The next 50 Years of Noise Control: UAVs and The Future of Urban Soundscape
Session 20

Sound, noise, annoyance? Information as a means to strengthen the public acceptance of civil drones

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ABSTRACT

Civil drones are becoming more and more present in public perception. Ranging from parcel delivery to wildlife protection and from precision farming to law enforcement, many applications are said to have the potential to transform markets. Due to this, nations and institutions around the world are trying to keep up with the dynamic technological developments by creating rules and regulations. Since all parties involved expect a strong increase in both the number of drones and the range of their uses, there is rising interest in the topic of public acceptance of these vehicles. Widespread acceptance can facilitate the dissemination of new technologies. Conversely, if citizens have concerns about the use of drones in their daily environment, it may hinder the proliferation of civil drones, especially in urban areas. The psychoacoustic properties of the vehicles have repeatedly been discussed as one such limiting factor. This paper discusses results of a representative national study on the social acceptance of civil drones, taking a closer look at the effects of information about drones as a potential means to foster public acceptance. The findings highlight the role of well-planned information campaigns as well as community engagement in ***managing the contribution of drones in future urban soundscapes.***

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1. INTRODUCTION

The concept of soundscape emerged in the second half of the 20th century in the attempt to describe the acoustic or sonic [1] environment perceived by people in analogy to the visual impression of one's surroundings as expressed by the term landscape. Today the term of soundscape is well established and often used in reference to urban environments, representing a mixture of sounds mostly from technological sources [2]. According to ISO 'Soundscape exists through human perception of the acoustic environment [3]. As unwanted sound is described as noise, and its (potential) emotional outcome among people as noise annoyance, using the term soundscape puts emphasis more on the general stimuli but on their immediate effect on human beings.

However, as the saying goes: 'There is more to the picture than meets the eye' [4]. Similarly, when referring to sound, one could also say that soundscape is more than meets the ear. Not only can the identical soundscape lead to different effects in different people, it can also result in different effects in the same person, depending on aspects such as biological rhythm, varying prioritization of personal goals, and current psychological state [5. In the next 50 years, such psychoacoustic aspects require substantially more scientific investigation in order to shed light on the two-thirds of variance in noise annoyance that for the time being cannot be explained by pure sound pressure level and related physical measures [6, p.45]. Concerning the acoustic effects of drones according to NASA, 'the role of non-acoustic factors to human response to UAM operations is still unknown' [7, p.28]. That issue needs to be addressed.

A recent nationwide study found the public acceptance of civil drones in Germany to be slightly more in favor of drones than opposed to them in general [8]. More detailed analysis revealed noise concerns to play a prominent role in explaining social acceptance, although noise was reported least out of all the concerns that were assessed. There was also an indication that the state of information on subject matter (ISM) could be a potential factor for influencing public acceptance [9]. The present paper aimed at examining this notion in more detail and to find out whether ISM could have the potential to alter the chain from sound to annoyance.

2. METHOD

The study was conceptualized at DLR German Aerospace Center and a prototype fielded early in 2018 by infas Institute for Applied Social Sciences (Bonn, Germany) as a Computer Assisted Telephone Interview (CATI). Using a dual-frame technique with 70% landline and 30% mobile phones, a random digital-dial design was used with the aim of reaching conclusive results representative for the German population.

Questions were asked in a standardized manner by specially trained employees in interviews with a duration of about 20 minutes. The answers were directly coded online according to the appropriate template. For quality assurance, online supervision could be performed occasionally by senior staff listening in on the calls. The study fully adhered to the professional code of conduct for telephone interviews agreed on in Germany [10].

Eight hundred thirty-two respondents took part in the study, which was conducted between March and May 2018, and answered all questions. Respondents were 51.8% male and 48.2% female, with ages ranging from 14 to 94 years (M = 51.5 years, SD = 18.2 years), and the average size of household was 2.5 persons (SD = 1.3 persons). The response rate was calculated at 3.8% following statistical procedures published by the American Association for Public Opinion Research [11]. Further information on the response rate and sampling procedures, as well as detailed results, can be found in [8].

During the interview, a set of 26 questions concerning various aspects of public acceptance were asked, including associations with the term drone, personal experiences, individual support of potential uses, personal concerns, and thoughts about general regulation. In addition, sociodemographic information was requested. Another question inquired about the respondents' subjective level of information about civil drones and their uses (Original German question: 'Wie gut fühlen sie sich insgesamt über zivile Drohnen und deren Einsatzmöglichkeiten informiert?'). In the following text, when analyzing and discussing the effect of knowledge on drone acceptance, it refers to the responses to this particular question.

3. RESULTS

3.1. Attitude towards civil drones in Germany

After being asked for their associations with the term drone in a first question, study participants were informed that the drones referred to in the remainder of the interview were unmanned aircraft that look like small helicopters with several rotors, typically four or more, and that only civil applications were relevant for this study. They were then asked how they would describe their general attitude towards civil drones, specifically, whether it was rather positive or rather negative. If they could not decide, the answer was coded as "undecided." Very few respondents refused to answer certain questions. For the sake of simplicity, those reactions were combined with "undecided" into one category, "undecided/refused."

Although there was a somewhat even distribution of negative and positive responses to civil drones, there was a slight advantage on the positive side (43% rather negative, 49% rather positive, and about 8% undecided, see Figure 1).

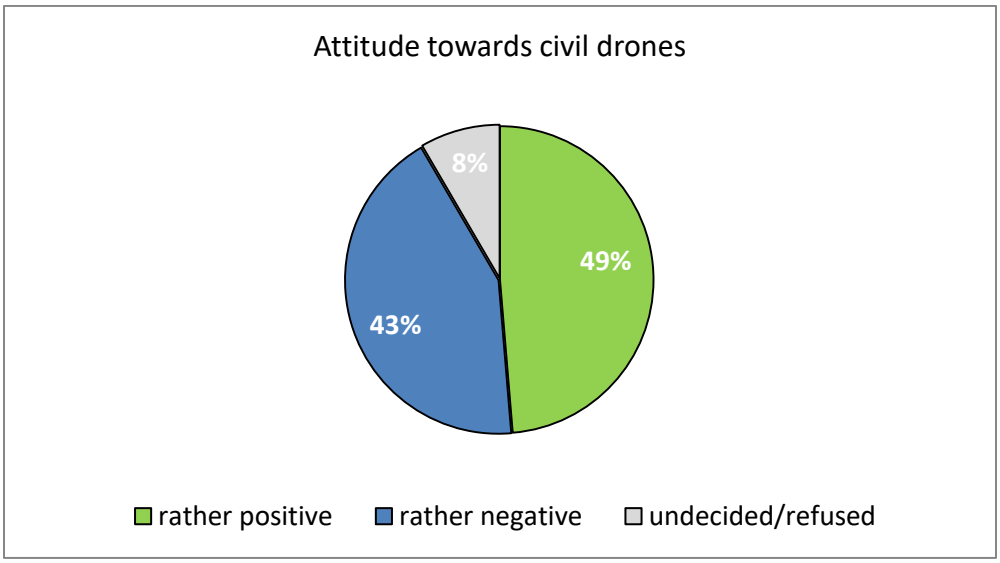

Figure 1: Attitude towards civil drones

In addition to this overall pattern, it has to be mentioned that the results varied in accordance with with several sociodemographic factors, such as gender, age, and place of residence. For instance, male respondents had a more positive attitude toward civil drones than female respondents, and younger study participants showed higher acceptance rates than older ones.

3.2. Knowledge about drones

When asked whether they felt informed about civil drones and their uses, about half of the respondents indicated that they felt "very well informed" (11.7%) or "somewhat informed" (40.6%) (see Figure 2). The remaining categories represented those who felt less informed. These accounted for 33.2% ("little informed") and 13.9% ("not informed at all"), and 0,5% undecided respondents ("do not know").

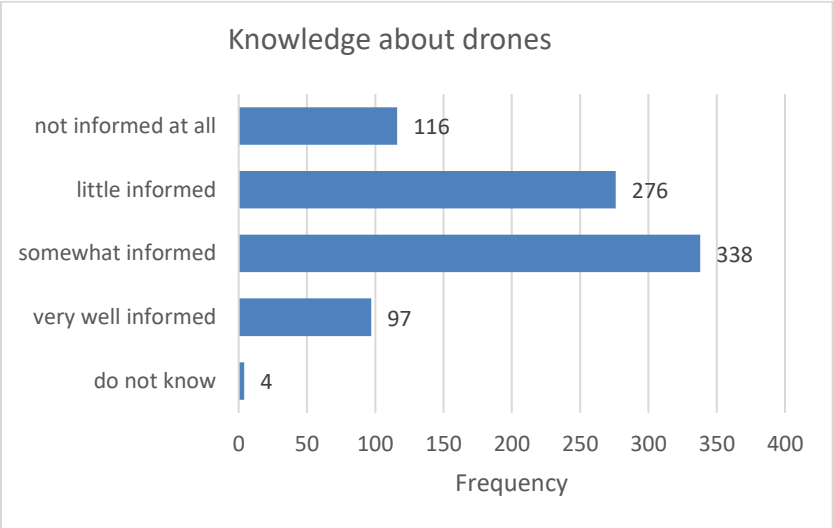

Figure 2: Knowledge about drones

Again, the results varied in accordance with sociodemographic factors such as gender and age. Male respondents reported better knowledge of civil drones than female respondents, and younger study participants asserted better knowledge than older participants. The results did not vary with respect to place of residence.

Figure 3 shows the distribution of knowledge about civil drones and their uses for the different levels of drone acceptance. An analysis of these data revealed a small but significant Spearman's rank correlation (two-tailed) of $r_s = .18$, $p < .001$, between drone acceptance and knowledge about drones and their uses. This relationship indicated that higher acceptance is associated with a better knowledge level. Descriptively, this correlation was higher than the correlation between knowledge and age, $r_s = .12$, $p = .001$, but lower than the correlation between knowledge and gender, $r_s = .23$, $p < .001$. The pattern for the correlations between drone acceptance and age, $r_s = .16$, $p < .001$, as well as drone acceptance and gender, $r_s = .23$, $p < .001$, was quite similar. Both knowledge and acceptance were higher for younger and male respondents. Please note that even though, in principle, Spearman's rho should not be applied to nominal variables, we calculated this index for relationships including "gender" in order to get an impression of the association of this variable with knowledge and attitude that is comparable to the other relationships reported in this section

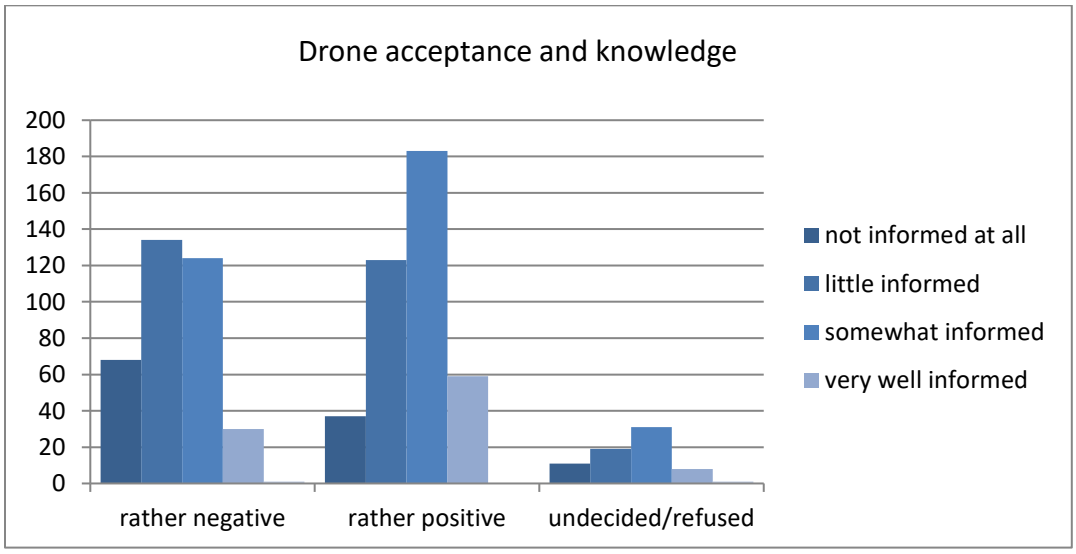

Figure 3: Drone acceptance and knowledge about drones

In addition to the absolute numbers displayed in Figure 3, Figure 4 shows the distribution of drone acceptance in percent for the different categories of knowledge. This further illustrates that subjects who described themselves as being better informed about drones in general more frequently reported a positive attitude towards these vehicles.

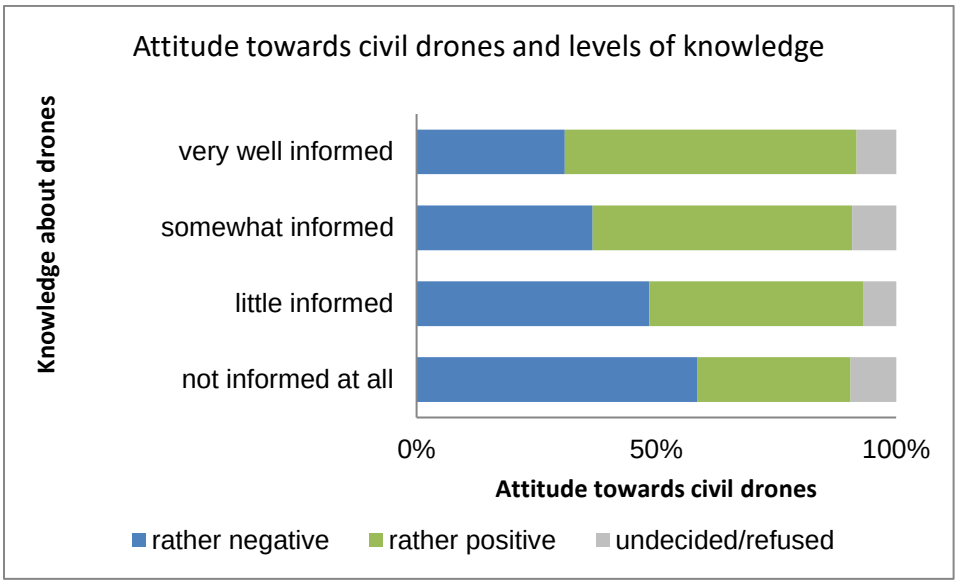

Figure 4: Attitude towards civil drones, separated by reported knowledge level

Being informed about civil drones also has an influence on which concerns people have about drones. When examining whether there is a difference in reported knowledge levels between people who are concerned about drones and those who are not, statistical analysis revealed significant group differences for concerns about animal welfare, liability and insurance, crime and misuse, violation of privacy, damages and injuries, and noise. In each case, respondents who were less informed about drones were more concerned about these issues than those who consider themselves more informed about drones. As can be seen in Figure 5, subjects who described themselves as being better informed about drones in general less frequently reported concerns about noise.

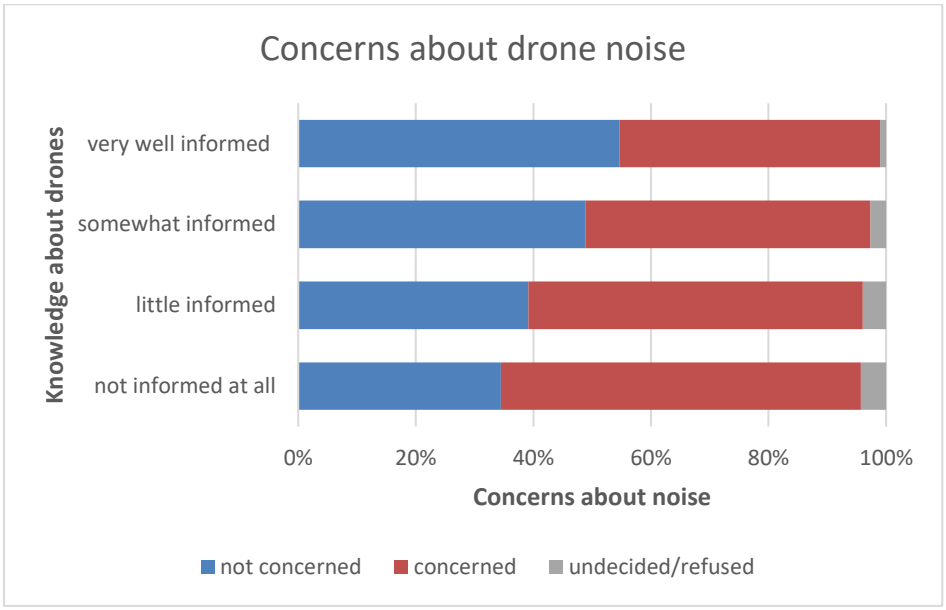

Figure 5: Concerns about drone noise, separated by reported knowledge level

3.3. Effect of interview

For many participants of this survey, the interview was the very first time they had talked about drones in detail for about 20 minutes. Touching upon a variety of positive and negative aspects, the general aim of the interview was neither to scare respondents nor to convince them to accept drone usage. To control for potential effects, a follow-up question was included at the end that asked about the potential change of opinion towards drones due to the interview content. Figure 6 shows the distribution of answers.

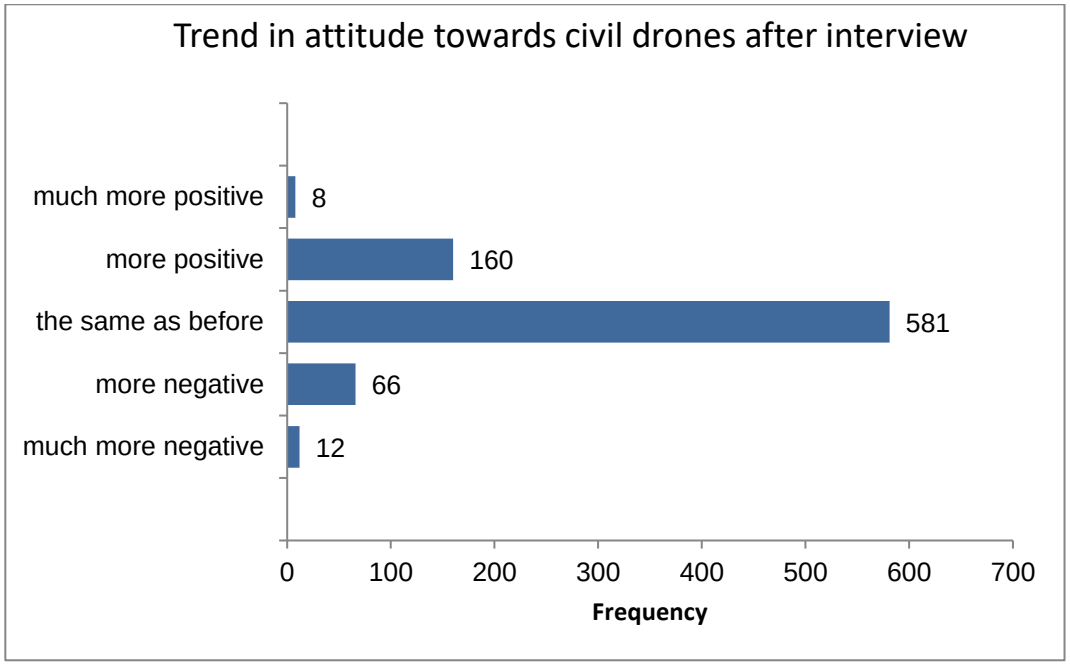

Figure 6: Trend in attitude towards civil drones at the end of interview

These results reveal that a majority of the opinions were stable throughout the interview (69.8%), while the percentage of subjects with a more positive opinion than before (20.2%) was slightly higher than the percentage of participants with a more negative one (8.2%). Interestingly, this not only confirms that the aim of presenting the interview content in a rather neutral manner was achieved, but also indicates that if there was indeed a change in opinion, it was more likely to be a positive shift.

Although Figure 7 indicates that this effect was slightly more pronounced for respondents who described themselves as having rather positive attitudes toward the use of civil drones at the start of the interview, the same trend seemed to be present for participants who had a rather negative attitude at the beginning as well. This substantiates the idea that both for rather positive and for rather negative initial statements, when a change was reported, it was more likely to be positive. However, the pattern was somewhat different for respondents who were undecided about their attitude towards civil drones at the beginning of the interview. Whereas a majority of this group

also gave the same answer as before, the number of positive shifts after the interviews seemed to be comparable to the number of negative shifts.

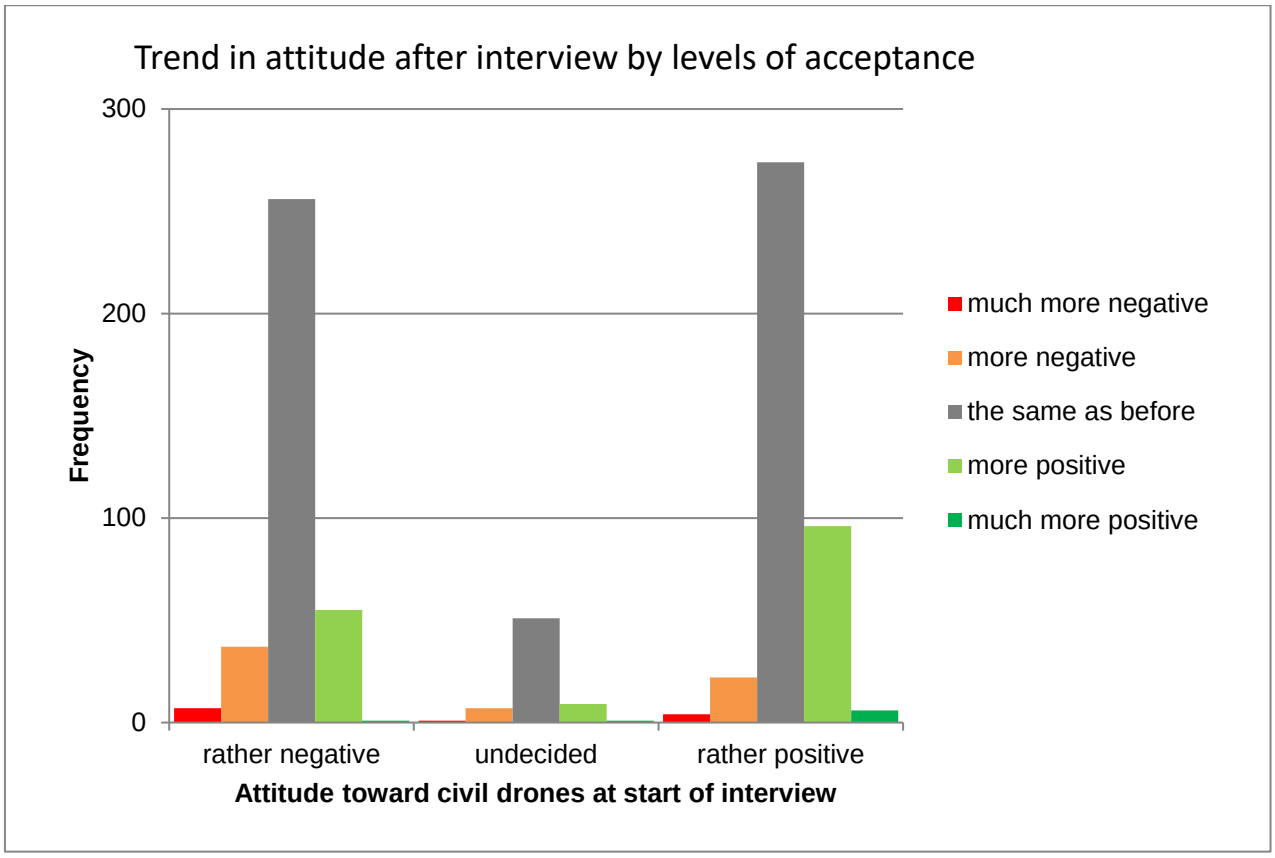

Figure 7: Trend in attitude towards civil drones after interview, separated by the different levels of acceptance at the beginning.

4. CONCLUSIONS

The current survey, which was based on the same dataset as Eißfeldt and colleagues [8], substantiates the notion that information on subject matter, in this case knowledge about drones and their uses, can play an important supporting role in broadening social acceptance. This finding is in line with prior research: The better people are informed about potential opportunities and risks, the more they accept the use of drones, also for the purpose of drone delivery [12,13,14]. Or, as [15] stated back in 2016 based on a nationally representative sample: "Knowledge drives enthusiasm: Exposure to information about drone delivery correlates with greater interest in the idea."

This statement seems to hold even for initial real-life experiences. In spite of noise being the "most common negative factor cited" [16], a strong majority of respondents from the first community in the US with direct experience had positive attitudes regarding drone delivery in their community [17]. It should be mentioned that – after initial feedback during first trials in Australia were negative

[,18,19,20] – not only has the reengineering of the propellers led to noise reductions of about 7 dbA [20], but the neighborhood has also been carefully prepared by means of an information campaign and a joint outreach program [22,23]. However, actual experience with drones (having seen or heard a drone) was associated with a higher likelihood of mentioning noise as a concern in response to an open question about negative aspects of drone delivery [16]. A similar finding was reported for the data analyzed here for a closed question as well [9], "when looking into information about whether a respondent has or has not reported having heard a drone yet, for those having heard a drone, a higher percentage of noise concern was revealed."

A positive effect of information has also been shown in a different context of urban air mobility. In a field study during the first flight of an air taxi in a European city, "a higher level of knowledge and information about air taxis significantly increases the willingness to use them" [24]. According to the authors: "This can be seen as an opportunity to further increase knowledge in the population and thus creating even higher acceptance rates."

This aspect could also be reflected in the positive trend found in this telephone survey: Providing information on drones more frequently led to positive changes of attitude than negative changes. However, this trend also shows that the issue of drones and all of their related aspects is still young, and attitudes can still be shaped and influenced to some degree, in any direction. Importantly, when conducting information campaigns, care has to be taken to provide information that is as unbiased as possible. For instance, potential risks need to be dealt with as much as expected benefits. This holds true for all methods applied to build knowledge about human response to drone noise [25], surveys, focus groups, interview or simulation studies[26]. Only in this way, acceptance of civil drones may be strengthened sustainably.

In summary, there is evidence ISM or knowledge about drones can have a supportive function for the acceptance of drones in general. Further research is needed in order to investigate whether this effect is strong enough that the chain from sound to annoyance can be broken by providing information on, enabling experiences with, and communicating transparently about drones in the community [27].

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