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REVIEW OF THE EFFECTS OF DRONE NOISE ON PEOPLE

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ABSTRACT

The current use of drones includes, but is not limited to scientific, commercial, military, and surveillance applications. With the application of drones expanding, and to potentially include air mobility to transport people, they will become part of the transportation mix. The approvals from the government authorities for new uses will of course require evidence of safe operation but will also need to consider the noise impact on the communities. To establish clear guidelines there is a need to have knowledge of the effects of the noise on those in the communities. This paper will present findings from a systematic review on the effects of drone noise on people. The review follows the PRISMA-ScR (Preferred Reporting Items for Systematic reviews and Metanalysis extension for Scoping Reviews) methodology. It involved a search for publications that are available with full text in English from 2000 to 2024. The initial search protocol provided 10,613 unique publications. Of these, 32 studies were found to be relevant for further analysis. This has led to identification of the current gaps in knowledge relating to the effects of drone noise on people.

Keywords: *drone noise, effect of noise, uav noise.*

1. INTRODUCTION

Drones, otherwise known as remotely piloted aircraft (RPA), unmanned aerial vehicles (UAVs), or unmanned aircraft systems (UAS), or colloquially referred to as unmanned aircraft, are either fixed wing or rotating wing aircraft that are operated remotely. They can carry a range of tools including, sensors – thermal, infrared, cameras, data recording tools, transponders, winches and many more depending on the intended use of the aircraft. Future applications may even include the transportation of people.

The use of drones is growing. Drones currently have many uses such as for scientific, commercial, delivery, military, surveillance, and recreational purposes. More use cases for drones are being identified and implemented almost daily. With drones being projected to increase in usage by 20% annually [1], the concern about their noise impact on the community will grow alongside their increasing use.

The effects of noise, which is any unwanted sound, can be measured both subjectively and objectively. Subjective responses can include psychoacoustic effects, which is defined as the branch of psychology concerned with the perception of sound and its physiological effects [2]. Objective responses can include physiological responses to noise from drones.

Current regulations and guidelines used to regulate drone usage struggle to keep up to the rapid changes in development and application of drones. Drone usage and the associated noise impact are often regulated by different bodies. For example, in Australia, the regulations and guidelines from the Civil Aviation Safety Authority (CASA) focus on the safe operation of drones and CASA has stated that "*the issue of aircraft or RPA noise is not part of our role*" [3]. The Department of Infrastructure, Transport, Regional Development, Communications and the Arts in Australia is responsible for the management of drone noise. However the Aircraft Noise Regulations 2018 [4] exempt specific types and operations of drones. The rapid growth and development of drones has outpaced the regulatory framework and in regard to noise, research is needed to investigate the effects of the interaction of drones

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and the people within the built environment so that the appropriate guidance and regulations can be created.

The aim of this systematic review is to synthesise and systematically map research that has investigated the effects that noise from drones have on people within the built environment. It is intended to provide the basis for directing future research on this topic by highlighting the gaps in knowledge that need to be addressed for the development appropriate regulations and guidelines on drone usage in Australia.

The following research question was developed to achieve the aims of this systematic review:

- What are the effects of drone noise on people?

2. METHODOLOGY

A systematic review approach was selected as the purpose aligned with the purpose of a systematic review as defined by Page et al[5]. Namely to identify the types of available evidence in a given field; to clarify key concepts/ definitions in the literature; to examine how research is conducted on a certain topic or field; to identify key characteristics or factors related to a concept; and to identify and analyse knowledge gaps. The PRISMA-ScR (Preferred Reporting Items for Systematic reviews and Metanalysis extension for Scoping Reviews)[5] methodology was selected.

Literature searches were limited to include full-text publications and government regulations that were available in English. The following selection criterion was used to determine whether the piece of literature was included in the review:

1. Studies involving healthy human adults with no hearing impediments. If the study included individuals from the excluded groups but reported the results for such participants separately, the study would then be included
2. Studies investigating the impact that drone noise has on humans; through:
    a. Subjective effects of drone noise on humans.
    b. Objective effects of drone noise on humans.
    c. Comparisons of subjective or objective effects of drone noise to other noise sources.
3. Studies including a source of noise that is perceived as a drone. This can include recording of drone noise, altering available drone noise, or altering any noise to replicate drone noise.

Three categories of search terms were created for this systematic review. The general search strategy is outlined below and was applied to SCOPUS, Dimensions, IEEE, Proquest, Environment Complete, Web of Science and Aerospace Research Central databases.

Table 1. Search terms used for the systematic review

Search Category	Search Terms Used
Drones	drone* OR rpa* OR "remotely piloted aircraft*" OR uav* OR "unmanned aerial*" OR "unmanned air*" OR "UAM*" OR "Urban air mobility*" OR "advanced air mobility" OR "AAM"
Noise	nois* OR acoustic* OR sound* OR psychoacoustic* OR auditory
Effect	impact* OR effect* OR perception* OR physio* OR objective* OR perform* OR task*

*Note * denotes a wildcard search term*

3. GENERAL FINDINGS

The search and selection process of the publications from the initial search strategy from the year 2000 to 2024 first resulted in the return of 16,024 publications. After removing duplications there were 10,613 publications. After a title search, 321 remained. All 321 abstracts, and if necessary full text, were then checked for relevance. After this final check, 31 papers were identified to be relevant of which 28 involved subjective assessments such as annoyance, loudness, threat, safety, pitch, tone, roughness, and other qualities of noise while 6 studies included objective measurements such as the ability to hear and/or identify sounds whilst drone noise is present. The initial findings highlight the diversity in the approach to the types of noise used to represent the noise from drones which is a reflection of the rapidly growing field. Similarly, there is a diversity in the approach to the methodology of assessing the noise from drones which makes selection of guidance on acceptable limits challenging. Thus, there are conflicting outcomes

indicating there is a need for more studies investigating the effects of noise from drones.

4. CONCLUSIONS

This paper summarises the work done up until the present day on this systematic review. By answering the research questions discussed above, this systematic review will be a significant contribution to the understanding the current research into the effects that the new technology of drones has on noise in the built environment. It will assist with development of regulations on the management of this new technology. Identifying the gaps in knowledge on the subjective and objective responses towards drone noise will assist to direct future research in this field.

5. ACKNOWLEDGMENTS

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6. REFERENCES

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