
Project**: SEAWave**

# Quantitative exposure perception studies

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## Abstract

The report provides information on the current state of research regarding exposure perception of 5G (theoretical background). It also explains the methods used to obtain the data of the present quantitative study within SEAWave. The results are not part of this report. They will be published in a peer-reviewed journal.

## Project Details

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# Contents

# 1 Introduction

Mobile communications (MC) work by transmitting electromagnetic signals between base stations and mobile devices such as mobile phones. They are called radiofrequency electromagnetic fields (RF-EMF). The technology behind this is constantly evolving and enabling ever higher data transmission rates. The latest mobile communications (MC) standard 5G has been rolled out in Europe since 2019 and is the successor to earlier MC standards (2G/GSM, 3G/UMTS, 4G/LTE). The quantitative survey presented here investigates with a sample of approximately 10,000 Europeans how citizens perceive exposure to electromagnetic fields (EMFs) in different situations, focusing on the rollout of the latest MC standard 5G. Further, the present study investigates participants' siting preferences for mobile phone base stations. It is based on a qualitative study, which was conducted within the SEAWave project in 2022 (Link et al., 2023).

## 1.1 Objective

The present study has two main objectives. First, the assessment of the general and situational 5G exposure perception of citizens. The situational exposure perception was assessed by showing the participants everyday situations where the person pictured is interacting with a mobile phone, is in the vicinity of mobile phone base stations, or is in a situation in which other people nearby interact with their phones. Second, it investigates which location citizens would prefer for siting of a new mobile phone base station and which factors influence their choice of location. Due to the large and diverse sample from ten European countries, sub-samples can be analysed, and a between-country comparison will also be possible.

## 1.2 5G deployment in Europe

5G rollout is at different stages of progress throughout Europe. These different rollout stages were taken into account when selecting the countries analysed to provide the most diverse picture possible. However, the expansion in most European countries is already well advanced in 2023. The European 5G Observatory, supported by the European Commission, is a platform that provides an overview of the 5G deployment in the European Union and releases quarterly reports. According to the European 5G Observatory (as of July 2022) 81% of the European Union's population can potentially receive 5G (European 5G Observatory, 2023).

The highest 5G network coverage within the European Union is achieved in the Netherlands with 100%, Italy with 99.7% and Finland with 94.7%. The lowest 5G network coverage is in the EU-countries Sweden with 20.5%, Romania with 26.8%, and Belgium with 29.6% (European 5G Observatory, 2023). The EU-countries examined in this study have, according to the European 5G

Observatory (2023), the following 5G network coverage: Finland: 94.7%, Germany: 93.2%, Austria: 91.7%, France: 88.8%, Greece: 85.7%, Spain: 82.3%, Slovenia: 63.9%, and Poland: 63.7%. Further, the UK achieves a network coverage of more than 77% of premises by at least one provider (Department for Science, Innovation & Technology, 2023). Serbia has 0% de facto 5G network coverage. Apart from a test station in Belgrade, there is still no 5G in Serbia in 2023 (RATEL - Regulatory Authority for Electronic Communications and Postal Services, 2023).

Standalone (SA) 5G operates on two frequency bands and has to be distinguished from Non-Standalone (NSA) 5G which uses Dynamic Spectrum Sharing (DSS), which uses the same frequency bands as 4G. While FR1 (FR=frequency range) uses frequency bands between 0.41 and 7.125 GHz, FR2 uses bands between 24.25 GHz and 52.60 GHz, which are accordingly in the millimetre range. In order to gain an overview of the current deployment status with regard to 5G DSS, 5G FR1 and 5G FR2, various meetings were held with the radiation protection agencies involved in the project, as well as discussions with the German Federal Network Agency and several network operators. Although SEAWave is explicitly researching potential health effects of frequencies in the millimetre-wave range (FR2), the focus of the present study is on the infrastructure that has already been implemented and therefore on 5G DSS and 5G FR1. Among other things, this had an impact on the creation of the stimulus materials used in this research.

# 2 State of research

This chapter gives an overview of the current state of research regarding both, exposure perception and risk perception. It also addresses common misconceptions that are relevant for exposure perception and summarizes previous findings concerning base station siting preferences.

The state of research presented is based on scientific literature as well as on the findings of the qualitative study already conducted in 2022, which is also part of the SEAWave project. Trends observed in this study guided the development of the quantitative survey. A detailed description of the method of the qualitative study on 5G exposure perception can be found in Deliverable 10.1 (Link et al., 2023).

## 2.1 Exposure perception

We define exposure perception as the extent to which a person believes to be exposed to an agent in a certain situation. In the case of RF-EMF associated with mobile phone use, this can be a global perception (e.g., believing that mobile communications EMFs are everywhere) or a differentiated assessment depending on the situation (e.g., believing that they are more exposed to RF-EMF when being in proximity to a base station compared to being further away).

### 2.1.1 Exposure perception and risk perception

Usually, risk perception, as it is described in the psychometric paradigm (e.g. Slovic, 1987), is assessed globally, e.g., with an item such as "How risky do you think mobile phone radiation is?". In contrast to this, a recent approach views risk perception as being multidimensional, including affective responses, the probability of encountering a potential hazard (exposure), the likelihood of suffering consequences from it, and the severity of the consequences (Walpole & Wilson, 2021; Wilson et al., 2019). In this approach, exposure is seen as a facet of risk, and exposure perception correspondingly as a facet of risk perception.

In line with this idea, Freudenstein, Wiedemann, and Brown (2015) found a correlation between situational exposure perception ("in your opinion, how strong is the exposure to the person in the above picture?") and situational risk perception ("how dangerous do you consider this situation to be for the person [placeholder describing scenario, e.g., using the laptop]?"). A global assessment of risk perception, however, is unlikely to only depend on situational exposure perception. Thus, it is important to distinguish between different assessments of risk perception (situational vs. global risk perception) when relating this concept to exposure perception.

Freudenstein, Wiedemann, and Brown (2015) further decomposed exposure perception into cognitive, moral, and affective components and examined their correlation with risk perception. In their study, the cognitive component was found to have the strongest relation to risk perception. The weakest relation was found between the affective component and risk perception.

While risk perception has already been investigated for 5G specifically (Frey, 2021; GIM, Gesellschaft für Innovative Marktforschung, 2022; Koh et al., 2020), our studies are – to the best of our knowledge – the first to focus on 5G exposure perception.

### 2.1.2 Exposure impact beliefs

So far, there are no clear results on how beliefs about exposure characteristics (e.g., duration of exposure) affect the risk perception of MC – or more generally EMFs (e.g., also those emitted by power lines). Freudenstein, Wiedemann, and Varsier (2015) specifically investigated which aspects influence risk perception most. They asked: “What do the potential health risks of electromagnetic fields from exposure sources like mobile phones, mobile communication masts, or other devices depend on?”. The majority of participants assumed that the duration of exposure has the strongest influence on potential health effects, followed by the strength of exposure, the distance to the exposure source, the frequency of exposure, and the number of exposure sources. The physical size of the exposure source, and the time of the day of exposure played a minor role in this context.

Therefore, the authors concluded that respondents revealed a rather adequate view about the impact of exposure characteristics like duration or strength of exposure. Further they found that the more adequate the participants' view was, the higher their risk perception regarding mobile phones. Nevertheless, Freudenstein, Wiedemann, and Varsier (2015) did not measure the relationship between exposure characteristics and exposure perception itself, but the relationship of the participants' view on exposure characteristics and risk perception. However, not all studies (Claassen et al., 2014; Cousin & Siegrist, 2010a, 2010b) found that laypeople's' conceptions about EMFs exposure are adequate. In our qualitative as well as the current quantitative studies, we therefore looked at additional factors that can influence laypeople's exposure perception of RF-EMF (see Chapter 3. "The present study").

## 2.2 Misconceptions

Using the so-called "mental model approach" (Morgan, 2002), Cousin and Siegrist (2010b) discovered some misconceptions about RF-EMF regarding the change of exposure magnitudes, regulation issues, and scientific processes. Their results were quantified in a later study (Cousin & Siegrist, 2010a). Claassen et al. (2014) conducted a similar study and created mental models of experts and laypeople regarding their EMF-specific knowledge, followed by a quantitative confirmatory study. Participants were shown statements about EMF exposure and indicated whether they thought they were true or false or if they did not know the answer. On average only six out of the 17 expert statements were rated correctly by the participants. Therefore, the authors concluded that laypeople have major knowledge gaps regarding EMFs from different sources (Claassen et al., 2014).

The three above-mentioned studies, for example, came to the conclusion that laypeople do not assess the relationship between distance and exposure correctly. Cousin and Siegrist (2010b) found that among laypeople, 14 out of 15 respondents thought that "radiation" was decreasing linearly, not with the inverse square of the distance from the source. Comparable results were obtained by Claassen et al. (2014): 68% of the respondents wrongly assumed that the field strength of power lines only gradually decreases with distance. In all three cases, the exposure from base stations was overestimated, e.g., by 12 out of 15 participants in the study of Cousin and Siegrist (2010b). In the qualitative study we conducted in December 2022, a similar trend emerged: 20 of the 35 people interviewed associated higher exposure with base stations than with mobile devices. In addition, Cousin and Siegrist (2010b) found that 14 out of 15 respondents were not aware that the interaction of base stations and mobile phones determines the radiation emitted from both sources. The quantitative studies by Claassen et al. (2014) and Cousin and Siegrist (2010a) also showed that less than one third of their participants (Claassen et al.: 24%,

Cousin and Siegrist: 29%) knew that emissions from the base station depends on how many mobile devices it interacts with simultaneously.

## 2.3 Base station siting preferences

Cousin and Siegrist (2010a) explored which locations laypeople prefer as base station sites by asking them to compare five scenarios pairwise. In each scenario, a village was pictured, with the base station located in different places. Their siting task revealed that – compared to other possible locations – most people preferred the site farthest away from the village. The second most chosen site was in a church steeple, installed out of sight. Visibility is consequently likely to be an important criterion in site selection (Cousin & Siegrist, 2010a).

Dohle et al. (2010) also investigated how different aspects – such as location – relate to each other by presenting the study participants several stimulus cards containing further information about the location, the visual appearance, the kind of building the base station is built on, and the decision process. The authors conducted a conjoint analysis to estimate participants' preferences by referring to an overall judgment (utility) about a set of alternatives – presented as stimulus cards. In line with Cousin and Siegrist (2010a), Dohle et al. (2010) concluded that locations outside the village are preferred. Further, appearance has the smallest influence on base station siting preferences. Nevertheless, covered or camouflaged base station were preferred to visible base stations. Consequently, there are different results regarding the importance of visibility and appearance of base stations with respect to siting preferences.

In a later, methodologically-similar study on base station siting, Cousin et al. (2011) divided participants into three experimental groups, with one of the groups receiving an informative text about RF-EMF and another group receiving an emotional text about the construction of a new base station. Specifically, the informative text provided information about GSM (2G) technology and its consequences for EMF exposure, with a special focus on the interaction effects between base stations and mobile phones. After receiving the information, participants were asked to compare the six possible base station sites pairwise. Compared to the control group and the second experimental group, the informative text led to a preference for base stations closer to the village, even though the site at the outskirts of the village was still favoured by many participants. Overall, the participants were able to transfer the information given in the text to the base station siting task.

In our previous qualitative study, participants had a free choice between six possible base station siting options. After their initial choice, they were provided with information about technological consequences for EMF exposure, similar to Cousin et al. (2011). Then, they were free to change their choice. About half of those who initially chose one of the two locations outside the village

area chose a closer location after being informed about the relationship between base stations and mobile devices and its influence on EMF exposure. In contrast to Cousin & Siegrist (2010a), we came to the finding that not the most distant location was preferred initially, but the one where the base station is placed on the roof of a factory building. A large number of respondents argued that the factory was already visually unappealing.

The general tendency to reject infrastructural elements that emit EMFs such as electricity pylons in close proximity has already been postulated by Wiedemann and Claus (2013) and Wiedemann et al. (2018) with the help of the theory of the (body-) buffer zone (Horowith et al., 1964). According to this, people construct a protective zone around themselves in order to preserve their bodily integrity. This may not only apply to the power grid as an EMFs' source, but also to mobile communications.

# 3 The present study

Building on our qualitative study on 5G exposure perception, the present study is the first, to our knowledge, to investigate 5G exposure perception in a quantitative manner. It addresses two main research aims: first, to investigate in which situations people feel particularly exposed to EMFs emitted by MC infrastructure or devices including 5G. Second, to learn about peoples' preferences for the siting of 5G emitting base stations, and about the factors influencing their choices.

In addition to these two main research questions, the study also aims to investigate how lay people perceive the relationship between 5G and health and how the two concepts of "risk perception" and "exposure perception" relate to each other.

Specifically, the present study investigates further, similar to Freudenstein, Wiedemann, and Varsier (2015), which factors have the greatest influence on EMF exposure perception. This involves reception (4G/5G/Wi-Fi), the EMF source (mobile phone or base station), quantity, proximity or distance, data transfer (upload/download), and location (indoor/outdoor). For this purpose, the participants are asked for several situational exposure assessments as well as for their exposure impact beliefs. The results of GIM, Gesellschaft für Innovative Marktforschung (2022) and our qualitative study suggest that based on personal considerations, different people come to different conclusions, when evaluating their personal exposure.

While previous studies on base station siting preferences drew a scenario where a fictional village was initially tethered to the cellular network, the scenario in our study was an upgrade from 2G to 4G/5G. Consequently, MC already existed in our fictional village. In contrast to Cousin et al. (2011), who demonstrated the effect of providing different kinds of information to three

different groups (one control group, two experimental groups) on base station siting preferences in an experimental study, the present study examines the impact of information on the same group of people. This study design is relevant to find out how providing information affects a person who has already decided on a location, probably based on intuition. Moreover, our study allows to examine the relevant factors influencing base station siting preferences, like distance, EMFs, reception, and visual appearance.

# 4 Methods

The following chapter describes how the study was designed, how the data was collected and how the data will be analysed. In addition, the sampling procedure is described here.

## 4.1 Joint survey with GOLIAT

The study was conducted within the framework of the two EU projects SEAWave and GOLIAT. GOLIAT and SEAWave are funded under the same call HORIZON-HLTH-2021-ENVHLTH-02-01. The survey is a joint activity within the Clue-H cluster formed by all four projects funded in this call. The collaboration ranged from the collaborative design of the survey to the joint data collection and analysis and will also include co-authored scientific publications.

## 4.2 The sample

The sample was drawn to be representative for age and gender (interlocking quota) as well as for regions (marginal quota) of the respective countries, based on NUTS1[1]. In order to create the interlocking quotas, six age ranges were defined (16-24, 25-34, 35-44, 45-54, 55-64, 65+) and gender was split into male and female. The proportions of the population mapping to each interlocking quota were based on data from Eurostat, the statistical agency of the EU. For more and country specific details see Appendix “Quotas”.

Characteristics such as highest educational level, current occupation or income were not taken into account in the quotas. Thus, representativeness cannot be granted for these characteristics. However, data on educational level, occupation and income were collected in the survey, so will be used to adjust analyses as appropriate. In addition, since recruitment in some regions and some age groups will likely be made difficult by their lower-than-average levels of internet access, representativeness of the data will be corrected through the application of survey weights where necessary.

[1] Eurostat map: https://ec.europa.eu/eurostat/documents/345175/7451602/2021-NUTS-1-map.pdf

## 4.3 Recruitment

The respondents were recruited by the panel provider Bilendi, which was selected in a public tender. We agreed with the panel provider that 1,000 high quality participants (i.e., participants who properly completed the questionnaire) should be generated per country and that recruitment should be based on an interlocking quota for age and gender and a marginal quota for region. For completing the survey, participants collect points from the panel provider, which can eventually be converted into rewards.

The soft launch for the countries UK, Germany and France started on September 14th, 2023, the soft launch for the remaining countries on Oktober 3rd, 2023. For this purpose, we aimed for approximately 60 completed surveys per country. Before full launching the survey on December 1st, 2023, the soft launch data was checked for plausibility and completeness. At this time, the survey is still in the field.

## 4.4 The survey design

Based on qualitative interviews and focus groups that were already conducted within the framework of SEAWave and GOLIAT, the survey objectives were defined, and the questionnaire structure was determined.

The questions on exposure perception as well as the base station siting task were strongly influenced by the qualitative study on 5G exposure perception (see Link et al., 2023). While the base station siting task remained almost unchanged, some changes were made to the exposure perception task. As for the qualitative study, the situations presented to the study participants (see section 4.5, figure 2) were chosen to cover some "dimensions" that may influence lay people's exposure perception. In addition to the already existing sketches, some new sketches were drawn by a professional illustrator for the quantitative survey. Unlike in the qualitative study, participants were not asked to rank all situations shown according to their exposure perception, but to rate each situation individually on a scale from 1 to 10. This decision was made due to the lack of space on the screen, especially on mobile phones, in order to increase the usability for the respondents. Also, respondents were no longer asked to put themselves into the situation, but to rate the exposure for the person pictured. This adjustment was made to a) detach from the personal relevance that a person might attach to the situation and b) to keep the cognitive effort as low as possible. As the participants are on their own when completing the survey, unlike in the focus group setting, a descriptive sentence was provided for each picture to give further context (e.g., "The person pictured is talking to another person via video calling (4G connection)."). Besides, specific questions about the respondents' exposure impact beliefs were

asked, with the aim of being able to compare their general beliefs with the evaluation of the individual situations.

In addition to questions based on the qualitative interviews and focus groups, already existing or validated scales were included in the questionnaire or provided clues for the generation of questions, for example to capture socio-demographic characteristics or the health and wellbeing of the participants. Sociodemographic questions were asked in the beginning of the survey due to their relevance for the quotas, followed by questions about the participants health and wellbeing, to make sure they are not influenced by the survey itself.

The questions on exposure perception were deliberately asked before the questions on risk perception in order to avoid raising the risk awareness of the respondents and thus biasing the exposure perception.

When the first draft of the questionnaire was ready, it was sent for external validation (content validity) to three independent experts in the fields of EMF, risk and exposure perception. The feedback of the external experts was discussed and, if considered useful, integrated into the questionnaire. Afterwards, a German and an English version of the questionnaire were created and implemented in the survey software Unipark.

Qualitative pretests were conducted at an early stage in Germany ($n$=6) and the UK ($n$=6), where participants were asked to speak their thoughts aloud while completing the survey. This enabled us to identify and refine unclear formulations and to further increase the usability of the questionnaire. The qualitative pretests in Germany were conducted online with the already implemented questionnaire, whereas the qualitative pretests in the UK were conducted with paper and pencil.

The revision of the content of individual questions was followed by quantitative pretests in order to be able to better assess the processing time of the questionnaire. For this purpose, 20 students of the IU International University of Applied Sciences answered the questionnaire and were given course credits. The average completion time was 16 minutes, which corresponds to our target value of less than 20 minutes.

The questionnaire was then translated into the following languages: French, Spanish, Finnish, Greek, Serbian, Polish, Slovenian. All languages except Slovenian were translated by a translation agency. The Slovenian translation was done by a colleague from the GOLIAT project who is a native speaker herself. All translations were thereafter checked and partially revised by native speakers of each language among SEAWave and GOLIAT work package partners. Finally, two to four lay people were recruited through the work package partners to complete the questionnaire in each language and share their feedback with us, which led to further amendments.

## 4.5 Procedure of the interviews

After participants were informed about the study and gave consent to participate (see Appendix "Participant information + consent form"), the survey started.

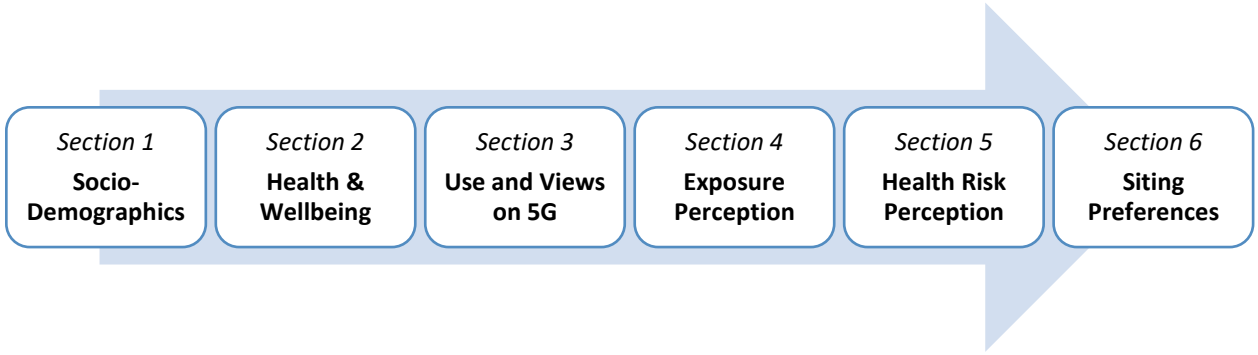



*Figure 1: Sections of the survey*

The survey consisted of 6 sections (see figure 1), each including questions about different topics.

In **the first section**, participants were asked about the region in which they live (quota 1), their gender and age (quota 2, interlocking), their maximum level of education, their household composition, and household income.

**The second section** asked about health and wellbeing. Respondents were asked to indicate how they assess their health in general, whether they have permanent health problems and how they rate various statements relating to their wellbeing. Lastly, for a number of complaints (e.g., headaches), participants were asked to indicate how often they suffered from them in the last seven days.

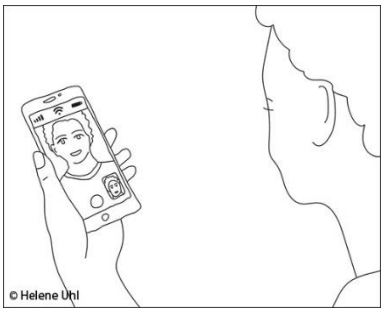
In **the third section** participants were asked about their use of and views on 5G. Specifically, we were interested in what kind of device and what kind of internet reception participants used when answering the survey. We also asked whether the participants themselves use 5G on their mobile phones, how they assess their knowledge of 5G and whether they feel informed about 5G. Lastly, participants were asked how they assess the introduction of 5G for themselves and for society as a whole. Based on their assessment (positive or negative), they were asked to choose the main reason for their assessment from a number of different options.

In **the fourth section** the participants' exposure perception was addressed. Before asking specifically about exposure perception, participants were asked how they evaluate certain statements about 5G and whether they are generally in favour of the expansion of the 5G network. Then they were asked how they perceive their everyday EMFs exposure (including mobile communications and 5G) and how they think their exposure to EMFs will change with the introduction of 5G.

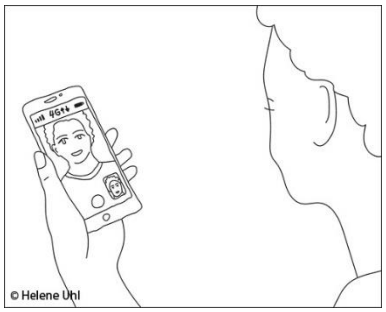
Finally, participants were shown situations where someone is using or seeing mobile communications technology and is consequently exposed to EMFs. There were five different groups of situations and each group consisted of two or three pictures, which differed regarding a certain aspect (e.g., the network type). Each group of situations was shown on a separate questionnaire page, so there were five pages, which were presented in a random order. Participants were asked to estimate on a ten-point Likert scale to what extend the person depicted is exposed to EMFs. Figure 2 shows all twelve exposure situations.

*Figure 2: Exposure situations shown*

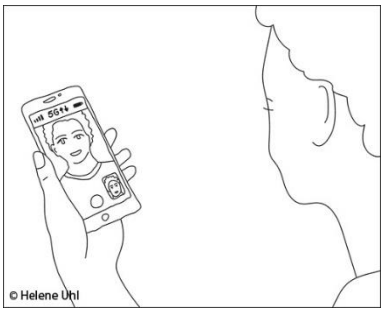
Video telephony




Video telephony with Wi-Fi reception



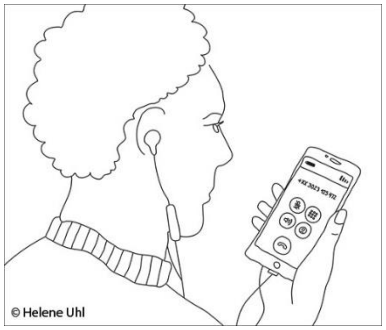

Video telephony with 4G reception




Video telephony with 5G reception

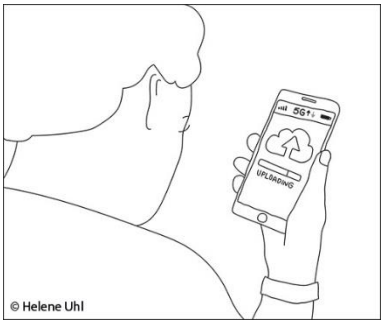
Phone call


Phone call with phone at the ear

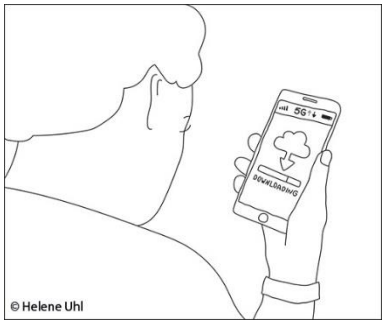



Phone call with headset

Data transfer

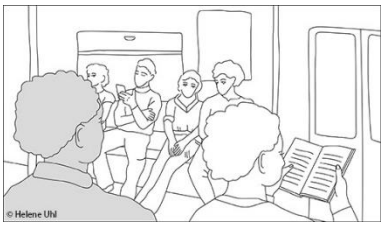



Uploading a file with 5G reception

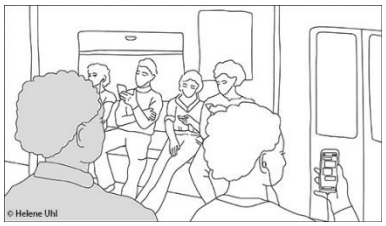



Downloading a file with 5G reception

Bystanders

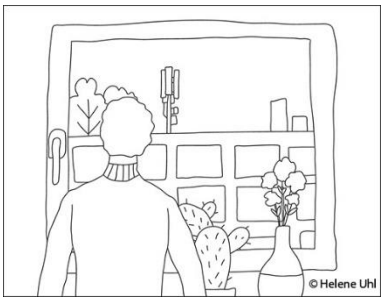



One person uses a mobile phone

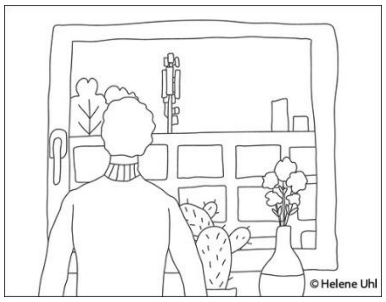



Four people use a mobile phone

Antennas




One 4G antenna visible




One 4G and 5G antenna visible


Three 4G and 5G antennas visible

Last, we recorded which exposure impact beliefs the subjects had.

In **the fifth section** participants were asked about their health risk perceptions. Having previously asked for a general assessment of the subjects' own knowledge of 5G, we were now specifically interested in how the subjects assess their knowledge of the relationship between 5G and health. They were then asked questions about epistemic certainty in relation to 5G and health, e.g., we were interested in how they assess the certainty of scientific results, or whether they view research and its results as a process. Subsequently, participants were asked to indicate the extent to which they agreed or disagreed with eleven statements made by individuals in qualitative

interviews conducted by the GOLIAT project. To find out how relevant 5G is in respondents' everyday lives, they were asked how often they think about 5G, follow media coverage, or talk about it themselves. They were also asked whether they were hypersensitive to EMFs and, if so, what symptoms they experience, how much they are affected by them, and how often these symptoms occur. Then, all study participants were asked to estimate what percentage of the population is hypersensitive to EMFs. Respondents were also asked to rate the severity of potential health consequences of various sources of EMFs: for themselves, for society, and for children.

Next, respondents were asked how susceptible they thought they were to potential health risks from 5G and how they thought 5G would contribute to a range of health problems. Last, respondents were asked to what extent they trust scientists and think current regulations are sufficient, and what percentage of the population they think is concerned about potential health effects from 5G.

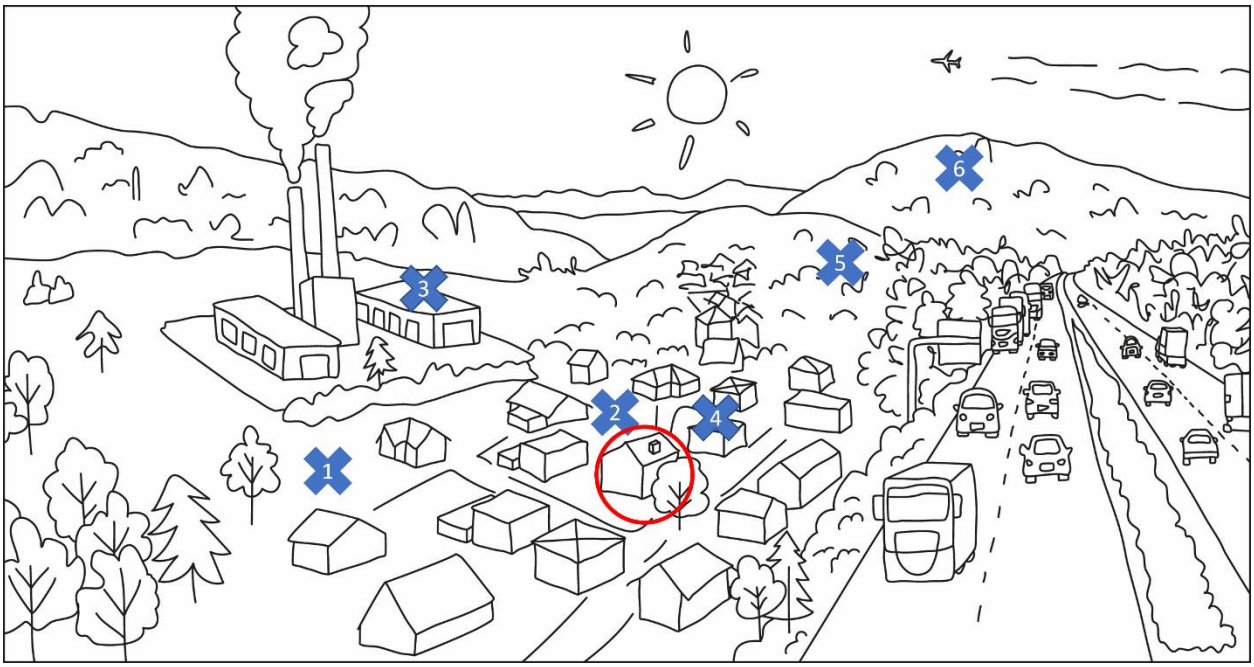



*Figure 3: Picture used in the siting task.*

In **the sixth section** the subjects were shown a picture (see figure 3) in which a village was depicted in the centre. They were told to imagine that they live in the encircled house and until now, there had only been 2G reception in the village. Now, a new base station antenna which would cover the village with 4G and 5G was supposed to be erected at one of the six possible locations (each marked with a number). After they had decided for a site, participants were asked how much their choice was influenced by a couple of predefined factors (reception, distance,

exposure to EMFs, visual appearance, other). On the next page, they were then given some basic information on the operation of base stations and mobile phones:

*"Since mobile phones and mobile phone masts interact with each other, mobile reception is worse the further away you are from the nearest mast. In addition, the further away a mast is, the stronger the mobile phone has to emit electromagnetic fields (EMFs) to send data.*

*We are usually much nearer to our mobile phones than we are to mobile phone masts. Therefore, people who regularly use a mobile phone are, overall, exposed more to EMFs from their mobile phones than from masts.*

*If you choose one of the urban locations (1, 2, 3, 4) for the mast, you will get 5G at full capacity. If the mast is placed at one of the more distant locations (5, 6), you will receive 5G with limited performance. This means that your data will be transmitted more slowly. We will show you the sketch again in a moment as a reminder."*

Subsequently they were asked to rethink their choice and decide again for one of the six possible locations. In case they changed their choice, they were asked how much reception, distance, EMFs, visual appearance, and other factors influenced their choice.

In general, all questions were compulsory. Only the estimation questions could be skipped.

## 4.6 Randomisation and quality checks

To minimise order effects, various response categories were presented in randomised order. As soon as answer categories such as "other" or "prefer not to answer" were present, these were excluded from the randomisation and remained as the last answer category(ies). The questions that were randomised can be found in Appendix "The questionnaire", where randomised questions are marked with †. Whole pages were only randomised for the picture-based assessment of exposure perception in everyday mobile phone use situations (five pages in total).

Two attention checks were integrated into the survey. The first attention check served to verify whether the participants had read the previously presented information and accordingly knew what "5G" means. For this purpose, the following question was asked three pages after the info text on 5G:

> *When we use the term "5G", we are talking about…*
>
> > *… a newly available brand of mobile phone.*
> >
> > *… a mobile app that uses artificial intelligence to increase productivity.*
> >
> > *… a mobile phone communication technology that allows high rates of data transfer.*

On the same page were the questions on the evaluation of 5G for oneself and for society.

At a later stage, embedded in the block of questions on the evaluation of statements by the public, the participants were asked to:

*Please check the box "strongly agree".*

The main purpose of this attention check was to check whether the participants read the questions carefully and answered them thoroughly.

If participants answered one of the attention checks incorrectly, they were immediately screened out. Other reasons for screen outs were:

- Full quotas (interlocking quota age & gender, marginal quota region)
- Falling below the minimum age of 16 years for participation
- Excessively long completion times (of more than 60 minutes) or interruptions of the survey

In the follow-up, further cleaning of the data was carried out by removing people from the data set who completed the survey very quickly (<10 min) or showed no variance in their response behaviour (straight liners).

## 4.7 Data analysis

A pipeline has been set up to import all data from the survey software into R, where it is aggregated into a single English language master file. The pipeline removes duplicate records, recodes variables, and flags records identified as containing missing data, illogical/ inconsistent responding, overuse of item nonresponse (e.g., "Don't Know"), or evident straight-lining behaviour will be flagged for exclusion. Respondents with missing data for any outcome/predictor variables will be excluded from the analyses as well.

Socio-demographic variables will then be analysed descriptively. Hypotheses including analysis methods and exploratory analyses were preregistered in the Open Science Framework (OSF). These can be accessed via the following links:

Paper 1 on Base Station Siting: https://osf.io/sm8ux

Paper 2 on Exposure Perception: https://osf.io/sm8ux

# 5 Results/discussion

The results will be made available to the public and published in peer-reviewed journals. Once the results are published, we will also provide an updated version of this report including references to the published findings.

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# 8 Appendix

## 8.1 Participant information + consent form

## Information for participants

Please read this information carefully before deciding whether or not to participate in the study. If you decide to participate, thank you. If you decide not to participate, thank you for considering participation.

### What is the goal of the survey?

5G is the latest mobile technology and was first widely rolled out in Europe in 2019. The goal of this survey is to find out how the public perceives and uses 5G mobile technology. To complete the survey, no prior knowledge about 5G technology is required on your part.

The survey is being conducted as part of two projects funded by the European Union and UK Research and Innovation. The lead institutions are the IU International University of Applied Sciences, the University of Exeter Medical School, and the University of Vienna.

### What is expected of participants?

The survey should take a maximum of **20 minutes** to complete. As researchers, we are interested in your opinions and views on the topic of mobile communications and 5G. We also collect some personal information, such as your age, gender, and income, and ask questions about your health and well-being.

### Can participants change their mind and cancel the survey?

You can cancel the survey at any time by closing your browser window. If at a later date you would like your data removed from the study, please contact us with your **participant number that is shown on the next page.**

### What data or information is collected and how is it used?

All responses you provide in this survey will be recorded. For some questions, you may indicate that you do not wish to answer them. All answers you give are anonymous - you cannot be personally identified in any way from the survey data collected or the analysis.

All data will be securely stored and shared, and can only be accessed by selected individuals at the three academic institutions collaborating on the survey. Research papers may be published using this data, but again, your responses will not be identifiable in the research results. After the last scientific publication based on the data is published, or after 2030, the data collected in this survey will be made freely available to the public. This means that interested parties can

use the data for their own research or commercial purposes. However, your responses will remain anonymous - you will not be identifiable in this dataset.

## Contact

If you have any further questions or concerns about this research, please contact us using the details below:

**Lead Researcher**

Prof. Dr. Christoph Böhmert christoph.boehmert@iu.org

## Ethics approval

This study has the ethical approval of the IU International University of Applied Sciences.

IU International University Ethics Committee – Chair
Prof. Dr. Stefanie André stefanie.andre@iu.org
Juri-Gagarin-Ring 152, 99084 Erfurt, Germany

## Consent form and acceptance of conditions

In order to participate in the survey, you must agree to all of the following:

**I acknowledge that:**

- I can terminate the survey at any time by closing my browser window.
- The data will be kept secure.
- The results of the project may be published, but my anonymity will be preserved.
- A fully anonymized data set containing my responses can be made publicly available after publication of the data in scientific journals, or after 2030.

**I acknowledge that:**

- My participation in the survey is completely voluntary.
- All my questions regarding the survey have been answered sufficiently.
- I am at least 16 years of age.
- I agree to participate in this survey.

Once you clicked "***Continue***", you will be taken to the first question. If you do not want to participate in the survey, please click "***I do not want to participate***" or close the browser window.

*I don't want to participate* *Continue*

***

The participant information and consent form were translated into: German, French, Spanish, Finnish, Polish, Slovenian, Serbian, and Greek.

## 8.2 The questionnaire

Your participant number: ###

**Some information about you…**

Please select your region of residence. *(note: drop down menu, country specific categories)*

East Midlands (England)

East of England

London

North East (England)

North West (England)

Northern Ireland

Scotland

South East (England)

South West (England)

Wales

West Midlands (England)

Yorkshire and the Humber

Please select your gender identity. *(note: drop down menu)*

Woman

Man

Transgender

Non-binary/non-conforming

Other

Prefer not to answer

Please enter your age.

###

What is your maximum level of education achievement? Please select the option most applicable to you. *(note: drop down menu)*

Completed compulsory education (typically at 15 or 16 years of age)

Completed further education (typically at 18 or 19 years of age)

Completed university degree(s)

Did not complete compulsory education

*- - - next page - - -*

Including yourself, how many people – including children – live here regularly as members of this household? [filter] *(note: drop down menu)*

1

…

10

*- - - next page - - -*

[filter] And how many of these are children aged under 16? *(note: drop down menu)*

0

1

…

10

*- - - next page - - -*

Do you have any children under the age of 16, who do not currently live in your household? *(note: single choice)*

Yes.

No.

Do you have grandchildren under the age of 16? *(note: single choice)*

Yes.

No.

*- - - next page - - -*

Which of these descriptions best describes your situation (in the last seven days)? *(note: single choice)*
*Please select only one.*

In paid work, e.g. employment, self-employment, working for your family business (or away temporarily)

In training, for example school, apprenticeship or study (not paid by the employer), even if on vacation

Unemployed and actively looking for a job

Doing housework, looking after children, or other persons

Retired

Permanently sick or disabled

In community or miliary service

Other

Don’t know

*- - - next page - - -*

Which of the following describes your household’s total annual income after tax and compulsory deductions, from all sources? If you don’t know the exact figure, please give an estimate. *(note: single choice, country specific categories)*

£12,100 or less

£12,101 - £16,800

£16,801 - £21,400

£21,401 - £26,200

£26,202 - £31,800

£31,801 - £37,800

£37,801 - £45,400

£45,401 - £55,300

£55,301 - £72,500

£72,501 or more

Prefer not to answer

*- - - next page - - -*

**Thinking about your own health and wellbeing…**

How is your health in general? Would you say it is… *(note: single choice)*

Very bad

Bad

Fair

Good

Very good

Prefer not to answer

Are you hampered in your daily activities in any way by any longstanding illness, or disability, infirmity or mental health problem? *(note: single choice)*

No.

Yes, to some extent.

Yes, a lot.

Prefer not to answer.

*- - - next page - - -*

Please indicate for each of the five statements which is closest to how you have been feeling over the last two weeks.

| | At no time | Some of the time | Less than half of the time | More than half of the time | Most of the time | All of the time | Prefer not to answer |
|---|---|---|---|---|---|---|---|
| I have felt cheerful and in good spirits. | O | O | O | O | O | O | O |
| I have felt calm and relaxed. | O | O | O | O | O | O | O |
| I have felt active and vigorous. | O | O | O | O | O | O | O |
| I woke up feeling fresh and rested. | O | O | O | O | O | O | O |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| My daily life has been filled with things that interest me. | O | O | O | O | O | O | O |

- - - *next page* - - -

During the <u>past 7 days</u>, how much have you been bothered by any of the following problems?

| | 0 = not at all | 1 | 2 | 3 | 4 = very much | Prefer not to answer |
|---|---|---|---|---|---|---|
| Stomach and bowel problems | O | O | O | O | O | O |
| Back pain | O | O | O | O | O | O |
| Pain in your arms, legs, or joints | O | O | O | O | O | O |
| Headaches | O | O | O | O | O | O |
| Chest pain or shortness of breath | O | O | O | O | O | O |
| Dizziness | O | O | O | O | O | O |
| Feeling tired or having low energy | O | O | O | O | O | O |
| Trouble sleeping | O | O | O | O | O | O |
| Brain fog (e.g. poor concentration, slow thinking) | O | O | O | O | O | O |

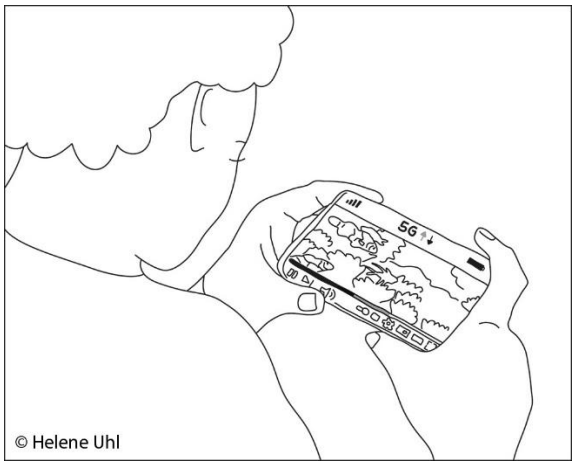
- - - *next page* - - -

**Please read the following text:**

5G is the latest mobile technology and was first widely rolled out in Europe in 2019. It enables faster data transfer (e.g. downloading films quicker, better quality video calls) compared to previous mobile technologies (e.g., 3G/4G).

Like previous mobile technologies, 5G phone networks rely on radio waves to transmit voice and data between 5G base stations (i.e. mobile communication antennas) and mobile phones (and other devices).

Several technological innovations have been introduced in 5G networks, including the use of higher-frequency radio waves than in traditional mobile networks, allowing more devices to access the internet simultaneously and transmit data at higher speeds.




*- - - next page - - -*

**Thinking about your own use of mobile phones…**

What device are you using to complete this survey? *(note: single choice)*

Desktop computer

Laptop

Smartphone

Tablet

Other

What type or internet connection are you using to complete this survey? *(note: single choice)*

Wired (connected to router via cable)

WiFi

3G/4G

5G

Other

Unsure

To your knowledge, do you use 5G on your mobile phone? *(note: single choice)*

No.

Yes.

Unsure.

*- - - next page - - -*

**Thinking specifically about your views on 5G technology…**

Please select the applicable option.

| | 1 = Strongly disagree | 2 | 3 | 4 = Neither agree nor disagree | 5 | 6 | 7 = Strongly agree |
|---|---|---|---|---|---|---|---|
| I know a lot about 5G technology. | O | O | O | O | O | O | O |

Please select the applicable option.

| | 1 = Not well at all | 2 | 3 | 4 | 5 | 6 | 7 = Very well |
|---|---|---|---|---|---|---|---|
| How well have you been informed about 5G technology? | O | O | O | O | O | O | O |

*- - - next page - - -*

How do you think the introduction of 5G technology affects… [filter]

| | -3 = Very negatively | -2 | -1 | 0 = Neither negatively nor positively | +1 | +2 | +3 = Very positively |
|---|---|---|---|---|---|---|---|
| … you personally? | O | O | O | O | O | O | O |
| … society as a whole? | O | O | O | O | O | O | O |

When we use the term "5G", we are talking about … *(note: single choice)*

… a newly available brand of mobile phone.

… a mobile app that uses artificial intelligence to increase productivity.

… a mobile phone communication technology that allows high rates of data transfer.

*- - - next page - - -*

[filter] What is your main reason for viewing the introduction of 5G as positive for you personally?[†] *(note: single choice)*

Better availability/network coverage

Increased speed (faster downloads, quicker uploads)

I prefer to use the most advanced technology available

I consider 5G to be better value for money than conventional mobile technologies

Sustainability/energy efficiency reasons

Other

I haven't thought about it

*- - - next page - - -*

filter What is your main reason for viewing the introduction of 5G as negative for you personally?† *(note: single choice)*

I am not able to benefit from 5G due to lack on availability/network coverage in my area or on my mobile phone

The speed of conventional mobile technologies (e.g. 3G/4G) are sufficient for my current needs

I prefer to use technologies that are familiar to me

5G is currently not affordable to me

Concerns about the environmental impact of antennas/base stations

Antennas/base stations are visually unappealing

Concerns about health

Less in-person services (e.g. banks, high street shops)

I haven't thought about it

Other

*- - - next page - - -*

filter What is your main reason for viewing the introduction of 5G as positive for society as a whole?† *(note: single choice)*

Increased productivity

Increased economic growth

Increased connectivity

The development of new applications and services

Sustainability/energy efficiency reasons

Strengthening e-Health (e.g. telemedicine, telesurgery)

Higher profits for companies

Other

I haven't thought about it

*- - - next page - - -*

filter What is your main reason for viewing the introduction of 5G as negative for society as a whole?† *(note: single choice)*

Higher data / energy consumption

Less in-person interactions

Antennas/base stations are visually unappealing

Concerns about the environmental impact of antennas/base stations

Decreased productivity

Loss of traditional in-person services (e.g. banks, high street shops)

Greater cost to the consumer

Negative effects on human health

Other

I haven't thought about it

*- - - next page - - -*

**Please read the following text:**

Mobile communications whether 2nd Generation (2G), 3rd Generation (3G), 4th Generation (4G) or 5th Generation (5G) uses radio waves to transmit data to and from mobile phones and other devices. These radio waves can also be called electromagnetic fields (EMFs).

You will now be asked questions about what you think about these electromagnetic fields (EMFs) – and what you think about 5G.

*- - - next page - - -*

Thinking about 5G …
*Please indicate whether you believe the following statements are right or wrong.*

| | Yes, I believe this is right. | No, I believe this is wrong. | I don't know |
|---|---|---|---|
| 5G technology exists in parallel to earlier mobile communications technology (such as 3G or 4G). | O | O | O |
| The number of mobile communication antennas is increasing due to the introduction of 5G. | O | O | O |
| With the introduction of 5G, people are exposed to a different type of electromagnetic field (EMFs). | O | O | O |

I am in favour of the expansion of the 5G network.

| 1 = Completely disagree | 2 | 3 | 4 = No opinion either way | 5 | 6 | 7 = Completely agree |
|---|---|---|---|---|---|---|
| O | O | O | O | O | O | O |

*- - - next page - - -*

Please answer the following questions.

| | 1 = Not at all | 2 | 3 | 4 = Moderately | 5 | 6 | 7 = To a very high degree |
|---|---|---|---|---|---|---|---|
| How much do you think you are exposed to electromagnetic fields (EMFs) from mobile communications devices and mobile phone masts (incl. 5G technology) in your everyday life? | O | O | O | O | O | O | O |

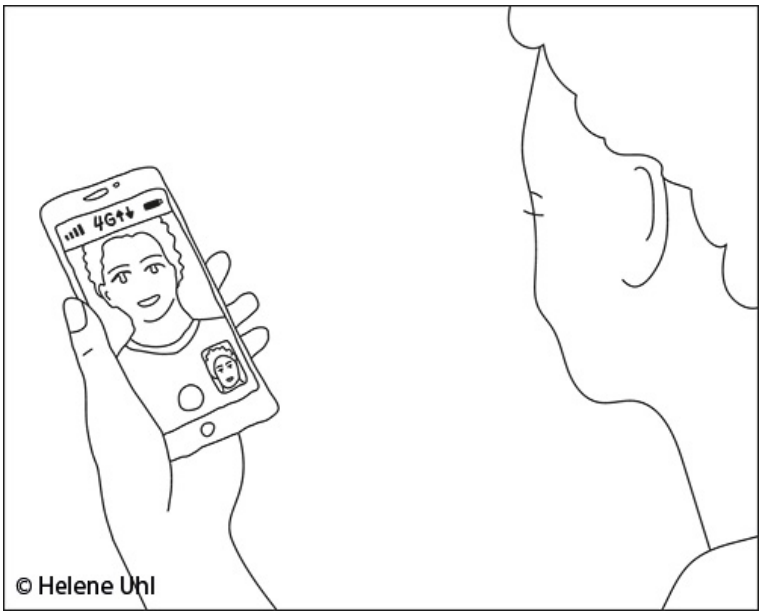
| | 1 = Decreases very much | 2 | 3 | 4 = Stays the same | 5 | 6 | 7 = Increases very much |
|---|---|---|---|---|---|---|---|
| How much do you think people's exposure to electromagnetic fields (EMFs) changes due to the introduction of 5G? | O | O | O | O | O | O | O |

*- - - next page - - -*

In the following you will be shown several pictures in sets of two or three. Please look at them carefully. After each picture, you will be asked to rate on a scale from 1 to 10 how much the person pictured is exposed to electromagnetic fields (EMFs).

Please only consider sources of EMFs that can be seen in the pictures.

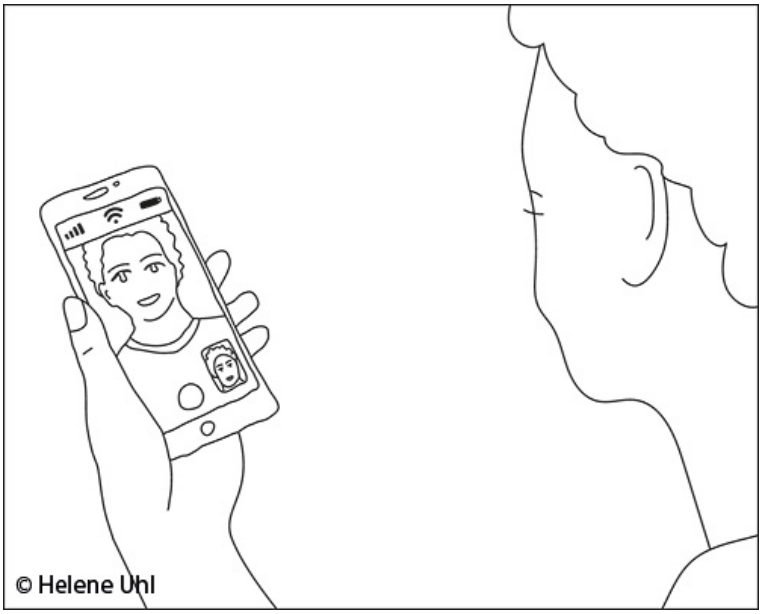
*- - - next page - - -*




The person pictured is talking to another person via video calling (4G connection).

How much do you think the person pictured is exposed to EMFs (4G connection)?

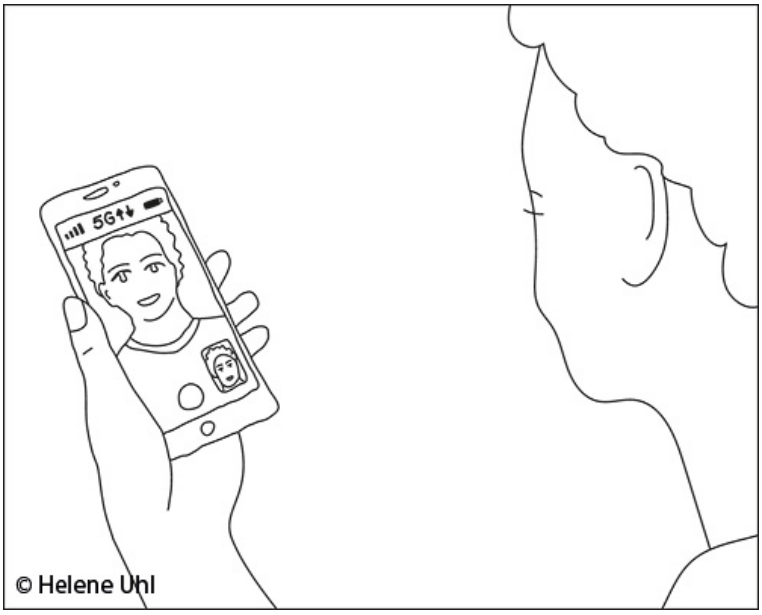
| 1 = not at all | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 = very much |
|---|---|---|---|---|---|---|---|---|---|
| O | O | O | O | O | O | O | O | O | O |




The person pictured is talking to another person via video calling (Wi-Fi connection).

How much do you think the person pictured is exposed to EMFs (Wi-Fi connection)?

| 1 = not at all | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 = very much |
|---|---|---|---|---|---|---|---|---|---|
| O | O | O | O | O | O | O | O | O | O |




The person pictured is talking to another person via video calling (5G connection).

How much do you think the person pictured is exposed to EMFs (5G connection)?

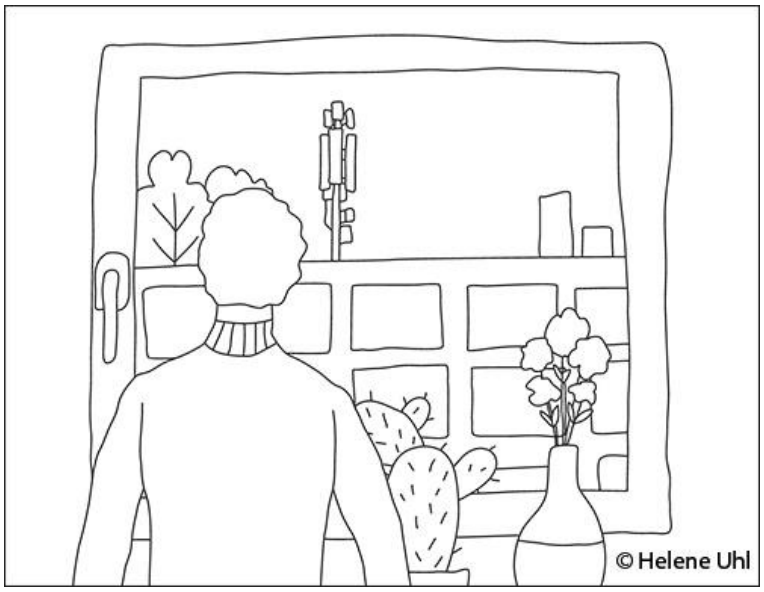
| 1 = not at all | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 = very much |
|---|---|---|---|---|---|---|---|---|---|
| O | O | O | O | O | O | O | O | O | O |

*- - - next page - - -*


The person pictured is looking out of the window at a house with one 4G mobile communication antenna on the roof.

How much do you think the person pictured is exposed to EMFs (one 4G antenna)?

| 1 = not at all | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 = very much |
|---|---|---|---|---|---|---|---|---|---|
| O | O | O | O | O | O | O | O | O | O |



The person pictured is looking out of the window at a house with one mobile communication antenna (4G and 5G) on the roof.

How much do you think the person pictured is exposed to EMFs (one 4G and 5G antenna)?

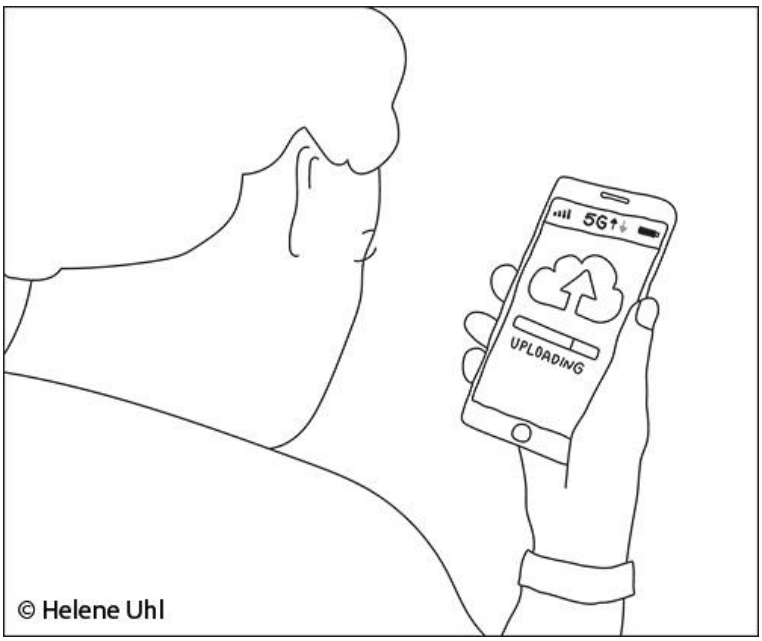
| 1 = not at all | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 = very much |
|---|---|---|---|---|---|---|---|---|---|
| O | O | O | O | O | O | O | O | O | O |


The person pictured is looking out of the window at a house with three mobile communication antennas (4G and 5G) on the roof.

How much do you think the person pictured is exposed to EMFs (three 4G and 5G antennas)?

| 1 = not at all | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 = very much |
|---|---|---|---|---|---|---|---|---|---|
| O | O | O | O | O | O | O | O | O | O |

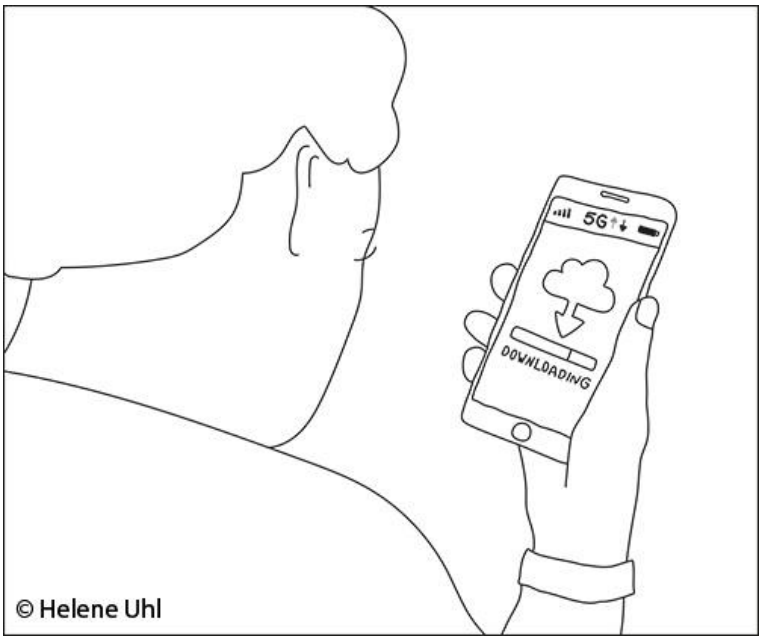
*- - - next page - - -*




The person pictured is uploading a file.

How much do you think the person pictured is exposed to EMFs (uploading a file)?

| 1 = not at all | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 = very much |
|---|---|---|---|---|---|---|---|---|---|
| O | O | O | O | O | O | O | O | O | O |




The person pictured is downloading a file.

How much do you think the person pictured is exposed to EMFs (downloading a file)?

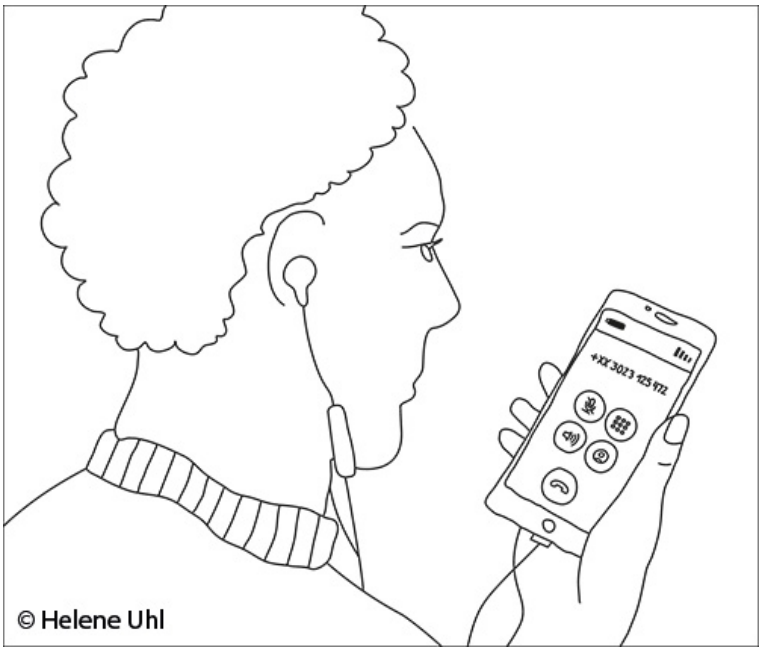
| 1 = not at all | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 = very much |
|---|---|---|---|---|---|---|---|---|---|
| O | O | O | O | O | O | O | O | O | O |

*- - - next page - - -*


The person pictured is making a phone call with their mobile phone at their ear.

How much do you think the person pictured is exposed to EMFs (phone call at ear)?

| 1 = not at all | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 = very much |
|---|---|---|---|---|---|---|---|---|---|
| O | O | O | O | O | O | O | O | O | O |




The person pictured is making a phone call with a headset.

How much do you think the person pictured is exposed to EMFs (phone call with headset)?

| 1 = not at all | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 = very much |
|---|---|---|---|---|---|---|---|---|---|
| O | O | O | O | O | O | O | O | O | O |

*- - - next page - - -*


The person pictured (front left in grey) is sitting on a train, surrounded by other people (one using a mobile phone).

How much do you think the person pictured (front left in grey) is exposed to EMFs (one person using a mobile phone)?

| 1 = not at all | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 = very much |
|---|---|---|---|---|---|---|---|---|---|
| O | O | O | O | O | O | O | O | O | O |


The person pictured (front left in grey) is sitting on a train, surrounded by other people (four using mobile phones).

How much do you think the person pictured (front left in grey) is exposed to EMFs (four using mobile phones)?

| 1 = not at all | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 = very much |
|---|---|---|---|---|---|---|---|---|---|
| O | O | O | O | O | O | O | O | O | O |

*- - - next page - - -*

In general, which part of the mobile phone infrastructure (such as mobile phones and masts) do you think exposes mobile phone users more to electromagnetic fields (EMFs)?† *(note: single choice)*

Mobile phone masts

Mobile phones

Both the same

Don't know

In general, which mobile communications technology (4G or 5G) do you think exposes mobile phone users more to EMFs? † *(note: single choice)*
*Please consider both mobile phones and mobile phone masts when answering this question.*

4G

5G

Both the same

Don't know

In general, where are mobile phone users more exposed to EMFs when making a phone call – indoors or outdoors? † *(note: single choice)*

Indoors

Outdoors

Both the same

Don't know

Mobile phones both transmit and receive signals. In general, the user is more exposed to EMFs from the mobile phone in situations when …† *(note: single choice)*

… the phone is receiving data (downloading).

… the phone is transmitting data (uploading).

Both the same

Don't know

*- - - next page - - -*

Please select the applicable option.

| | 1 = Strongly disagree | 2 | 3 | 4 = Neither agree nor disagree | 5 | 6 | 7 = Strongly agree |
|---|---|---|---|---|---|---|---|
| I know a lot about the relationship between 5G technology and health. | O | O | O | O | O | O | O |

*- - - next page - - -*

To what extent do you agree or disagree with the following statements?

| | 1 = Strongly disagree | 2 | 3 | 4 = Neutral | 5 | 6 | 7 = Strongly agree |
|---|---|---|---|---|---|---|---|
| Scientific knowledge about the relationship between 5G technology and health is rarely certain. | O | O | O | O | O | O | O |
| Results of scientific research on the relationship between 5G technology and health are not yet definitive. | O | O | O | O | O | O | O |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Scientific knowledge about the possible effects of 5G on health is constantly changing. | O | O | O | O | O | O | O |
| The current scientific understanding about the relationship between 5G technology and health may, in the future, be shown to be false. | O | O | O | O | O | O | O |

- - - *next page* - - -

During recent interviews with members of the public, the following statements about 5G technology and health came up. To what extent do you agree or disagree with them?

| | 1 = Strongly disagree | 2 | 3 | 4 | 5 | 6 = Strongly agree | 7 = I don't know |
|---|---|---|---|---|---|---|---|
| "Higher frequency electromagnetic fields (EMFs) are potentially more dangerous to health than lower frequency EMFs." | O | O | O | O | O | O | O |
| "Most experts now agree that the electromagnetic fields (EMFs) emitted by 5G technologies are probably dangerous for people's health." | O | O | O | O | O | O | O |
| "Most experts think that exposure to electromagnetic fields (EMFs) from 5G technologies is less dangerous for health than air pollution." | O | O | O | O | O | O | O |
| "The highest frequency electromagnetic fields (EMFs) emitted by 5G phones can penetrate the brain." | O | O | O | O | O | O | O |
| "Living in an area with more 5G mobile phone antennas puts people at significantly greater risk of health problems." | O | O | O | O | O | O | O |
| "Telecommunications engineers working in mobile phone antennas can suffer from burns if an antenna is not switched off during their task." | O | O | O | O | O | O | O |

*- - - next page - - -*

During recent interviews with members of the public, the following statements about 5G technology and health came up. To what extent do you agree or disagree with them?

| | 1 = Strongly disagree | 2 | 3 | 4 | 5 | 6 = Strongly agree | 7 = I don't know |
|---|---|---|---|---|---|---|---|
| "Most experts are confident that with each new generation of mobile phone technologies, the risk to human health has increased." | O | O | O | O | O | O | O |
| "Holding a mobile phone directly to your ear during a call using 5G can cause skin to heat up." | O | O | O | O | O | O | O |
| "Holding a mobile phone directly to your ear during a call can heat tissue in the inner ear or brain." | O | O | O | O | O | O | O |
| Please check the box "strongly agree". | O | O | O | O | O | O | O |
| "Heating of the skin has negative impacts on health." | O | O | O | O | O | O | O |
| "Heating of the inner ear or brain has negative impact on health." | O | O | O | O | O | O | O |

*- - - next page - - -*

**Thinking about 5G technology and health…**

How often in your daily life do you…

| | 1 = Never | 2 | 3 | 4 = Sometimes | 5 | 6 | 7 = Very often |
|---|---|---|---|---|---|---|---|
| … think about possible risks of 5G technology-related EMFs to health? | O | O | O | O | O | O | O |
| … follow media coverage (e.g. newspapers, TV, Facebook, Twitter, Reddit, blogs) on the possible risks of 5G technology-related EMFs to health? | O | O | O | O | O | O | O |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| … talk about possible risks of 5G technology-related EMFs to health (including in conversation, via Facebook, twitter, chat, online forum or similar)? | O | O | O | O | O | O | O |

*- - - next page - - -*

Do you consider yourself to be particularly sensitive to the electromagnetic fields (EMFs) associated with 5G technology? [filter] *(note: single choice)*

No

Yes

Prefer not to answer

*- - - next page - - -*

[filter] Do you consider that you experience any of the following symptoms due to electromagnetic fields (EMFs) associated with 5G technology? [†] *(note: multiple choice)*
You can select more than one answer.

Psychological [e.g. anxiety, depression, difficultly concentrating, memory difficulties, fatigue, stress]

Skin sensitivity [e.g. skin irritation, skin rash]

Skin sensations [e.g. burning, numbness, tingling, facial pricking]

Respiratory [e.g. asthma, breathing difficulties, hoarse dry throat, dry cough]

Sensory changes [e.g. impaired sense of smell, impaired sense of taste]

Pain [e.g. back pain, joint pain, headaches, migraines]

Cardiac [e.g. heart palpations, high blood pressure]

Sensations in the head [e.g. warmth in head, heaviness in head, pressure in ear]

Digestive issues [e.g. irritable bowel syndrome, nausea]

Other symptoms

None of the above

Prefer not to answer

[filter] Please select the applicable option.

| | 1 = No impact at all | 2 | 3 | 4 = Moderate impact | 5 | 6 | 7 = Extremely high impact | Prefer not to answer |
|---|---|---|---|---|---|---|---|---|
| What impact do these symptoms have on your everyday life? | O | O | O | O | O | O | O | O |

filter How frequently do you experience these symptoms due to electromagnetic fields (EMFs) associated with 5G technology? *(note: single choice)*

Several times a week

Once or twice a week

Fortnightly

Monthly

Every few months

Once or twice a year

Lass than that or never

Prefer not to answer

*- - - next page - - -*

What percentage of the population do you believe is sensitive to 5G technology-related electromagnetic fields (EMFs)?
*By 'sensitive' we mean, that some people experience unpleasant symptoms (e.g. headache, nausea, concentration problems, palpitation, etc.) when they are around electromagnetic fields (e.g. near electric devices, computers, power lines, or during mobile phone calls).*

*Please enter a whole number from 0 to 100.*
*Please note: This question can be skipped if you feel unable to provide an estimate.*

_____ %

*- - - next page - - -*

How serious are the potential health risks for you <u>personally</u> from electromagnetic fields (EMFs) related to the following technologies?†

| | 1 = Not at all serious | 2 | 3 | 4 = Somewhat serious | 5 | 6 | 7 = Extremely serious |
|---|---|---|---|---|---|---|---|
| 5G mobile technologies | O | O | O | O | O | O | O |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Older mobile technologies (3G/4G) | O | O | O | O | O | O | O |
| Wi-Fi | O | O | O | O | O | O | O |
| Microwave ovens | O | O | O | O | O | O | O |
| Power lines | O | O | O | O | O | O | O |
| Radio | O | O | O | O | O | O | O |
| TV | O | O | O | O | O | O | O |

*- - - next page - - -*

How serious are the potential health risks to the general public from electromagnetic fields (EMFs) related to the following technologies?[†]

| | 1 = Not at all serious | 2 | 3 | 4 = Somewhat serious | 5 | 6 | 7 = Extremely serious |
|---|---|---|---|---|---|---|---|
| 5G mobile technologies | O | O | O | O | O | O | O |
| Older mobile technologies (3G/4G) | O | O | O | O | O | O | O |
| Wi-Fi | O | O | O | O | O | O | O |
| Microwave ovens | O | O | O | O | O | O | O |
| Power lines | O | O | O | O | O | O | O |
| Radio | O | O | O | O | O | O | O |
| TV | O | O | O | O | O | O | O |

*- - - next page - - -*

How serious are the potential health risks to children from electromagnetic fields (EMFs) related to the following technologies? [†]

| | 1 = Not at all serious | 2 | 3 | 4 = Somewhat serious | 5 | 6 | 7 = Extremely serious |
|---|---|---|---|---|---|---|---|
| 5G mobile technologies | O | O | O | O | O | O | O |
| Older mobile technologies (3G/4G) | O | O | O | O | O | O | O |
| Wi-Fi | O | O | O | O | O | O | O |
| Microwave ovens | O | O | O | O | O | O | O |
| Power lines | O | O | O | O | O | O | O |
| Radio | O | O | O | O | O | O | O |
| TV | O | O | O | O | O | O | O |

*- - - next page - - -*

To what extent do you agree or disagree with the following statements?

| | 1 = Strongly disagree | 2 | 3 | 4 = Neither agree nor disagree | 5 | 6 | 7 = Strongly agree |
|---|---|---|---|---|---|---|---|
| "I consider myself at risk of experiencing potential health impacts from EMFs related to 5G technology." | O | O | O | O | O | O | O |
| "I think I have a high chance of experiencing negative health impacts due to EMFs related to 5G technology." | O | O | O | O | O | O | O |
| "I am unlikely to experience any negative health impacts due to EMFs related to 5G technology." | O | O | O | O | O | O | O |

*- - - next page - - -*

How much might using 5G technologies contribute to the following health issues?

| | 1 = Not at all | 2 | 3 | 4 = Moderately | 5 | 6 | 7 = Very much |
|---|---|---|---|---|---|---|---|
| The spread of infectious viruses (e.g. Coronavirus) | O | O | O | O | O | O | O |
| Cancer | O | O | O | O | O | O | O |
| Reproductive issues (e.g. infertility, miscarriage) | O | O | O | O | O | O | O |
| General health conditions (e.g. headaches, stomach aches, insomnia) | O | O | O | O | O | O | O |
| Developmental conditions in children | O | O | O | O | O | O | O |
| Skin/tissue heating (e.g. or the inner ear) | O | O | O | O | O | O | O |
| Mental health problems (e.g. anxiety, depression) | O | O | O | O | O | O | O |

*- - - next page - - -*

To what extent do you agree or disagree with the following statements.

| | 1 = Completely disagree | 2 | 3 | 4 = Neutral | 5 | 6 | 7 = Completely agree |
|---|---|---|---|---|---|---|---|
| I trust scientists to provide reliable information about possible effects of 5G technology on health. | O | O | O | O | O | O | O |
| Current 5G technology regulations are sufficient to protect human health. | O | O | O | O | O | O | O |

*- - - next page - - -*

What percentage of the public do you believe are concerned about possible effects of 5G technology on health?
*Please give a whole number from 0 to 100.*
*Please note: This question can be skipped if you feel unable to provide an estimate.*

_____ %

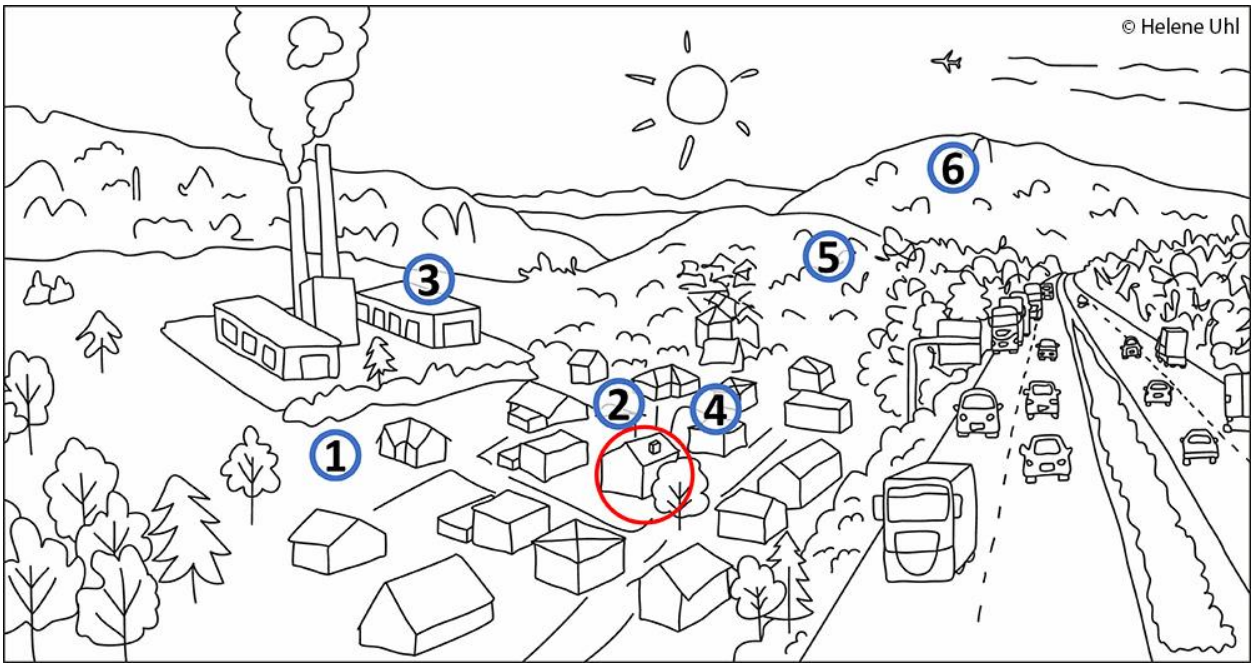
*- - - next page - - -*

**Please read the following text:**

Now we would like you to put yourself in a situation where a new mobile phone mast will be erected. Imagine that you live in the house circled in red. Six possible locations have been identified for the new mast. They are marked and numbered on the map.

For your information: At the moment you have only 2G reception at your home, which means you can call and write text messages, but can only use the internet via mobile data to a very limited extent. With the new mobile phone mast, the village will have 4G and 5G coverage.

Please take a moment to look at the entire picture in detail.




Which location would you prefer for the new 4G/5G mobile phone mast? *(note: single choice)*

Location 1: The mobile phone mast is erected on the outskirts of the village and anchored to the ground.

Location 2: The mobile phone mast is erected on a nearby square and anchored to the ground.

Location 3: The mobile phone mast is erected on the roof of the factory.

Location 4: The mobile phone mast is erected on a nearby rooftop of a house.

Location 5: The mobile phone mast is erected on a hill near the village and anchored to the ground.

Location 6: The mobile phone mast is erected on a hill far outside the village and anchored to the ground.

How strongly did the following factors influence your choice of location?[†]

| | 1 = No influence at all | 2 | 3 | 4 = Moderately | 5 | 6 | 7 = Very strong influence |
|---|---|---|---|---|---|---|---|
| Reception | O | O | O | O | O | O | O |
| Distance | O | O | O | O | O | O | O |
| Electromagnetic fields (EMFs) | O | O | O | O | O | O | O |
| Visual appearance | O | O | O | O | O | O | O |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Other | O | O | O | O | O | O | O |

*- - - next page - - -*

**Please read the following information about mobile phones and mobile phone masts carefully:**

Since mobile phones and mobile phone masts interact with each other, mobile reception is worse the further away you are from the nearest mast. In addition, the further away a mast is, the stronger the mobile phone has to emit electromagnetic fields (EMFs) to send data.

We are usually much nearer to our mobile phones than we are to mobile phone masts. Therefore, people who regularly use a mobile phone are, overall, exposed more to EMFs from their mobile phones than from masts.

If you choose one of the urban locations (1, 2, 3, 4) for the mast, you will get 5G at full capacity. If the mast is placed at one of the more distant locations (5, 6), you will receive 5G with limited performance. This means that your data will be transmitted more slowly. We will show you the sketch again in a moment as a reminder.

*- - - next page - - -*

What did the text you just read state about the overall exposure and reception of regular mobile phone users?[†] *(note: multiple choice)*
Comparing mast that are closer or further away…
*Multiple answers can be selected.*

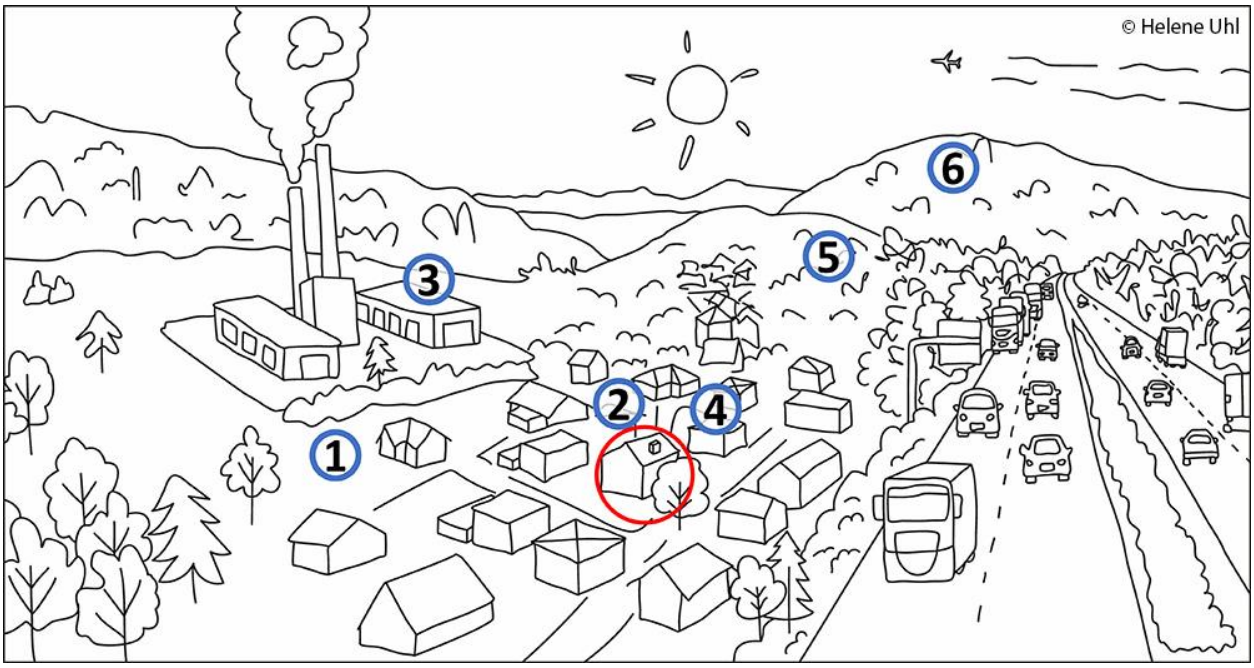
The reception is usually better if the mast is closer.

The overall exposure to EMFs is usually lower if the mast is closer.

The reception is usually worse if the mast is closer.

The overall exposure to EMFs is usually higher if the mast is closer.

Now that you have read the information on mobile phone and mast interaction, which location would you prefer for the new 4G/5G mobile phone mast? [filter] *(note: single choice)*




Location 1: The mobile phone mast is erected on the outskirts of the village and anchored to the ground.

Location 2: The mobile phone mast is erected on a nearby square and anchored to the ground.

Location 3: The mobile phone mast is erected on the roof of the factory.

Location 4: The mobile phone mast is erected on a nearby rooftop of a house.

Location 5: The mobile phone mast is erected on a hill near the village and anchored to the ground.

Location 6: The mobile phone mast is erected on a hill far outside the village and anchored to the ground.

- - - *next page* - - -

filter After reading the text, you chose a different location than before. How strongly did the following factors influence your second choice of location? †

| | 1 = No influence at all | 2 | 3 | 4 = Moderately | 5 | 6 | 7 = Very strong influence |
|---|---|---|---|---|---|---|---|
| Reception | O | O | O | O | O | O | O |
| Distance | O | O | O | O | O | O | O |
| Electromagnetic fields (EMFs) | O | O | O | O | O | O | O |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Visual appearance | O | O | O | O | O | O | O |
| Other | O | O | O | O | O | O | O |

***

The questionnaire was translated into: German, French, Spanish, Finnish, Polish, Slovenian, Serbian, and Greek.

### 8.3 Debriefing

Thank you for participating in this survey! The goal of the survey was:

1. To examine the general public's perception of 5G exposure.
2. To examine the general public's perception of the potential health effects of 5G exposure.

Regarding mobile phone electromagnetic fields (EMFs), the World Health Organization (WHO) says: “A large number of studies have been performed over the last two decades to assess whether mobile phones pose a potential health risk. To date, no adverse health effects have been established as being caused by mobile phone use. From all evidence accumulated so far, no adverse short- or long-term health effects have been shown to occur from the radio frequency signals [i.e. EMFs] produced by base stations.”

For more information on 5G and the potential health effects of 5G, visit the World Health Organization website: https://www.who.int/news-room/questions-and-answers/item/radiation-5g-mobile-networks-and-health (in English) and the UK Government website: https://www.gov.uk/government/collections/electromagnetic-fields (in English).

If you decide you no longer wish to participate in this study, you can request deletion of your data by providing your participant number "###". To do so, please contact the person listed below.

Your anonymous data will be stored and shared securely and can only be accessed by selected individuals at the three academic institutions involved in this project. Research papers may be published using this data, but again, you will not be personally identifiable in the research results. After the last scientific publication based on the data is published, or after 2030, the data collected in this survey will be made freely available to the public. This means that anyone can request to use the data for their own research or for commercial purposes. However, your responses will remain anonymous - you will not be personally identifiable in this dataset.

If you have any further questions or concerns about this study, please contact the person listed below:

Lead researcher: Prof. Dr. Christoph Böhmert, christoph.boehmert@iu.org

***

The debrief was translated into: German, French, Spanish, Finnish, Polish, Slovenian, Serbian, and Greek. The sources of information were adapted to each country by naming a local authority in addition to WHO as a source.

## 8.4 Quotas

### 8.4.1 Interlocking Quotas for Age & Gender

| | Austria | | Germany | | Spain | | France | | Finland | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Age** | **Female** | **Male** | **Female** | **Male** | **Female** | **Male** | **Female** | **Male** | **Female** | **Male** |
| **16-24** | 5,82 % | 6,18 % | 5,59 % | 6,08 % | 5,59 % | 5,93 % | 6,92 % | 7,25 % | 6,13 % | 6,49 % |
| **25-34** | 8,28 % | 8,66 % | 7,69 % | 8,25 % | 6,97 % | 7,07 % | 7,75 % | 7,48 % | 7,92 % | 8,44 % |
| **35-44** | 8,24 % | 8,37 % | 7,76 % | 7,93 % | 9,42 % | 9,41 % | 8,40 % | 8,00 % | 7,98 % | 8,47 % |
| **45-54** | 9,20 % | 9,13 % | 8,71 % | 8,80 % | 10,11 % | 10,19 % | 8,82 % | 8,59 % | 7,57 % | 7,79 % |
| **55-64** | 9,10 % | 8,92 % | 9,66 % | 9,54 % | 8,76 % | 8,39 % | 8,67 % | 8,07 % | 8,46 % | 8,28 % |
| **65+** | 9,84 % | 8,28 % | 10,73 % | 9,26 % | 9,78 % | 8,37 % | 10,83 % | 9,22 % | 12,01 % | 10,47 % |
| **Total** | 50,47% | 49,53% | 50,14 % | 49,86 % | 50,64 % | 49,36 % | 51,38 % | 48,62 % | 50,07 % | 49,93 % |

| | UK | | Greece | | Poland | | Serbia | | Slovenia | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Age** | **Female** | **Male** | **Female** | **Male** | **Female** | **Male** | **Female** | **Male** | **Female** | **Male** |
| **16-24** | 6,86 % | 7,24 % | 5,70 % | 6,29 % | 5,46 % | 5,73 % | 5,63 % | 5,96 % | 5,05 % | 5,63 % |
| **25-34** | 8,80 % | 8,90 % | 6,72 % | 6,95 % | 8,45 % | 8,77 % | 7,57 % | 7,94 % | 6,86 % | 7,90 % |
| **35-44** | 8,28 % | 8,16 % | 8,95 % | 8,95 % | 10,04 % | 10,32 % | 8,72 % | 8,97 % | 8,74 % | 9,93 % |
| **45-54** | 9,20 % | 8,93 % | 9,84 % | 9,29 % | 8,12 % | 8,11 % | 8,53 % | 8,39 % | 8,70 % | 9,41 % |
| **55-64** | 7,88 % | 7,62 % | 8,92 % | 7,91 % | 8,57 % | 7,84 % | 8,90 % | 8,06 % | 8,86 % | 8,91 % |
| **65+** | 50,54 % | 49,46 % | 51,24 % | 48,76 % | 51,34 % | 48,66 % | 51,31 % | 48,69 % | 48,96 % | 51,04 % |

The quotas are based on EU's statistical agency Eurostat, that provides statistics and data on the EU and its member states.

### 8.4.2 Quotas for Region

| Serbia | | Finland | | Austria | |
|---|---|---|---|---|---|
| Northern Serbia | 51,37 % | Manner-Suomi | 99,46 % | Ostösterreich | 43,88 % |
| Southern Serbia | 48,63 % | Åland | 0,54 % | Südösterreich | 20,25 % |
| | | | | Westösterreich | 35,87 % |

| Germany | | France | | UK | |
|---|---|---|---|---|---|
| Baden-Württemberg | 13,41 % | Île de France | 18,47 % | North East | 4,03 % |
| Bayern | 15,96 % | Centre - Val de Loire | 3,75 % | North West | 10,95 % |
| Berlin | 4,45 % | Bourgogne - Franche-Comté | 4,11 % | Yorkshire and The Humber | 8,23 % |
| Brandenburg | 2,99 % | Normandie | 4,89 % | East Midlands | 7,24 % |
| Bremen | 0,82 % | Hauts-de-France | 8,90 % | West Midlands | 8,76 % |
| Hamburg | 2,26 % | Grand Est | 8,33 % | East of England | 9,22 % |
| Hessen | 7,61 % | Pays-de-la-Loire | 5,65 % | London | 13,66 % |
| Mecklenburg-Vorpommern | 1,92 % | Bretagne | 5,00 % | South East | 13,61 % |
| Niedersachsen | 9,60 % | Nouvelle Aquitaine | 8,97 % | South West | 8,37 % |
| Nordrhein-Westfalen | 21,58 % | Occitanie | 8,89 % | Wales | 4,71 % |
| Rheinland-Pfalz | 4,96 % | Auvergne - Rhône-Alpes | 11,95 % | Scotland | 8,43 % |
| Saarland | 1,19 % | Provence-Alpes-Côte d'Azur | 7,47 % | Northern Ireland | 2,79 % |
| Sachsen | 4,71 % | Corse | 0,51 % | | |
| Sachsen-Anhalt | 2,57 % | DOM-ROM/COM/RUP FR | 3,12 % | | |
| Schleswig-Holstein | 3,47 % | | | | |
| Thüringen | 2,51 % | | | | |

| Spain | | Greece | | Poland | |
|---|---|---|---|---|---|
| Noroeste | 9,00 % | Attica (Athens) | 35,37 % | Poludniowy | 20,59 % |
| Noreste | 9,33 % | Aegean Island, Crete | 11,31 % | Pólnocno-Zachodni | 16,34 % |
| Comunidad de Madrid | 14,31 % | Northern Greece | 28,43 % | Poludniowo-Zachodni | 10,14 % |
| Centro | 11,46 % | Central Greece | 24,89 % | Pólnocny | 15,24 % |
| Este | 29,38 % | | | Centralny | 9,68 % |
| Sur | 21,54 % | | | Wschodni | 14,00 % |
| Canarias | 4,98 % | | | Województwo Mazowieckie | 14,02 % |

| Slovenia | |
|---|---|
| Slovenia | 100,00 % |

The quotas are based on EU's statistical agency Eurostat, that provides statistics and data on the EU and its member states.