Drone Acceptance and Noise Concerns - Some Findings

Hinnerk Eißfeldt

Verena Vogelpohl

DRONE ACCEPTANCE AND NOISE CONCERNS - SOME FINDINGS

Hinnerk Eißfeldt & Verena Vogelpohl

DLR German Aerospace Center
Institute of Aerospace Medicine
Department of Aviation and Space Psychology
Hamburg, Germany

Drones are becoming ever more present in public perception. Ranging from parcel delivery to wildlife protection, from precision farming to law enforcement, and from industrial inspection to digital fireworks, many applications are said to have market-changing potential. Against this background, nations and institutions around the world are trying to keep up with the dynamic development concerning rules and regulations. Since all of the parties involved anticipate a strong increase in both the number of drones and their range of uses, there is a rising interest in the acceptance of civil drones in the public. Widespread public acceptance can promote the dissemination of new technologies. Conversely, concerns among citizens about the use of drones in their daily environment could pose potential barriers to the further proliferation of civil drones, especially in urban areas. The psychoacoustic properties of drones have repeatedly been discussed as being one such limiting factor. This paper reports results of a representative national study on the social acceptance of civilian drones, taking a closer look at noise considerations. Therefore the results help improve understanding of the perception of civil unmanned aerial vehicles.

Drones – understood here as unmanned aerial vehicles (UAV) of a civilian nature – are becoming increasingly visible among the public. Applications range from parcel delivery to animal welfare, from the production of live images of major events to the fight against crime, and from the inspection of industrial facilities to the design of artificial fireworks. Almost monthly, the media reports on new uses for drones and patent applications. Thus drone technology is often regarded as having a disruptive quality in certain markets and industries. On a global level, the International Transport Forum of the OECD (ITF 2018) and the World Economic Forum (WEF 2019) have described opportunities and challenges for future drone usages in recent reports. National and international institutions are trying to establish rules and procedures to keep up with the dynamic development. With a continued strong increase in the use of drones expected by all of those who are involved, there is also an increasing interest in the public's perception of this new element. As airport planning has repeatedly shown, a lack of public acceptance can be a limiting factor for further growth in aviation (e.g. Suau-Sanchez, 2011). Similarly, certain concerns among the public regarding the use of drones could restrict their wider dissemination: “One potential outcome of scaled-up drone operations is an increase in urban noise volume exceedances above legal or desired limits” (ITF 2018, p.39).

Method

The study on drone acceptance was conceptualized at DLR German Aerospace Center and fielded by infas Institute for Applied Social Sciences 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.

The questions were asked in a standardized manner by specially trained employees in a telephone interview of approximately 20 minutes in length. After each call, the answers were entered into an online database using an appropriately designed template. For quality assurance, online supervision was performed by senior staff who occasionally listened in on

the calls. The study fully adhered to the professional code of conduct for telephone interviews agreed upon in Germany (ADM 2016). 832 respondents took part in the study, which was conducted between March and May 2018, and answered all questions. Respondents were 51.8% male, 48.2% female; their age ranged from 14 to 94 years (mean 51.5, SD 18.2); the mean size of household was 2.5 (SD 1.3). Further information on the response rate and sampling procedures, as well as detailed results, can be found in Eißfeldt et al. (2018).

Results

The study was planned as a telephone survey to measure the public acceptance of civil drones in Germany. Only a few questions contained information about noise and will be referenced in the following in order to assess the effect of noise concerns on the acceptance of civil drones.

Associations with the term drone

After explaining the purpose of the study and gaining consent for participation, at the beginning of the interview, the respondents were asked whether they knew the term "drones" in aviation. All of the 97% participants who answered that question in the affirmative were subsequently asked in an open question to indicate what they associate with a drone. A total of 794 participants gave answers ranging from a single word to several complex sentences, all of which were protocolled onsite by the interviewer. Later these qualitative data were coded into 6 categories: espionage/surveillance/observation (32%), film/video/photography (27%), leisure/hobby (21%), parcel delivery/transport/air taxi (21%), danger/accident/threat (20%), and military/weapon (19%). About 18% were coded "other," indicating a wide range of associations not covered by these categories. Among the 715 different associations with the term, drone noise was among the least mentioned, only 6 times in total. In one of these cases, noise was explicitly considered unproblematic as drones would fly with electric engines making no sound.

Attitude towards civil drones in Germany

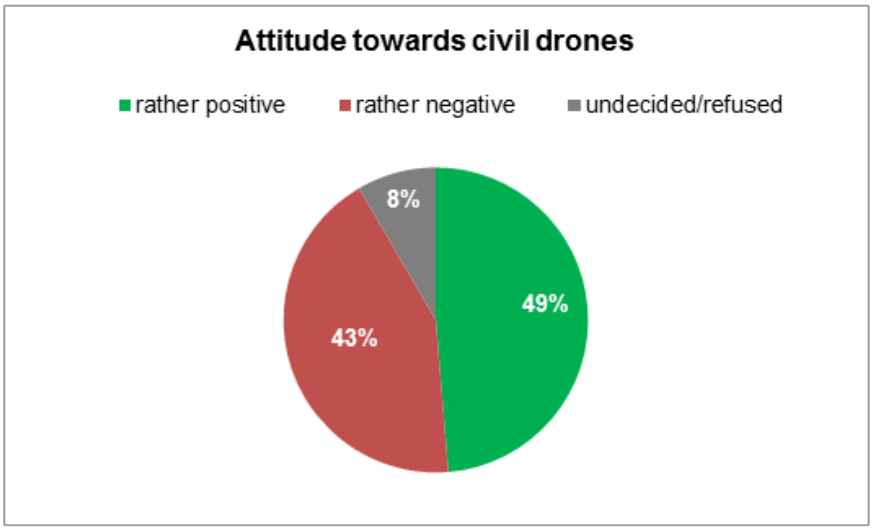

Figure 1. Attitude towards civil drones

After being asked for their associations with the term drone, 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). The results vary in accordance with with several sociodemographic factors such as gender, age, income, and place of residence. Male respondents have a more positive attitude toward civil drones compared to females. Younger study participants show higher acceptance than older participants.

Areas of concern with civil drones

Later during the telephone interview, 7 different areas of concern that had been identified from the literature were asked about in randomized order to avoid sequence effects. When asked to what extent they are concerned about aspects of civil drone usage, most of the respondents confirmed their concern about the possibility of misusing drones for criminal purposes (91%, see also Figure 2), followed by privacy concerns (86%). Concerns connected with mishaps all raised concerns in the range of 72% - 75% followed closely by concerns about animal welfare. Concerns about noise were confirmed less frequently (53%).

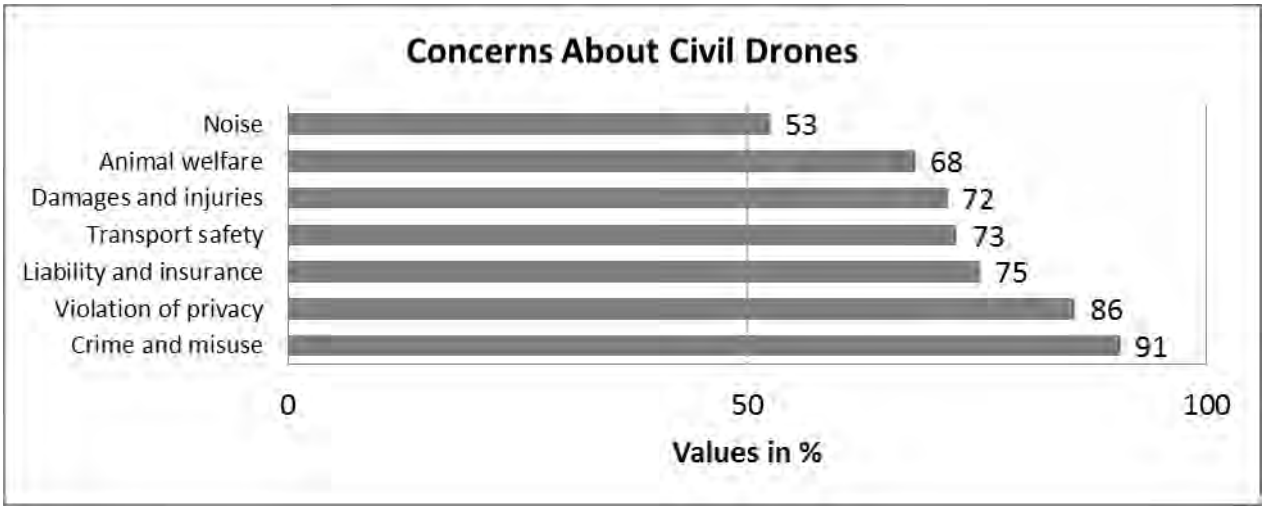

Figure 2. Concerns about civil drones

As a whole, a large majority of respondents named at least three or more subjects of concern regarding civil drone usage (91%). However, the number of aspects mentioned varied with respondent age and gender, with women and older respondents more concerned than younger or male respondents.

Experience and concerns. About half of the participants (47%) reported having experiences with drones in their personal lives (36.4%), on the job (4%), or in both contexts (6.1%). Looking into the concerns expressed by this group reveals that those who have some kind of experience with a drone have significantly less concern about potential accidents, animal welfare, or transportation risks than those who have no experience. Chi-square tests at the 10% level reveal significant values for concerns about damages and injuries χ^2 (1) = 3.09, p = .08, OR = .76, animal welfare χ^2 (1) = 4.29, p = .04, OR = .73, and transport safety χ^2 (1) = 3.39, p = .07, OR = .75. As shown in Figure 3 throughout all areas asked about the amount of concern is higher for participants reporting no experience with civil drones all areas of

concern.

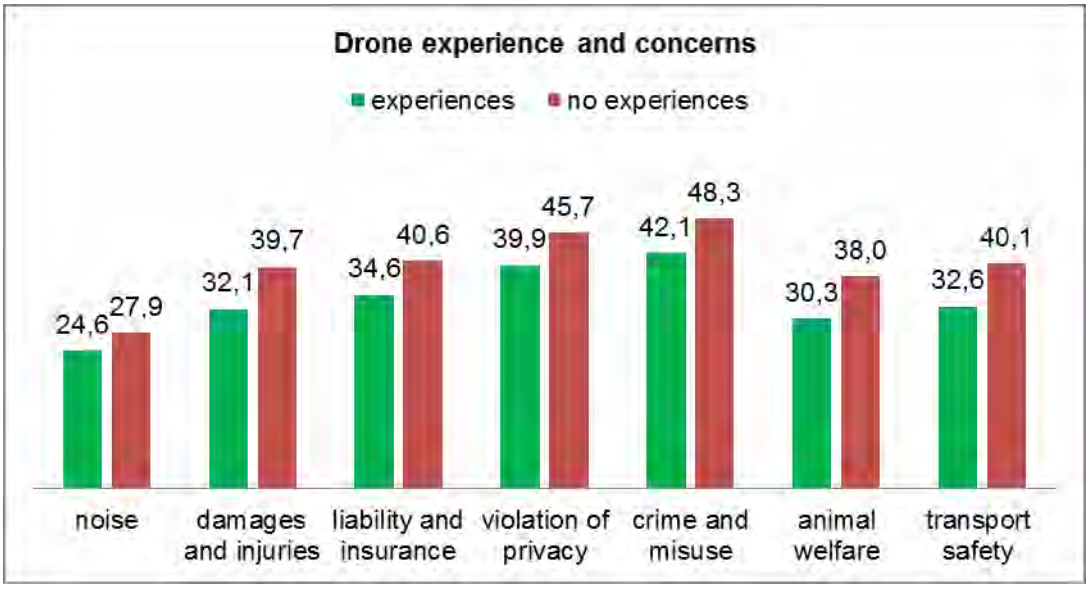

Figure 3. Areas of concern and experience with civil drones

Noise concerns and direct experience. Somewhat surprising was the rather low level of concern about drone noise (53%), as this had been discussed as being a potential barrier before. However, 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: χ^2 (1) = 3.29, p = .07, OR = 1.45.

Concerns about civil drones and acceptance. The influence of the various concerns about civil drones on the public acceptance thereof was analysed using Chi-square Automatic Interaction Detection (CHAID). According to Perreault & Barksdale (1980), the CHAID method partitions a contingency table produced from cross-tabulation by using a semihierarchical, sequential procedure. One of its advantages is that it can be used with non-parametric survey data. In our case, the attitude towards civil drones was the parent group variable to be split up by the different categories of the predictors – the various areas of concerns. Of all areas of concerns listed in Figure 2, being or not being concerned about noise explained the attitude towards civil drones best χ^2 (2) = 38,6, p = .000, OR = .41. On the next level of the decision tree model, among those concerned about noise, concerns about transport safety explain the most variance, and among those not concerned about noise, their concerns about the violation of privacy are the major factor.

Knowledge about drones

Towards the end of the interview respondents have been asked to what extent they felt informed about drones in general. Answers were given on a 4-point-Likert-scale ranging from 1 = very well informed to 4 = not informed at all. 11.7% described themselves as “very well” informed, 40.6% were informed “a bit,” 33.2% indicated being “only a little” informed, and 13.9% “not at all.”

In a first step, the subjective level of information about drones was tested against the attitude towards civil drones. As can be seen in Figure 4, subjects who describe themselves as better informed about drones in general have a more positive attitude towards civil drones.

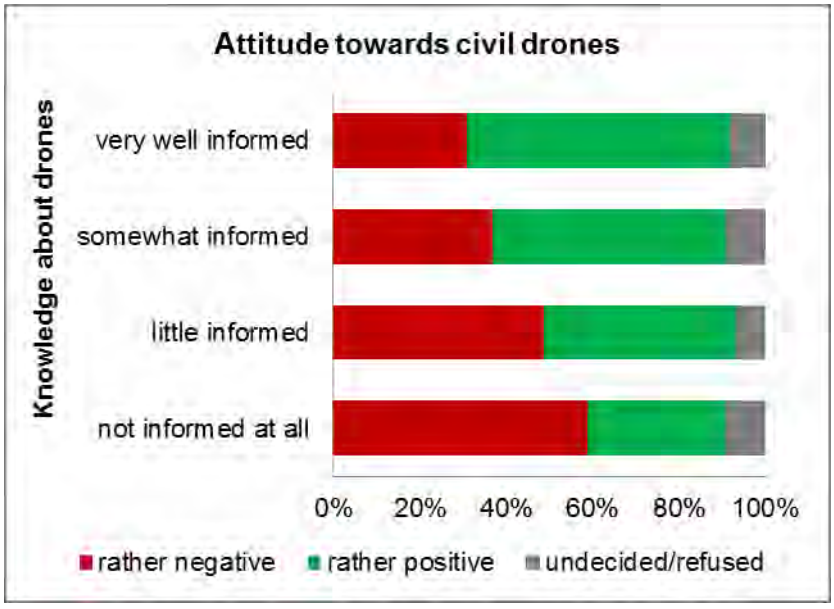

Figure 4. Attitude towards civil drones at different levels of knowledge about drones

Information about drones comes through various channels and could be biased; for example, information on noise levels could be exaggerated. Therefore in a second step, the subjective level of information about drones was tested against concerns about noise. As can be seen in Fig 5, subjects who describe themselves as being better informed about drones in general are less concerned about noise.

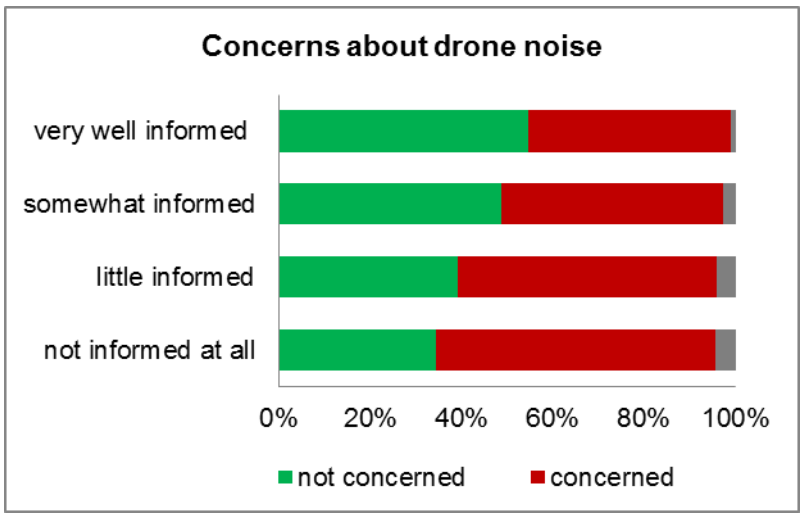

Figure 5. Concerns about drone noise at different levels of knowledge about drones

Discussion

Similar to comparable studies, a somewhat consolidated pattern of acceptance was found with slightly more than four out of ten respondents being rather negative about civil drones, about five out of ten indicating rather positive attitude towards drones, and the rest being undecided. A more detailed look revealed that the attitude towards drones in a civil context has a complex pattern of origins. Among other things, it depends on gender and age, but also on the individual level of information about civil drones. This is well in line with an online survey published by German Industries Aerospace Association (BDLI 2016), which showed acceptance concerning the civil usage of drones to be evenly split among participants, with 42% positive and negative each and about 15% stating they do not know. Also this study

found that 53% of participants expressed that noise exposure would be potential risk of drone usage, and also found that the potential violation of privacy was the highest concern of participants (84%).

The results presented here have shown that a good level of information about drones has positive effects on both reducing concerns and improving acceptance. Although not in the focus of the initial study and not prominent on first glance, noise concerns could be confirmed as being an important factor for the acceptance of civil drones. Although reported by only about half of all participants, among all concerns about usage of civil drones noise concerns have the strongest impact on acceptance. Environmental noise and annoyance is targeted by recent studies (Guski 2017) and international guidelines (WHO 2018). Stakeholders of drone usage thus are well advised to invest at maximum on reducing sound emissions to the lowest level possible.

Increased knowledge about and personal experience with civil drones both comes together with a decrease in noise concerns. To conduct information campaigns tailored to specific target groups and to provide hands-on experience could support drone usage in general. For metropolitan areas participatory noise sensing (Eißfeldt, in press) could be another approach supporting the development of urban air mobility. Further research should focus on such measures to further increase the public acceptance of civil drones and the successful development of the U-space and its applications.

References

ADM Arbeitskreis Deutscher Markt- und Sozialforschungsinstitute e.V. (2016). Richtlinie für telefonische Befragung. Retrieved from https://www.adm-ev.de/standards-richtlinien/ [29.08.2018].

BDLI (2016). Chancen und Risiken ziviler Drohnen. Retrieved from https: //www.bdl.aero /de/results/?q=drohnen [29.08.2018].

Eißfeldt, H., Vogelpohl, V., Stolz, M., Papenfuß, A., Biella, M., Belz, J. & Kügler, D. (2018) The acceptance of civil drones in Germany. Manuscript submitted for publication.

Eißfeldt (in press). Supporting urban air mobility with citizen participatory noise sensing: A concept. Proceedings of the 2019 WWW Conference. DOI: 10.1145/3308560.3317059.

ITF International Transport Forum (OECD) (2018). (Un)certain Skies? Drones in the World of Tomorrow. Retrieved from https://www.itf-oecd.org/uncertain-skies-drones [29.08.2018].

Perreault, W. D., & Barksdale, H. C. (1980). A model-free approach for analysis of complex contingency data in survey research. Journal of Marketing Research, 17(4), 503-515. http://dx.doi.org/10.2307/3150503

Guski, R., Schreckenberg, D. & Schuemer, R. (2017). WHO Environmental Noise Guidelines for the European Region: A Systematic Review on Environmental Noise and Annoyance. International Journal of Environmental Research and Public Health 14(12):1539. DOI: 10.3390/ijerph14121539.

Suau-Sanchez, P., Pallares-Barbera, M., & Paül, V. (2011). Incorporating annoyance in airport environmental policy: noise, societal response and community participation. Journal of Transport Geography, 19(2), 275-284. doi: http://dx.doi.org/10.1016/ j.jtrangeo.2010.02.005.

WEF World Economic Forum (2019). Advanced drone operations toolkit: Accelerating the drone revolution. Geneva, WEF.

WHO (2018) Environmental Noise Guidelines for the European Region. World Health Organisation Regional Office for Europe.