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Determining physiological reaction probabilities to noise events during sleep

Bestimmung physiologischer
Reaktionswahrscheinlichkeiten auf Lärmereignisse
im Schlaf

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Abstract

Some of the activations that occur during sleep, e.g. awakening reactions, can be considered adverse effects of noise events (e.g., airplane overflights or train passings) during the night. The occurrence of such reactions is an important indicator of the sleep disturbing potential of the particular noise stimulus and it is often desired to exactly quantify that potential in terms of a probability. Awakenings are considered the strongest form of reaction to noise stimuli during sleep and are one of the most often adopted criteria in night time noise protection concepts. However, the correct determination of noise induced awakening probability has given rise to debate in the scientific community in recent

years. Because during every night's sleep, spontaneous awakenings can occur at any time, it remains unknown in principle, whether a particular awakening observed during the presence of a noise stimulus was induced by that stimulus or emerged spontaneously. Nevertheless, correctly determining the awakening probability in question is key when it comes to forecasting noise effects during the night. This article introduces two definitions of reaction probability, discusses their advantages and disadvantages, and develops a model of the influence of the time window duration in which reactions of sleepers are screened on the calculated reaction probability.

Zusammenfassung

Einige im Schlaf auftretende Aktivierungen, z. B. Aufwachreaktionen, können als schlafbeeinträchtigende Effekte von nächtlichen Lärmstimuli (z. B. Flugzeugüberflüge oder Zugvorbeifahrten) aufgefasst werden. Die Auftretenswahrscheinlichkeit solcher Reaktionen ist ein wichtiger Hinweis auf das schlafstörende Potenzial des entsprechenden Lärmstimulus und soll oft so genau wie möglich ermittelt werden. Aufwachreaktionen gelten als stärkste Form der Reaktion auf Lärmstimuli in der Nacht und sind eines der am häufigsten verwendeten Kriterien für den Nachtlärmschutz. Die wissenschaftlich korrekte Ermittlung der lärminduzierten Aufwachwahrscheinlichkeit wurde jüngst unter Lärmwirkungsforschern kontrovers diskutiert. Weil

man in jeder Nacht jederzeit auch spontan erwachen kann, ist einem während eines Lärmstimulus beobachteten Aufwachen prinzipiell nicht anzusehen, ob dieses ursächlich auf den Lärmstimulus zurückzuführen war oder spontan auftrat. Dennoch ist die korrekte Bestimmung der entsprechenden Wahrscheinlichkeit für die Prognose von nächtlichen Lärmwirkungen entscheidend. In diesem Artikel werden zwei Definitionen der Reaktionswahrscheinlichkeit eingeführt und deren Vor- und Nachteile besprochen. Ferner wird ein Modell zum Einfluss der Dauer des Zeitfensters, in dem Reaktionen des Schlafers geprüft werden, auf die berechnete Reaktionswahrscheinlichkeit entwickelt.

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Notes

1. 1.

The backslash “\” denotes the set difference, it can be read as “in A_{induced} but not in $A_{\text{spontaneous}}$ ”.

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- Probability calculation
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- Sleep disturbances

Schlüsselwörter

- Ereignisbezogene Reaktionen
- Lärmwirkungen
- Reaktionswahrscheinlichkeit
- Wahrscheinlichkeitsrechnung
- Aufwachreaktionen
- Schlafstörungen

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