 and 2 and are also available open access from the UPCommons repository (Goodman-Deane et al, 2022b).

3.3.1 Module A: Technology access and use

Participants were asked multiple-choice questions about their access to and frequency of use of various kinds of technology. Questions were based on items in the Internet Access Survey 2017 (Office for National Statistics, 2017) to allow for comparison with UK national statistics. The Internet Access Survey asked about computer and internet use. Similar questions were added about the use of mobile phones, smartphones and tablet devices.

3.3.2 Module B1: Technology for transport

Module B1 was developed especially for the Dignity project and covered various aspects of the use of technology for transport. Participants were first asked to rate their confidence in

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their ability to plan an unfamiliar, local public transport journey using a computer and using a smartphone, on a scale from 1 (Not at all confident) to 10 (Totally confident). This provides a general estimate of participants' self-efficacy with the use of technology in transport.

Additional self-report questions examined what sources (both digital and non-digital) participants used to obtain information about public transport, how often participants used particular digital transport services, and whether and why participants felt limited in their regular travel within their region. Details of the questions are given in Appendix A.

3.3.3 Module B2: General computer and mobile device activities

Participants were asked whether they had performed various technology activities recently. A first set of questions asked about activities in the previous 3 months, and a second set examined activities that are commonly performed less frequently or relate to a deeper knowledge of technology devices, over the previous 12 months. The activities are described in the questionnaire in Appendix A. The questions were based on ones in the Internet Access Survey 2017 (Office for National Statistics, 2017). The specific activities were adjusted to be more applicable to digital transport services. In order to match the Internet Access Survey 2017, interviewees were asked if they had performed activities in the first set for personal use only, while they were asked if they had done activities in the second set for either personal or work use.

3.3.4 Module C: Attitudes towards technology

This module was split into two parts to avoid participant fatigue due to the similarity of the question format. Module C1 was administered first, then Module D, followed by Module C2.

Module C1 examined overall attitudes towards technology using the ATI (Affinity for Technology Interaction) scale which examines "whether users tend to actively approach interaction with technical systems or, rather, tend to avoid intensive interaction with new systems" (Franke et al, 2018). The ATI scale comprises nine self-report items with a six-point response scale from "completely disagree" to "completely agree". An overall ATI score is calculated by reversing the scores for the three negatively worded items and then computing the mean of the resultant nine items (Franke et al, 2018).

Module C2 explored attitudes further using additional questions developed by the UCAM as part of the 2019 UK survey (Goodman-Deane et al, 2021a). The items are shown in Table 7 and use the same six-point response scale from "completely disagree" to "completely agree". Items 1 and 3 concerned the participant's willingness to explore an unfamiliar interface, which is often important for successful use of a novel technological system. A mean of these two items was used to give a combined "willingness to explore" score. Other items examined confidence in using a new technology, self-reported ability to recover from errors and interest in technology for its own sake.

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Table 7: Questions examining further attitudes towards technology

Please indicate the degree to which you agree/disagree with the following statements
1. When I'm not sure what to do next on a technical system, I try out different things until something works.
2. I need to be shown how to use a technical system many times before I'm confident about using it.
3. I am uneasy about tapping or clicking on things that I don't recognise in case something breaks.
4. If I tap on the screen or press a button and something happens that wasn't what I expected, I can usually sort it out by myself.
5. If my current technical system works fine for what I want to do, I have no interest in getting a new one.

3.3.5 Module D: Digital interface competence

Module D assessed participants' performance on eight basic digital interface tests using a simplified paper prototyping method. In each test, the participants were shown a picture of a smartphone interface on a paper showcard and asked what they would do to achieve a particular goal. The interfaces were created in English, based on those in the UK survey, and then adapted for use in the different countries with different languages and locations. The interfaces for the English survey are shown in Figure 3 and in Appendix 2 (Showcards F to I).

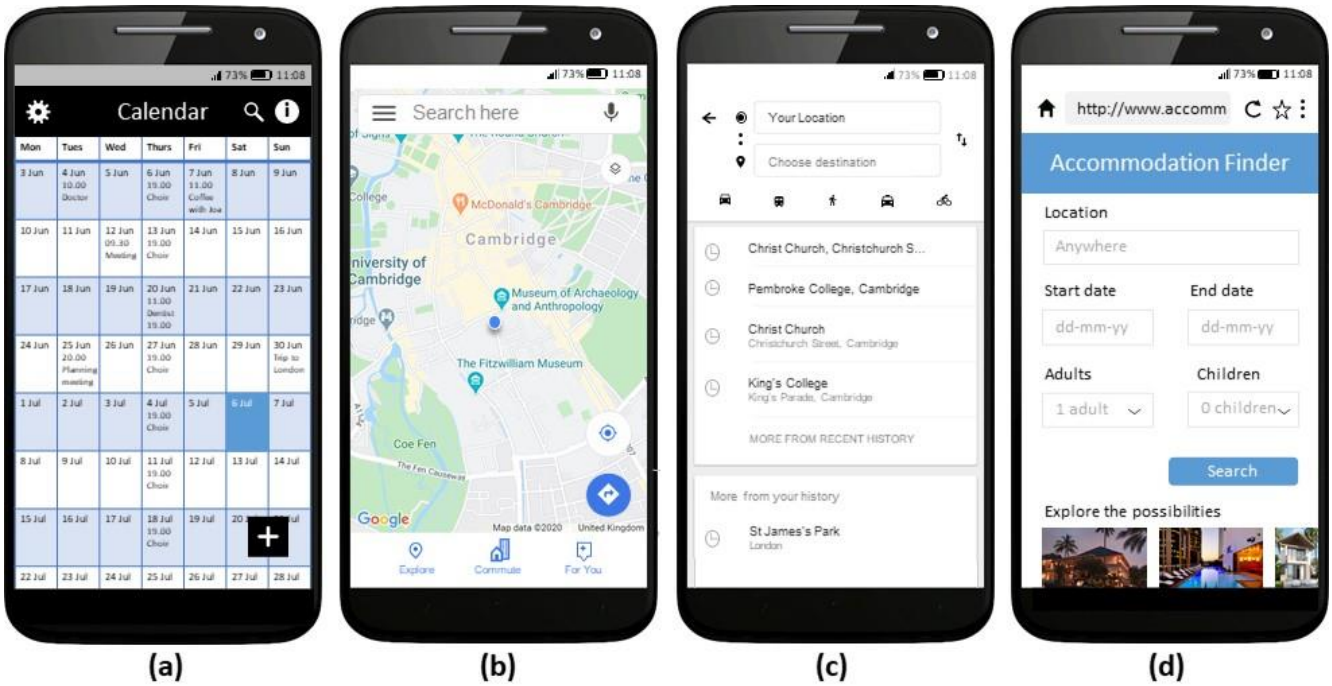

Figure 3: Interfaces used in the digital interface competence tests. Mock-ups of: (a) a calendar application, (b) a mapping application based on Google Maps, (c) a location choice screen within a mapping application, (d) a website for finding accommodation.

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Participants were asked to indicate on the showcard what they would do to achieve a particular goal. For example, one of the goals for the interface in Figure 3(a) was to search for a particular event in the calendar. In some cases, achieving a goal would require several actions. Participants were asked to indicate just the first action they would do. The interviewer coded each response as one of a set of predetermined options such as: Tapped on the magnifying glass symbol, tapped on the settings symbol, scrolled (placed finger on interface and moved it up/down or left/right), something else, said "I don't know" or preferred not to answer.

This simplified paper prototyping method was used to keep the length and cost of the interviews down, enabling a larger sample size. It was based on the method used by the authors in a previous survey to examine performance on mobile phone menu interfaces (Bradley et al, 2012).

The full set of goals used in the questionnaire is shown in Table 8. The goals were chosen to cover a range of common, basic interface patterns on a smartphone. As such, the tests examined a basic level of digital interface competence, rather than the capability to perform complex tasks on a digital device.

Table 8: Goals used in the digital interface competence tests

Interface	Goal
Fig 3(a): Mock-up of a calendar application	Search for a particular event in the calendar
	Change the settings, such as the coolers used in the calendar
	Create a new event in the calendar on the 6th July
Fig 3(b): Mock-up of a mapping application	See a menu with more options
Fig 3(c): A location choice screen within the mapping application	Get back to the previous screen
Fig 3(d): Mock-up of a website for finding accommodation	Change the number of adults in the search
	Make an onscreen keyboard appear so that you can enter a location in the search
	Set this webpage to be one of your bookmarks or favourites so that you can find it easily later on

The methodology for this module was adapted so that it could be administered at 2m distance if required under COVID-19 restrictions. This distance may make it difficult for the interviewer to see exactly what the interviewee is indicating on the showcard. Thus, interviewees were encouraged to describe their actions out loud. Interviewers were instructed to try to see what the interviewee actually did on the card if possible, and code this in preference to what they said, but they could use the verbal description to help if they couldn't see in sufficient detail.

The digital interface competence tests were validated for the UK survey by comparing performance on the paper prototype tests in the questionnaire with performance on similar tasks on real devices.

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3.3.6 Module E: Capabilities

Module E examined participants' sensory, motor and cognitive capabilities. These can have a large impact on a user's interaction with an interface. Questions were chosen to be compatible with those in the Towards Better Design survey (Tenneti et al, 2013) so that data could be compared with the more detailed data in that previous survey. It was necessary to keep this section short as it was not the main focus of the survey. As a result, most of the questions included were self-report, except for vision which was tested directly using a test chart.

As with the questionnaire as a whole, participants could decline to answer any or all of these questions. This was particularly emphasized in this section because it gathered potentially sensitive information. Most of the missing data was on the vision test, possibly because it was more complicated or had administration difficulties. 1.6% of the German sample, 7.6% of the Italian, 1.5% of Barcelona and 5.5% of Flanders skipped this question. 22.3% of the Dutch sample had missing data on this question. This was largely caused by postal difficulties resulting in the vision test chart not arriving in time for the start of the survey (see Section 3.4.5).

The other (self-report) questions in this module had a maximum missing rate of 0.6% in Germany, 1.8% in Italy, 0.8% in Barcelona, 1.2% in Flanders and 1.8% in the Netherlands.

The vision test examined participants' near comfort vision. They were given a printed LogMAR vision chart with rows of block letters at decreasing sizes (see Appendix 2 Showcard K). The letters were printed at high (70%) contrast. Participants were asked to hold the chart at a comfortable reading distance to mimic what happens when people use mobile devices in practice. They were asked to read out the smallest row that they could read comfortably. If they made 2 or more errors on that row, they were asked to read the row above, until the interviewer identified the smallest row that the participant could read both comfortably and correctly. It is important to note that this test is not a standard vision test and does not examine threshold vision but rather what participants themselves feel is comfortable. This was chosen because of the importance of comfort in successful product use in practice. This test was very similar to one used in Tenneti et al (2013).

Participants were then asked to rate how difficult they would find it to pick up a small object such as a safety pin, to give an estimate of their dexterity capability. This was shortened from the previous UK survey (Goodman-Deane et al, 2021a) which asked participants about three separate dexterity tasks.

Participants were also asked to rate how limited they were in their daily activities because of limitations with eyesight, hearing, problems with their hands, problems with mobility, reaching their arms out, and problems with memory or concentration. They chose from Not at all limited, Somewhat limited and Very limited. This provides an overview of participants' capabilities and allows the production of a variable to estimate disability. However, note that some of these categories (particularly "problems with memory or concentration") may be under-sampled, as people with such difficulties are less likely to take part in a survey of this type.

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3.3.7 Module F: Demographics

Finally, participants answered questions on their age, gender, social grade or income, education, general health, what type of area they live in (urban or rural) and whether they were an immigrant to the country. The last was determined by asking if they were a citizen of the country and, if so, whether they obtained that citizenship at birth. The social grade/income and education questions were written specifically for each country as detailed in Section 3.4. The question on the type of area /could be asked in two different ways – either directly or assessed using the interviewee's postal code.

3.4 Differences in questionnaires between countries

Each survey company created/used their own questions on social grade/income and education, in conjunction with the Dignity research team in that country. This was done to enable the measures to match the ways in which these variables are typically measured in each country and the education system in that country. Section 5.1 discusses how these measures were used to determine whether an interviewee had a low social grade, low income or low education.

In addition, survey companies were given some flexibility in how they determined whether the interviewee lived in an urban or rural area. There were also some difficulties in administering certain parts of the questionnaire in some countries, resulting in differences in the data obtained.

These differences are detailed for each country in the rest of this section.

3.4.1 Germany

Social grade and income were examined in the German sample using a set of questions covering the following: the interviewee's job situation and current occupation, their household size, the number of children in their household, their own income and their household income.

Education was examined by asking for the interviewee's highest school or university qualification, with response options corresponding to German qualifications. The type of area (urban or rural) was determined using postal code.

In the German questionnaire, Module B1 q3 (about sources of travel information) was specified to refer only to public transport. This was not the case in the other countries. 20.7% of the sample said that they did not use public transport and therefore did not describe their sources of travel information.

3.4.2 Italy

In the Italian survey, the social grade of the interviewee's family was directly assessed by the interviewer using two criteria: 1) the income and purchasing power of the family; 2) the social-cultural level of the interviewee and other members of their family, especially the head of the

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family. A list of "typical occupations" in each class was provided to the interviewers to help them with this assessment.

Education was examined by asking for education level out of: Postgraduate specialization, Degree, University degree, Senior high school, Junior high school, Elementary school and No schooling. The type of area (urban or rural) was approximated by the size of the commune (region).

3.4.3 Barcelona Metropolitan Area

Social grade was assessed in the Barcelona survey using a set of categories about the interviewee's occupation such as "Self-employed with dependent workers", "Self-employed without dependent workers", "Manager", "Professional, technician, middle management", "Administrative, office, commercial worker", etc. as these are the categories used in the Catalan Institute for Statistics (IDESCAT).

Education was examined using response options based on the Spanish education system. The type of area was determined by asking interviewees if they lived in an urban, rural or low-density urban (e.g. residential or suburban) area. As the Barcelona Metropolitan Area is almost entirely urban, none of the sample selected "rural" and only 4.0% selected "low-density urban" with the remainder selecting "urban".

The Barcelona survey included an extra module on daily mobility behaviours, including questions about how the COVID-19 pandemic had affected daily mobility patterns and public opinion on measures for future urban planning. Some of the results can be found in Roca et al. (2021).

3.4.4 Flanders

Income was examined in the Flanders survey by asking interviewees about their current financial situation. Response options were "Living comfortably on your current income", "Managing to make ends meet on current income", "Difficult to get by on current income" and "Very difficult to manage on current income". This question was added to the survey after some of the difficulties in processing the income data for Germany. The later start date of the Flanders survey enabled this change to be made to this survey but not to the other surveys.

Education was examined using response options based on the Belgium education system. The type of area of residence was determined by asking participants for their postal code/zipcode. This was used to identify their municipality of residence. A rural/urban classification of municipalities was then used to determine whether the participant lived in a rural or urban area.

There was an error in the routing of the questionnaire for Module B2. This meant that many interviewees were not asked the questions in Module B2 when they should have been. Consequently, the results for Module B2 are invalid for this dataset and have been removed from the distributed dataset.

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3.4.5 The Netherlands

Social grade was examined in the Dutch survey by asking about occupation using a set of broad categories.

Education was examined using response options based on the Dutch education system. Interviewees were asked directly whether they lived in an urban or rural area.

For all the countries, the vision test chart had to be printed centrally (in the UK) and distributed to ensure consistency (see note on Appendix 2 Showcard K). There was a delay in distributing this chart to the Dutch survey company due to postal difficulties. This meant that the first batch of interviews was conducted without the vision test. As a result, there was missing data on the vision test in Module F for 22.3% of the weighted sample (22.2% of the unweighted sample).

3.5 Limitations

The surveys took place during the COVID-19 pandemic. This may have made some people more cautious about taking part in a survey that involved face-to-face contact, even though COVID-19 restrictions and guidance were followed. This is likely to disproportionately affect those with underlying health conditions and may thus skew the samples away from older people and those with disabilities. This was mitigated to some extent by setting a quota on age. However, there may be a greater proportion of healthy and active people among the older segments of the survey samples than in the older population as a whole. The survey results may thus underestimate the difficulties that people have with travel and technology, as well as the numbers of people with disabilities.

The COVID-19 pandemic also impacted patterns of technology use. Social distancing and lockdown measures have resulted in an increase in use of various digital technology applications such as video internet calls and online shopping. This has resulted in many people having to learn new technology skills and try out technology activities that they had not done (or had not done much) previously (McClain et al, 2021).

This means that the patterns of technology use seen in the surveys may differ significantly from those observed in surveys that took place prior to the COVID-19 pandemic, including the UK survey on which the DIGNITY surveys were based (Goodman-Deane et al, 2021a). As the DIGNITY surveys were conducted at different times during the pandemic (as the restrictions in the different countries allowed), there may also be some differences between the DIGNITY surveys. However, these are likely to be more minor as even the earliest survey (Germany) took place some months after the pandemic and lockdowns started, and so we would expect the changed patterns to show up in it.

Another consideration is the variation in sampling methods and sample sizes between countries. This makes cross-country comparison difficult. For example, Germany and Italy used area sampling methods with samples of over 1000 participants in an attempt to produce population-representative samples. The other surveys used quota sampling with either on-street recruitment or recruitment through networks. On-street sampling (used in Barcelona and the Netherlands) under-samples those who leave the house less frequently. This effect was likely to be more pronounced during the COVID-19 pandemic when more vulnerable individuals and those in poorer health were less likely to go out. Sampling through networks

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(used in Flanders) is also open to bias, as it relies on the interviewers' and interviewing company's contacts. Using quotas helps to reduce these biases but it is impossible to set quotas on all relevant variables (e.g., health and disability) and thus some bias remains. As a result, the Barcelona, Flanders and Dutch surveys are less robust than those in Germany and Italy and provide more indicative and less population-representative results.

Furthermore, regardless of what type of sampling is used, certain types of people are less likely to take part in a survey and may therefore be under-represented. This includes people with cognitive difficulties for whom answering a survey like this would be difficult.

4. Results by country

This section describes headline results from Modules A to E of the surveys, looking at each country's sample as a whole. Data from Module E (Demographics) is not included because a demographic breakdown of each survey sample has already been provided in Section 3.2. The results are discussed for all the countries together in Section 4.8. Some further results are presented in Section 5 which breaks down some of the key results by different subgroups of the population.

Note that a previous UK survey (conducted in 2019 as part of a previous project) used a very similar questionnaire, with the omission of Module B1 (Section 3.3.2). The results from this survey may also be useful to readers in understanding the spread of factors affecting digital mobility exclusion across Europe. Readers may therefore wish to access and use the results from this previous survey. A summary of the results can be found in (Goodman-Deane et al, 2021a) and the full dataset is available open access (registration required) at (Engineering Design Centre, 2022).

The full dataset for the German survey is available open access from the UPCommons repository (Goodman-Deane et al, 2022b) and the datasets for the other DIGNITY surveys will be available open access from there by the end of the DIGNITY project (end 2022). Some results and analyses from the German survey are also published in (Goodman-Deane et al, 2021b; Goodman-Deane et al, 2022a; Bradley et al, 2021) and results from the Barcelona survey are published in (Roca et al, 2021).

All the results presented in this report use weighted data except those for the Barcelona Metropolitan Area where no weighting variable was calculated. Details of the weighting for each country are given in Sections 3.2.1 to 3.2.5. Note that, due to missing data for some variables, the total number of respondents (n) is different for different variables – this is thus specified for each variable in the graphs in this section. Responses of "Don't know" were counted as Missing unless otherwise indicated in Section 4.1.

4.1 Key variables

Table 9 describes the key variables reported on in this section, how they were calculated and other relevant notes. More details on the questions used to generate these variables are given

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in Section 3.3. Graphs for each of these variables are given in the following sections for each of the survey countries.

Table 9: Key variables from the surveys presented in this report

Module	Key variable(s)	How the variable was calculated and additional notes
A: Technology access and use	Access to various technologies	Interviewees were asked this directly.
	Frequency of use of various technologies	Interviewees were asked this directly
B1: Technology for transport	Confidence planning travel with a computer and smartphone	Interviewees were asked this directly
	Use of digital sources of travel information	Interviewees selected up to three sources that they use to find out information about travel. This variable indicates if they included any digital sources (e.g., websites, apps, social networks) in this selection.
	Frequency of use of selected digital mobility services	Interviewees were asked about their use of six different digital transport services. The highest frequency with which they used any of these was also calculated.
	Limitations in travel for various reasons	Interviewees were asked if they were limited in their regular travel within the region for seven different reasons. The maximum limitation out of these was also calculated and is reported as the limitation for "any of the above reasons" in the graphs in this report.
B2: General computer and mobile device activities	Technology activities: Set 1 (activities in the last 3 months)	Interviewees were asked if they had done a selection of technology activities in the last 3 months (see Section 3.3.3). If an interviewee had not used any technology device (computer, tablet or smartphone) in this time period, they were not asked this question and their responses were assumed to be No.
	Technology activities: Set 2 (activities in the last 12 months)	Interviewees were asked if they had done another selection of technology activities in the last 12 months (see Section 3.3.3). If an interviewee had not used any technology device (computer, tablet or smartphone) in this time period, they were not asked this question and their responses were assumed to be No.
C: Attitudes towards technology	ATI (Affinity for Technology Interaction)	Interviewees completed the ATI scale and their overall ATI score (between 1 and 6) was calculated as described in Section 3.3.4. Responses were categorised into Low (<3), Medium (3-4) and High (>4). These bands were chosen so that they are centred around the mid-point of the scale (3.5). The Medium category is slightly narrower than the others to allow for the central tendency bias in Likert scales.
	Willingness to explore an unfamiliar interface	Interviewees completed individual items and an aggregate "willingness to explore" score (between 1 and 6) was calculated from these as described in Section 3.3.4. Responses were categorised into Low (<3), Medium (3-4) and High (>4). These bands were chosen so that

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		they are centred around the mid-point of the scale (3.5). The Medium category is slightly narrower than the others to allow for the central tendency bias in Likert scales.
D: Digital interface competence	Performance on eight individual interface tests	The researchers coded interviewees' responses to each test into correct and incorrect based on whether they were likely to result in successful achievement of the goal. "I don't know" was coded as incorrect because it indicates uncertainty and may reflect a lack of willingness to try out options.
	Overall basic digital interface competence	A measure of respondents' basic digital interface competence was calculated using the total number of tests done correctly (out of eight). It was recorded as Missing data if the participant declined to do at least half (four or more) of the tests because this is likely to indicate failure to engage with the module as a whole (perhaps due to time pressure) rather than difficulties with a particular test which may be more indicative of competence issues. Because of the basic nature of the tests involved, the number of tests correct was categorised as follows: • Low: 4 or fewer tests correct. We estimate that people with these scores are likely to struggle on many modern digital interfaces, particularly on smartphones and tablets. • Medium: 5 or 6 tests correct. These people are still likely to have some difficulties • High: 7 or 8 tests correct. A fairly high level of basic digital interface competence. This does not necessarily translate to competence with more complex interfaces and tasks.
E: Capabilities	Near comfort vision ability	The smallest line on the near vision test chart that interviewees could read comfortably (see Section 3.3.6 for details).
	Self-reported dexterity: Picking up a safety pin	Interviewees were asked to rate how easy or difficult they would find it to pick up a small object such as a safety pin.
	Limitations in daily activities due to issues with various capabilities	Interviewees were asked to rate the level of limitations in their daily activities due to issues with six sensory, motor and cognitive capabilities. The maximum limitation out of these was also calculated and is reported as the limitation for "any of the above capabilities" in the graphs in this report. Note that some of these categories (particularly "memory or concentration") may under-report the numbers experiencing limitations in the population as a whole because people with these difficulties are less likely to take part in a survey of this type.

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4.2 Note on cross-country comparisons

The surveys differ in their sampling methods and sample size. In addition, they were conducted at different times (see Table 1 in Section 3.1) and thus may have affected to differing extents by changes in technology use patterns as a result of the COVID-19 pandemic and restrictions. There may also be differences in the ways in which questions were interpreted in different cultures. This means that cross-country comparisons need to be done with great care in order to avoid unhelpful or misleading implications. This level of analysis is out of scope for this deliverable and thus cross-country comparisons are not presented directly. Instead, the key results for each country are presented in turn. Cross-country comparisons may be a valuable area for future work.

4.3 Results for Germany

This subsection presents headline results from the German survey. Detailed results from this survey, broken down into different sub-groups of the population, are published in Goodman-Deane et al (2021b) and Goodman-Deane et al (2022a).

4.3.1 Module A: Technology access and use

This section presents headline figures from Module A (see Section 3.3.1 for details of this module). Figure 4 gives figures for the percentage of German respondents with access to different kinds of digital technologies, while Figure 5 gives a breakdown of the frequency of use of different digital technologies.

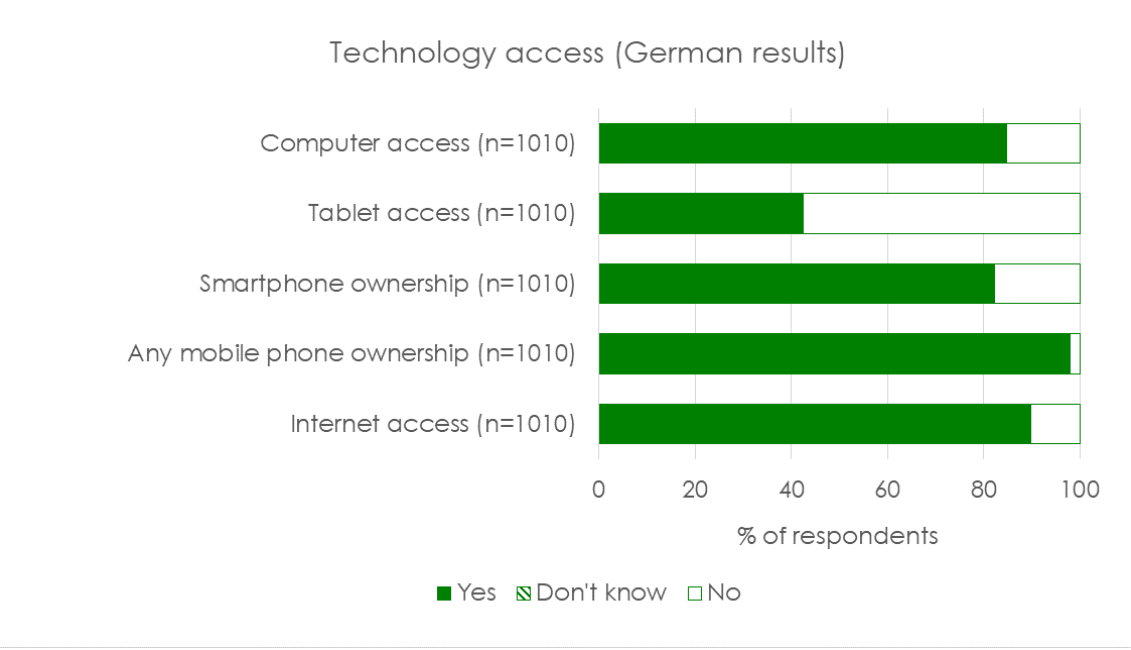

Figure 4: Technology access (German results)

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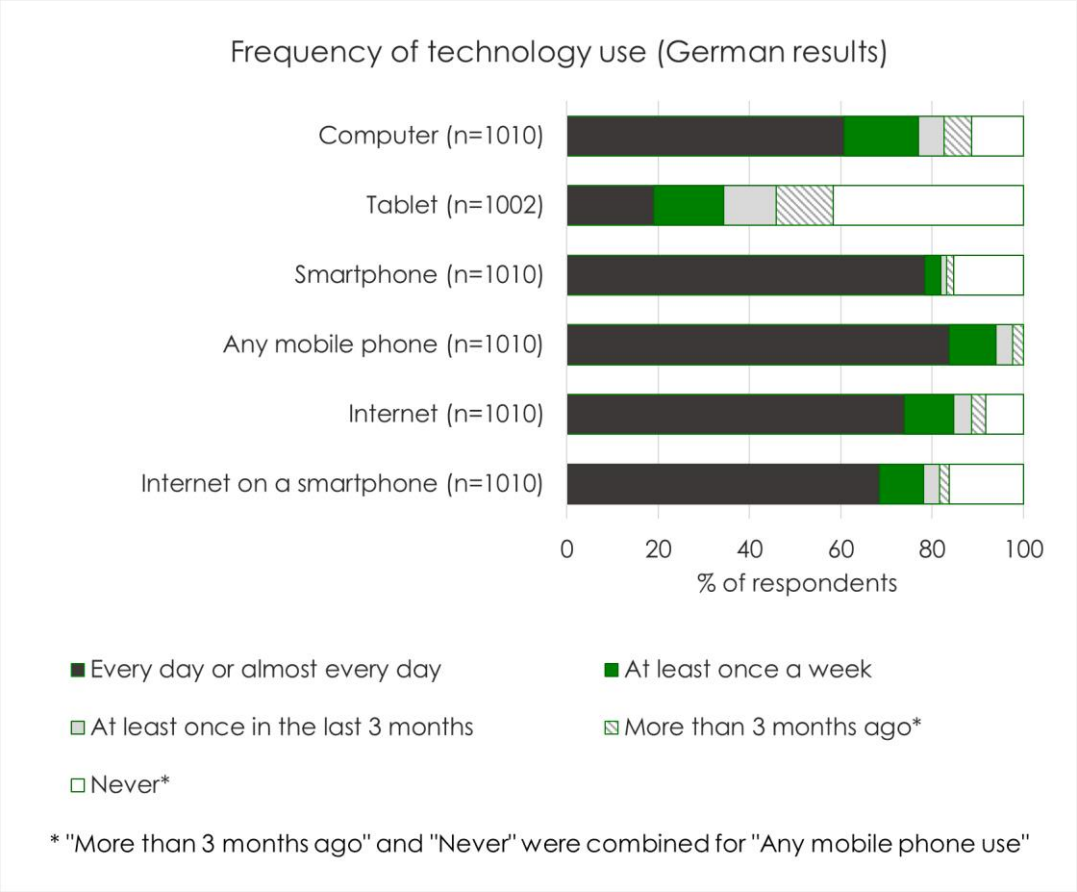

Figure 5: Frequency of technology use (German results)

4.3.2 Module B1: Technology for transport

This section presents headline figures from Module B1 (see Section 3.3.2 for details of this module). Figure 6 shows the distribution of respondents' ratings of their confidence in planning an unfamiliar, local, public transport journey using a computer and using a smartphone. Figure 7 describes the frequency of use of a selection of digital mobility services. Finally, Figure 8 presents results on the proportions of respondents reporting feeling "very limited" or "slightly limited" in their regular travel within the region, for a variety of reasons.

Participants were also asked how they find out information about their travel. In the German survey, this question focused on travel by public transport only. Participants could select up to three responses. 52.6% of respondents included a digital information source in their selection (not counting responses of "Other", while 26.7% listed non-digital sources only, and 20.7% said that they do not use public transport (n=1010).

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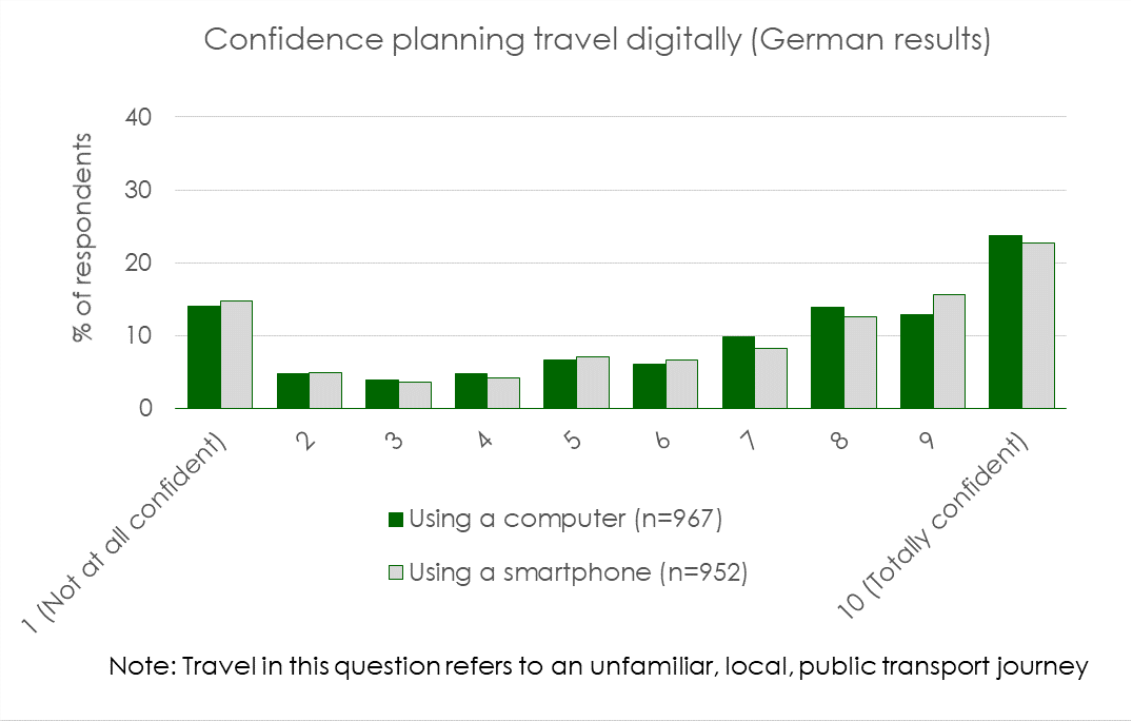

Figure 6: Confidence planning travel digitally (German results)

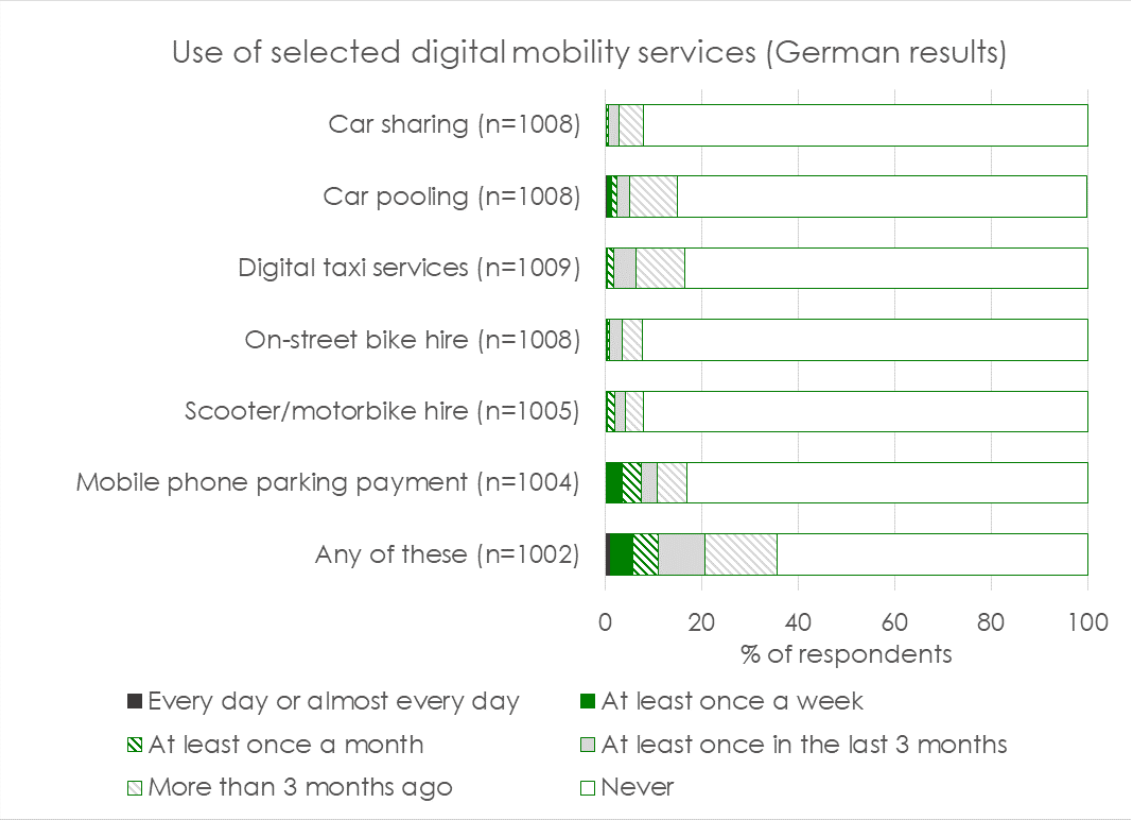

Figure 7: Use of selected digital mobility services (German results)

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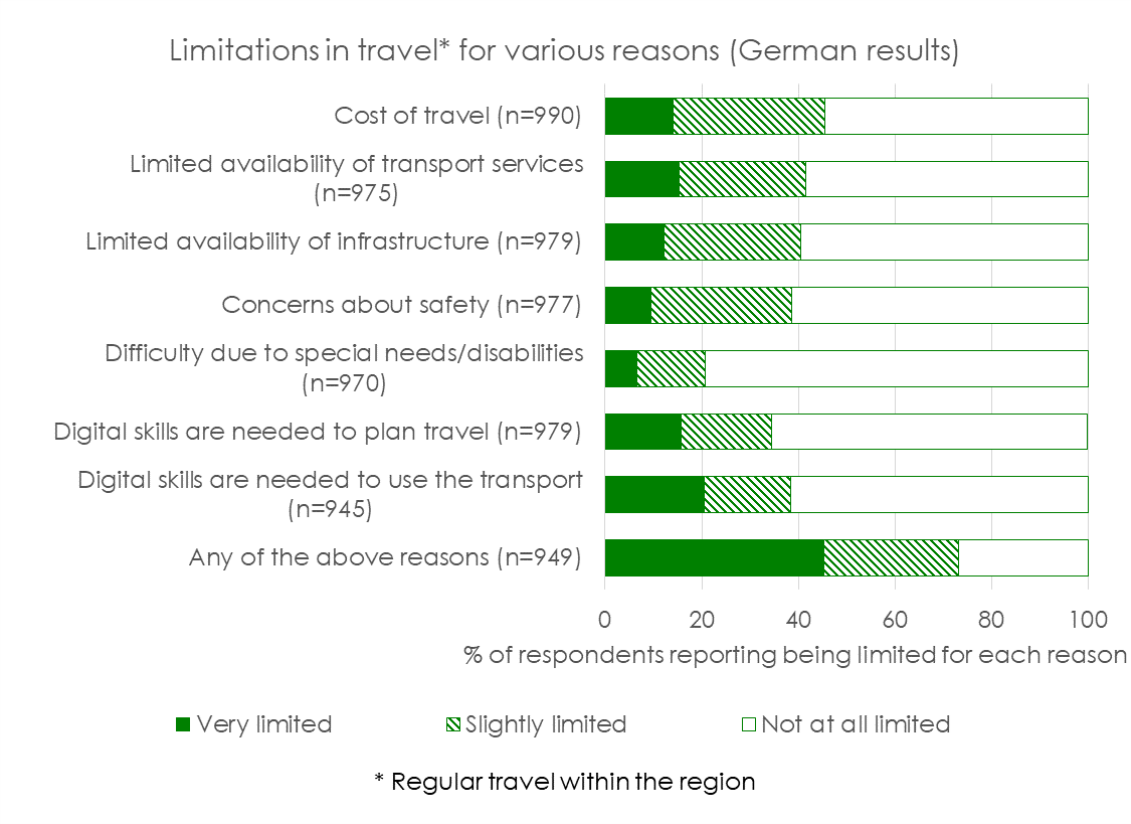

Figure 8: Limitations in travel for various reasons (German results)

4.3.3 Module B2: General computer and mobile device activities

This section presents headline figures from Module B2 (see Section 3.3.3 for details of this module). Figure 9 reports on whether respondents had conducted an initial set of technology activities in the previous 3 months. Figure 10 examines a second set of activities that are commonly performed less frequently or relate to a deeper knowledge of technology devices. It reports on whether respondents had conducted these over the longer period of the previous 12 months.

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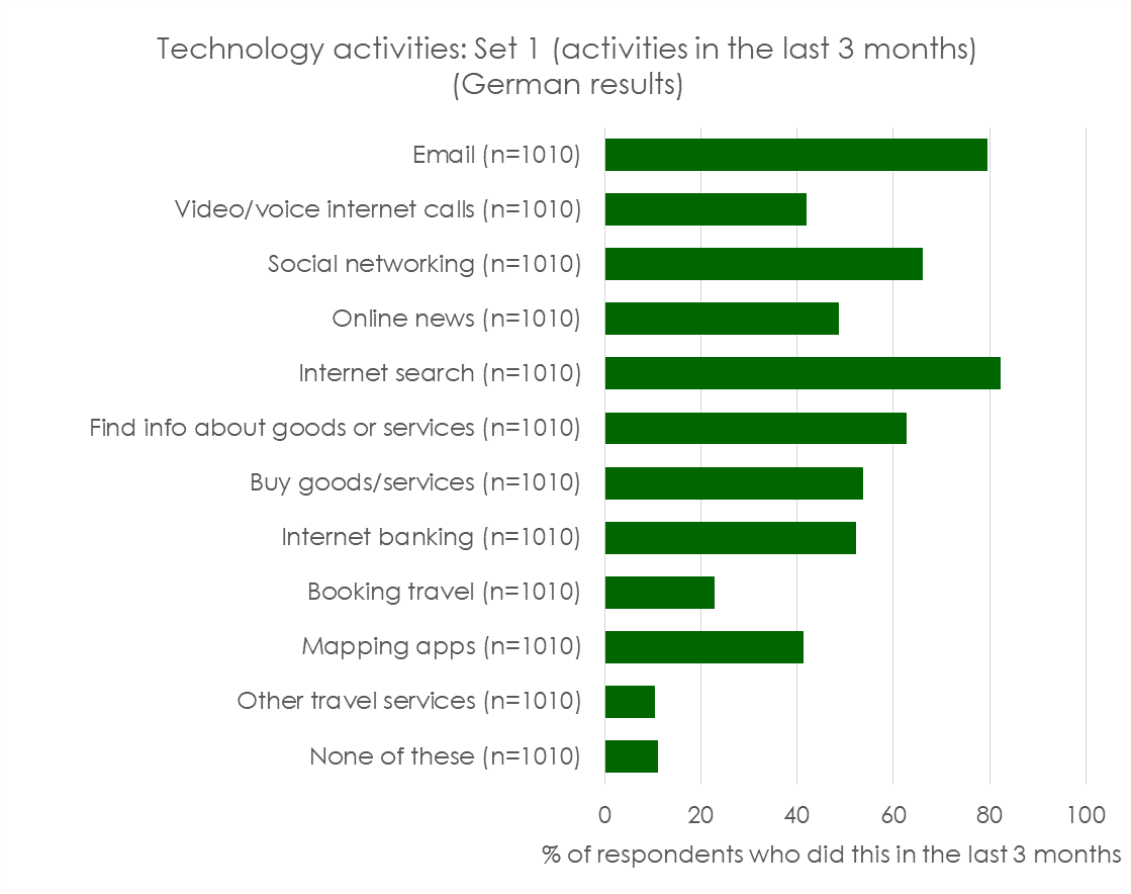

Figure 9: Technology activities: Set 1 (activities in the last 3 months) (German results)

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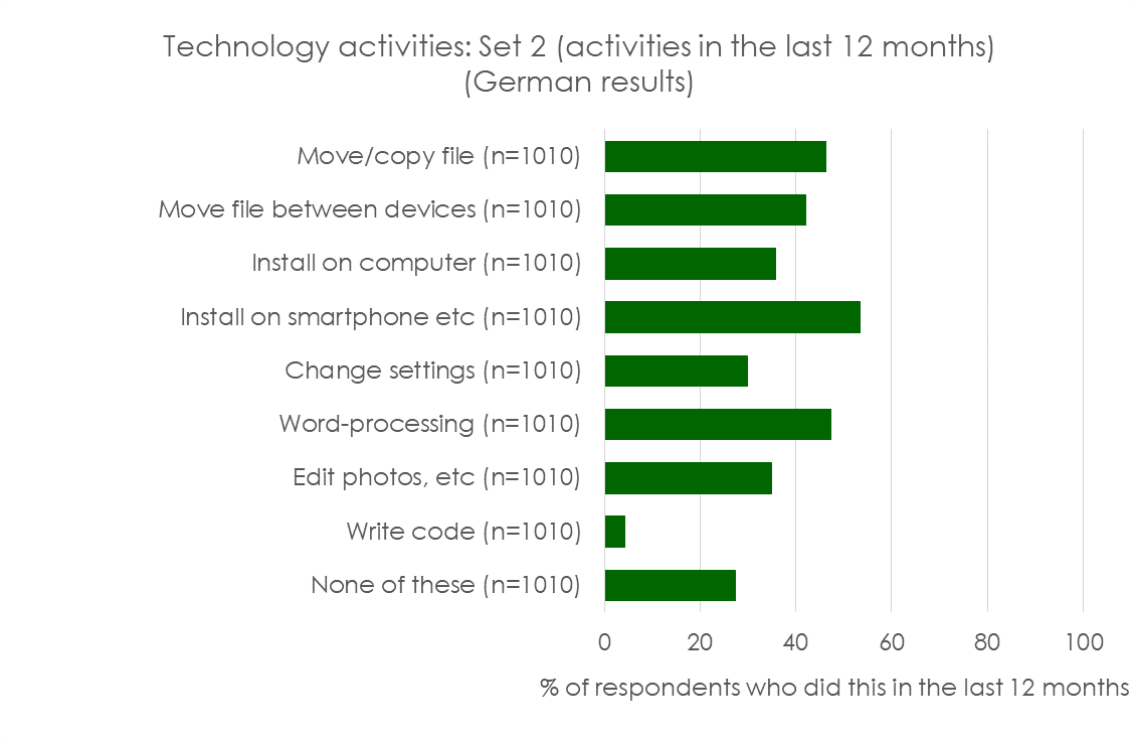

Figure 10: Technology activities: Set 2 (activities in the last 12 months) (German results)

4.3.4 Module C: Attitudes towards technology

Figure 11 presents headline figures from Module C. ATI and Willingness to Explore scores were calculated from the respondents' answers as described in Section 3.3.4, and were then categorised into Low, Medium and High as described in Section 4.1.

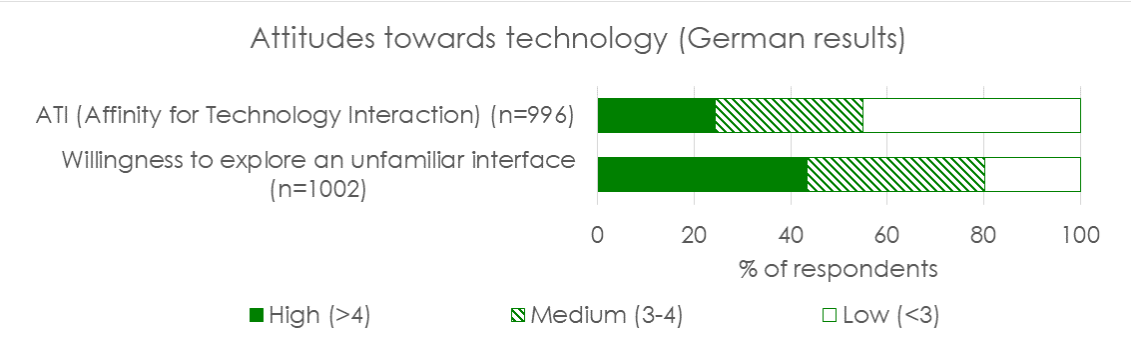

Figure 11: Attitudes towards technology (German results)

4.3.5 Module D: Digital interface competence

This section presents headline figures from Module D (see Section 3.3.5 for details of this module). Figure 12 describes the proportion of respondents who did each individual interface

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test correctly. The total number of tests done correctly was then used to give an estimate of the respondents' overall basic digital interface competence, shown in Figure 13. The banding of results into Low, Medium and High competence is explained in Table 9 in Section 4.1.

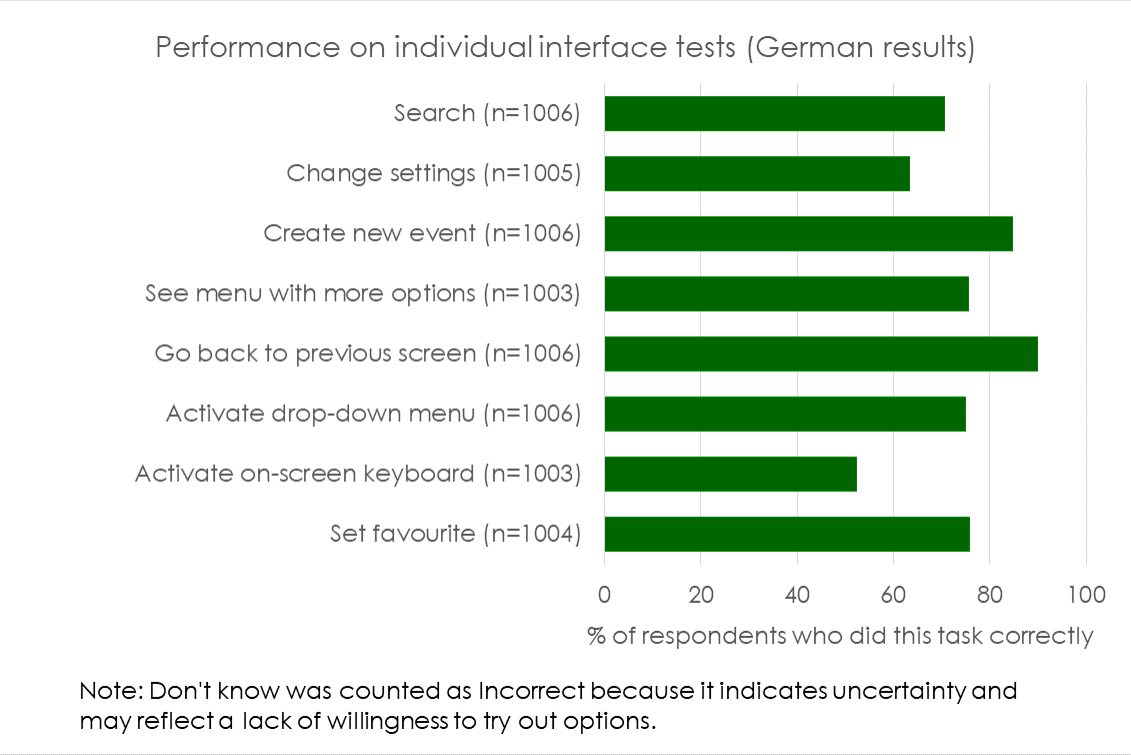

Figure 12: Performance on individual interface tests (German results)

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement N°875542.

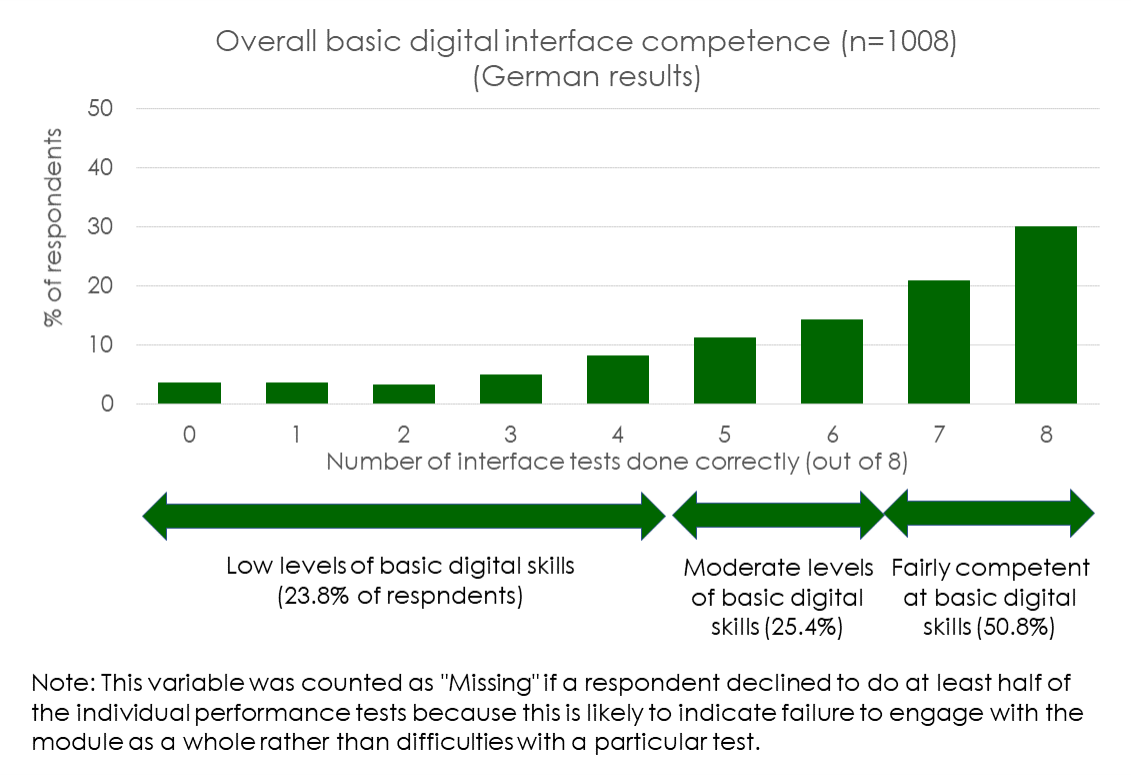

Figure 13: Overall basic digital interface competence (n=1008) (German results)

4.3.6 Module E: Capabilities

This section presents headline figures from Module E (see Section 3.3.6 for details of this module). Figure 14 gives the results from the near comfort vision test, performed using a handheld LogMAR chart. Dexterity was then assessed by asking respondents how difficult they would find it to pick up a small object such as a safety pin. The results are shown in Figure 15. Finally, Figure 16 shows the proportions of respondents reporting being "somewhat limited" or "very limited" due to difficulties with various capabilities.

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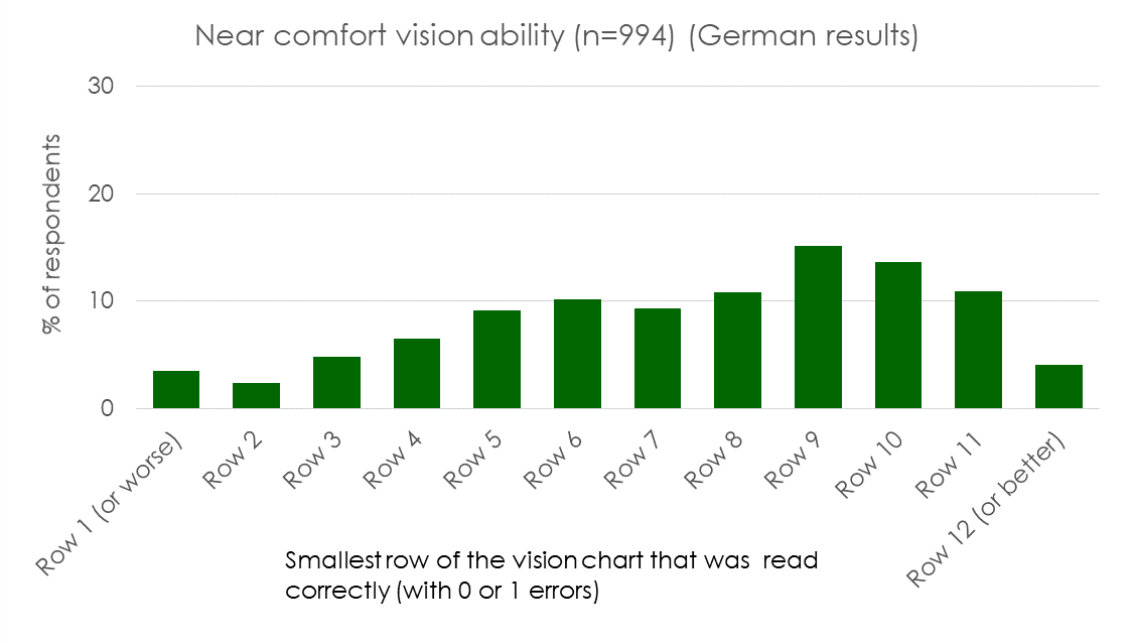

Figure 14: Near comfort vision ability (n=994) (German results)

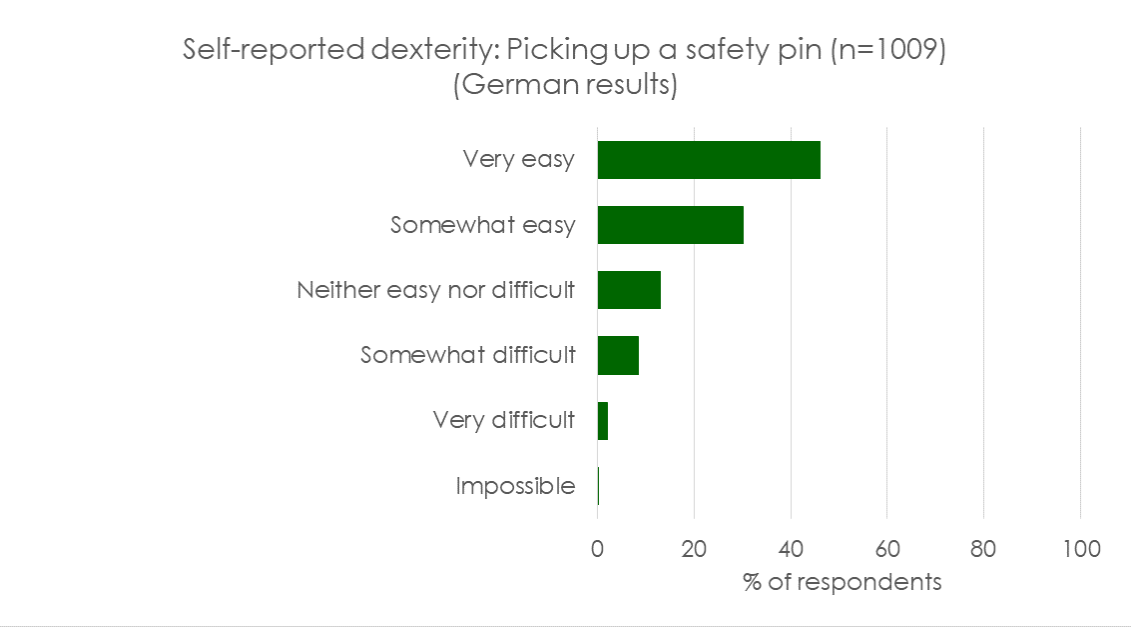

Figure 15: Self-reported dexterity: Picking up a safety pin (n=1009) (German results)

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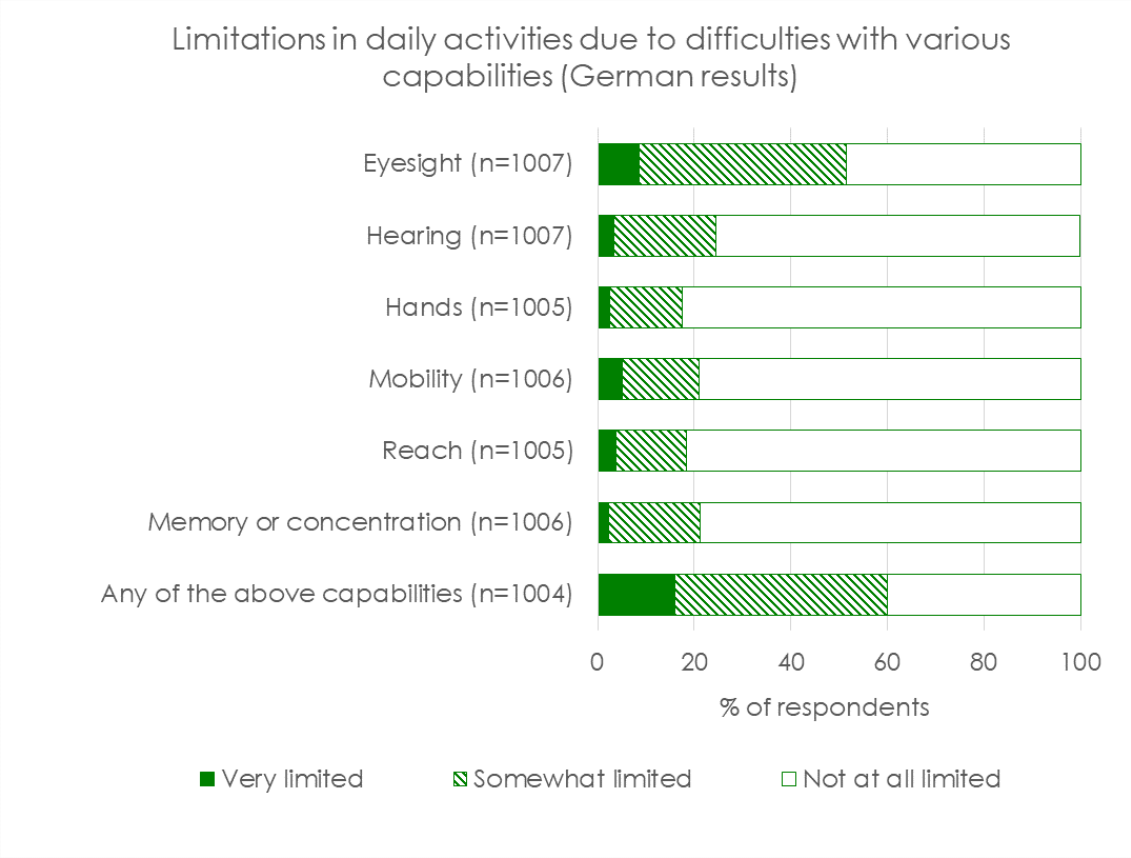

Figure 16: Limitations in daily activities due to difficulties with various capabilities (German results)

4.4 Results for Italy

This subsection presents headline results from the Italian survey.

4.4.1 Module A: Technology access and use

This section presents headline figures from Module A (see Section 3.3.1) for details of this module). Figure 17 gives figures for the percentage of Italian respondents with access to different kinds of digital technologies, while Figure 18 gives a breakdown of the frequency of use of different digital technologies.

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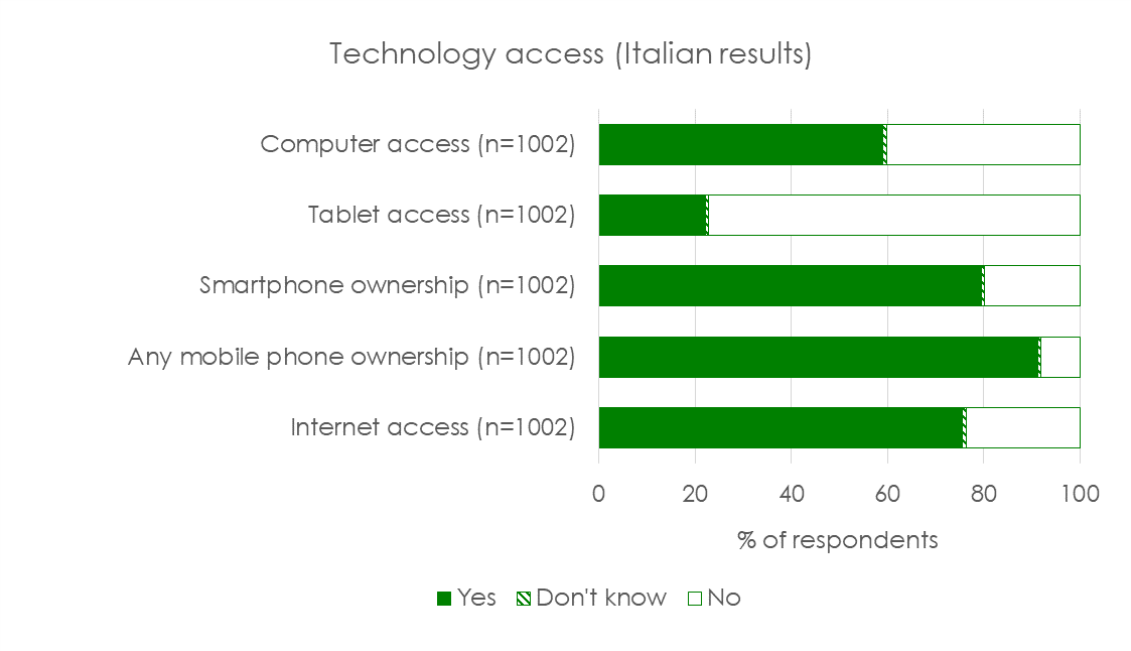

Figure 17: Technology access (Italian results)

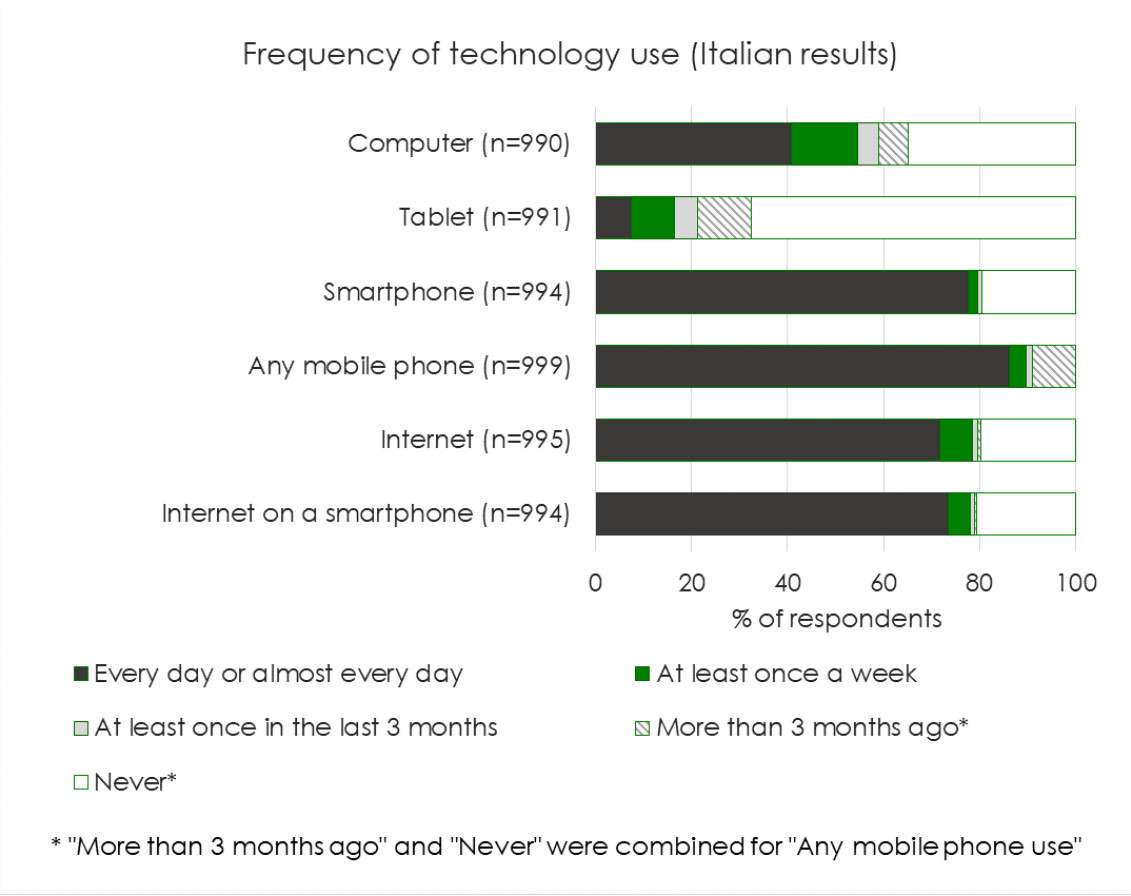

Figure 18: Frequency of technology use (Italian results)

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4.4.2 Module B1: Technology for transport

This section presents headline figures from Module B1 (see Section 3.3.2 for details of this module). Figure 19 shows the distribution of respondents' ratings of their confidence in planning an unfamiliar, local, public transport journey using a computer and using a smartphone. Figure 20 describes the frequency of use of a selection of digital mobility services. Finally, Figure 21 presents results on the proportions of respondents reporting feeling "very limited" or "slightly limited" in their regular travel within the region, for a variety of reasons.

Participants were also asked how they find out information about their travel. Participants could select up to three responses. 54.9% of respondents included a digital information source in their selection (not counting responses of "Other", while 45.1% listed non-digital sources only (n=1002).

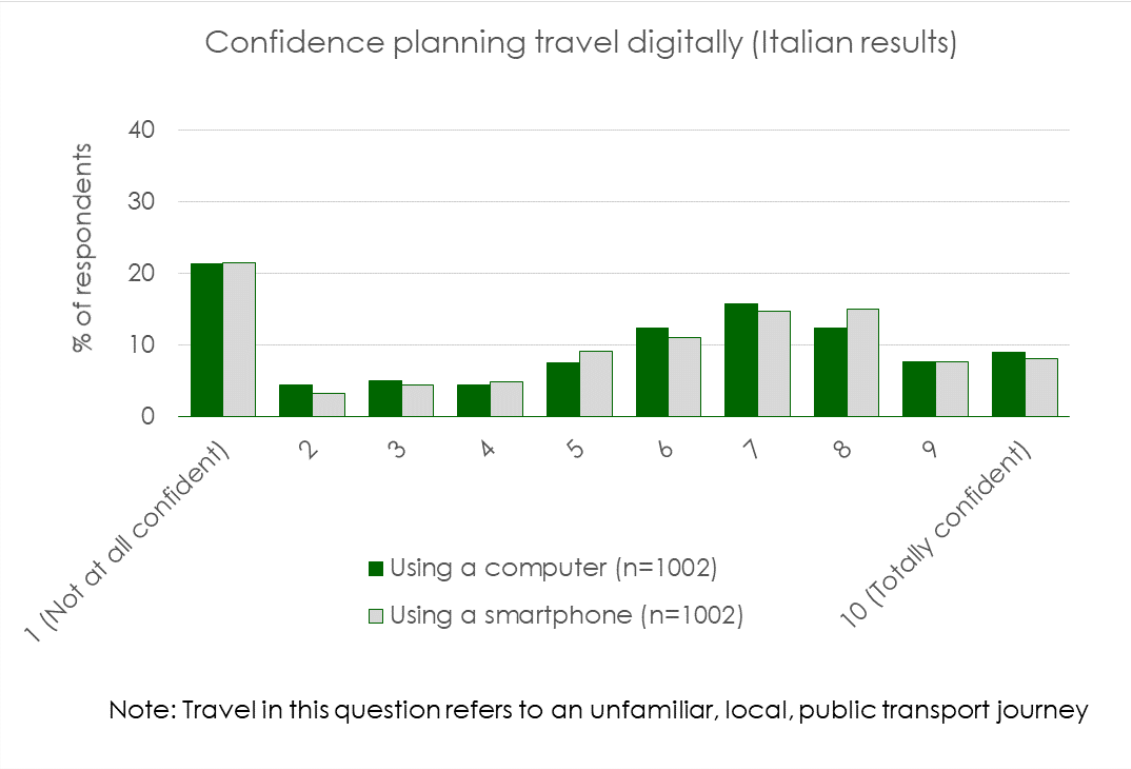

Figure 19: Confidence planning travel digitally (Italian results)

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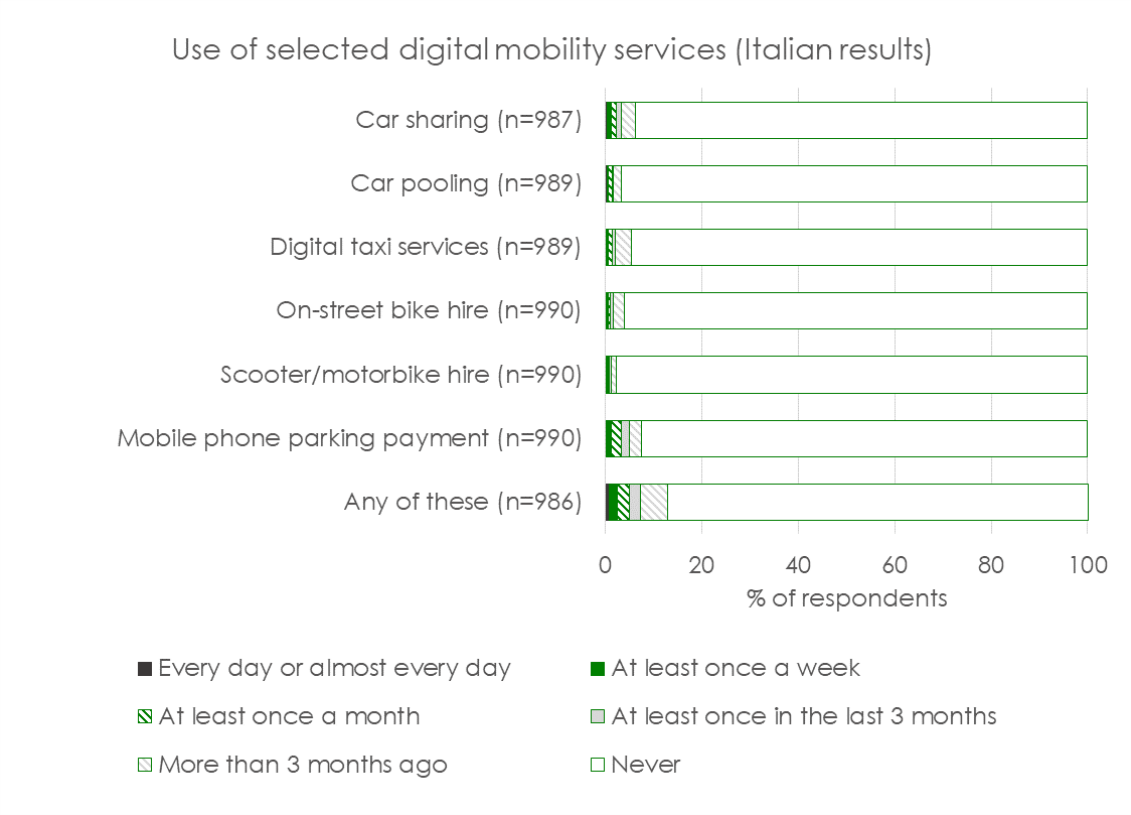

Figure 20: Use of selected digital mobility services (Italian results)

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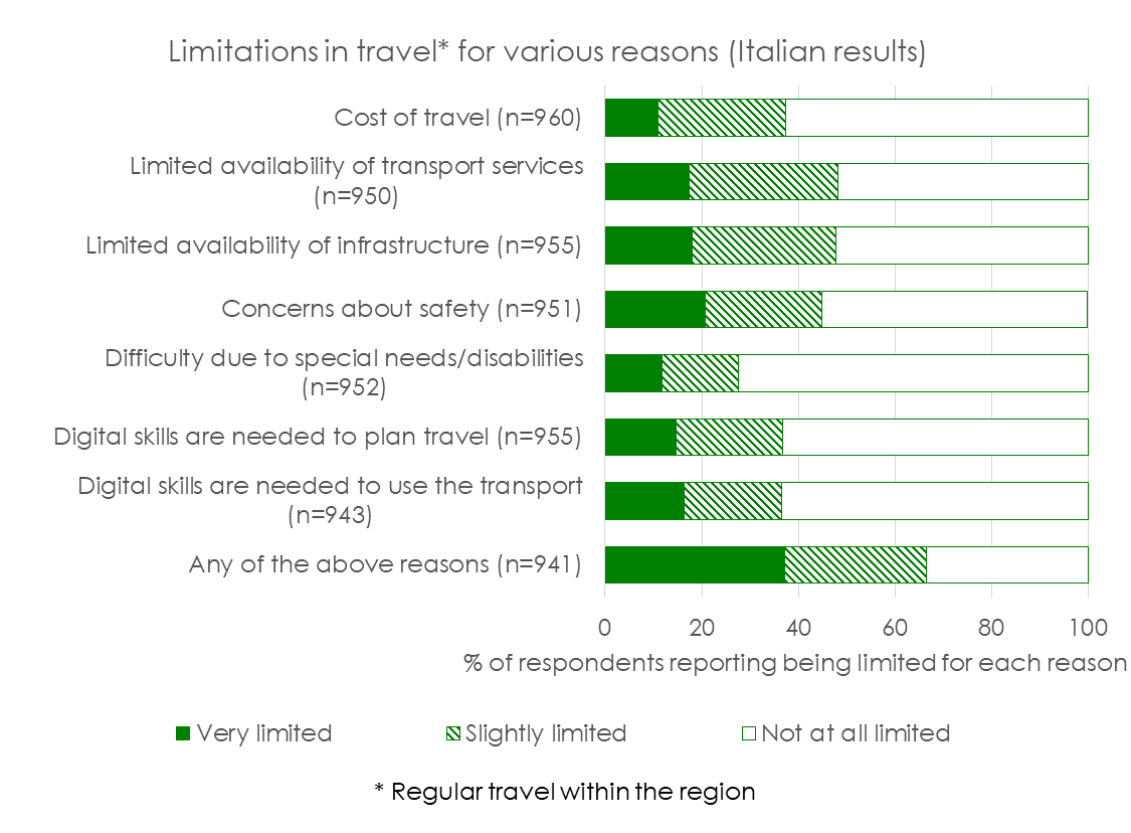

Figure 21: Limitations in travel for various reasons (Italian results)

4.4.3 Module B2: General computer and mobile device activities

This section presents headline figures from Module B2 (see Section 3.3.3 for details of this module). Figure 22 reports on whether respondents had conducted an initial set of technology activities in the previous 3 months. Figure 23 examines a second set of activities that are commonly performed less frequently or relate to a deeper knowledge of technology devices. It reports on whether respondents had conducted these over the longer period of the previous 12 months.

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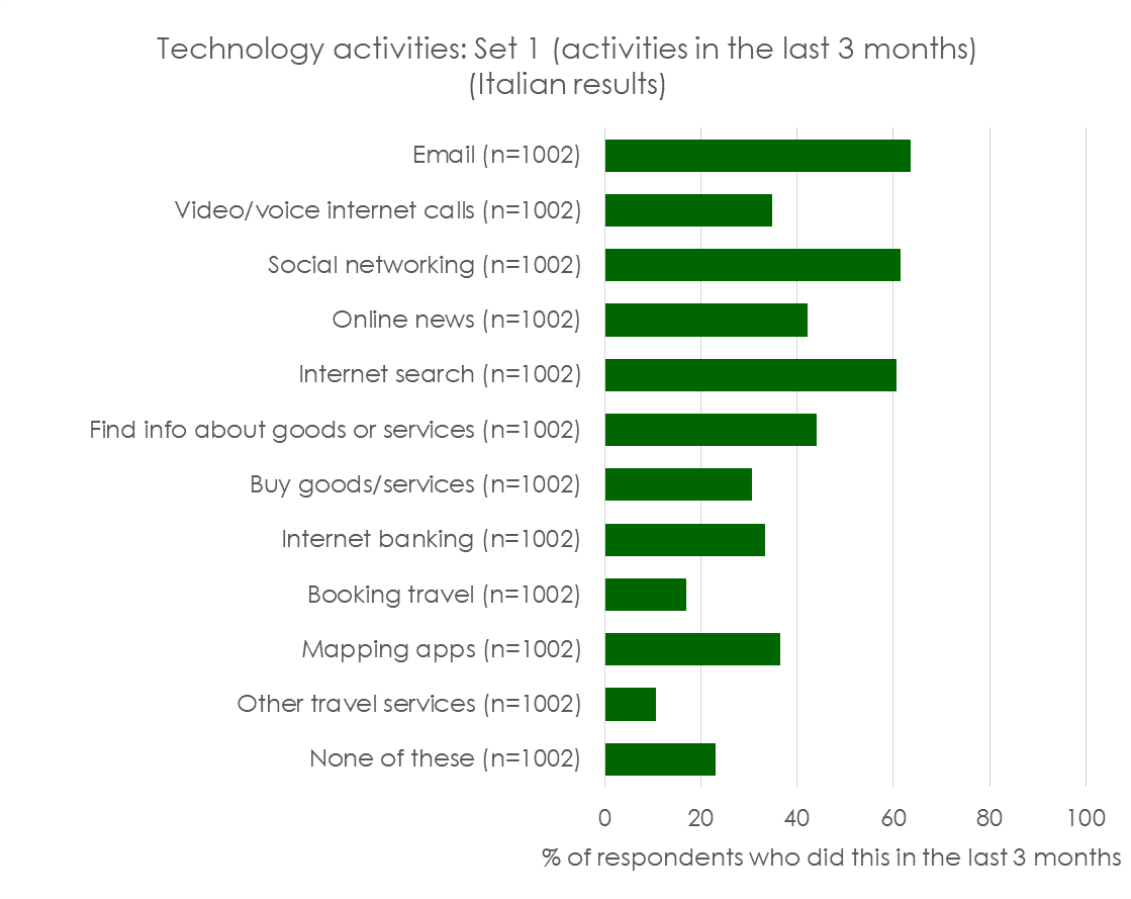

Figure 22: Technology activities: Set 1 (activities in the last 3 months) (Italian results)

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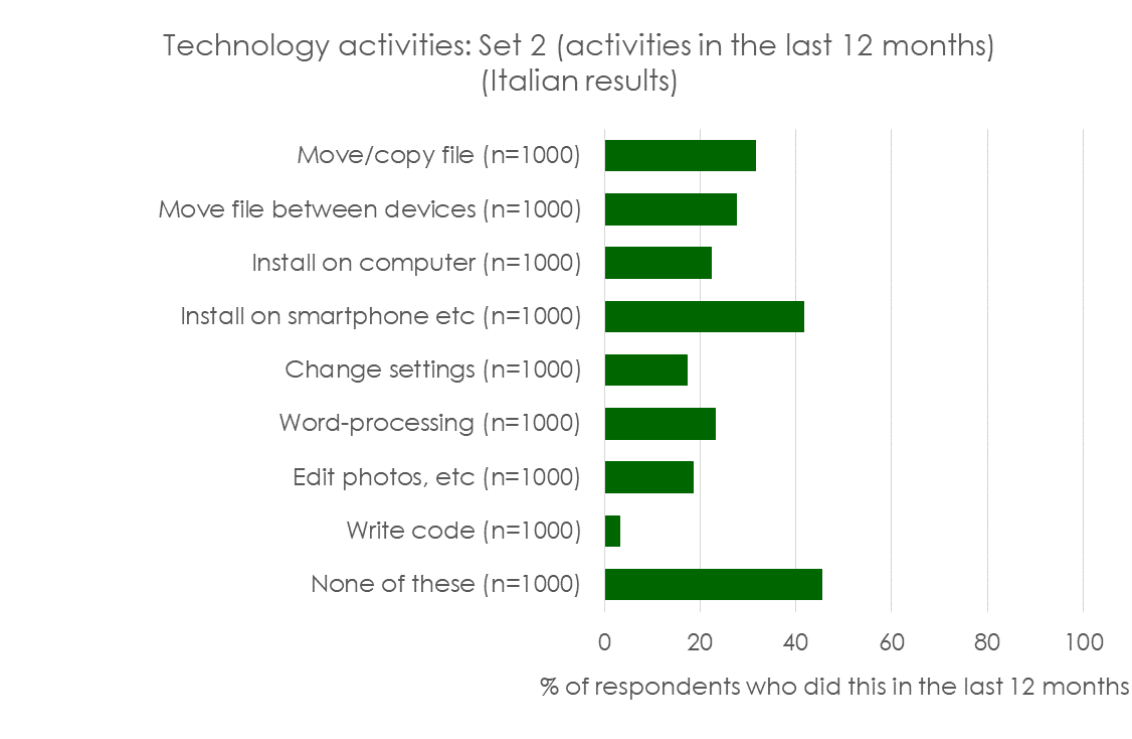

Figure 23: Technology activities: Set 2 (activities in the last 12 months) (Italian results)

4.4.4 Module C: Attitudes towards technology

Figure 24 presents headline figures from Module C. ATI and Willingness to Explore scores were calculated from the respondents' answers as described in Section 3.3.4, and were then categorised into Low, Medium and High as described in Section 4.1.

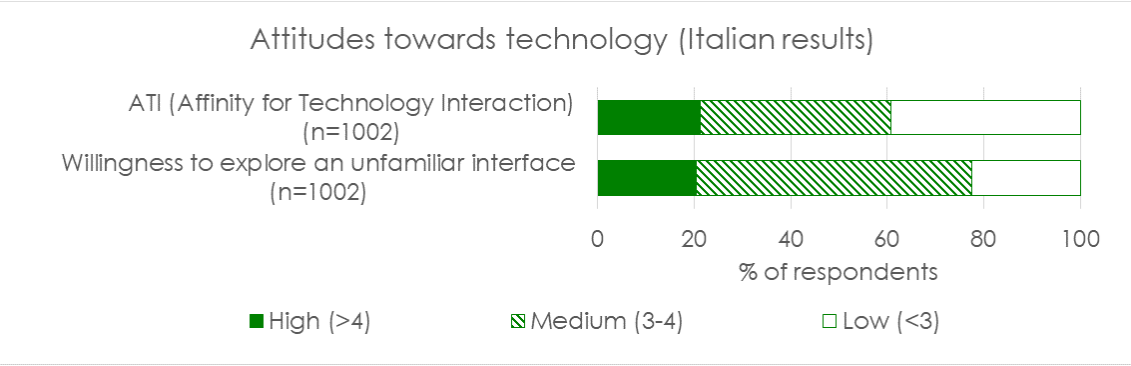

Figure 24: Attitudes towards technology (Italian results)

4.4.5 Module D: Digital interface competence

This section presents headline figures from Module D (see Section 3.3.5 for details of this module). Figure 25 describes the proportion of respondents who did each individual interface

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test correctly. The total number of tests done correctly was then used to give an estimate of the respondents' overall basic digital interface competence, shown in Figure 26.

Note that there is an unusually high proportion of participants scoring 0 on overall digital interface competence (i.e., who did not get any of the digital interface tests correct). This is considerably higher than the proportion scoring 0 in the other countries. They may reflect a genuinely higher proportion of people in Italy with extremely low digital interface competence or it may reflect differences in survey administration, e.g., how much the interviewers in different countries pushed participants to guess an answer to the tests rather than just saying "I don't know". Some support for this latter possibility is given by the fact that 76.1% of Italian respondents who had never used a smartphone scored 0 on digital interface competence, compared with between 17.6% and 51.6% in the other countries. However, this is not conclusive and there are likely to be other factors also at work.

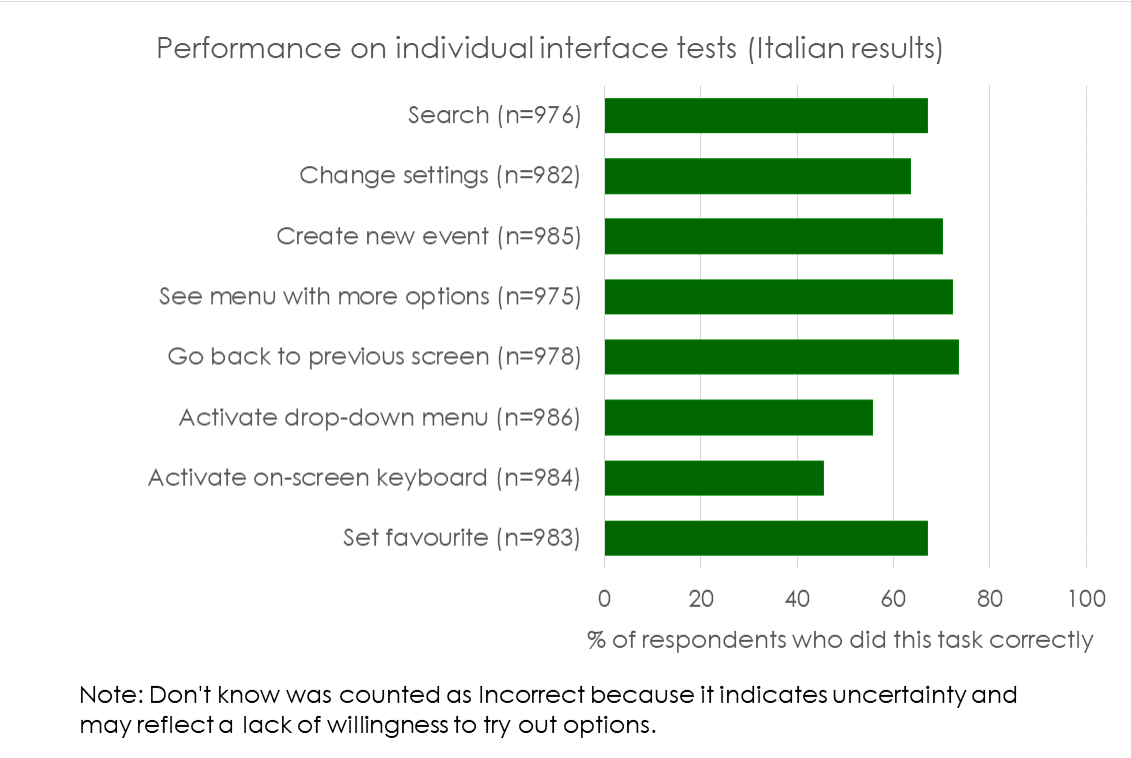

Figure 25: Performance on individual interface tests (Italian results)

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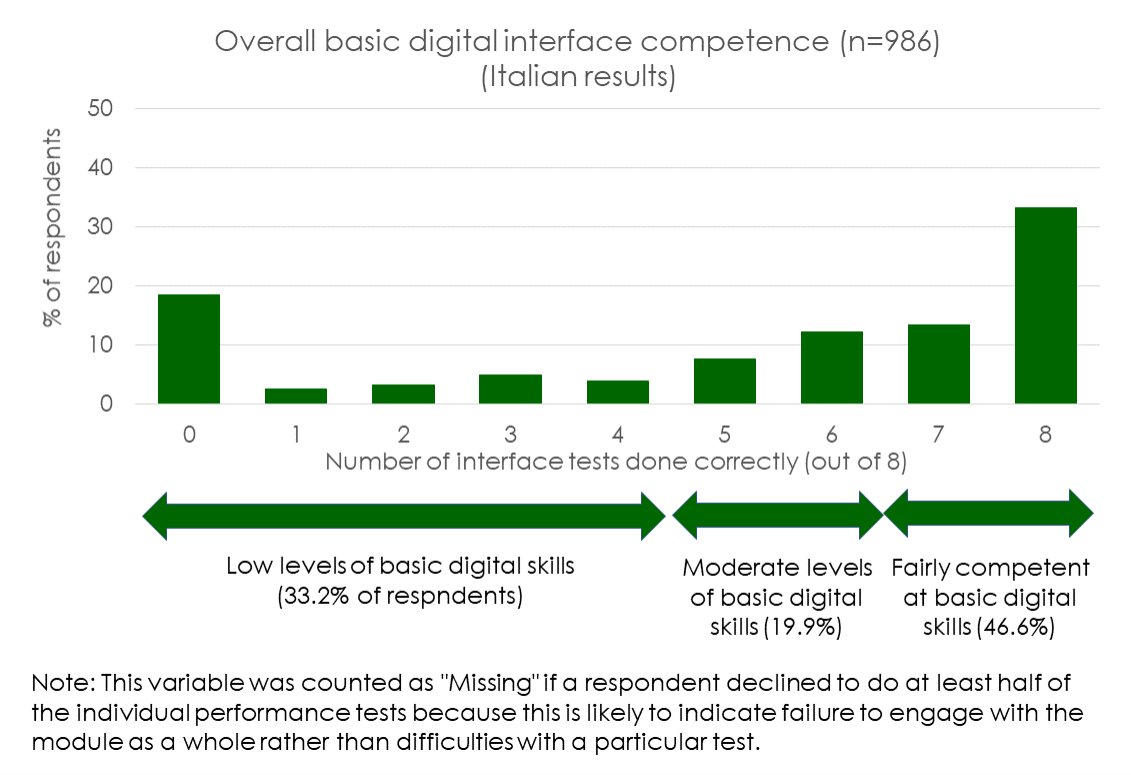

Figure 26: Overall basic digital interface competence (n=986) (Italian results)

4.4.6 Module E: Capabilities

This section presents headline figures from Module E (see Section 3.3.6 for details of this module). Figure 27 gives the results from the near comfort vision test, performed using a handheld LogMAR chart. Note that there is an unusually high proportion of respondents with very poor vision (Row 1 or worse) compared to the other survey countries. This may be due to using a "comfort vision" measure, where participants were encouraged to identify the smallest row that they could read **comfortably**, i.e., quickly and with certainty. Cultural differences may cause participants to interpret this in different ways and push themselves more or less on the vision test. Alternatively, poor lighting may have been an issue as the Italian survey was conducted in respondents' homes, or there may have been a more general issue with administering the vision test in Italy.

Dexterity was then assessed by asking respondents how difficult they would find it to pick up a small object such as a safety pin. The results are shown in Figure 28. Finally, Figure 29 shows the proportions of respondents reporting being "somewhat limited" or "very limited" due to difficulties with various capabilities.

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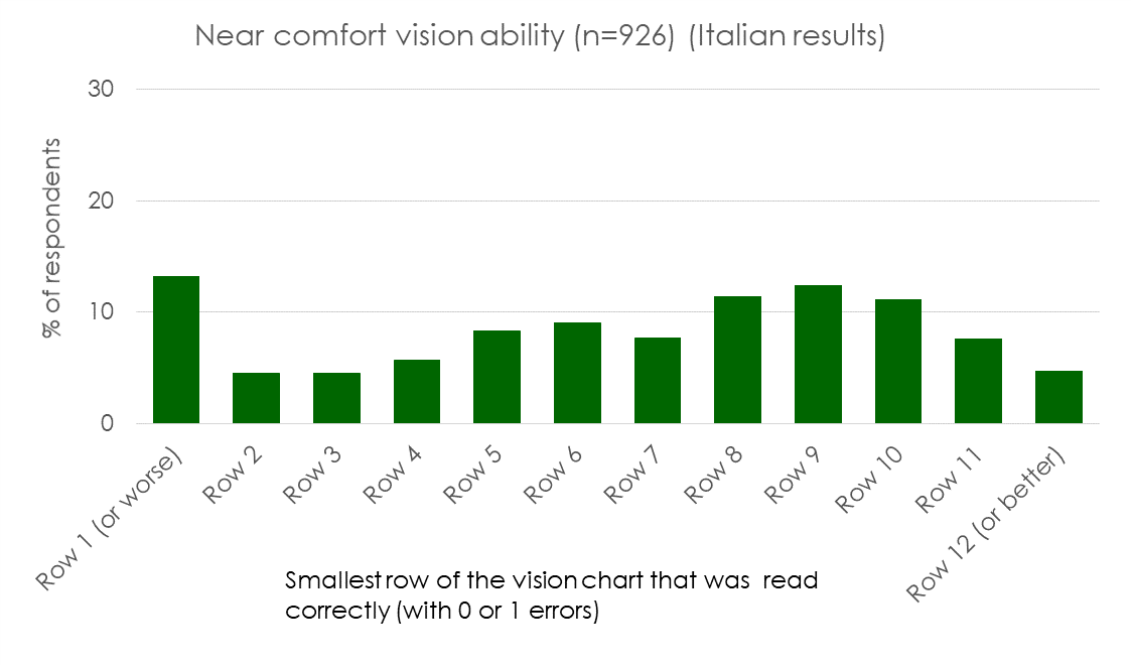

Figure 27: Near comfort vision ability (n=926) (Italian results)

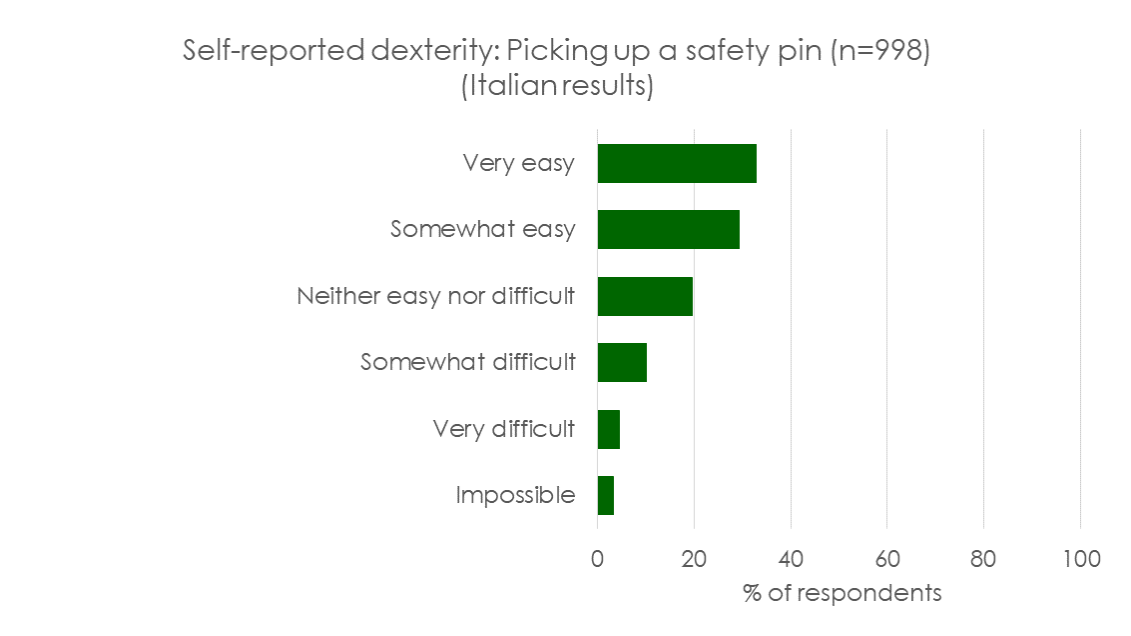

Figure 28: Self-reported dexterity: Picking up a safety pin (n=998) (Italian results)

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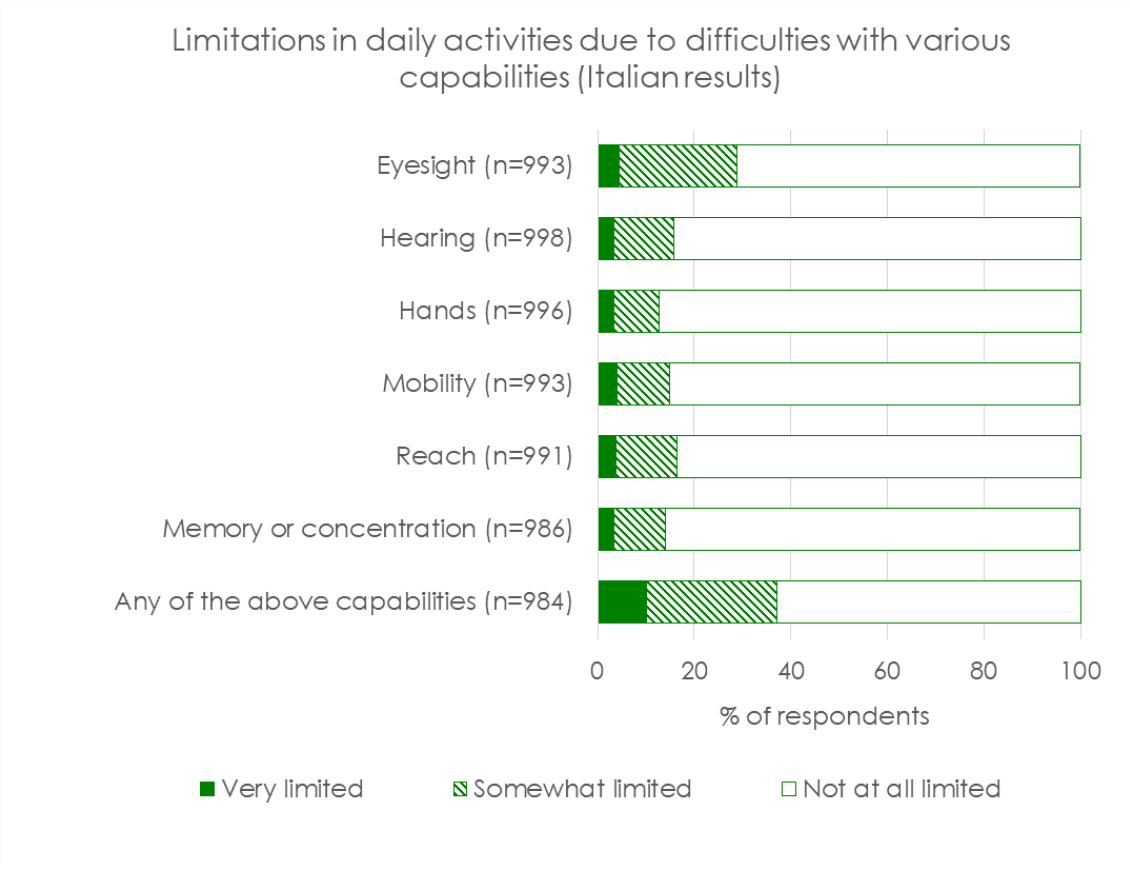

Figure 29: Limitations in daily activities due to difficulties with various capabilities (Italian results)

4.5 Results for the Barcelona Metropolitan Area

This subsection presents headline results from the survey in the Barcelona Metropolitan Area. In this section, Barcelona is used as an abbreviation for Barcelona Metropolitan Area in the graph titles and figure captions in this section.

4.5.1 Module A: Technology access and use

This section presents headline figures from Module A (see Section 3.3.1 for details of this module). Figure 30 gives figures for the percentage of respondents in the Barcelona Metropolitan Area with access to different kinds of digital technologies, while Figure 31 gives a breakdown of the frequency of use of different digital technologies.

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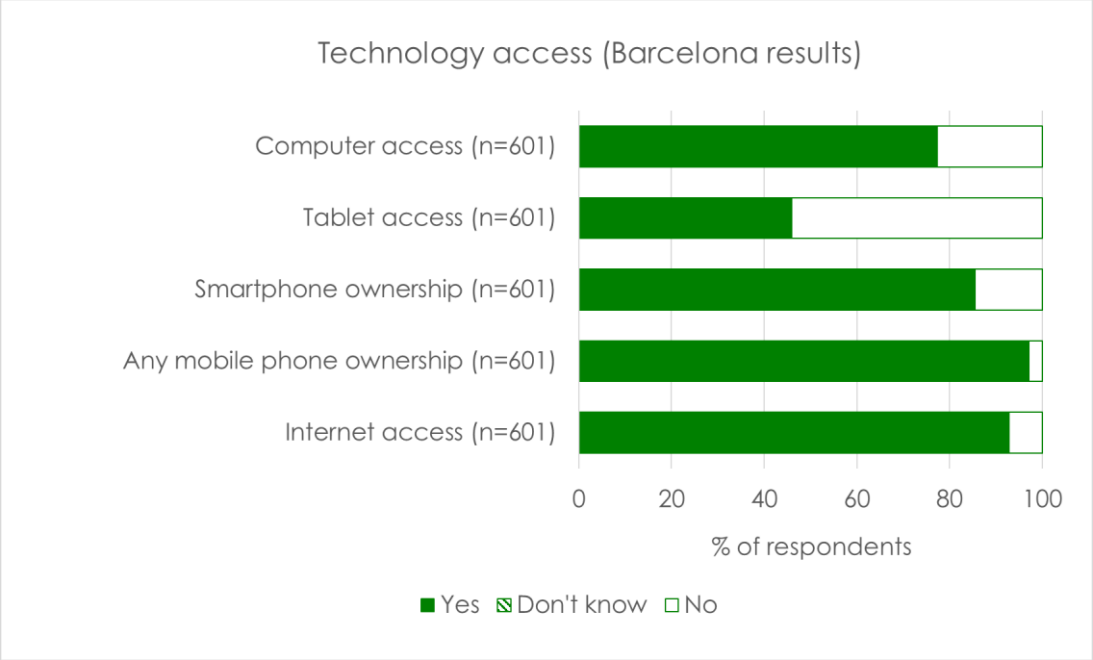

Figure 30: Technology access (Barcelona results)

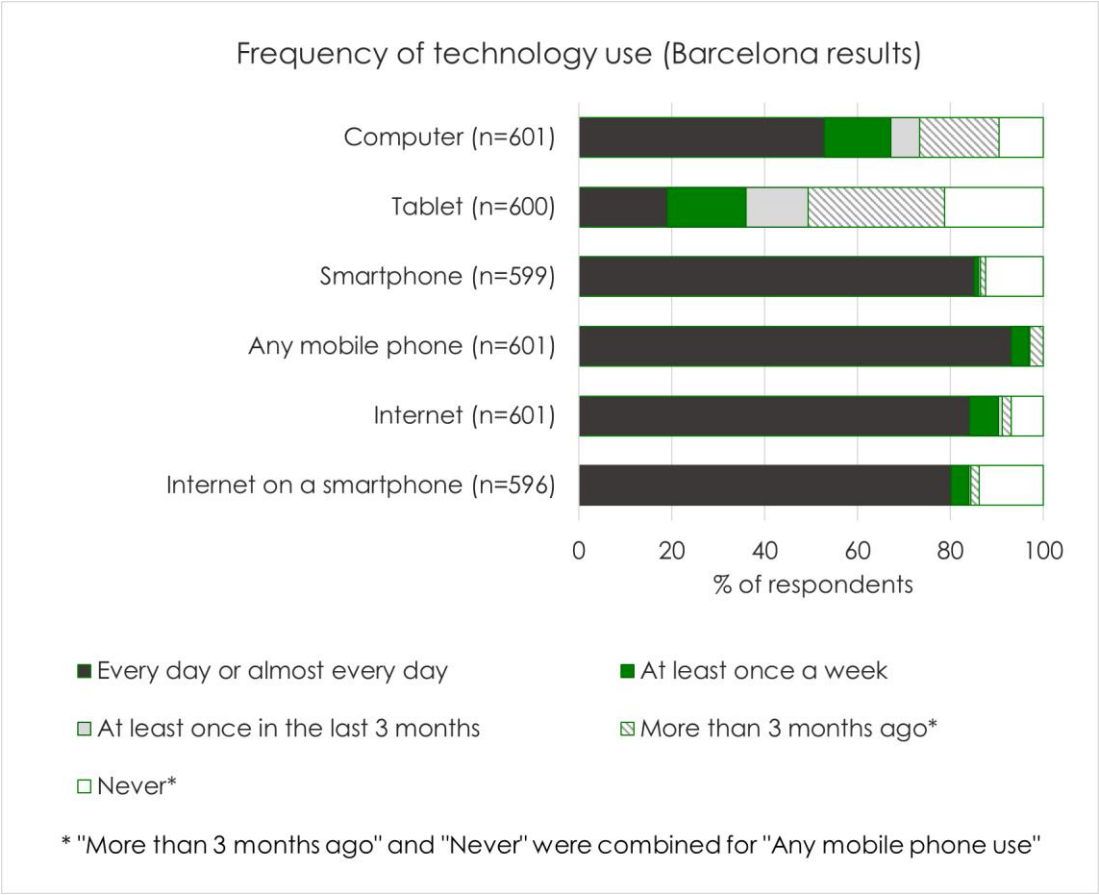

Figure 31: Frequency of technology use (Barcelona results)

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4.5.2 Module B1: Technology for transport

This section presents headline figures from Module B1 (see Section 3.3.2 for details of this module). Figure 32 shows the distribution of respondents' ratings of their confidence in planning an unfamiliar, local, public transport journey using a computer and using a smartphone. Figure 33 describes the frequency of use of a selection of digital mobility services. Finally, Figure 34 presents results on the proportions of respondents reporting feeling "very limited" or "slightly limited" in their regular travel within the region, for a variety of reasons.

Participants were also asked how they find out information about their travel. Participants could select up to three responses. 82.9% of respondents included a digital information source in their selection (not counting responses of "Other", while 17.1% listed non-digital sources only, (n=596).

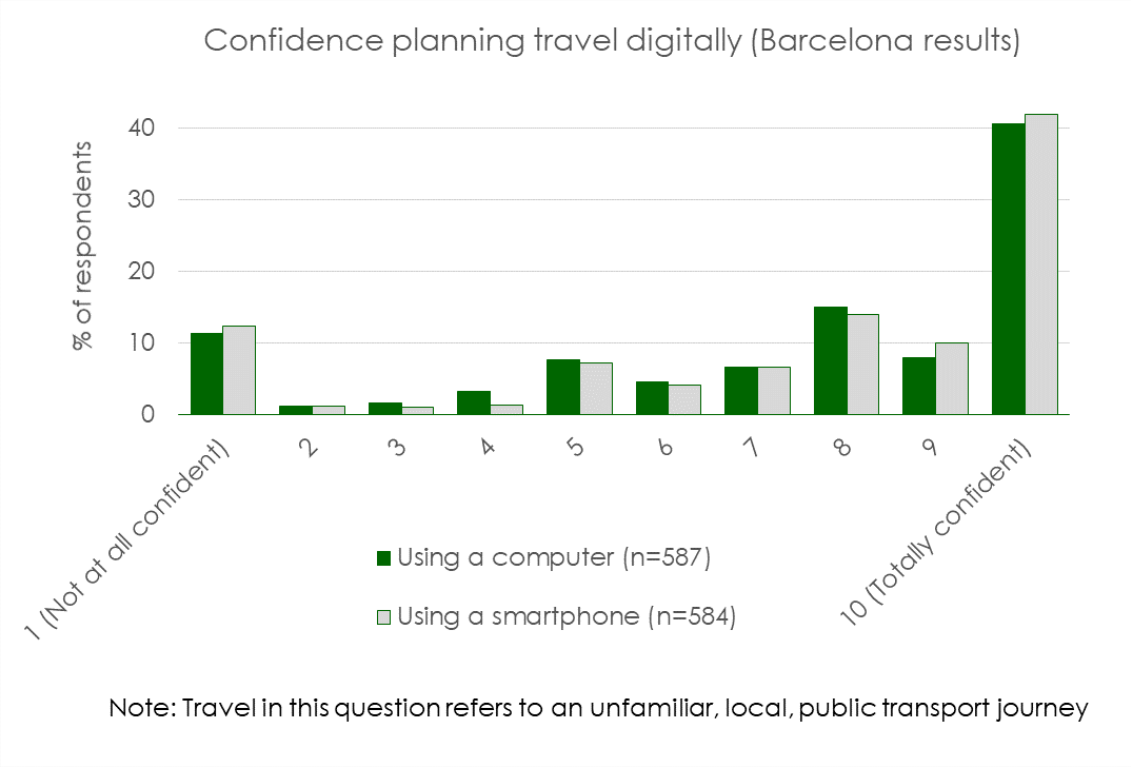

Figure 32: Confidence planning travel digitally (Barcelona results)

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement N°875542.

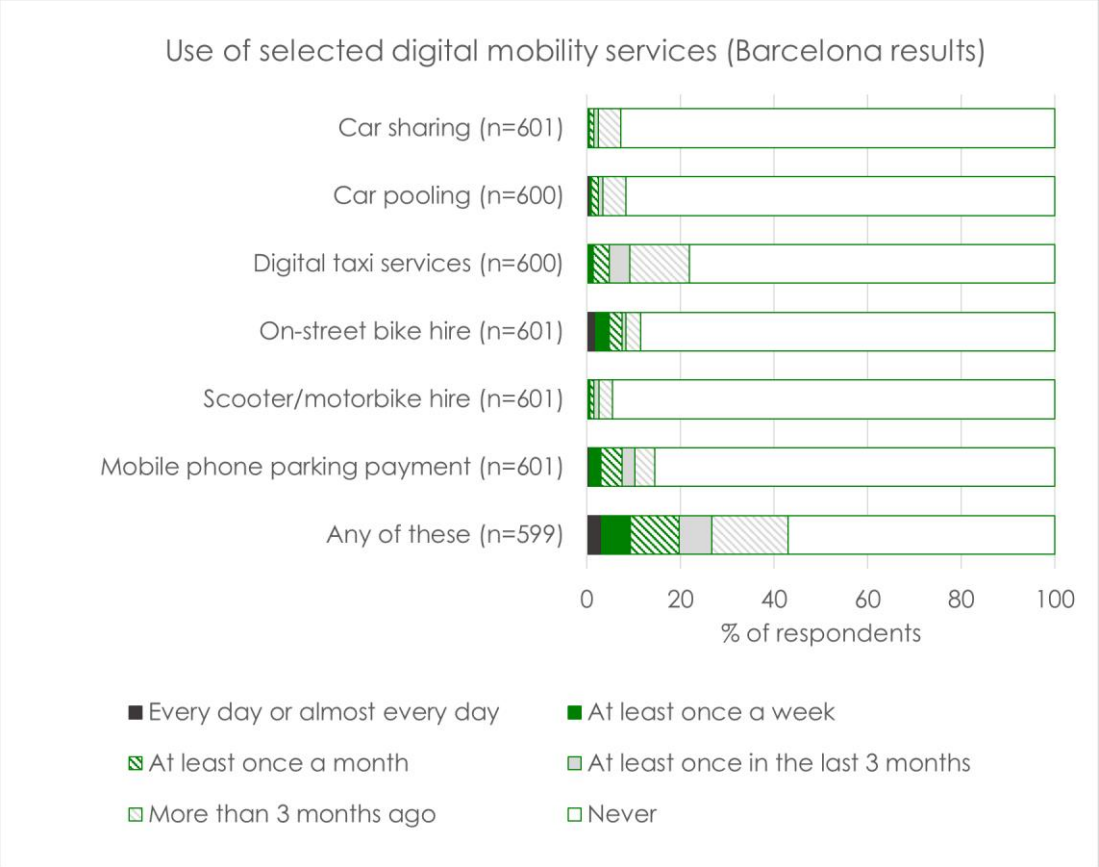

Figure 33: Use of selected digital mobility services (Barcelona results)

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement N°875542.

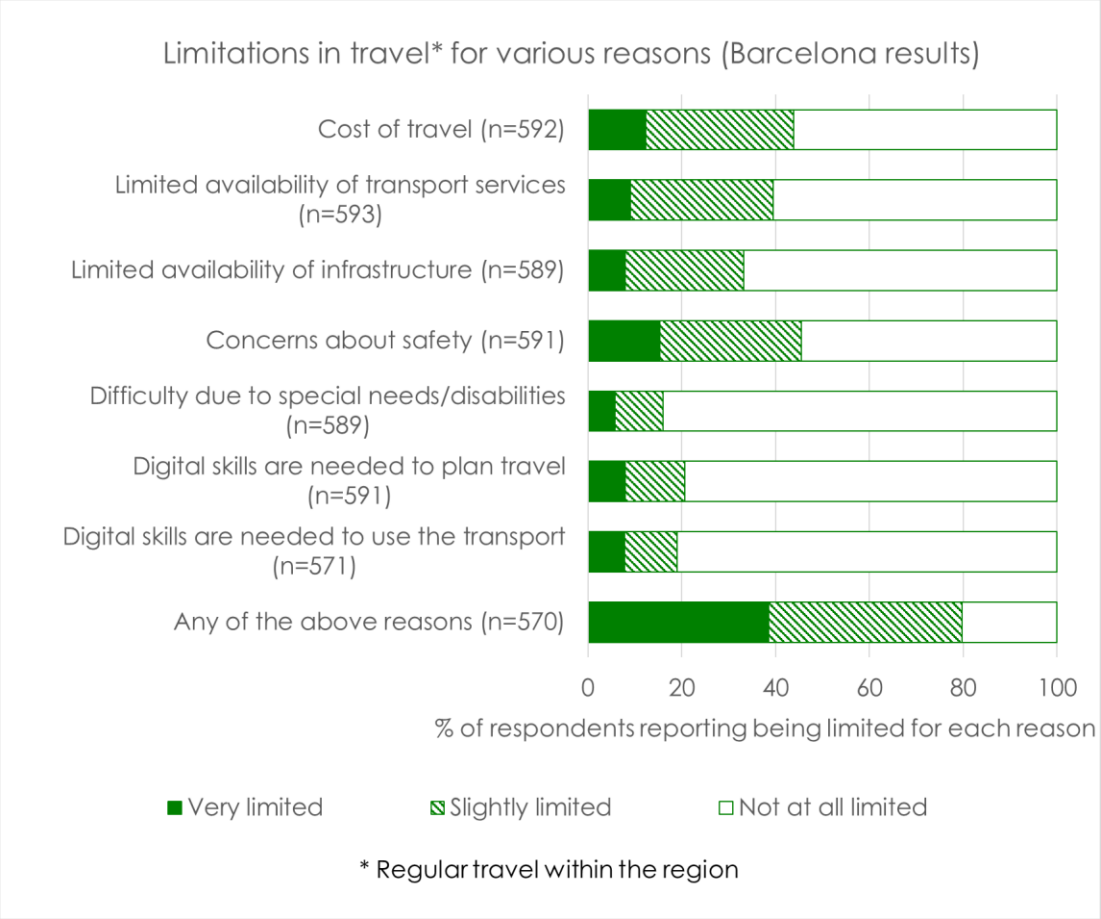

Figure 34: Limitations in travel for various reasons (Barcelona results)

4.5.3 Module B2: General computer and mobile device activities

This section presents headline figures from Module B2 (see Section 3.3.3 for details of this module). Figure 35 reports on whether respondents had conducted an initial set of technology activities in the previous 3 months. Figure 36 examines a second set of activities that are commonly performed less frequently or relate to a deeper knowledge of technology devices. It reports on whether respondents had conducted these over the longer period of the previous 12 months.

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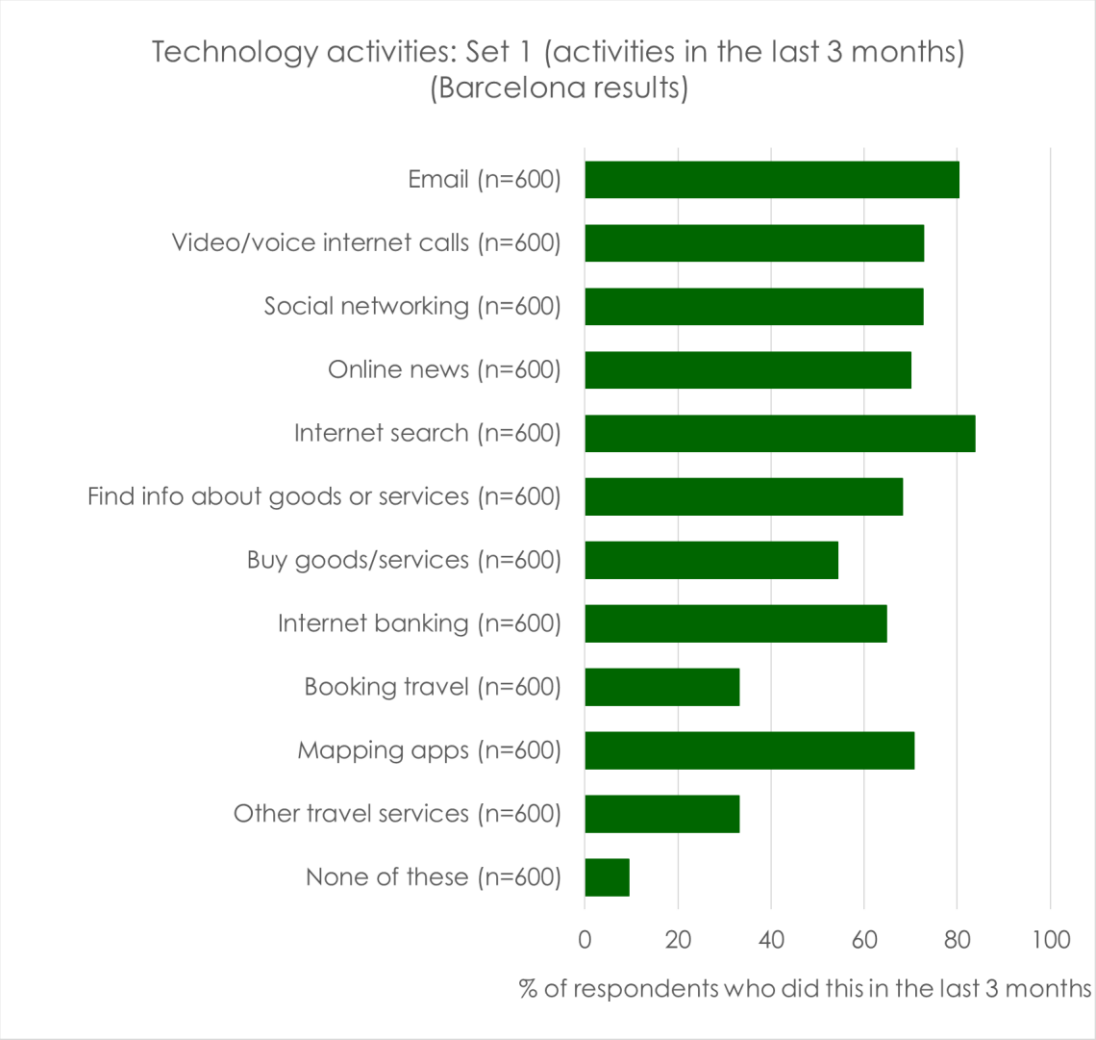

Figure 35: Technology activities: Set 1 (activities in the last 3 months) (Barcelona results)

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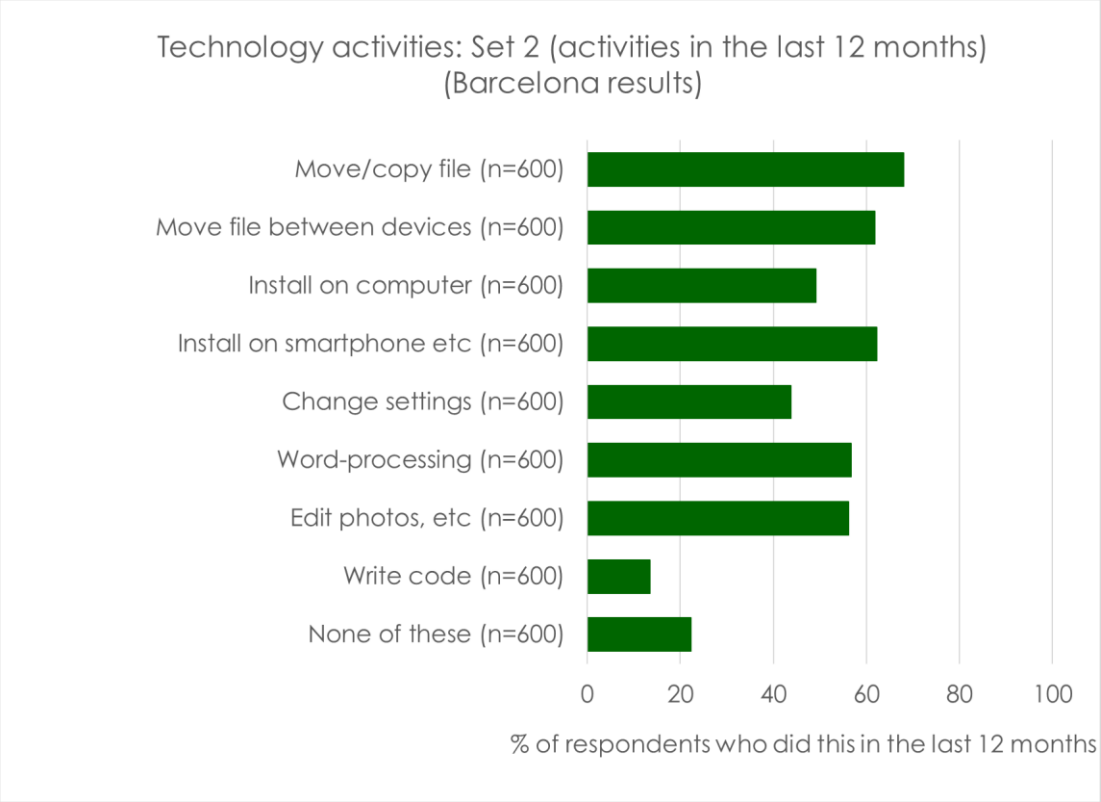

Figure 36: Technology activities: Set 2 (activities in the last 12 months) (Barcelona results)

4.5.4 Module C: Attitudes towards technology

Figure 37 presents headline figures from Module C. ATI and Willingness to Explore scores were calculated from the respondents' answers as described in Section 3.3.4, and were then categorised into Low, Medium and High as described in Section 4.1.

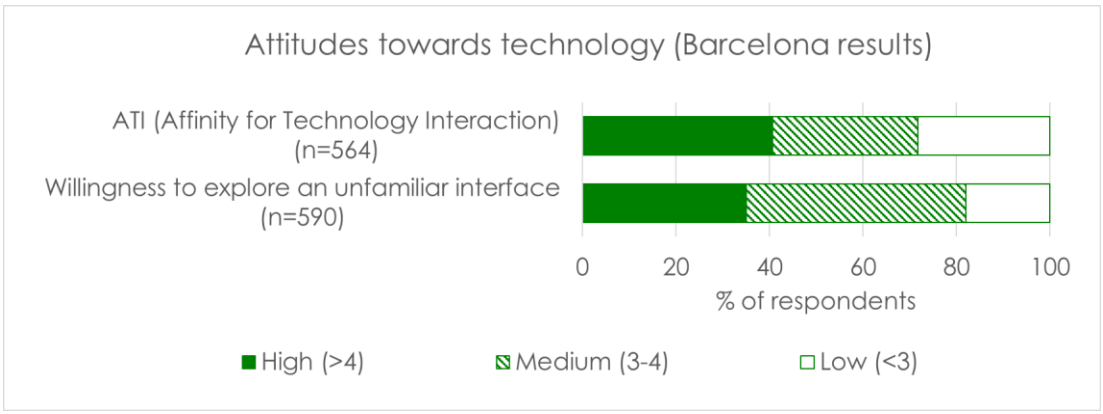

Figure 37: Attitudes towards technology (Barcelona results)

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement N°875542.

4.5.5 Module D: Digital interface competence

This section presents headline figures from Module D (see Section 3.3.5 for details of this module). Figure 38 describes the proportion of respondents who did each individual interface test correctly. The total number of tests done correctly was then used to give an estimate of the respondents' overall basic digital interface competence, shown in Figure 39.

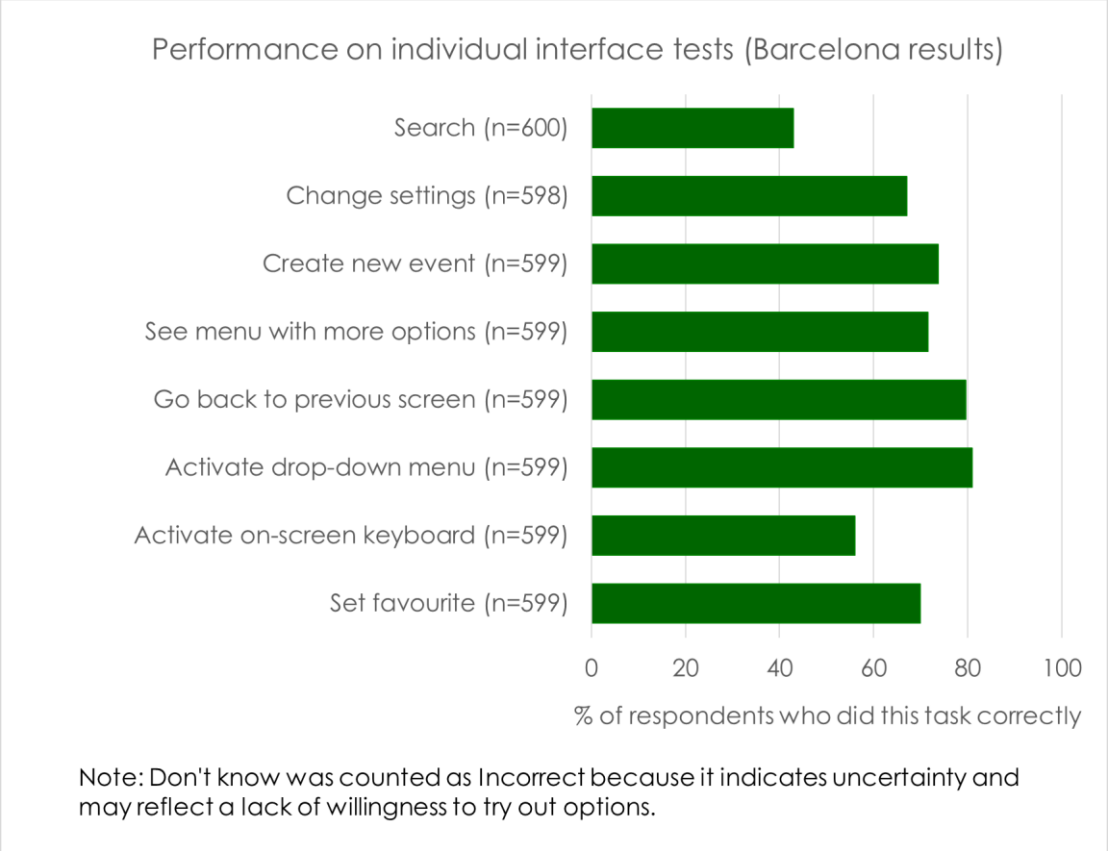

Figure 38: Performance on individual interface tests (Barcelona results)

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement N°875542.

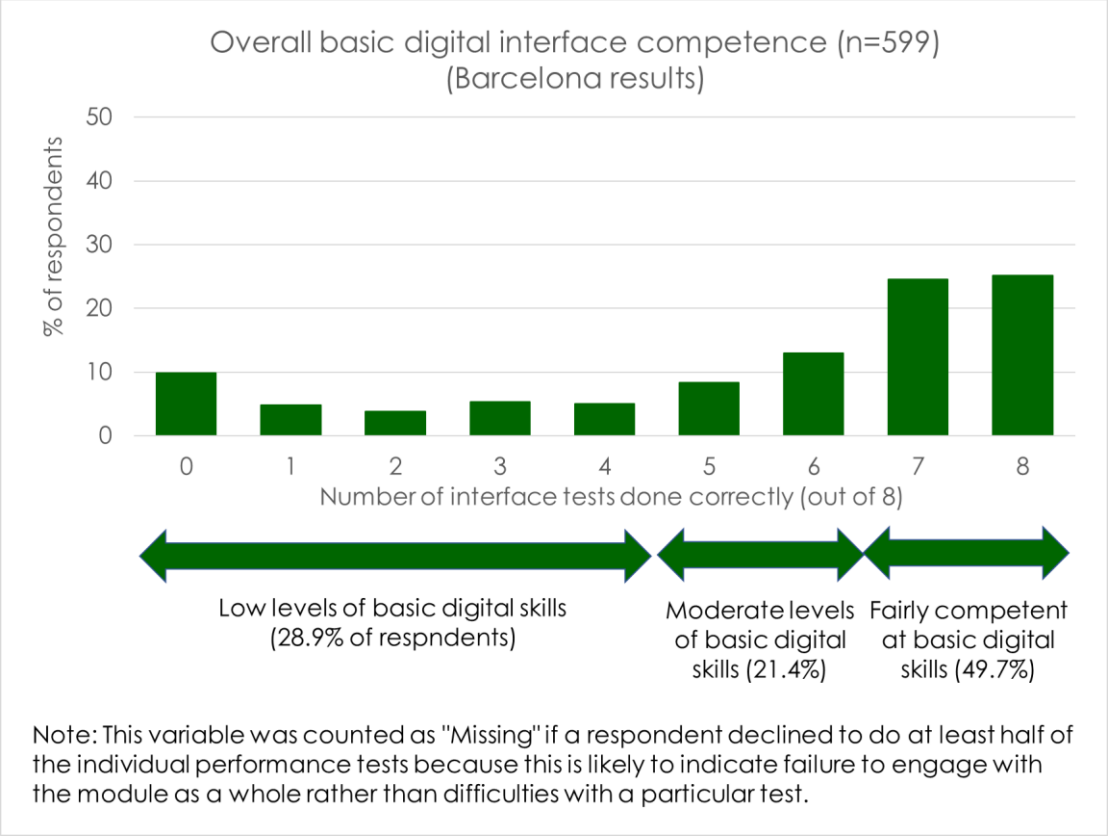

Figure 39: Overall basic digital interface competence (n=599) (Barcelona results)

4.5.6 Module E: Capabilities

This section presents headline figures from Module E (see Section 3.3.6 for details of this module). Figure 40 gives the results from the near comfort vision test, performed using a handheld LogMAR chart. Dexterity was then assessed by asking respondents how difficult they would find it to pick up a small object such as a safety pin. The results are shown in Figure 41. Finally, Figure 42 shows the proportions of respondents reporting being "somewhat limited" or "very limited" due to difficulties with various capabilities.

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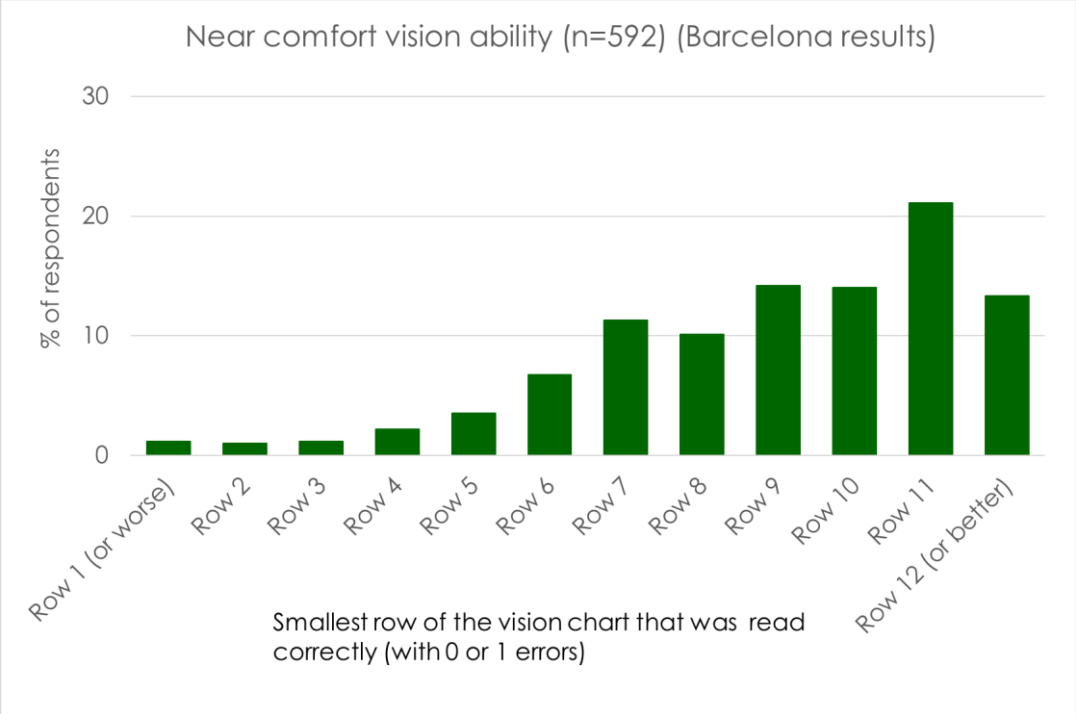

Figure 40: Near comfort vision ability (n=592) (Barcelona results)

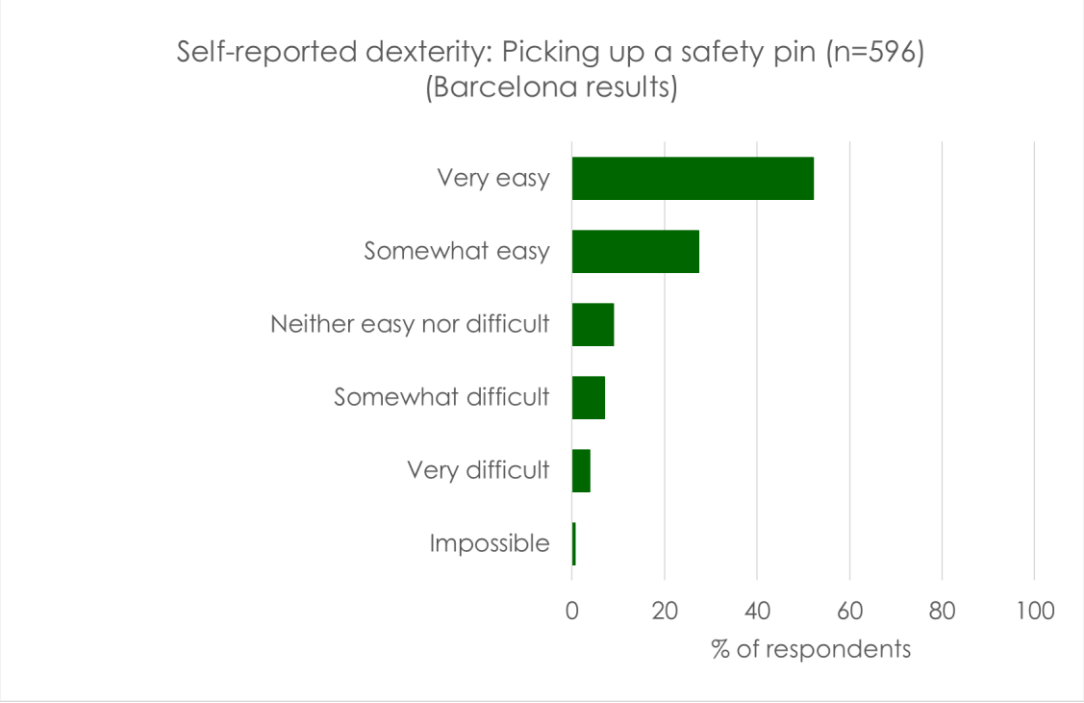

Figure 41: Self-reported dexterity: Picking up a safety pin (n=596) (Barcelona results)

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement N°875542.

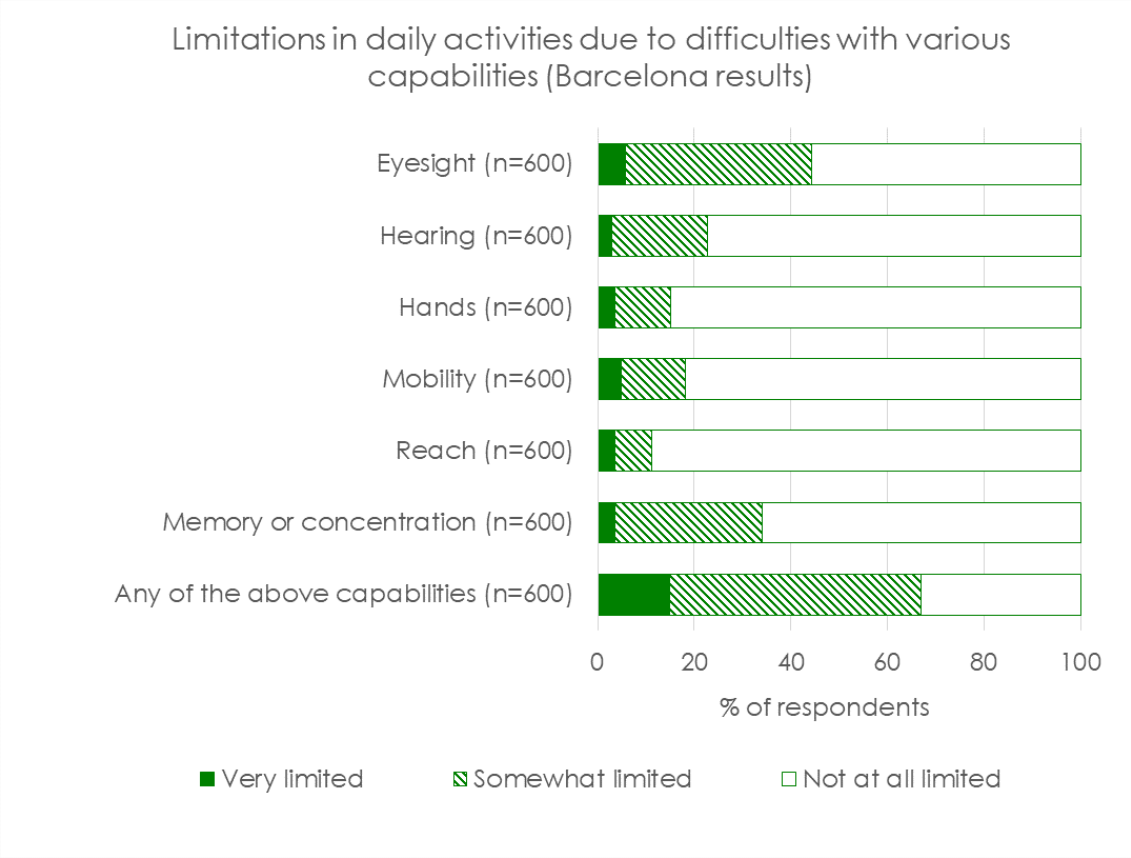

Figure 42: Limitations in daily activities due to difficulties with various capabilities (Barcelona results)

4.6 Results for Flanders

This subsection presents headline results from the survey in Flanders.

4.6.1 Module A: Technology access and use

This section presents headline figures from Module A (see Section 3.3.1 for details of this module). Figure 43 gives figures for the percentage of respondents in Flanders with access to different kinds of digital technologies, while Figure 44 gives a breakdown of the frequency of use of different digital technologies.

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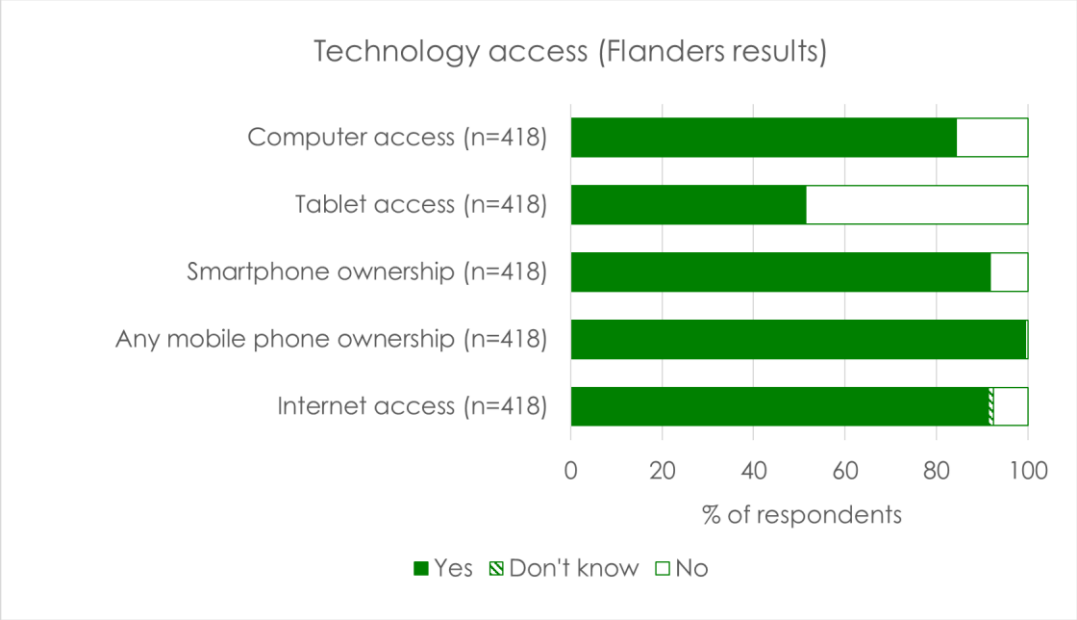

Figure 43: Technology access (Flanders results)

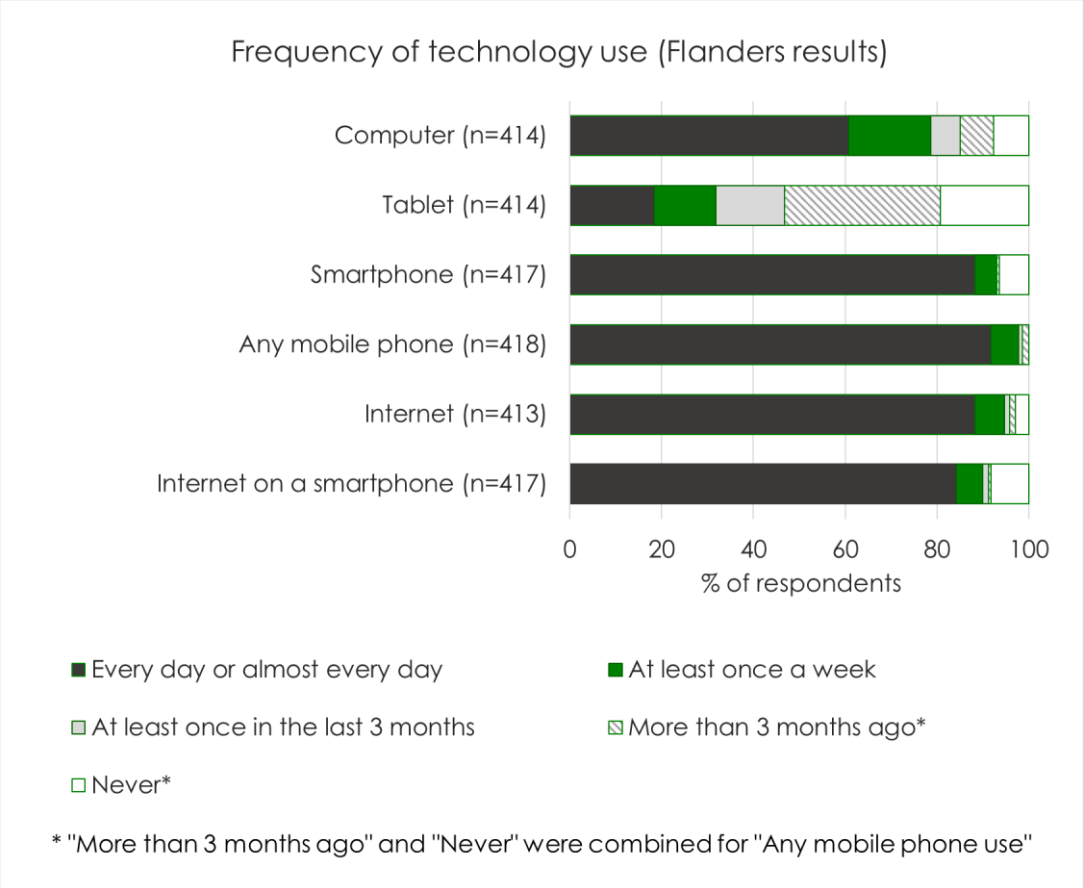

Figure 44: Frequency of technology use (Flanders results)

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4.6.2 Module B1: Technology for transport

This section presents headline figures from Module B1 (see Section 3.3.2 for details of this module). Figure 45 shows the distribution of respondents' ratings of their confidence in planning an unfamiliar, local, public transport journey using a computer and using a smartphone. Figure 46 describes the frequency of use of a selection of digital mobility services. Finally, Figure 47 presents results on the proportions of respondents reporting feeling "very limited" or "slightly limited" in their regular travel within the region, for a variety of reasons.

Participants were also asked how they find out information about their travel. Participants could select up to three responses. 79.2% of respondents included a digital information source in their selection (not counting responses of "Other", while 20.8% listed non-digital sources only (n= 418).

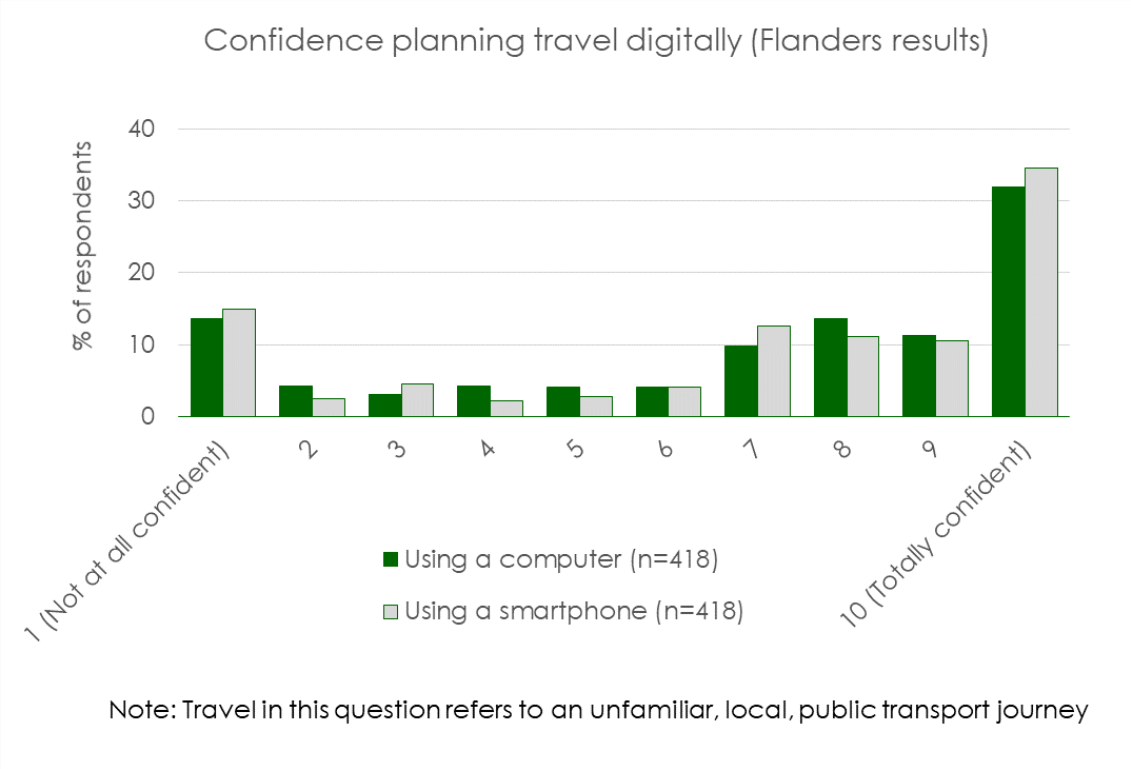

Figure 45: Confidence planning travel digitally (Flanders results)

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement N°875542.

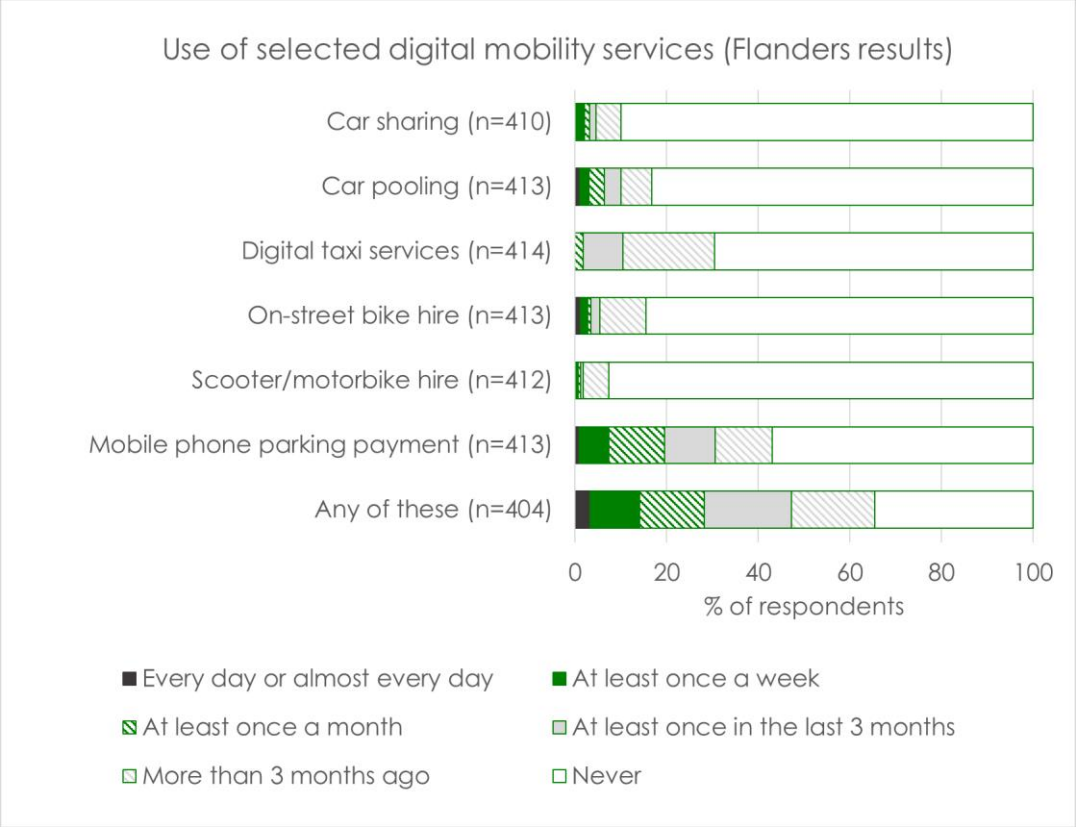

Figure 46: Use of selected digital mobility services (Flanders results)

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement N°875542.

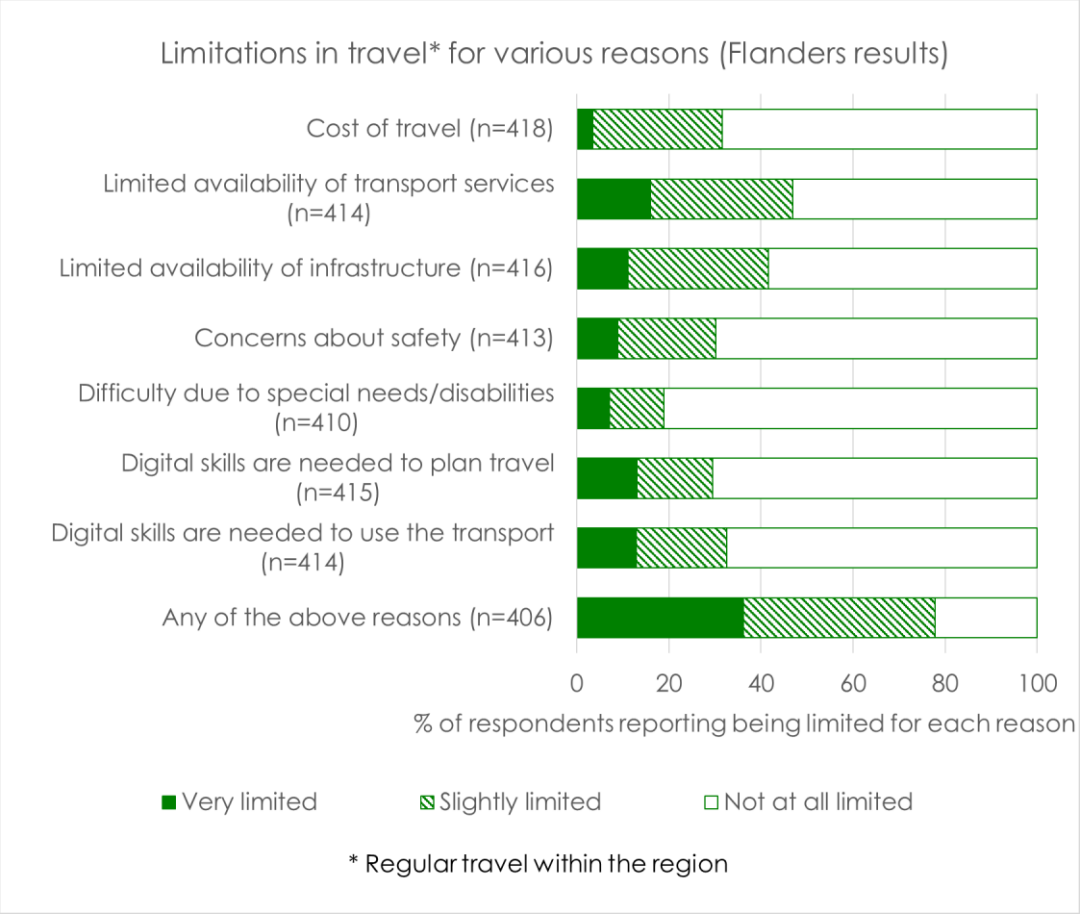

Figure 47: Limitations in travel for various reasons (Flanders results)

4.6.3 Module B2: General computer and mobile device activities

As explained in Section 3.4.4, there was an error in the routing of the questionnaire for Module B2 in the Flanders survey. Consequently, the results for Module B2 are invalid for this dataset.

4.6.4 Module C: Attitudes towards technology

Figure 48 presents headline figures from Module C. ATI and Willingness to Explore scores were calculated from the respondents' answers as described in Section 3.3.4, and were then categorised into Low, Medium and High as described in Section 4.1.

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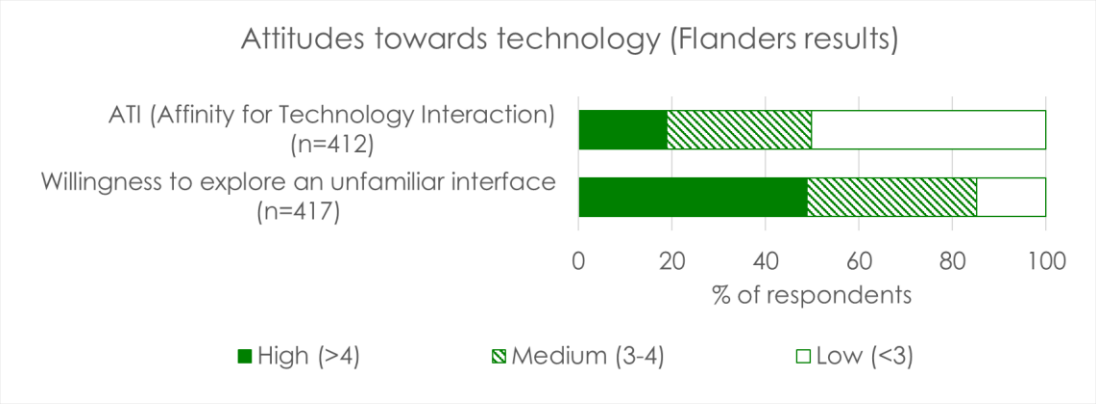

Figure 48: Attitudes towards technology (Flanders results)

4.6.5 Module D: Digital interface competence

This section presents headline figures from Module D (see Section 3.3.5 for details of this module). Figure 49 describes the proportion of respondents who did each individual interface test correctly. The total number of tests done correctly was then used to give an estimate of the respondents' overall basic digital interface competence, shown in Figure 50.

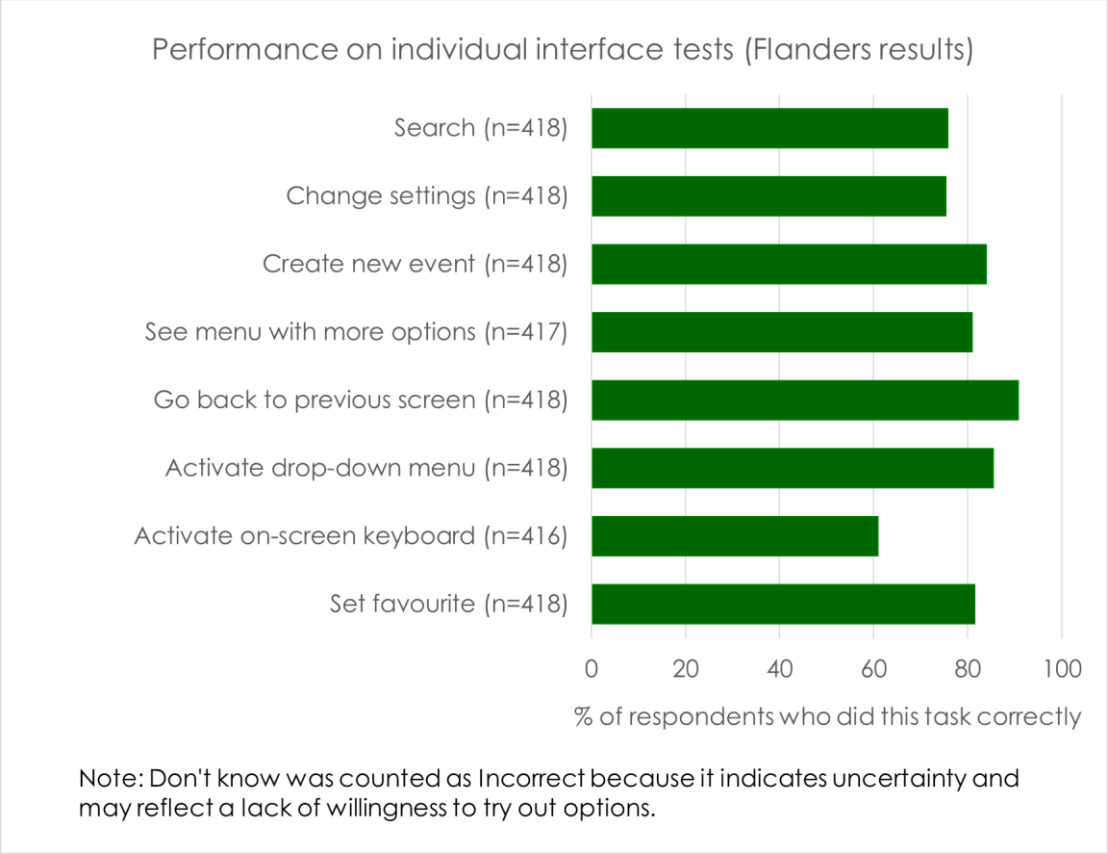

Figure 49: Performance on individual interface tests (Flanders results)

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement N°875542.

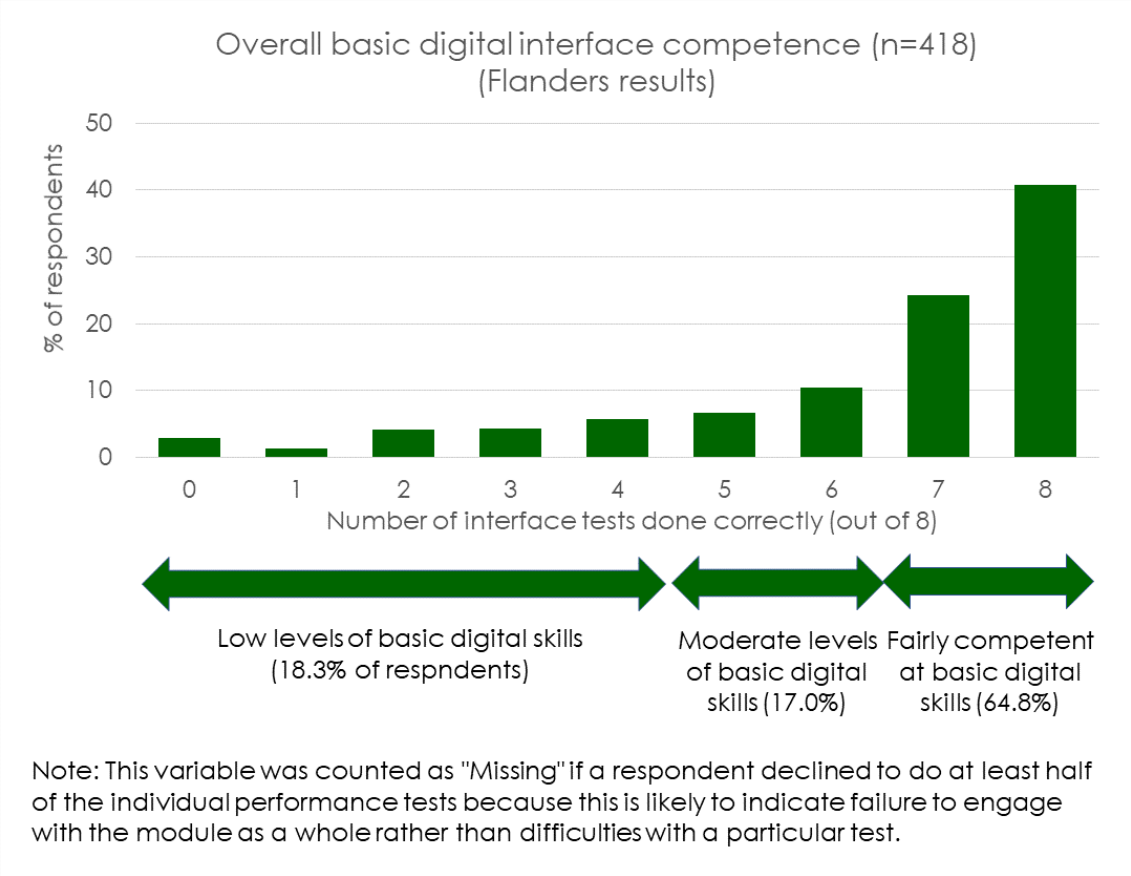

Figure 50: Overall basic digital interface competence (n=418) (Flanders results)

4.6.6 Module E: Capabilities

This section presents headline figures from Module E (see Section 3.3.6 for details of this module). Figure 51 gives the results from the near comfort vision test, performed using a handheld LogMAR chart. Dexterity was then assessed by asking respondents how difficult they would find it to pick up a small object such as a safety pin. The results are shown in Figure 52. Finally, Figure 53 shows the proportions of respondents reporting being "somewhat limited" or "very limited" due to difficulties with various capabilities.

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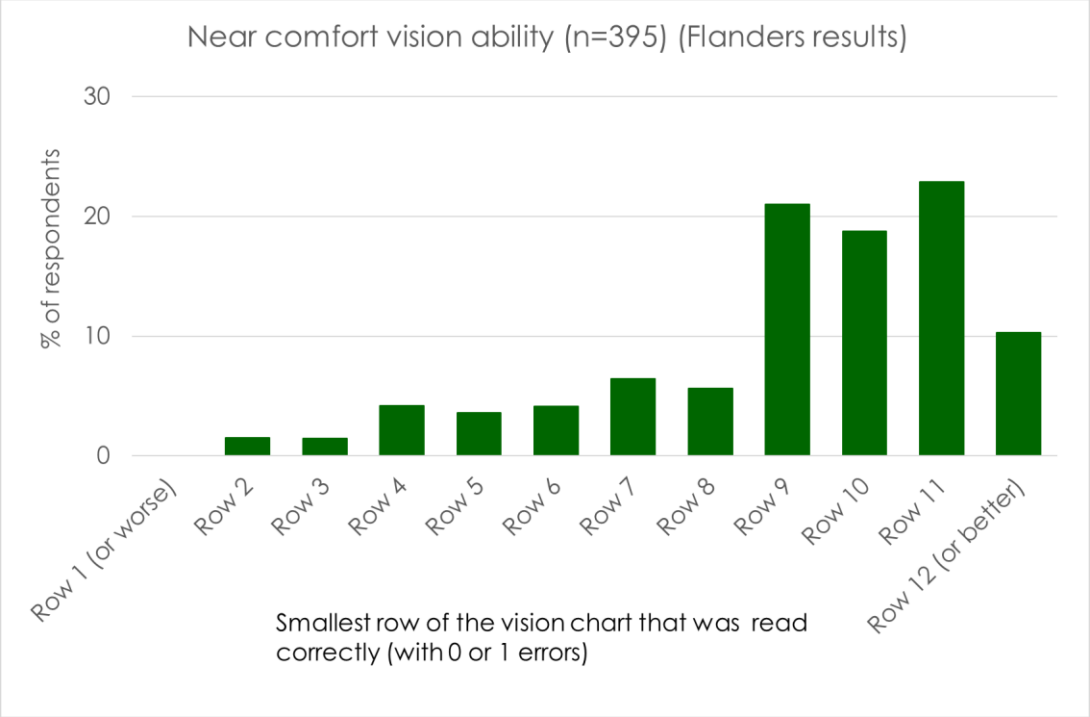

Figure 51: Near comfort vision ability (n=395) (Flanders results)

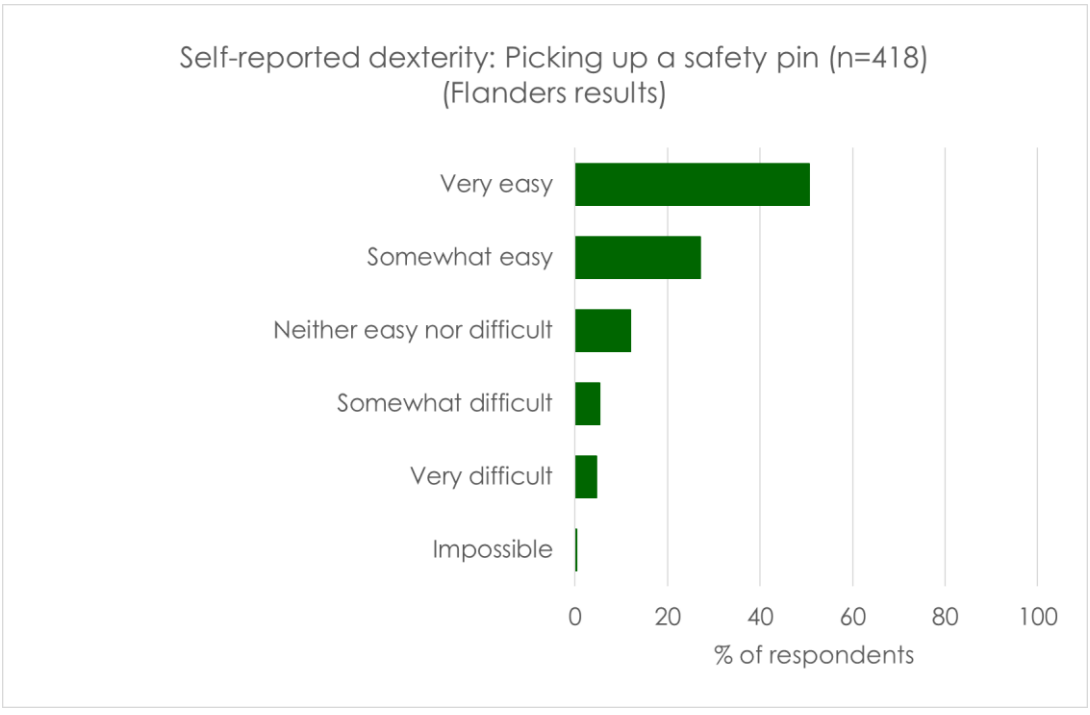

Figure 52: Self-reported dexterity: Picking up a safety pin (n=418) (Flanders results)

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement N°875542.

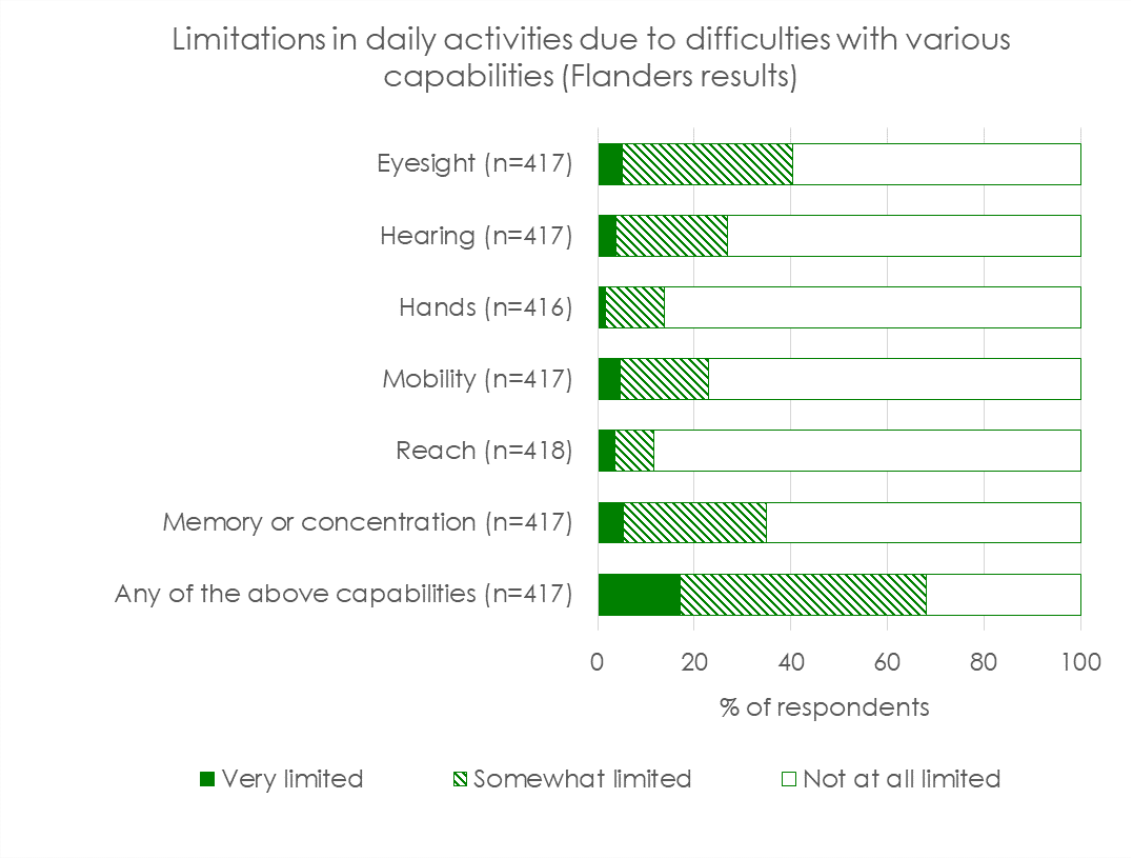

Figure 53: Limitations in daily activities due to difficulties with various capabilities (Flanders results)

4.7 Results for the Netherlands

This subsection presents headline results from the survey in the Netherlands.

4.7.1 Module A: Technology access and use

This section presents headline figures from Module A (see Section 3.3.1 for details of this module). Figure 54 gives figures for the percentage of Dutch respondents with access to different kinds of digital technologies, while Figure 55 gives a breakdown of the frequency of use of different digital technologies.

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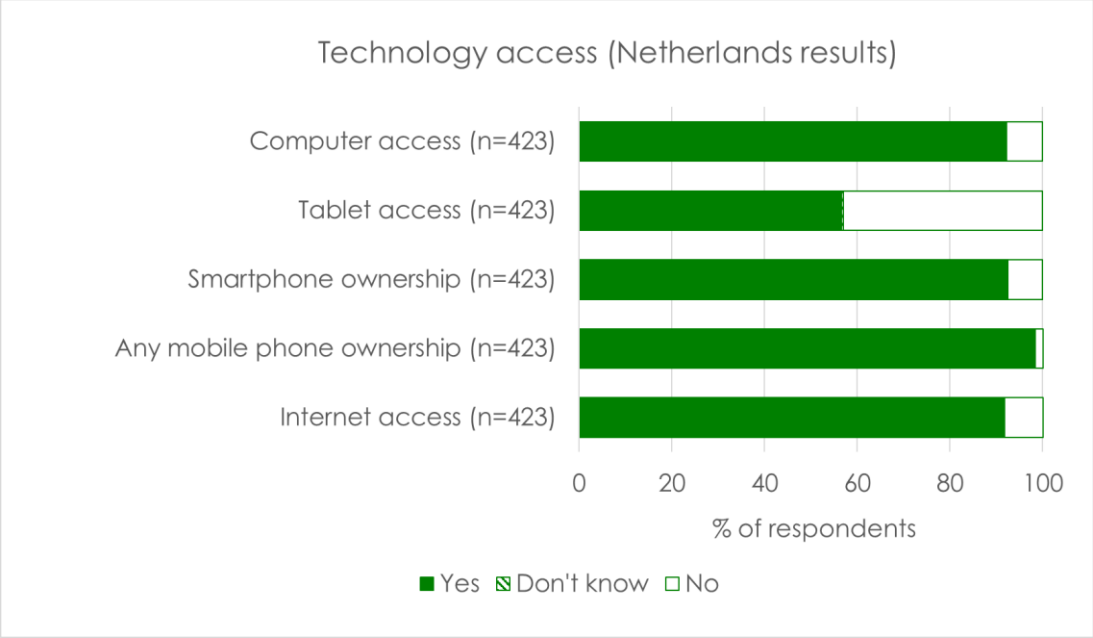

Figure 54: Technology access (Netherlands results)

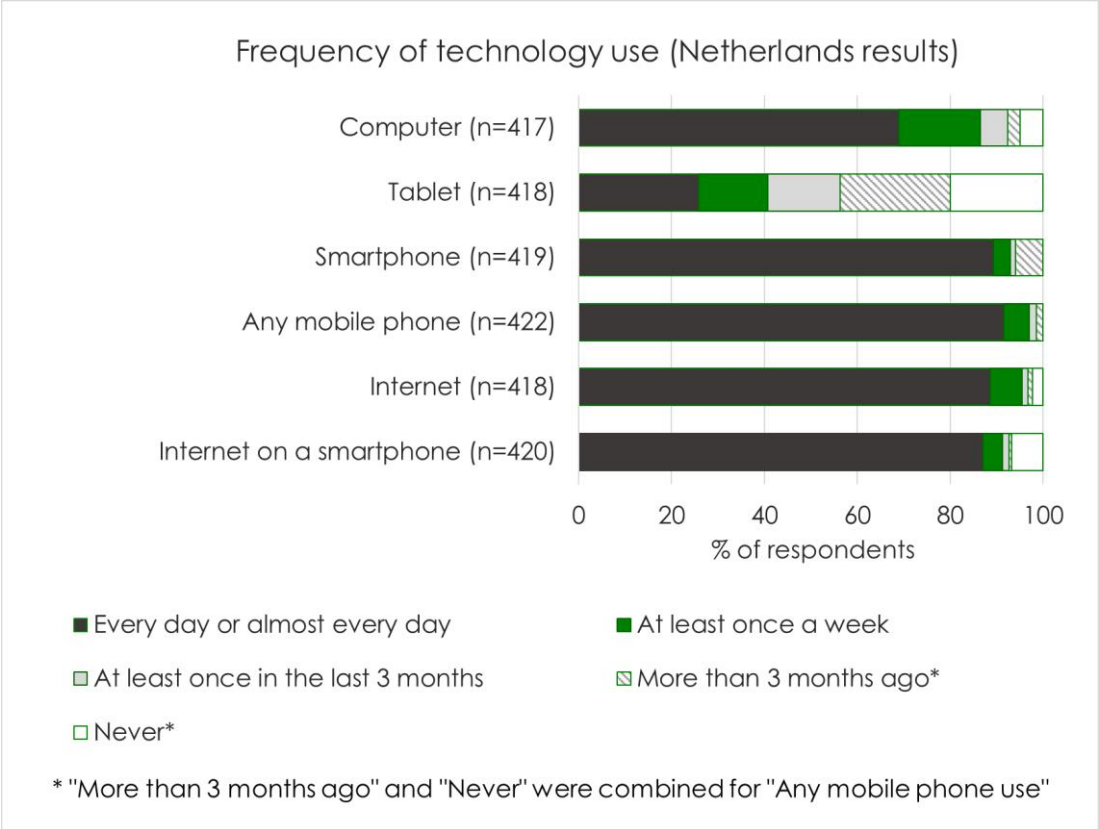

Figure 55: Frequency of technology use (Netherlands results)

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4.7.2 Module B1: Technology for transport

This section presents headline figures from Module B1 (see Section 3.3.2 for details of this module). Figure 56 shows the distribution of respondents' ratings of their confidence in planning an unfamiliar, local, public transport journey using a computer and using a smartphone. Figure 57 describes the frequency of use of a selection of digital mobility services. Finally, Figure 58 presents results on the proportions of respondents reporting feeling "very limited" or "slightly limited" in their regular travel within the region, for a variety of reasons.

Participants were also asked how they find out information about their travel. Participants could select up to three responses. 84.5% of respondents included a digital information source in their selection (not counting responses of "Other", while 15.5% listed non-digital sources only (n=423).

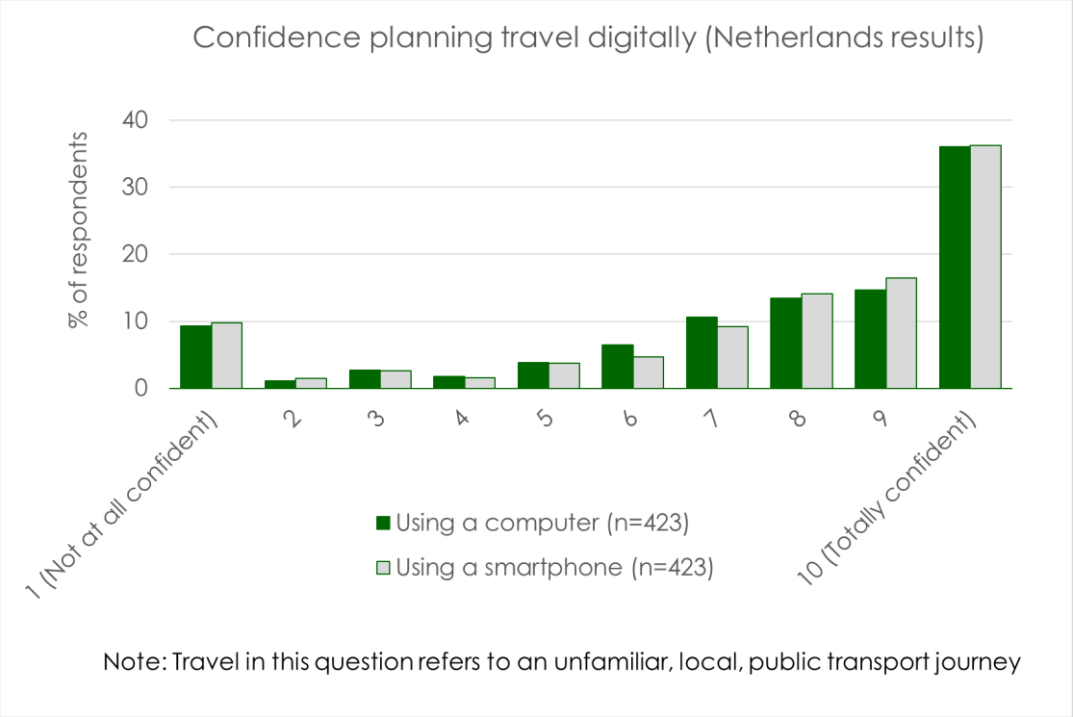

Figure 56: Confidence planning travel digitally (Netherlands results)

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement N°875542.

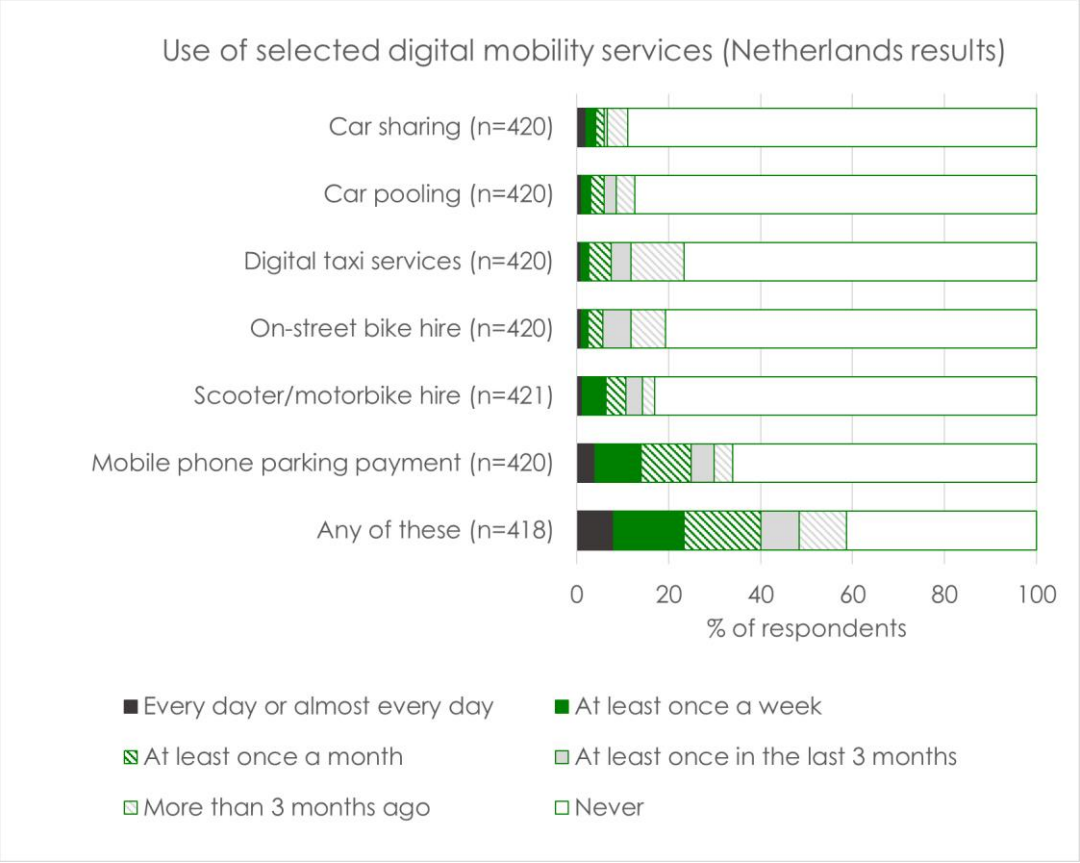

Figure 57: Use of selected digital mobility services (Netherlands results)

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement N°875542.

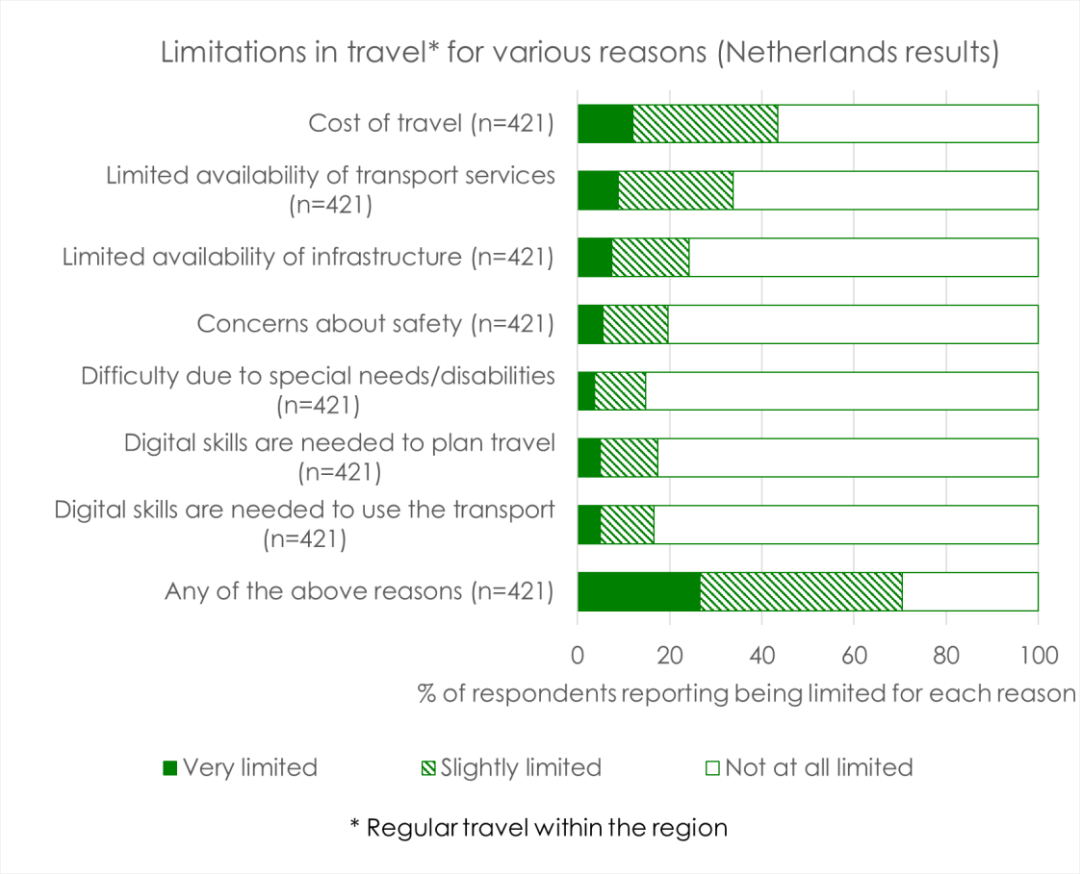

Figure 58: Limitations in travel for various reasons (Netherlands results)

4.7.3 Module B2: General computer and mobile device activities

This section presents headline figures from Module B2 (see Section 3.3.3 for details of this module). Figure 59 reports on whether respondents had conducted an initial set of technology activities in the previous 3 months. Figure 60 examines a second set of activities that are commonly performed less frequently or relate to a deeper knowledge of technology devices. It reports on whether respondents had conducted these over the longer period of the previous 12 months.

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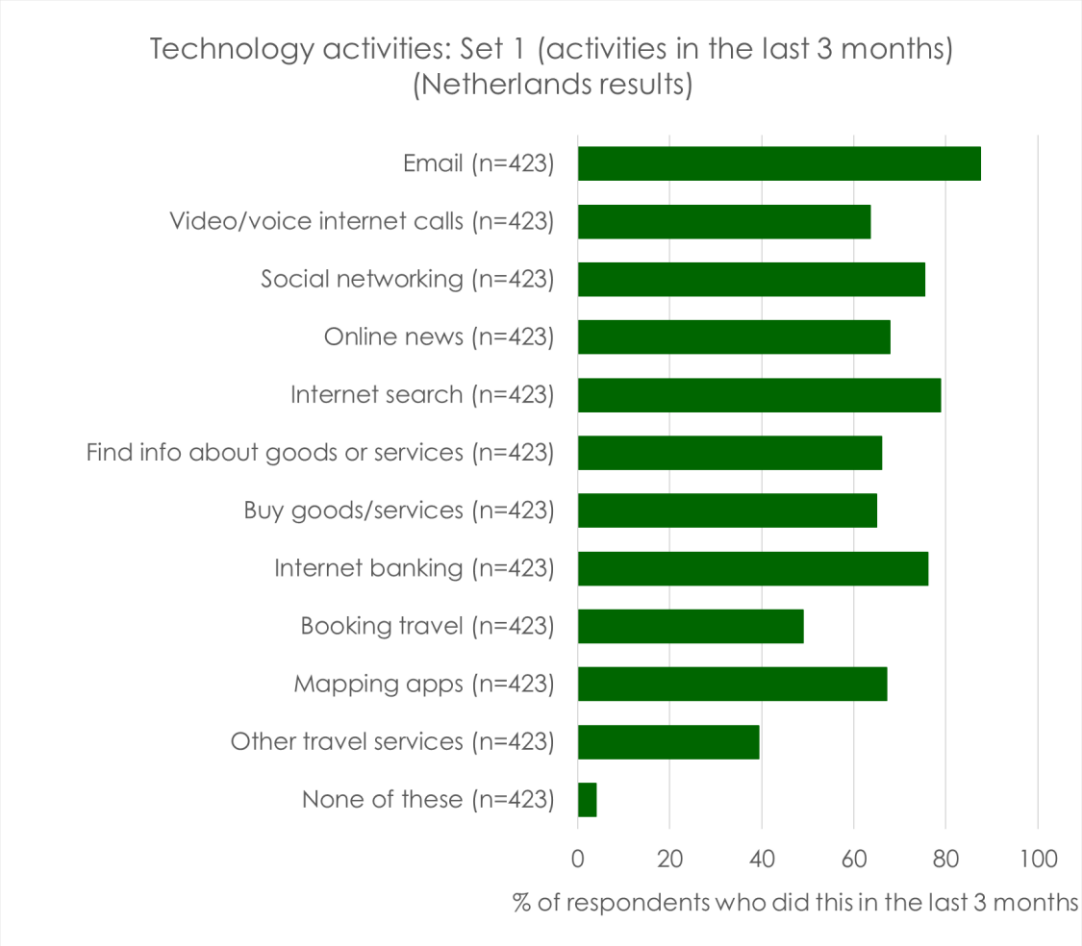

Figure 59: Technology activities: Set 1 (activities in the last 3 months) (Netherlands results)

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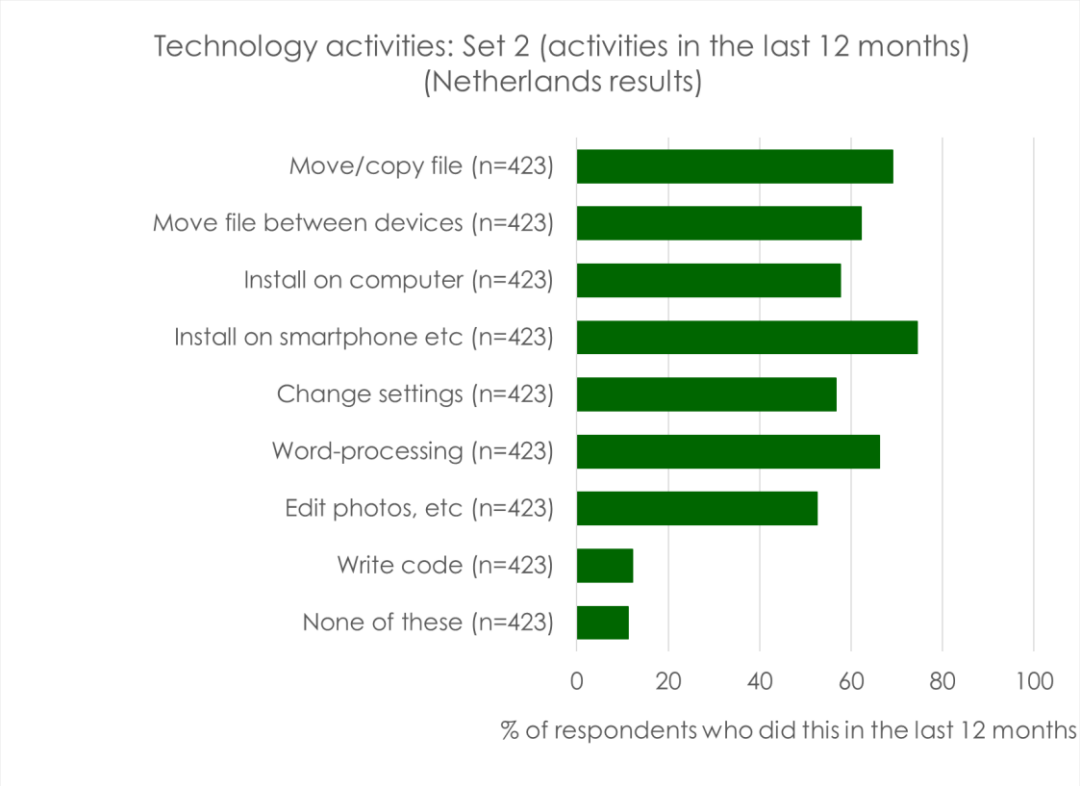

Figure 60: Technology activities: Set 2 (activities in the last 12 months) (Netherlands results)

4.7.4 Module C: Attitudes towards technology

Figure 61 presents headline figures from Module C. ATI and Willingness to Explore scores were calculated from the respondents' answers as described in Section 3.3.4, and were then categorised into Low, Medium and High as described in Section 4.1.

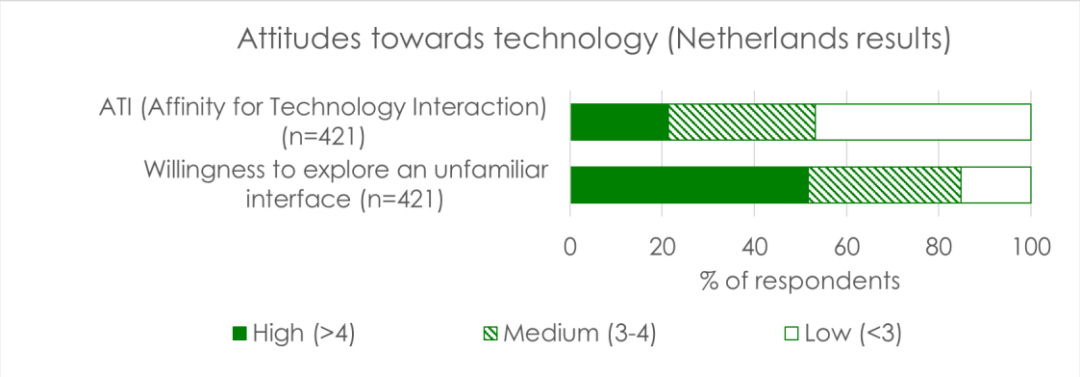

Figure 61: Attitudes towards technology (Netherlands results)

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4.7.5 Module D: Digital interface competence

This section presents headline figures from Module D (see Section 3.3.5 for details of this module). Figure 62 describes the proportion of respondents who did each individual interface test correctly. The total number of tests done correctly was then used to give an estimate of the respondents' overall basic digital interface competence, shown in Figure 63.

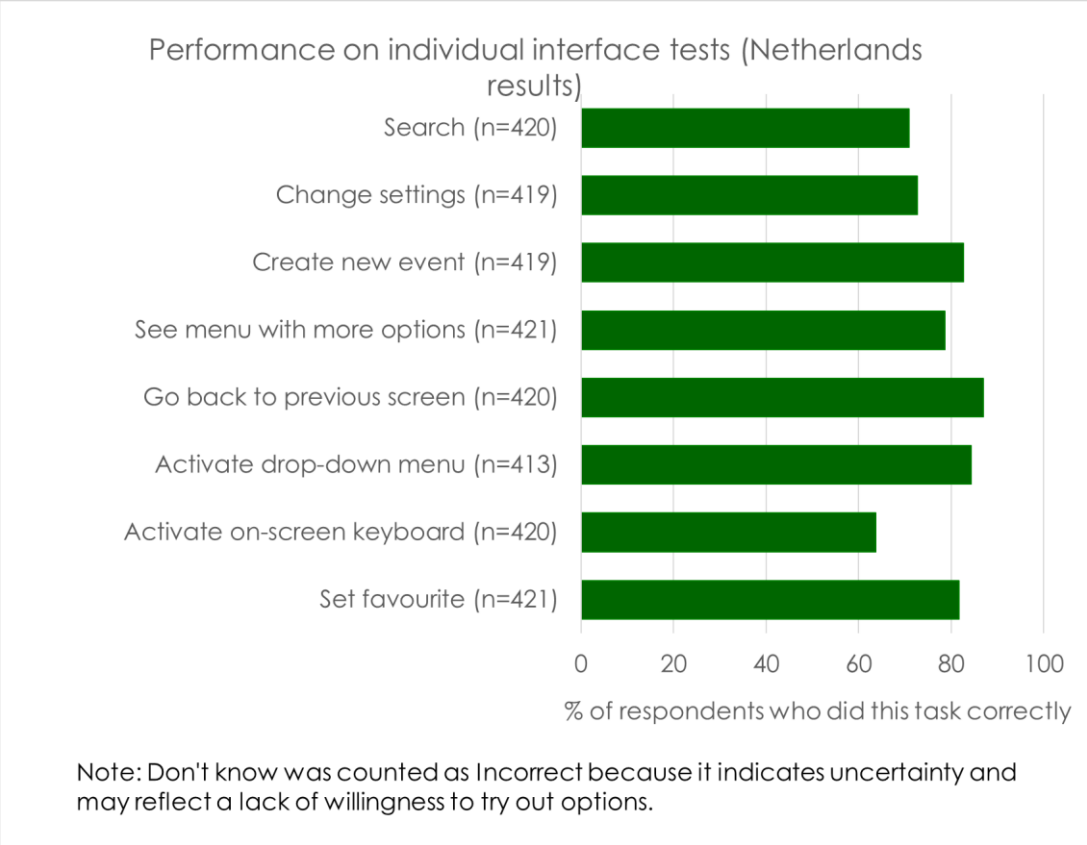

Figure 62: Performance on individual interface tests (Netherlands results)

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement N°875542.

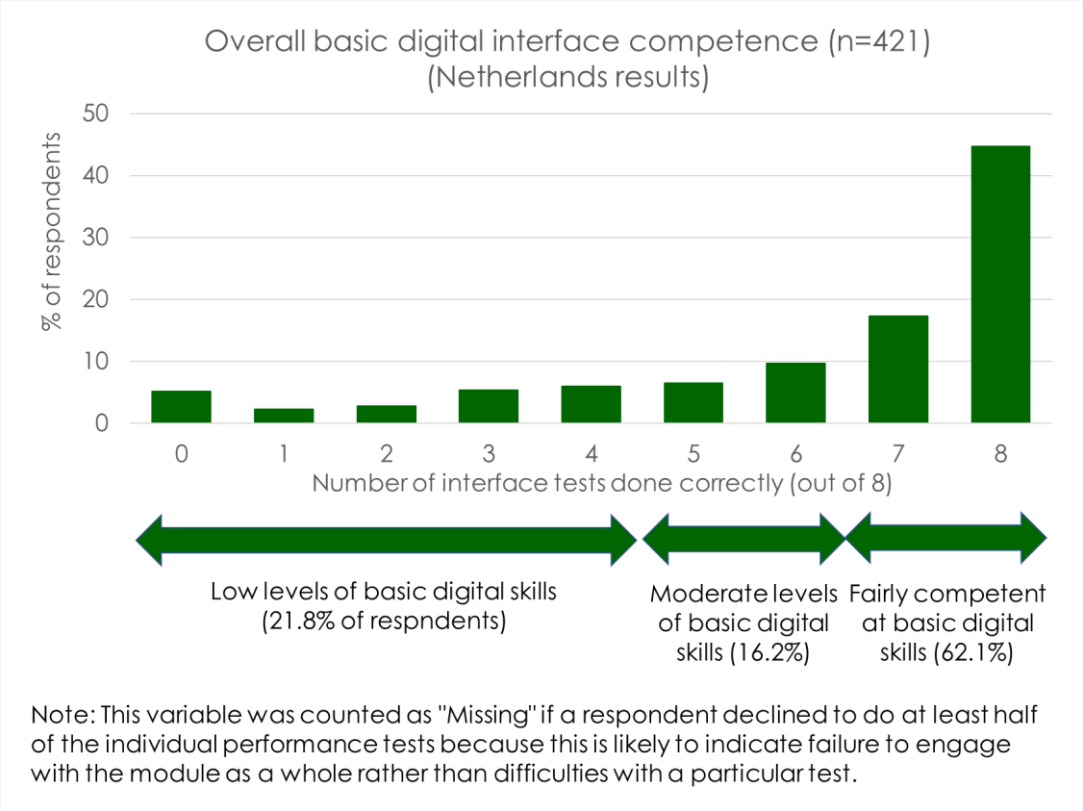

Figure 63: Overall basic digital interface competence (n=421) (Netherlands results)

4.7.6 Module E: Capabilities

This section presents headline figures from Module E (see Section 3.3.6 for details of this module). Figure 64 gives the results from the near comfort vision test, performed using a handheld LogMAR chart. There was a low response rate to this question in the Netherlands (only 329 out of 423 survey respondents answered this question). This was due to a delay in distributing this chart, resulting in the first batch of interviews missing out this question, as explained in Section 3.4.5.

Dexterity was then assessed by asking respondents how difficult they would find it to pick up a small object such as a safety pin. The results are shown in Figure 65. Finally, Figure 66 shows the proportions of respondents reporting being "somewhat limited" or "very limited" due to difficulties with various capabilities.

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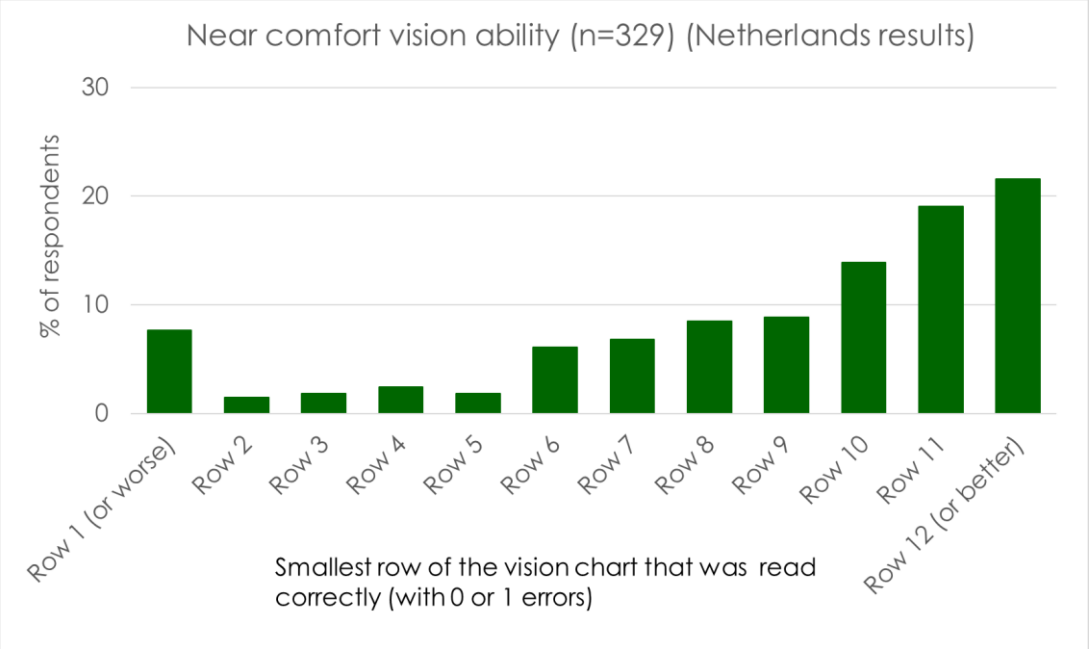

Figure 64: Near comfort vision ability (n=329) (Netherlands results)

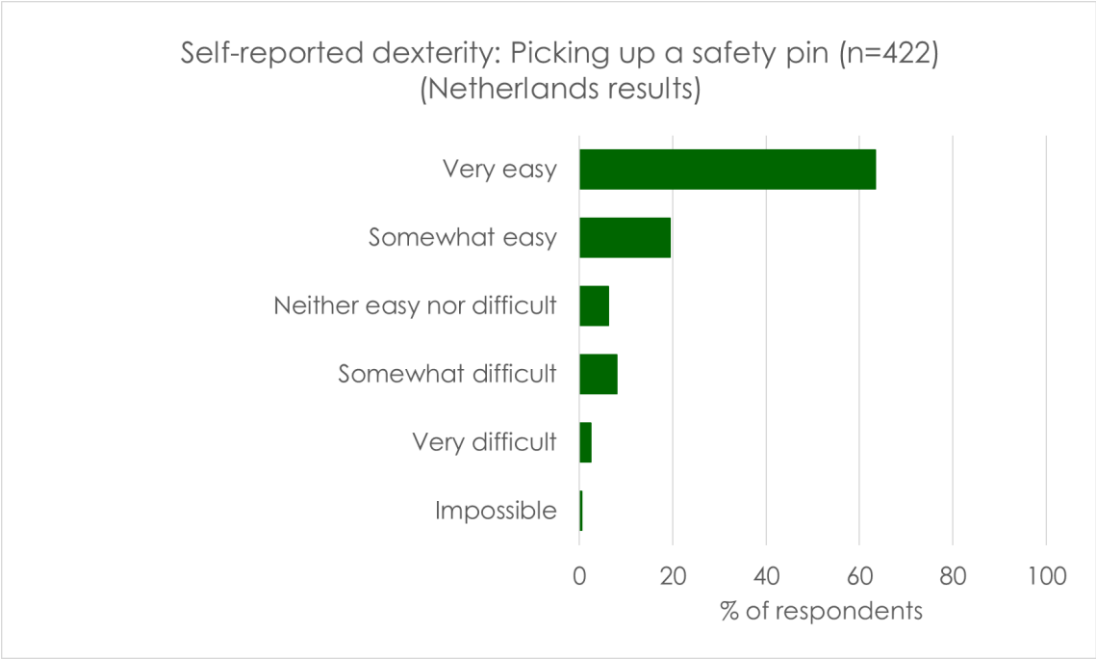

Figure 65: Self-reported dexterity: Picking up a safety pin (n=422) (Netherlands results)

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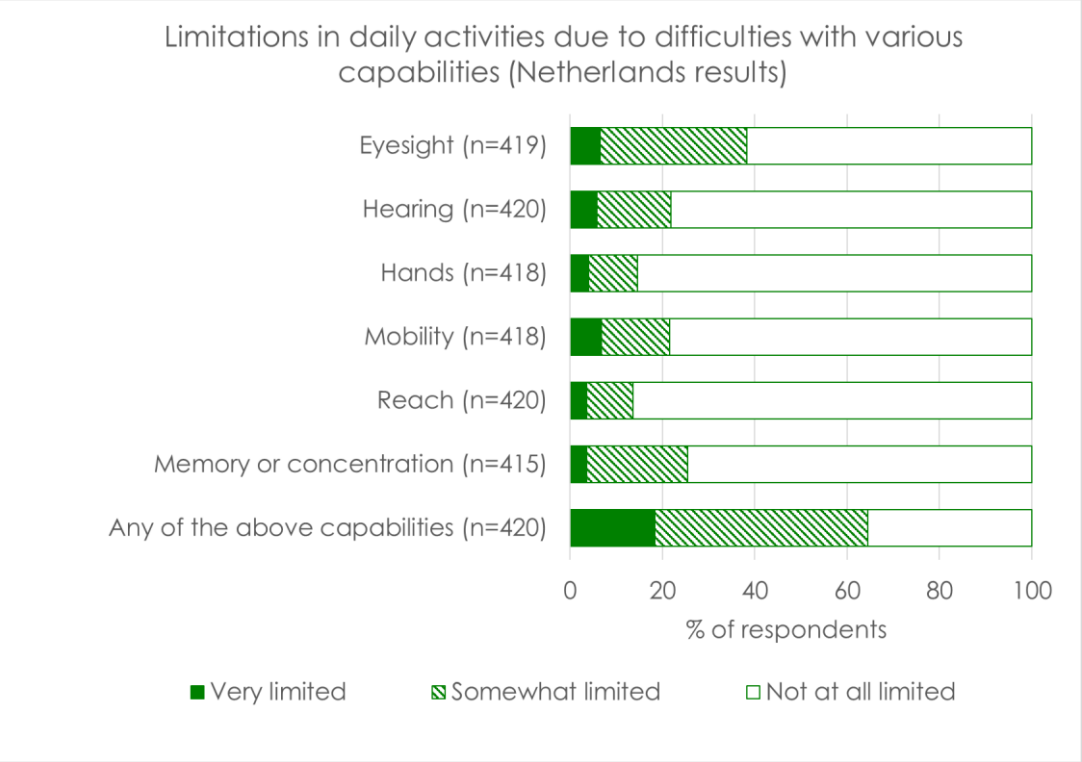

Figure 66: Limitations in daily activities due to difficulties with various capabilities (Netherlands results)

4.8 Discussion

The results show that substantial numbers of people in all the countries surveyed lack access to or do not use digital technology. The figures vary between countries, from 7.2% who lack internet access in Barcelona to 23.7% who lack it in Italy, and 6.8% who have never used the internet on a smartphone in the Netherlands to 20.6% who have never done so in Italy.

The differences between the survey results in different countries are large but care needs to be taken in comparing them directly due to differences in survey sampling, the time when they were conducted and cultural differences in how questions are interpreted (see Section 4.2). Nevertheless, all these figures represent substantial proportions of the population and thus large numbers of people who are potentially excluded from using mobility products and services that require technology access and use.

The results indicate that digital mobility services requiring the installation of a new app on a smartphone are likely to be particularly exclusionary. For example, this affects around 47% of the German sample. This is due to the large numbers of people who do not own a smartphone or who do own one but have not installed an app on it in the last 12 months (see FiguresFigure 10, Figure 23,Figure 36 and Figure 60). The latter situation is not an absolute barrier to them installing a new app, but it suggests a degree of inability or unwillingness to do so. Details of how exclusion can be estimated for different kinds of mobile services based on their

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technology access requirements, and figures for Germany can be found in (Bradley et al, 2021).

The survey results also show that substantial numbers of people have low levels of digital interface competence, ranging from 18.3% in Flanders to 33.2% in Italy. As before, caution is needed in comparing the results between countries. However, these figures in general indicate that there are large numbers of people who have access to technology but are still likely to struggle with using basic smartphone interfaces. These figures highlight the importance of designing interfaces so that they are easy to use and do not assume prior knowledge of commonly used technology symbols or interface patterns. To achieve this, it is important to develop and test these interfaces with a wide range of people from across the population.

The surveys also examined attitudes towards technology. Those with low affinity for technology interaction (ATI) range from 28.2% in Barcelona to 50.2% in Flanders. These people are likely to be more hesitant about using new technology and may have a tendency to avoid it (Franke et al, 2018). Greater efforts are likely to be needed to motivate this substantial segment (up to half) of the population to adopt a new technology, e.g., by explaining the personal benefits of using the technology. It may also be helpful to make new systems look and feel more familiar, e.g., by basing the interaction on interaction patterns that are already well established in older technology or in the non-digital world.

The surveys also examined how technology is currently used in travel (see Sections 4.3.2, 4.4.2, 4.5.2, 4.6.2 and 4.7.2). They found high levels of travel limitations: the proportions of those reporting being very limited in their travel[25] ranged from 26.5% in the Netherlands to 45.2% in Germany. Furthermore, substantial numbers of these respondents reported limitations because digital skills were needed to plan the travel or use the transport. This ties in with results that show that between 15.5% (in the Netherlands) and 45.1% (in Italy) of the sample did not select any digital means of finding out travel information.

The use of digital mobility services was even lower, with between 34.6% (in Flanders) and 87.1% (in Italy) never having used any of the services examined in the survey[26]. Over 50% in each of the countries surveyed had not used any of them in the last 3 months. These findings indicate that there is a long way to go before these services truly become mainstream, especially in Italy.

Finally, Module E of the survey questionnaire examined physical, sensory and cognitive capabilities. These results can be useful in determining what proportions of the population are likely to be able to interact with interface elements, e.g., see the text and graphics comfortably or activate small touchscreen controls reliably (Waller et al, 2010). It is important to recognise that the numbers of people with capability limitations are high, with between 10.1% (in Italy) and 18.4% (in the Netherlands) reporting being very limited in at least one capability[27] and between 37.2% (in Italy) and 68.1% (in Flanders) reporting being somewhat or very limited. It is also important to realise that people often experience limitations in more than

[25] This relates to regular travel within the region for any of the stated reasons (see Appendix A).
[26] The survey examined car sharing, car pooling, digital taxi services, on-street bike hire, scooter/motorbike hire and mobile phone parking payment.
[27] The survey asked about limitation in daily activities because of issues with one or more of the listed capabilities (vision, hearing, ability of the hands, mobility, reach, memory and concentration).

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one capability at the same time. For example, 36.3% of the German sample reported limitations because of more than one capability.

5. Differences between vulnerable to exclusion groups

Dignity Deliverable 1.1 (Hoeke et al, 2020) identified six groups that may be at higher risk of digital mobility exclusion, based on an examination of the literature. These groups may have a higher risk of being excluded from the use of digital mobility products or services because of a range of issues including a lack of access to the required technology, a lack of digital skills and specific mobility and travel requirements. This does not mean that all members of these groups are at higher risk, but that a greater proportion of them may experience digital mobility exclusion in some form.

A seventh group (Migrants) was later added to this list as it became clear that this group may also have some special requirements in terms of digital mobility services. The resultant seven groups are: Older people, Women, People with low levels of education, People with low levels of income, Inhabitants of rural areas, Migrants and People with disabilities.

The results from the DIGNITY surveys can help to inform the understanding of these groups, especially in regard to whether and how they are at risk of dignity mobility exclusion. It is outside the scope of this report to present a full analysis of how the survey results vary between these groups, and thus this deliverable presents just a few key results for a single dataset. The German dataset was chosen because it has the most robust set of subgroups (see Section 5.2). Future work could examine the subgroup results in different countries.

The choice of variables examined in this section is informed by an analysis that was conducted separately for the German survey looking at a wide range of variables (Goodman-Deane et al, 2021b; Goodman-Deane et al, 2022a). That analysis indicated that the same groups tended to have the lowest values on all the technology variables (technology access, use, attitudes and competence). As a result, the breakdown of variables by group is presented for just a few of the key technology variables to demonstrate the trends. These include frequency of internet use and frequency of internet use on a smartphone because these are essential parts of many digital mobility services. Basic digital interface competence is also included because it has a large influence on whether people can actually use digital systems in practice. In addition, results are presented for travel limitations because these exhibit some different features from the technology variables.

A full breakdown of the variables by group is given for the German survey in (Goodman-Deane et al, 2021b; Goodman-Deane et al, 2022a) and a breakdown of some of the variables for older people, women and those with low education in the Barcelona survey is given in (Roca et al, 2021).

5.1 Definitions of groups

The vulnerable to exclusion groups were defined in terms of the survey variables as follows.

Older people

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Older people were defined as those giving their age as 65 or more.

Women

Women were defined as those giving their gender as female.

People with low levels of education

The levels of education in each country were (approximately) matched to the International Standard Classification (ISCED) levels (Eurostat, undated). Levels matching ISCED levels 0-2 were defined as being "low levels of education". Table 10 lists the definitions used for each of the survey countries/regions. In all cases, the levels of foreign qualifications were not detailed and thus foreign qualifications were treated as missing data in determining whether someone had a low level of education.

Table 10: Education levels counted as "low education" for each country

Country/Region	Definition of low education levels
Germany	Secondary general school leaving certificate, Certificate of ten-grade school of general education in the former GDR and below.
Italy	Junior high school and below.
Barcelona	Compulsory education and below. Compulsory education includes primary education and the first four years of secondary education
Flanders	Lower secondary education (the first 3 years of secondary) and below. Secondary includes general, technical, artistic and vocational secondary education.
The Netherlands	Primary education, preparatory vocational secondary education and below.

People with low levels of income (or low social grade)

When the survey was created, it was still uncertain whether income, social grade or another variable would be used in the analysis. One consideration was that questions about income can be sensitive or difficult to answer and may result in a high non-response rate. For example, the German questionnaire asked about income directly and 38.9% of interviewees did not specify their own individual income and 9.7% did not specify their household income.

Therefore, the survey company and Dignity research team in each country was given flexibility in whether they examined income or social grade and how. The questions used in each country are described in Section 3.4. As a result, consistent low income or low social grade measures were not possible across the set of countries. Table 11 summarises what measures were created and the main limitations of these measures.

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Table 11: Low income and social grade measures for each country and their limitations

Country/Region	Low income or low social grade measure	Main limitations
Germany	Low income: An estimate was calculated using the interviewee's household income and a poverty line based on €1040 per month for a single-person household (Statistisches Bundesamt, 2021). The poverty line for multi-person households was calculated from this based on the OECD-modified household size (OECD, undated).	9.7% of the sample did not specify their household income leading to a lot of missing data on the low income variable.
Italy	Low social grade: Lower or Middle-Lower social grades, as assessed by the interviewer based on income and social-cultural level (see Section 3.4.2).	This may be subjective but is otherwise OK.
Barcelona	No low income or social grade variable is used. This is because the response categories for occupation (see Section 3.4.3) were too broad in terms of their match to social grade to allow for a reliable social grade measure to be produced. A measure involving both occupation and education was considered but this had a high number of "uncertain" cases and was very similar to the "low education" variable for those participants who were categorised. Researchers who are interested in income may wish to use the survey data on occupation in conjunction with data on the average income for different occupation categories (Institute of Statistics of Catalonia, undated).	No low income or social grade variable is used.
Flanders	Low income: interviewees were classified as having a low income if they found it difficult or very difficult to get by on their current income.	This may be subjective and only 24 people (5.7% of the sample) identified themselves as being in this category.
The Netherlands	Low social grade: An approximation was made based on occupation. "Roughly low social grade" includes Skilled, semi-skilled and unskilled labour, people with disabilities and full-time carers for those with disabilities, people with a state pension only and those who have been 6 or more months unemployed. "Higher social grade" including senior, medium and junior management, operational and executive staff (including trainees). Students and housewives/househusbands were counted as "Uncertain".	Using categorised occupation data can only give a rough approximation.

Inhabitants of rural areas

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The survey company and Dignity research team in each country was given flexibility in how they determined whether the interviewee lived in an urban or rural area. Thus, the definition of rural inhabitant varied between countries and was not reliable in some of the countries, as described in Table 12.

Table 12: Definitions of rural inhabitant used for each country

Country/Region	Definition of rural inhabitant
Germany	Those living in areas identified as a "rural distinct with some densification" or "sparsely populated rural district" according to the official classification from the Federal Office for Building and Regional Planning (BBR). However, this definition means that some people who are counted as rural may live in small towns.
Italy	Those living in communes (regions) with 2000 people or fewer. However, communes typically contain surrounding countryside as well as towns. Thus, it is likely that many people in larger communes actually live in a rural setting or location. This variable thus considerably underestimates rural inhabitants and so is not used in the analysis in this report.
Barcelona	N/A as the Barcelona Metropolitan Area is almost entirely urban.
Flanders	Those living in municipalities classified as rural. As with Germany, this may mean that some people classified as rural may live in small towns or vice-versa.
The Netherlands	Those who reported living in a rural area.

Migrants

Migrants were defined as those who did not have citizenship of the survey country at birth.

People with disabilities

People with disabilities were defined to be those who reported being "very limited" in their daily activities due to issues with their eyesight, hearing, hands, mobility, reach, memory or concentration. This includes those with temporary disabilities because these are likely to impact on current use of digital mobility services. The definition was chosen to include disabilities in the main areas that are likely to impact on digital mobility services. It does exclude some disabilities and thus has some limitations. It is also important to note that people with certain types of disabilities (especially cognitive) are less likely to take part in a survey and thus the numbers for these groups are likely to be underestimates. However, this serves to give a rough approximation of the situation. A self-reported measure looking at impact on daily life was used rather than an official measure in order to capture a wider range of those experiencing disability in practice.

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5.2 Group sizes in each survey sample

The sizes of the vulnerable to exclusion groups within each of the survey samples are shown in Table 13. Some of the groups were not calculated for particular countries as explained in Section 5.1 and the sizes of these groups are given in the table as N/A.

Table 13: Sizes of the vulnerable to exclusion groups in each survey

Group	Germany	Italy	Barcelona	Flanders	Netherlands
Whole sample	1010	1002	601	418	423
Older people	255	267	135	102	98
Women	515	519	312	211	214
People with low education	345	375	185	100	81
People with low income/People with low social grade	75	185	N/A	24	182
Rural inhabitants	286	N/A	N/A	205	78
Migrants	98	76	132	76	38
People with disabilities	160	99	89	71	77

As shown in Table 13, the German survey has subgroups that consistently contain at least 75 people. In contrast, all of the other countries/region have subgroups that are either missing or contain fewer than 40 participants. We have not calculated a minimum size on subgroups for analysis. However, in general, results from smaller samples have less power and are less generalizable. In addition, the German dataset is population-representative (see Section 3.2.1), meaning that subgroup analysis is more reliable. As a result, the German dataset was selected for the presentation of results in this section. Future work may examine the situation in the other countries because the experiences of some of these groups may be influenced by country-specific factors. However, a complete comparison of all the groups is likely to be less reliable than for Germany.

5.3 Results

The breakdown by group of frequency of internet use and frequency of internet use on a smartphone are shown in Figure 67 and Figure 68. These show that the lowest levels of usage are among older people and people with disabilities and (to a lesser extent) low education. The numbers of those who never use the technology are particularly low for internet use on a smartphone among older people and people with disabilities.

Figure 69 gives the breakdown by group of basic overall digital interface competence. Again, the lowest levels of digital interface competence are seen among older people, people with disabilities and (to a lesser extent) those with low education.

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Figure 70 shows how the reported levels of travel limitations vary between the different groups. As before, older people and people with disabilities report the highest levels of being "very limited" for any of the listed reasons. However, the low income group reports the second highest levels when being "slightly limited" is also included.

Figures Figure 71, Figure 72 and Figure 73 show the breakdown for some of the reasons for these travel limitations. These show that digital reasons particularly impact older people and those with disabilities. As might be expected, cost has the biggest impact on people with low income, and difficulties due to special needs or disabilities has the biggest impact on people with disabilities.

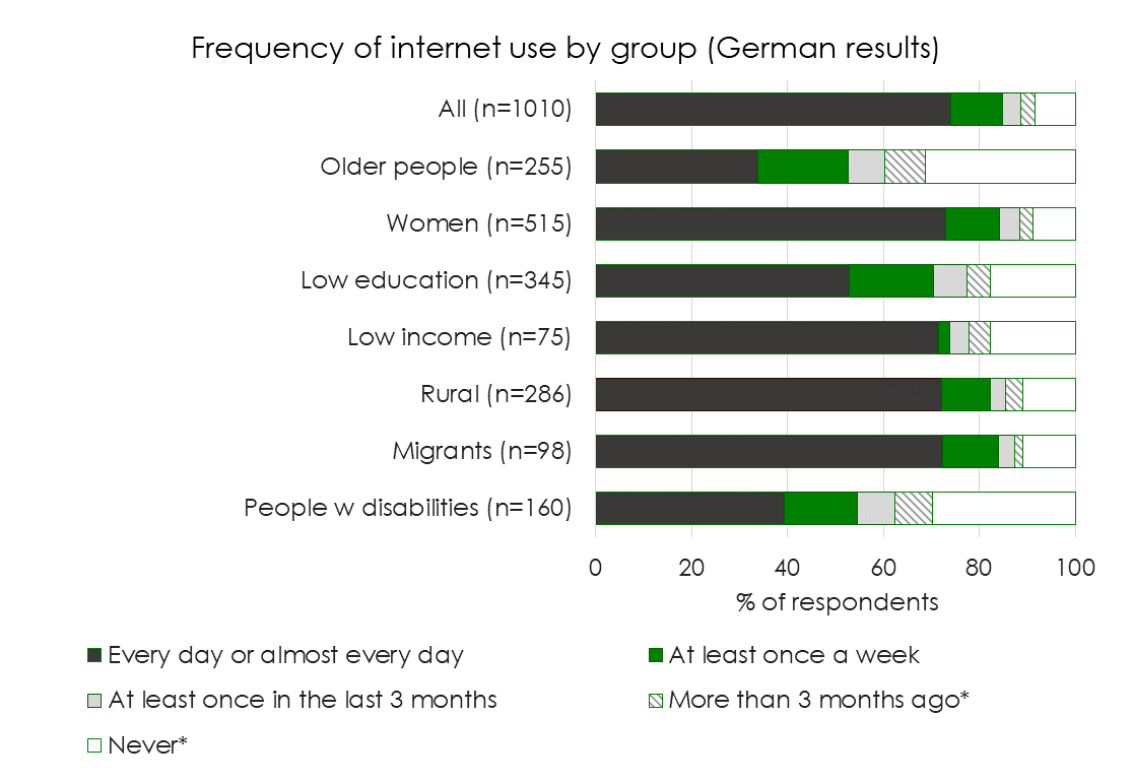

Figure 67: Frequency of internet use by group (German results)

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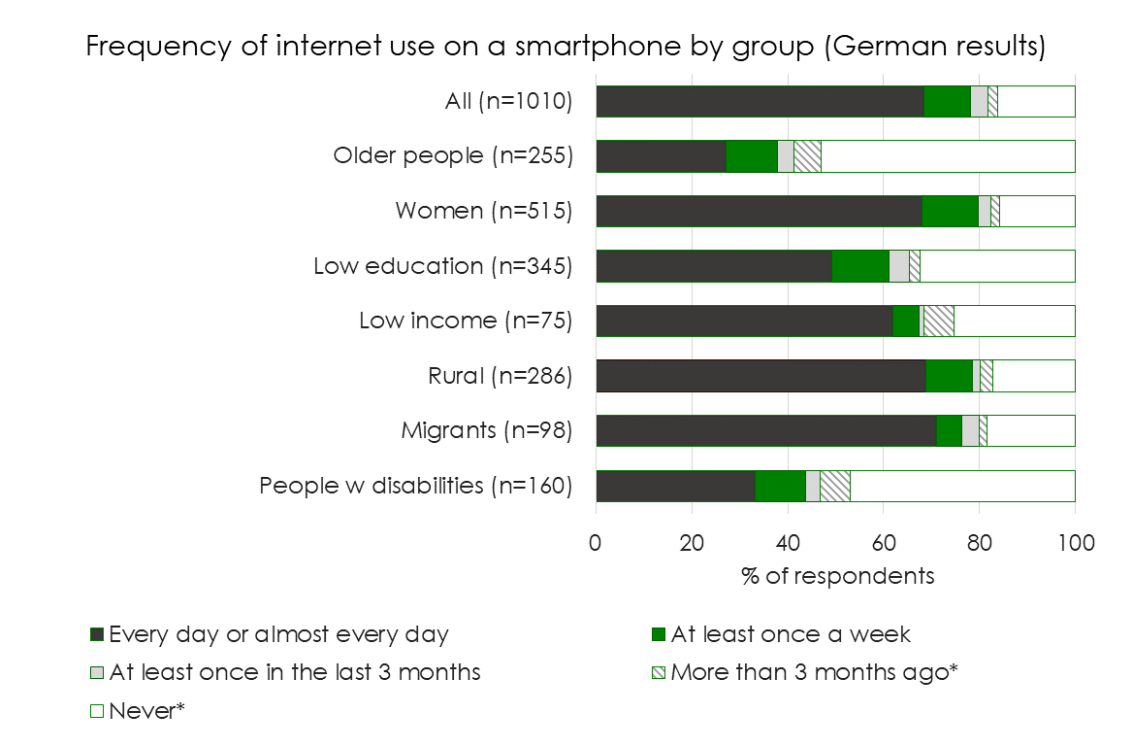

Figure 68: Frequency of internet use on a smartphone by group (German results)

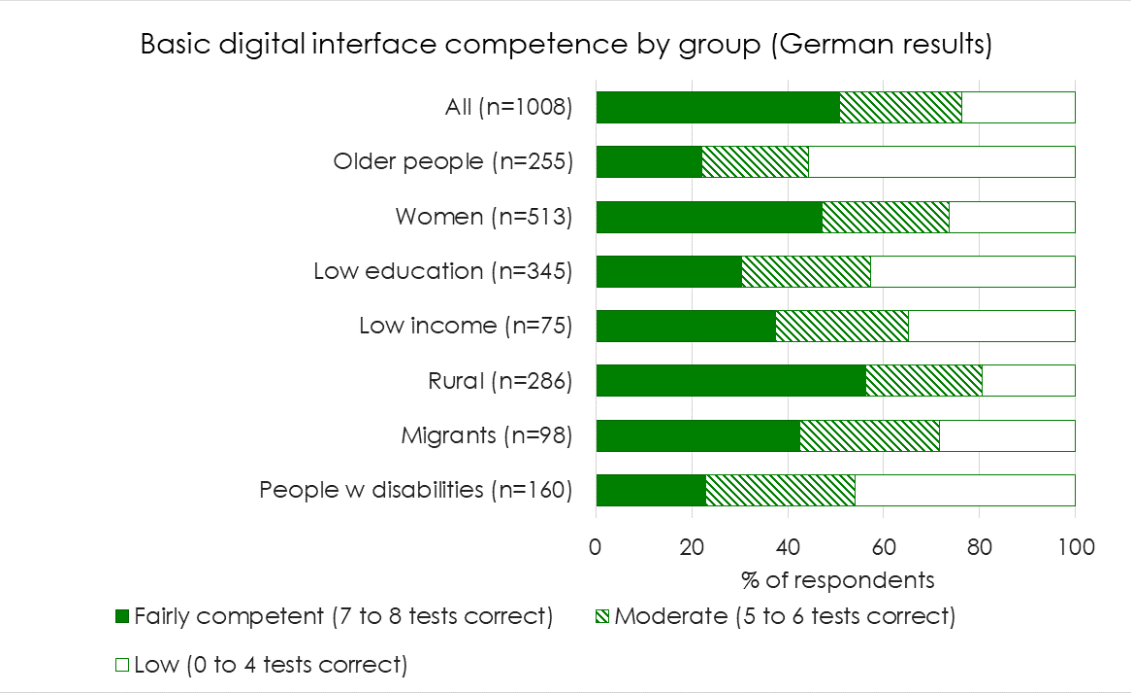

Figure 69: Basic digital interface competence by group (German results)

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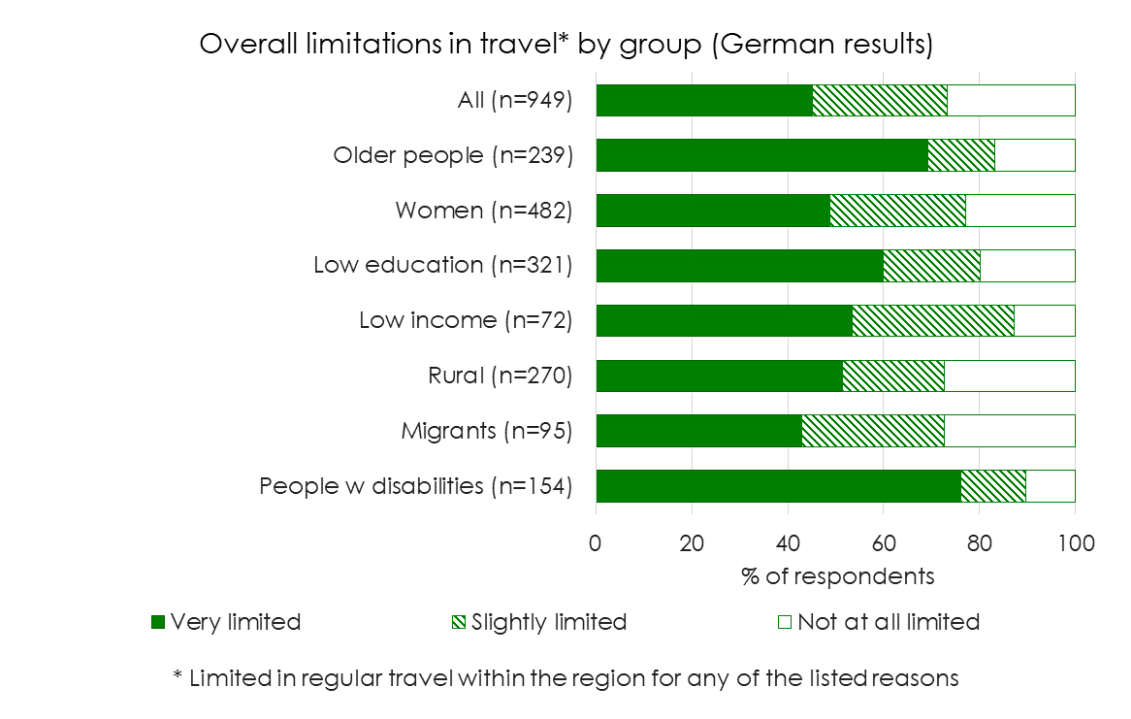

Figure 70: Overall limitations in travel by group (German results)

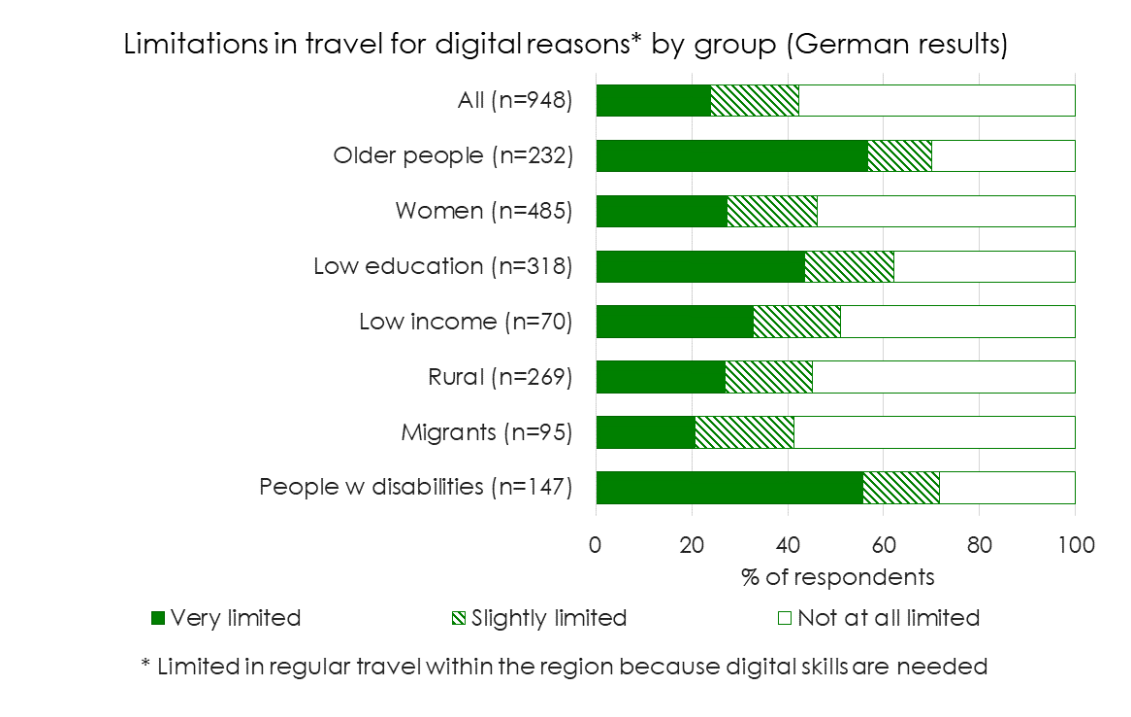

Figure 71: Limitations in travel for digital reasons by group (German results)

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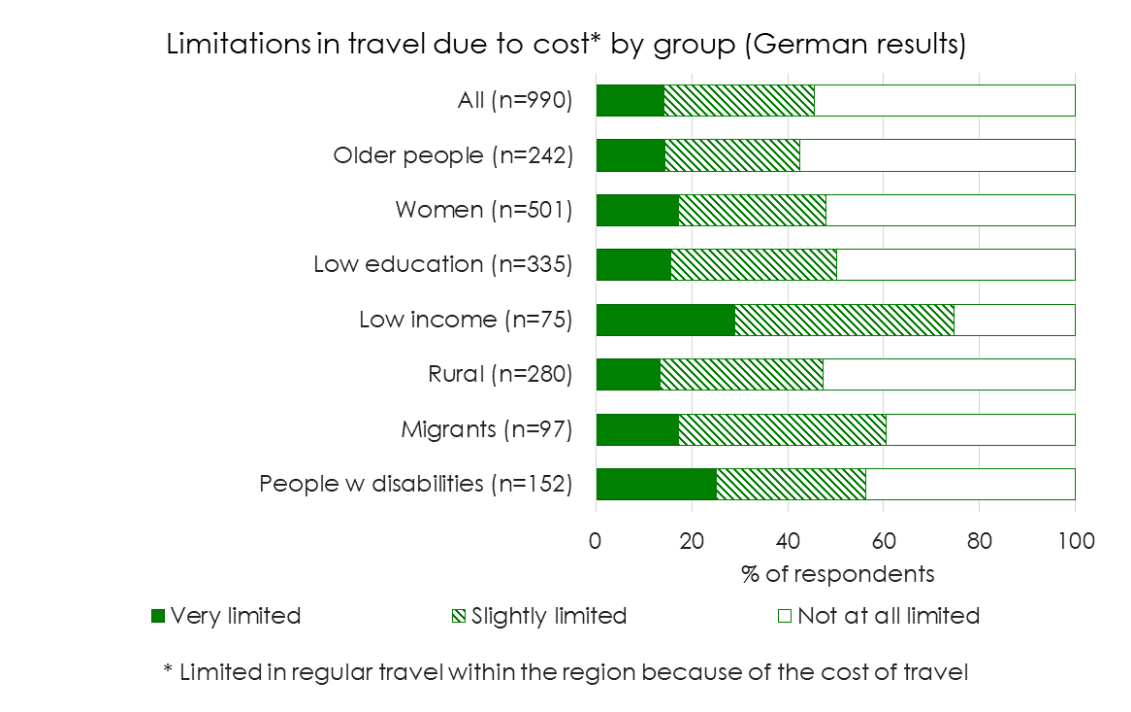

Figure 72: Limitations in travel due to cost by group (German results)

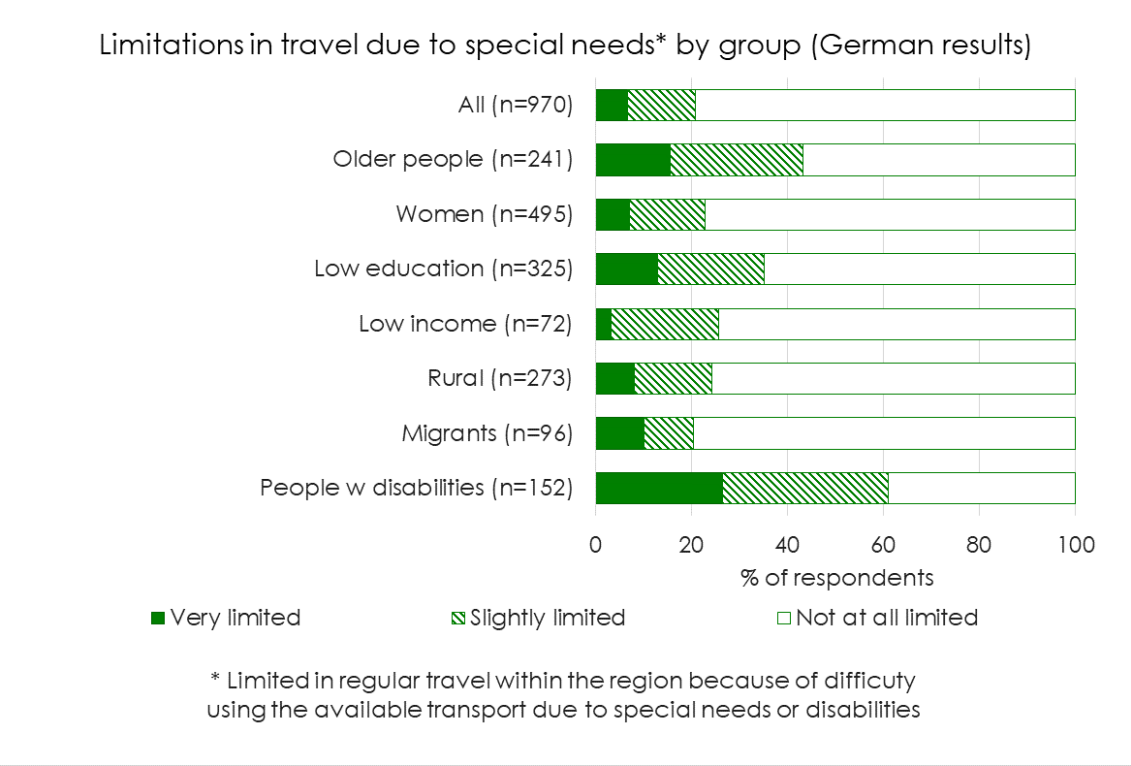

Figure 73: Limitations in travel due to special needs by group (German results)

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5.4 Discussion

This section has provided a breakdown of some key variables by group for the German sample. Further results including significance testing can be found in (Goodman-Deane et al, 2021b; Goodman-Deane et al, 2022a).

Overall, older people, those with disabilities and (to a lesser extent) those with low levels of education[28] had the lowest levels of technology variables, including digital technology access, use, competence and attitudes. It is important to remember that these groups are not mutually exclusive. In particular, there is a large overlap between older people and those with disabilities. For example, 67.8% of those reporting a disability in the German sample were aged 65 or over.

These same groups also experience the most travel limitations[29], with the addition of the group with low income, both in general and for reasons to do with digital skills[30]. As might be expected, the low income group experienced the most limitations in their travel due to cost, and people with disabilities experienced the most limitations because of difficulty using the transport due to special needs or disabilities.

These results highlight the extra importance of inclusive design when designing for older people, those with disabilities and those with low education. This is also vitally important when designing systems for a wider population that includes a significant number from these groups (e.g., the general public). These groups contain large numbers that lack access to or rarely/never use key examples of digital technology, especially smartphones. In addition, around half of these groups (in the German sample) had low digital interface competence and are thus likely to struggle on many modern digital interfaces, particularly on a smartphone.

It is also sobering to realise that these are the same groups experiencing the highest levels of mobility poverty. This presents a key challenge to develop more inclusive mobility systems and not inadvertently further exclude these vulnerable groups in the move to digitalisation.

6. Conclusions and further work

This deliverable includes a questionnaire that can be used to gather data on key user factors that affect digital mobility exclusion. This questionnaire was used in five European regions and countries to provide an indication of how these factors are spread across the population. However, this is a fast-changing field, and it is important to continue to update the knowledge in this area in response to changes in digital technology, mobility services and users' familiarity with technology. We hope that the questionnaire can be updated and continue to be used to gather valuable information.

This deliverable presents general results from the surveys in each of the survey countries and regions. The results indicate that substantial numbers of people in all the countries surveyed lack access to or do not use digital technology. Furthermore, large numbers, even among

[28] See Section 5.1 for definitions of the groups.
[29] Limitations in regular travel within the region
[30] Because digital skills are needed to either plan travel or use the transport

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those with technology access, have low levels of basic digital interface competence, indicating that they are likely to struggle with using basic smartphone interfaces.

The use of digital mobility services such as car sharing, digital taxi services and mobile phone parking payment was low, especially in Italy where 87% had never used any of the digital mobility services examined in the survey. There were also high levels of travel limitations, including substantial numbers of people who reported limitations because digital skills were needed to plan the travel or use the transport.

Examining different subgroups of the population, initial results from the German survey indicate that older people, those with disabilities and (to a lesser extent) those with low levels of education had the lowest levels of technology variables, including digital technology access, use, competence and attitudes. These same groups also experience the most travel limitations, both in general and for reasons to do with digital skills.

This deliverable has presented only an initial description and analysis of the survey results. Further exploration and analysis of the data will be undertaken by members of the DIGNITY consortium. The full datasets will also be made available open access on the UPCommons repository (Universitat Politècnica de Catalunya, undated) for other researchers who would like to explore the data further[31].

In particular, cross-country comparisons have not been presented in this deliverable due to the extra care needed when comparing datasets from surveys with different sampling methods and sizes (see Section 4.2). Further work could examine this in more detail, seeking to understand some of the differences between countries in terms of digital mobility exclusion.

Similarly, a breakdown of the results for different subgroups was only presented for Germany. Further work could expand this exploration to the other survey countries to see whether similar patterns exist in the other countries and whether there are country-specific issues for some of the subgroups.

In addition, the team at the University of Cambridge are using the data from the DIGNITY surveys to further develop the exclusion audit method that estimates how many and what types of people are likely to be excluded from a particular product or service. The existing Cambridge Exclusion Calculator (Waller et al, 2010; Engineering Design Centre, undated) examines non-digital products and services. The data from the DIGNITY surveys provides a rich resource to extend this into the digital world taking into account key factors that impact on the successful use of digital products and services. Some initial work on this has already been done estimating the exclusion associated with technology access (see Section 4.8; Bradley et al, 2021; Nesterova et al, 2021). Future work will extend this to cover aspects to do with technology competence and attitudes towards technology.

Another promising area for future work is the development of personas based on a cluster analysis of the datasets. This has already been done for the earlier UK survey (Engineering Design Centre, 2020; Goodman-Deane et al, 2021c). Using a population-representative dataset ensures that the resultant personas represent the whole breadth of the population

[31] The full dataset for the German survey is already available open access on the UPCommons repository (Goodman-Deane et al, 2022b) and the datasets for the other DIGNITY surveys will be available open access from there by the end of the DIGNITY project (end 2022).

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and enables figures to be attached to each persona to indicate how many people in the population it represents. The persona sets can help stakeholders to understand and consider the different types of groups that need to be considered in the development of digital mobility services.

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Appendix 1: English version of the questionnaire

Notes for the interviewer and instructions for questionnaire routing are included in red italics. For example, some questions were only asked if the interviewee responded in a particular way on previous questions. Note that the routing was usually coded into the CAPI (computer assisted personal interviewing programme) not implemented directly by the interviewer.
Some notes on how the questionnaire was translated and adapted for different countries are included in blue italics.

A. Technology access and use

1. Do you have access to a **computer** (laptop or desktop) in **any** location (home, work or any other place)?
   Interviewer note: this question is specifically about laptops and desktop. Smartphones and tablets are covered later
   - ☐ Yes
   - ☐ No
   - ☐ Don't know

2a. *Only ask if No to q1*

Have you ever used a **computer**?

- ☐ Yes
- ☐ No
- ☐ Don't know

2. *Only ask if Yes to q1 OR Yes to q2a (either has access to a computer or has ever used a computer)*
   In the last 3 months, how often (on average) have you used a **computer**? Please include use in any location (home, work or any other place). *Interviewer: Ask participant to look at Showcard A*
   - ☐ Every day or almost every day
   - ☐ At least once a week
   - ☐ Less than once a week but at least once in the last 3 months
   - ☐ I last did this more than 3 months ago
   - ☐ I have never done this
   - ☐ Don't know

3. Do you have access to the **internet** in **any** location (by any device)? Please include access on a computer, tablet and smartphone.
   - ☐ Yes
   - ☐ No
   - ☐ Don't know

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4a. *Only ask if No to q3*

Have you ever used the internet?

- ☐ Yes
- ☐ No
- ☐ Don't know

4. *Only ask if Yes to q3 OR Yes to q4a (either has access to internet or has ever used the internet)*
In the last 3 months, how often (on average) have you used the **internet**? Please include use in any location (home, work or any other place), and on any device. *Interviewer: Ask participant to look at Showcard A*
   - ☐ Every day or almost every day
   - ☐ At least once a week
   - ☐ Less than once a week but at least once in the last 3 months
   - ☐ I last did this more than 3 months ago
   - ☐ I have never done this
   - ☐ Don't know

5. Do you own a **smartphone**? A smartphone is a mobile phone with a touchscreen that can access the Internet and run downloaded programmes (apps).
   - ☐ Yes
   - ☐ No
   - ☐ Don't know

6. *Only ask if respondent owns a smartphone (Yes to q5)*
In this question, if you own more than one smartphone, please answer about the smartphone that you use the most. What kind of smartphone do you own? You can check your phone to help answer this if you like.
If the participant does not know, ask: Is it OK if I have a look at your phone to help answer this question? *Interviewer then codes the answer if it is obvious from a quick look at the phone. Otherwise, choose "Don't know".*
Translation note: The names of the operating systems may vary between countries
   - ☐ iOS (e.g. iPhone)
   - ☐ Android
   - ☐ Windows
   - ☐ Other
   - ☐ Don't know

   Roughly, how old is your smartphone? If you received the phone second-hand, please try to estimate how old you think it is overall.
   - ☐ Less than 1 year
   - ☐ 1-2 years
   - ☐ 3-4 years
   - ☐ More than 4 years
   - ☐ Don't know

   Is it OK if I measure the screen on your smartphone?
   If yes, turn the screen on so you can see it clearly. Then measure the screen (NOT THE WHOLE PHONE) from one corner to the opposite corner (across the diagonal) with the ruler provided.

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The interviewee may have to do this themselves if social distancing is required. If so, please check that they are measuring just the screen.
Interviewer note: If you are conducting an in-home interview and the participant cannot find or access their smartphone, then code this under "Didn't have their smartphone with them"

- ☐ Length of diagonal (in cm) _____cm
- ☐ Prefer not to answer
- ☐ Didn't have their smartphone with them

7a. *Only ask if No to q5 (participant does not own a smartphone)*

Have you ever used a smartphone?

- ☐ Yes
- ☐ No
- ☐ Don't know

7. *Only ask if Yes to q5 OR Yes to q7a (owns a smartphone or has ever used a smartphone)*
In the last 3 months, how often (on average) have you used a **smartphone**? *Interviewer: Ask participant to look at Showcard A*

- ☐ Every day or almost every day
- ☐ At least once a week
- ☐ Less than once a week but at least once in the last 3 months
- ☐ I last did this more than 3 months ago
- ☐ I have never done this
- ☐ Don't know

8. *Only ask if Yes to q5 OR Yes to q7a (owns a smartphone or has ever used a smartphone) AND participant has ever used a smartphone (i.e. in addition, exclude people who answer NEVER to q7)*
In the last 3 months, how often (on average) have you used a **smartphone to access the internet**? Please include the use of apps that use the internet (e.g. Facebook, e-mail) as well as internet browsers. *Interviewer: Ask participant to look at Showcard A*

- ☐ Every day or almost every day
- ☐ At least once a week
- ☐ Less than once a week but at least once in the last 3 months
- ☐ I last did this more than 3 months ago
- ☐ I have never done this
- ☐ Don't know

9a. Do you own a **mobile phone that is not a smartphone**?

- ☐ Yes
- ☐ No
- ☐ Don't know

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9. *Only ask if respondent has a mobile phone (Yes to q9a)*
In the last 3 months, how often (on average) have you used a **mobile phone that is not a smartphone**? *Interviewer: Ask participant to look at Showcard A*
   - ☐ Every day or almost every day
   - ☐ At least once a week
   - ☐ Less than once a week but at least once in the last 3 months
   - ☐ I last did this more than 3 months ago
   - ☐ I have never done this
   - ☐ Don't know

10. Do you have access to a **tablet device**? This is a small portable computer that uses a touchscreen but is not a smartphone. This includes ebook readers. This card shows some examples. *Show showcard B with photos of tablet devices*
   - ☐ Yes
   - ☐ No
   - ☐ Don't know

11. *Only ask if respondent has access to a tablet (Yes to q10)*
What kind of tablet(s) do you have access to? You can choose more than one answer.
Translation note: the names of tablets may vary between countries
   - ☐ iPad
   - ☐ Android
   - ☐ Windows
   - ☐ Amazon tablet on which you can install and run apps (e.g. Amazon Fire)
   - ☐ An eReader (A tablet device on which you can read ebooks but not install apps)
   - ☐ Other. Please specify _____
   - ☐ Don't know

12a. *Only ask if No to q10*

Have you ever used a tablet device?
   - ☐ Yes
   - ☐ No
   - ☐ Don't know

12. *Only ask if Yes to q10 OR a12a (has access to a tablet OR ever used a tablet)*
In the last 3 months, how often (on average) have you used a **tablet device**? *Interviewer: Ask participant to look at Showcard A*
   - ☐ Every day or almost every day
   - ☐ At least once a week
   - ☐ Less than once a week but at least once in the last 3 months
   - ☐ I last did this more than 3 months ago
   - ☐ I have never done this
   - ☐ Don't know

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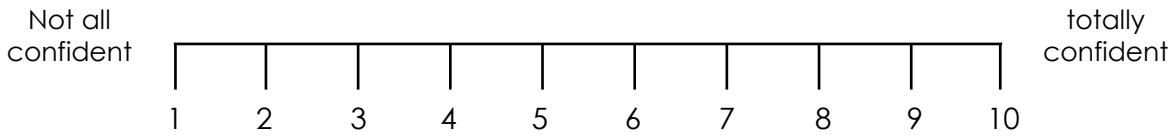
B1. Technology for public transport

We would like to know how confident you are in doing certain activities. For the following questions, please rate how confident you are that you have the capability to do the tasks alone and unaided.

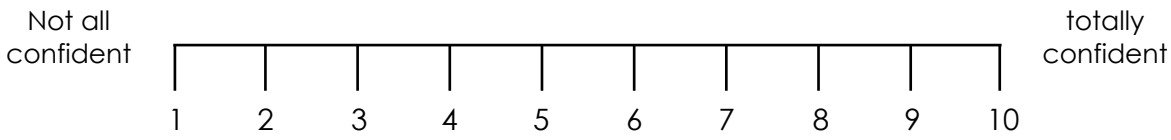
1. *Notes to interviewer: If participant does not normally have access to a computer, ask them to imagine that they have been presented with whatever computer they prefer to do the task alone and unaided. If the participant is only confident about using one particular computer or application then they should rate their confidence using that one.*

By using a computer, how confident are you that you can successfully plan an unfamiliar, local public transport journey? *Interviewer: Ask participant to look at Showcard C*



2. *Notes to interviewer: If participant does not normally have access to a smartphone, ask them to imagine that they have been presented with whatever type of smartphone they prefer to do the task alone and unaided. If the participant is only confident about using one particular smartphone or application then they should rate their confidence using that one*

By using the internet or application on your smartphone, how confident are you that you can successfully plan an unfamiliar, local public transport journey? *Interviewer: Ask participant to look at Showcard C*



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We would now like to know about what you actually do in practice.

3. What do you use to find out information about your travel, e.g. schedules, routes, cancellations, congestion?
   Translation note: Examples of services may vary between countries.
   Select up to 3 responses
   - ☐ I do not look up this information because I already know it and do not expect any additional issues
   - ☐ I do not look up this information because I do not know where to find it
   - ☐ Word-of-mouth
   - ☐ My own paper copies of information such as timetables and route maps
   - ☐ Information at a public transport stop or station
   - ☐ The website or app of the transport operator or service
   - ☐ The social networks (e.g. Twitter) of the transport operator or service
   - ☐ Other users' social networks (e.g. Twitter) who are reporting incidents
   - ☐ A search engine (e.g. Google)
   - ☐ Navigation apps (e.g. Google maps, Citymapper)
   - ☐ Other websites or apps (e.g. Moovit, National Rail Enquiries). Please specify_____
   - ☐ Radio/TV
   - ☐ Other: Please specify_____

4. How often do you use the following digital transport services?
   Translation note: The examples of services may vary between countries
   Interviewer: Ask participant to look at Showcard D for response options in each case

	Every day or almost every day	At least once a week	At least once a month	At least once in the last 3 months	More than 3 months ago	Never	Don't know
Car sharing (on-street car hire via the internet or an app) (e.g. Bluemove, Zipcar)							
Carpooling (sharing car journeys so that multiple people travel in the same vehicle) (e.g. BlaBlaCar, LiftShare)							
Taxi services that are booked digitally (e.g. Cabify, Uber)							
On-street bike hire (e.g. nextbike, Bicing)							
On-street scooter or motorbike hire (e.g. Yego, Lime)							
Using a mobile phone to pay at a parking meter							

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5. Have you used any other digital transport services at least once in the last 3 months?
   - ☐ Yes
   - ☐ No

   If yes, please specify: _____

   For each service mentioned, ask:
   How often do you use that service:
   - ☐ Every day or almost every day
   - ☐ At least once a week
   - ☐ At least once a month
   - ☐ At least once in the last 3 months

6. Thinking about your regular travel within this region: to what extent do you feel limited in your travel by the following aspects? In this question, we define "limited" as wanting to travel more but feeling unable to.
   Interviewer: Ask participant to look at Showcard D2

	Not at all limited	Slightly limited	Very limited
The cost of the travel			
Limited availability of transport services (e.g. bus, trains or shared vehicles)			
Limited availability of infrastructure (e.g. bus stops or bike lanes)			
Concerns about the safety of the transport services			
Difficulty using the available transport due to special needs or disabilities			
Difficulty planning travel before a trip because digital skills are required to do so (e.g. to look up information or buy a ticket)			
Difficulty during trips because digital skills are needed to use the transport (e.g. to unlock a rented bike or show a digital ticket)			

Do you feel limited because of any other reasons? If so, please specify: _____

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B2. General computer and mobile device activities

We would now like to know, more generally, about the kinds of activities you have carried out on computers and mobile devices.

Note to interviewer: If participant asks if doing these activities with assistance counts, then say Yes.

1. *Do not ask if (EITHER Never OR "More than 3 months ago" to A2 OR No/Don't know to A2a) (computer use)*
   AND (EITHER Never OR "More than 3 months ago" to A7 OR No/Don't know to A7a) (smartphone use)
   AND (EITHER Never OR "More than 3 months ago" to A12 OR No/Don't know to A12a) (tablet use)
   Do ask if they have used one of these (e.g. tablet) even if they have not used the others
   Translation note: Examples of technology (e.g. Citymapper, Snapchat) may vary between countries. However, Facebook, Twitter and Instagram stay in the same in all countries

   In the last **3 months**, which of the following activities have you carried out for personal use? Please include doing them on any device (e.g. computer, tablet or smartphone). Tick all that apply.

   - ☐ Sending and/or receiving emails
   - ☐ Making video or voice calls over the internet (e.g. Skype, FaceTime)
   - ☐ Using Facebook
   - ☐ Using Twitter
   - ☐ Using Instagram
   - ☐ Other social networking (e.g. Snapchat, LinkedIn)
   - ☐ Reading online news sites, newspapers or news magazines
   - ☐ Searching for information on the internet
   - ☐ Finding information about goods or services on the internet
   - ☐ Buying or ordering goods or services on the internet (This could be via an internet browser or on an app)
   - ☐ Internet banking
   - ☐ Booking travel on the internet, e.g. tickets or accommodation
   - ☐ Using a mapping application, e.g. Google maps, Citymapper
   - ☐ Using other internet services related to travel
   - ☐ None
   - ☐ Don't know

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2. *Do not ask if (EITHER Never to A2 OR No/Don't know to A2a) (computer use)*
   AND (EITHER Never to A7 OR No/Don't know to A7a) (smartphone use)
   AND (EITHER Never to A12 OR No/Don't know to A12a) (tablet use)
   Do ask if they have used one of these (e.g. tablet) even if they have not used the others
   Thinking about the last **12 months** (note the longer time period), which of the following activities have you carried out? Include **both** personal and work use. Tick all that apply.
   - ☐ Copying or moving a file or folder on a computer or mobile device
   - ☐ Transferring files between computers and other devices such as a camera or smartphone
   - ☐ Installing software or applications on a computer
   - ☐ Installing an app on a **tablet** or **smartphone**
   - ☐ Changing the settings of any software, including apps (e.g. changing the standard font size, or changing your home location on a mapping app)
   - ☐ Using word-processing software (e.g. Microsoft Word)
   - ☐ Using software to edit photos, videos or audio files
   - ☐ Writing computer code using a programming language
   - ☐ None
   - ☐ Don't know

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C1. Attitudes towards technology (part 1)

In the following set of questions, we will ask you about your interaction with technical systems. The term "technical systems" refers to apps and other software applications, as well as entire digital devices (e.g., smartphone, mobile phone, computer, TV, car navigation system).

Interviewer note: ask participant to look at Showcard E and answer using the appropriate letter code, i.e. "a / b / c / d / e / f", rather than 'completely disagree / completely agree' etc.

Please indicate the degree to which you agree/disagree with the following statements.	a. completely disagree	b. largely disagree	c. slightly disagree	d. slightly agree	e. largely agree	f. completely agree
1. I like to occupy myself in greater detail with technical systems.						
2. I like to try out the functions of new technical systems.						
3. I predominately deal with technical systems because I have to.						
4. When I have a new technical system in front of me, I try it out intensively.						
5. I enjoy spending time becoming acquainted with a new technical system.						
6. It is enough for me that a technical system works; I don't care how or why.						
7. I try to understand how a technical system exactly works.						
8. It is enough for me to know the basic functions of a technical system.						
9. I try to make full use of the capabilities of a technical system.						

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D. Technology symbols and interfaces

I am going to show you some pictures of smartphones with different apps and webpages on them. I will ask you what you would do to achieve certain things on the phone. The things that I'm asking you to do might require a sequence of steps in order to complete fully, but here we are only interested in **the first thing** that you would do to try and achieve the goal. You can have a try even if you have not used a smartphone before, and it is also fine to say "I don't know".

Note to interviewer: In the following questions, DO NOT show the options to the participants. Instead, the participant indicates what they would do by pointing to parts of the showcard and describing out loud what they are doing. Please encourage them to do this unless they say they don't know. Try to see what they actually do on the card if possible, and code this in preference to what they say. If you can't see where they touch in sufficient detail, then use what they say to help you. Then code the response into the options given. You can repeat the question if the respondent doesn't seem to understand.

Show showcard F. Here is a picture of a smartphone with a screen from a calendar app on it.

1. What would you do to search for a particular event in the calendar?
   Please indicate on the picture the first thing that you would do to try and achieve this.
   Please also describe out loud what you are doing as I may not be able to see it clearly.
   Code response (DO NOT SHOW these options to the participant)
   - ☐ Tapped on 
   - ☐ Tapped on 
   - ☐ Scrolled (placed finger on screen and moved it up/ down or left/right)
   - ☐ Something else
   - ☐ Said "I don't know"
   - ☐ Prefer not to answer
2. What would you do to change the settings, such as the colours used in the calendar?
   Please indicate on the picture the first thing that you would do to try and achieve this
   Please also describe out loud what you are doing.
   Code response (DO NOT SHOW these options to the participant)
   - ☐ Tapped on 
   - ☐ Something else
   - ☐ Said "I don't know"
   - ☐ Prefer not to answer
3. What would you do to create a new event in the calendar on the 6th July?
   Please indicate on the picture the first thing that you would do to try and achieve this.
   Please also describe out loud what you are doing.
   Code response (DO NOT SHOW these options to the participant)
   - ☐ Tapped on 
   - ☐ Tapped (or press and hold) on 6th July
   - ☐ Something else
   - ☐ Said "I don't know"
   - ☐ Prefer not to answer

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Show showcard G. Here is a picture of a smartphone with a screen from a navigation app on it.
Translation note: The showcard is adjusted for each country to use a map location in that country.

4. What would you do to see a menu with more options?
   Please indicate on the picture what you would do. Please also describe out loud what you are doing.
   Code response (DO NOT SHOW these options to the participant)
   Translation note: The text in the icons in the second response option ismodified for each country.
   - ☐ Tapped on ☰
   - ☐ Tapped on one of the three icons in the bottom row 

   - ☐ Tapped on layers icon 
   - ☐ Something else
   - ☐ Said "I don't know"
   - ☐ Prefer not to answer

5. Imagine that you pressed something by mistake and the screen changed to the one shown in this picture *(show showcard H – you can keep showcard G in view for comparison but make it clear which one is the new one that you want them to indicate on)*. What would you do to get back to the previous screen?
   Please indicate on the picture the first thing that you would do to try and achieve this.
   Please also describe out loud what you are doing.
   Code response (DO NOT SHOW these options to the participant)
   - ☐ Tapped back arrow ←
   - ☐ Touched the screen and then moved their finger back and forth on the screen
   - ☐ Something else
   - ☐ Said "I don't know"
   - ☐ Prefer not to answer

Show showcard I. Here is a picture of a smartphone with a webpage from a travel company on it.

6. At the moment, this webpage shows a search for accommodation for 1 adult. What would you do to change the number of adults?
   Please indicate on the picture the first thing that you would do to try and achieve this.
   Please also describe out loud what you are doing.
   Code response (DO NOT SHOW these options to the participant)
   - ☐ Tapped box with "1 adult"
   - ☐ Tapped on Search
   - ☐ Something else
   - ☐ Said "I don't know"
   - ☐ Prefer not to answer

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7. A smartphone does not have a physical keyboard. If you want to enter the location *(roughly indicate the word "Location" on the show card)*, you need an onscreen keyboard to type it in.
   What would you do to make this keyboard appear?
   Please indicate on the picture the first thing that you would do to try and achieve this.
   Please also describe out loud what you are doing.
   Code response (DO NOT SHOW these options to the participant)
   - ☐ Tapped in white rectangle labelled "Anywhere"
   - ☐ Tapped on a different data entry field
   - ☐ Something else
   - ☐ Said "I don't know"
   - ☐ Prefer not to answer

8. What would you do to set this webpage to be one of your bookmarks or favourites so that you can go to it easily later on?
   Please indicate on the picture what you would do. Please also describe out loud what you are doing.
   Code response (DO NOT SHOW these options to the participant)
   - ☐ Tapped on ☆
   - ☐ Tapped on ⋮
   - ☐ Something else
   - ☐ Said "I don't know"
   - ☐ Prefer not to answer

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C2. Attitudes towards technology (part 2)

As before, here are some statements about your interaction with technical systems. Just to remind you, by "technical systems" we mean apps, software and digital devices. Please indicate the degree to which you agree or disagree with each statement.

Interviewer note: ask participant to look at Showcard J and answer using the appropriate letter code, i.e. "a / b / c / d / e / f", rather than 'completely disagree / completely agree' etc.

Please indicate the degree to which you agree/disagree with the following statements.	a. completely disagree	b. largely disagree	c. slightly disagree	d. slightly agree	e. largely agree	f. completely agree
1. When I'm not sure what to do next on a technical system, I try out different things until something works.						
2. I need to be shown how to use a technical system many times before I'm confident about using it.						
3. I am uneasy about tapping or clicking on things that I don't recognise in case something goes wrong.						
4. If I tap on the screen or press a button and something happens that wasn't what I expected, I can usually sort it out by myself.						
5. If my current technical system works fine for what I want to do, I have no interest in getting a new one.						

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E. Capabilities

In this section, we will ask you about your capabilities, e.g. your vision, dexterity and memory. We're asking this because these affect how people interact with technology. The information can help designers to produce interfaces that are easier to see and use for a wider range of people. You can decline to answer any or all of these questions if you wish, without giving a reason.

1. To start with, we will consider your vision.

   Interviewer to show participant showcard K (vision test chart)

   We will use this vision chart. But this is not a proper eye test like you would get in an opticians and it does not give a proper measure of your vision.

   Hand chart to participant

   Please hold the chart at a distance that is comfortable for you, as if you were reading a book or browsing the Internet on your phone.

   Now please read out the smallest row that you can read **comfortably**. Note that this is not like a normal eye test. We are **not** looking for the smallest possible row that you can read if you push yourself, but for the smallest one that you can read **comfortably**. By this, we mean **quickly and with certainty**. You can adjust the distance to be more comfortable if you like.

   If participant appears to be struggling to read the row that they've chosen, ask them to try the row above: Would you like to try the row above instead?

   As they read out the row, check how many letters they get wrong. You can check against the following chart. Note that each row begins with a different letter (except lines 2 and 12). This can help you identify which row they are reading out.

   Line 1: H U D F N P R K
   Line 2: R F Z K N D U P
   Line 3: N Z P R F V U E
   Line 4: E D P V R H Z N
   Line 5: D R U P F Z H V
   Line 6: U R E K H P F V
   Line 7: Z R V F E K D P
   Line 8: P H R F V K N Z
   Line 9: K U P E V N H D
   Line 10: F R K E D U N Z
   Line 11: V K U F R N P Z
   Line 12: R K Z V N D P H

   For these purposes, participants are considered to get the line correct if they make 0 or 1 error. They get it wrong if they make 2 or more errors.

   - *If they got the line correct (0 or 1 errors), record the line below and move to the next question*
   - *If they got the line wrong (2 or more errors), ask them to read out the row above:* Thank you very much. Now I would like you to read out the row just above that one. *Continue until they read a row correctly (0 or 1 errors) and record that row below.*

   The smallest row read correctly (with 0 or 1 errors): _____

   ☐ Prefer not to answer

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Now there are a few questions about how difficult you would find some common tasks if you tried them today.

2. How easy or difficult would you find it to pick up a small object such as a safety pin?
   Interviewer note: ask participant to answer using the appropriate letter code on Showcard L, i.e. "a / b / c / d", rather than 'very easy / very difficult' etc.

   - ☐ Very easy
   - ☐ Somewhat easy
   - ☐ Neither easy nor difficult
   - ☐ Somewhat difficult
   - ☐ Very difficult
   - ☐ Impossible
   - ☐ Prefer not to answer

Now there are a few questions about how much your capabilities affect your daily life. In these questions, we're interested in your real-life experience e.g. while using any glasses or other aids you normally use.

3. To what extent, if at all, are you limited in your daily activities because of ……

   Interviewer note: ask participant to answer using the appropriate letter code on Showcard M, i.e. "a / b / c / d", rather than 'not at all limited / somewhat limited' etc.

	a) Not at all limited	b) Somewhat limited	c) Very limited	d) Prefer not to answer
a. your **eyesight**	4	3	2	1
b. your **hearing**	4	3	2	1
c. any problems with your **hands**	4	3	2	1
d. any problems with your **mobility**	4	3	2	1
e. any problems with **reaching your arms above your head or out to the sides**	4	3	2	1
f. any difficulties with your **memory or concentration**	4	3	2	1

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F. Demographics

1. Please give your age (in years):
   - ☐ It is: _____
   - ☐ Prefer not to answer

2. What best describes your gender?
   - ☐ Female
   - ☐ Male
   - ☐ Prefer to self-describe _____
   - ☐ Prefer not to answer

3. *A COUNTRY-SPECIFIC QUESTION ON SOCIAL GRADE OR INCOME*

4. *A COUNTRY-APPROPRIATE QUESTION EXAMINING EDUCATIONAL ATTAINMENT*

5. How is your health in general?
   Interviewer note: ask participant to answer using the appropriate letter code on Showcard P
   A. Very good
   B. Good
   C. Fair
   D. Poor
   E. Very poor
   F. Prefer not to answer

6. What type of area do you live in?
   Translation note: The questionnaire in some countries ascertains type of area using postal code instead of multiple choice.
   - ☐ Urban
   - ☐ Rural

7. Do you have *[INSERT RELEVANT COUNTRY]* citizenship?
   Translation note: There may be variations in the exact wording for this question and the next question between countries. Alternatives include: What is your current nationality (or nationalities)? What was your nationality/nationalities at birth?
   - ☐ Yes
   - ☐ No
   - ☐ Prefer not to answer

8. *Only ask if Yes to previous question (F q7)*
   Did you acquire *[INSERT RELEVANT COUNTRY]* citizenship at birth or at a later date?
   - ☐ At birth
   - ☐ At a later date
   - ☐ Prefer not to answer

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Appendix 2: English version of the showcards

The showcards were presented on separate A4 pieces of paper. They were translated into the survey language and the mocked-up interfaces (in Showcards F to I) were modified to use locations and examples relevant to the survey country. Some of the text sizes, white space and line spacing have been modified for this report to fit the showcards in this appendix.

Showcard A

Use with Section A questions 2, 4, 7, 8, 9, 12

A. Every day or almost every day

B. At least once a week

C. Less than once a week but at least once in the last 3 months

D. I last did this more than 3 months ago

E. I have never done this

F. Don't know

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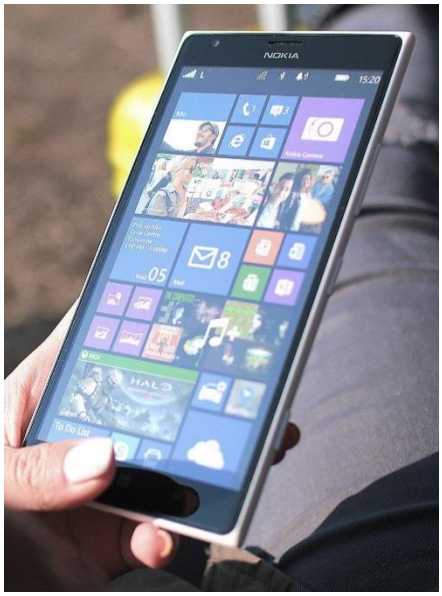
Showcard B

Examples of tablet devices

Use with Section A question 10



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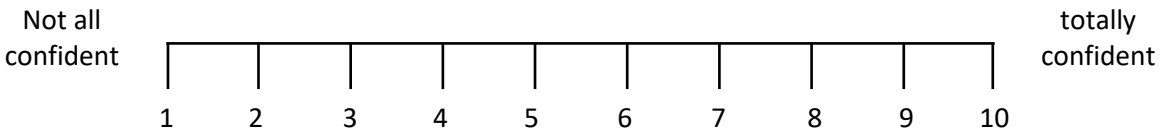
Showcard C

Levels of confidence

Use with Section B1 questions 1 and 2

Please rate your level of confidence on this scale:



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Showcard D

Use of digital transport services

Use with Section B1 question 4

A. Every day or almost every day

B. At least once a week

C. At least once a month

D. At least once in the last 3 months

E. I last did this more than 3 months ago

F. I have never done this

G. Don't know

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Showcard D2

Possible reasons for feeling limited in travel

Use with Section B1 question 6

	Not at all limited	Slightly limited	Very limited
1. The cost of the travel			
2. Limited availability of transport services (e.g. bus, trains or shared vehicles)			
3. Limited availability of infrastructure (e.g. bus stops or bike lanes)			
4. Concerns about the safety of the transport services			
5. Difficulty using the available transport due to special needs or disabilities			
6. Difficulty planning travel before a trip because digital skills are required to do so (e.g. to look up information or buy a ticket)			
7. Difficulty during trips because digital skills are needed to use the transport (e.g. to unlock a rented bike or show a digital ticket)			

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Showcard E

Attitudes towards technology

Use with Section C1

Please indicate the degree to which you agree/disagree with the following statements:

	a. completely disagree	b. largely disagree	c. slightly disagree	d. slightly agree	e. largely agree	f. completely agree
1. I like to occupy myself in greater detail with technical systems.						
2. I like to try out the functions of new technical systems.						
3. I predominately deal with technical systems because I have to.						
4. When I have a new technical system in front of me, I try it out intensively.						
5. I enjoy spending time becoming acquainted with a new technical system.						
6. It is enough for me that a technical system works; I don't care how or why.						
7. I try to understand how a technical system exactly works.						
8. It is enough for me to know the basic functions of a technical system.						
9. I try to make full use of the capabilities of a technical system.						

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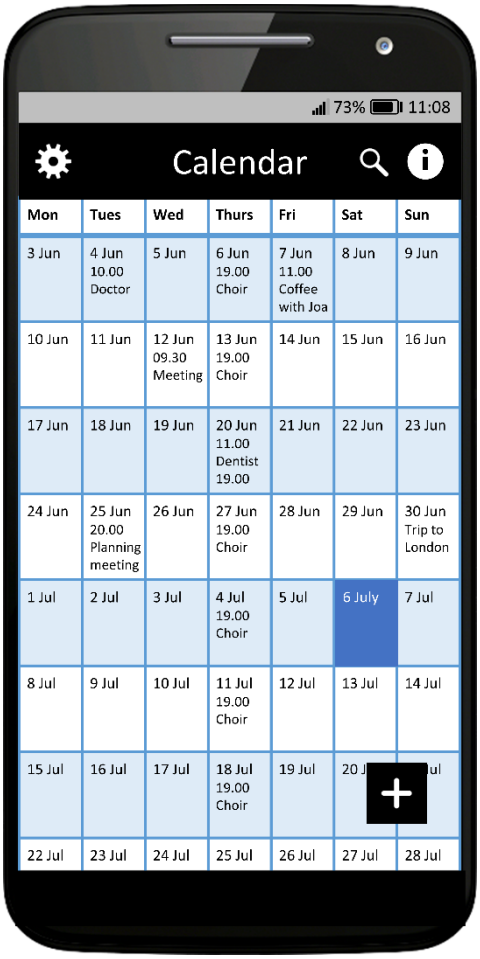
Showcard F

Interface 1

Use with Section D questions 1-3

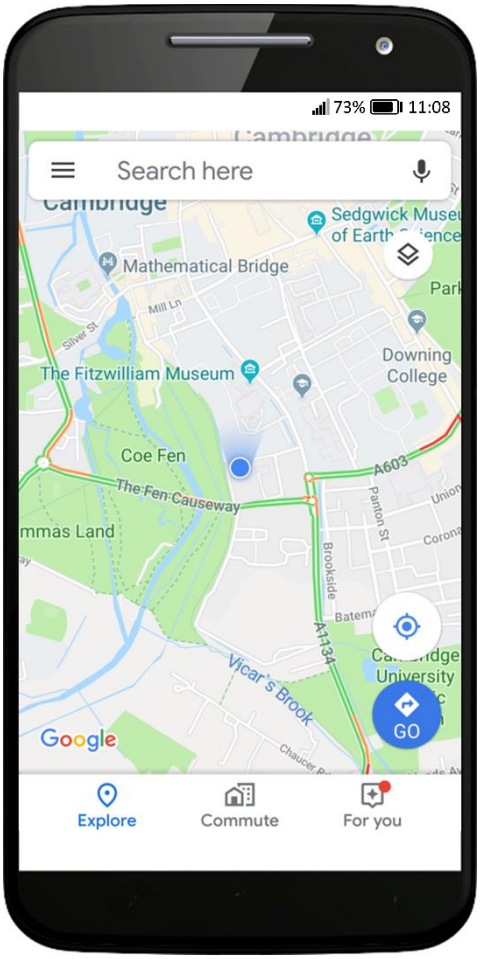


This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement N°875542.

Showcard G

Interface 2

Use with Section D questions 4-5



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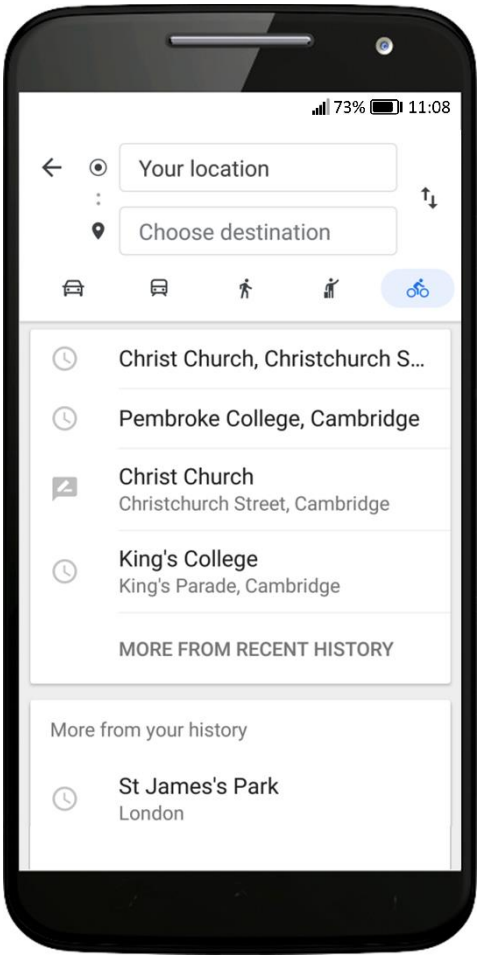
Showcard H

Interface 3

Use with Section D question 5



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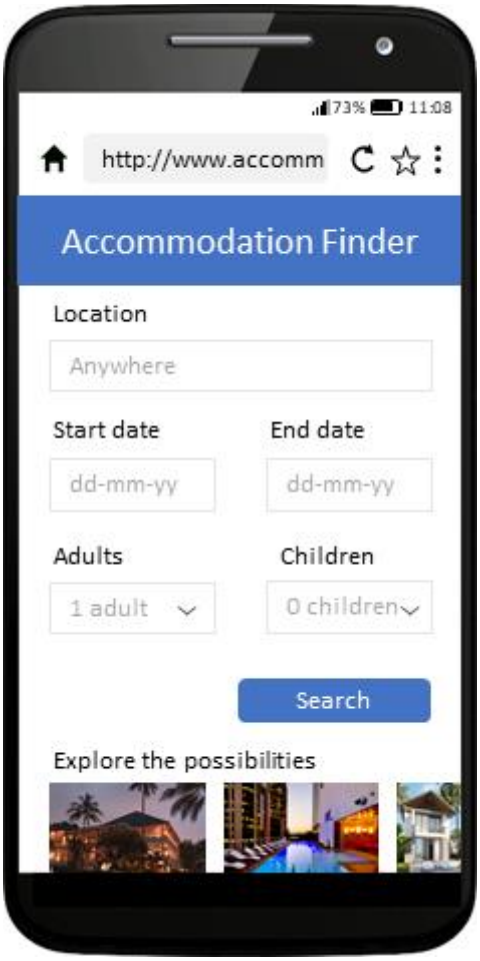
Showcard I

Interface 4

Use with Section D questions 6-8



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Showcard J

Attitudes towards technology

Use with Section C2

Please indicate the degree to which you agree/disagree with the following statements:

	a. completely disagree	b. largely disagree	c. slightly disagree	d. slightly agree	e. largely agree	f. completely agree
1. When I'm not sure what to do next on a technical system, I try out different things until something works.						
2. I need to be shown how to use a technical system many times before I'm confident about using it.						
3. I am uneasy about tapping or clicking on things that I don't recognise in case something goes wrong.						
4. If I tap on the screen or press a button and something happens that wasn't what I expected, I can usually sort it out by myself.						
5. If my current technical system works fine for what I want to do, I have no interest in getting a new one.						

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Showcard K

Vision test chart

Use with Section E question 1

Important note: This chart was used to estimate the participant's near comfort vision. It was therefore important that it was printed at a consistent size, resolution and contrast. To ensure this, all the charts were printed by the team at the University of Cambridge on the same printer and type of paper. They were then mailed out to the survey companies in each country. The chart below is not at the size and resolution required for practical use and is included for illustrative purposes only. Researchers wishing to use this test chart in practice should contact the team at the University of Cambridge.

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Showcard L

Use with Section E question 2

A. Very easy

B. Somewhat easy

C. Neither easy nor difficult

D. Somewhat difficult

E. Very difficult

F. Impossible

G. Prefer not to answer

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Showcard M

Use with Section E question 3

A. Not at all limited

B. Somewhat limited

C. Very limited

D. Prefer not to answer

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Showcard N

Use with Section F question 3

Translation note: This is the UK version of the response options for this question. This showcard was modified as appropriate for the social grade/income question(s) asked in that country.

A. Higher managerial, administrative or professional e.g. Established Doctor, Solicitor, Board Director in a large organisation (200+ employees), top level Civil Servant / Public Service employee

B. Intermediate managerial, administrative or professional e.g. New qualified (under 3 years) Doctor, Solicitor, Board Director in a small organisation, Middle Manager in a large organisation, Principal Officer in the Civil Service / Local Government

C. Supervisory role; clerical; junior managerial, administrative or professional e.g. Office Worker, Student Doctor, Foreman with 25+ employees, Salesperson

D. Skilled manual worker e.g. Skilled Bricklayer, Carpenter, Plumber, Painter, Bus / Ambulance driver, HGV driver, AA Patrolman

E. Semi or unskilled manual worker e.g. Manual workers, all apprentices in skilled trades, Caretaker, Park Keeper, non-HGV driver, Shop Assistant, Pub / Bar worker

F. Full time education

G. Housewife / Homemaker

H. Disabled or full time carer for someone disabled

I. Retired - State Pension only *

J. Unemployed for 6+ months **

K. Prefer not to answer

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Showcard O

Use with Section F question 4

Translation note: This is the UK version of the response options for this question. This showcard was modified as appropriate for each country and the education question asked in that country.

A. 1 - 4 O levels / CSEs / GCSEs (any grades), Entry Level, Foundation Diploma

B. NVQ Level 1, Foundation GNVQ, Basic Skills

C. 5+ O levels (passes) / CSEs (grade 1) / GCSEs (grades A*- C), School Certificate, 1 A level / 2 - 3 AS levels / VCEs, Higher Diploma

D. NVQ Level 2, Intermediate GNVQ, City and Guilds Craft, BTEC First / General Diploma, RSA Diploma

E. Apprenticeship

F. 2+ A levels / VCEs, 4+ AS levels, Higher School Certificate, Progression / Advanced Diploma

G. NVQ Level 3, Advanced GNVQ, City and Guilds Advanced Craft, ONC, OND, BTEC National, RSA Advanced Diploma

H. Degree (for example BA, BSc), Higher degree (e.g. MA, PhD, PGCE)

I. NVQ Level 4 - 5, HNC, HND, RSA Higher Diploma, BTEC Higher Level

J. Professional qualifications (e.g. teaching, nursing, accountancy)

K. Other vocational / work-related qualifications

L. Foreign qualifications

M. No qualifications

N. Prefer not to answer

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Showcard P

Use with Section F question 5

A. Very good

B. Good

C. Fair

D. Poor

E. Very poor

F. Prefer not to answer

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