Applied Acoustics 132 (2018) 118–123

Contents lists available at ScienceDirect

Applied Acoustics

journal homepage: www.elsevier.com/locate/apacoust

Effect of traffic noise on mental performance with regard to introversion and task complexity

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ARTICLE INFO

Keywords:
Traffic noise
Extraversion
Neuroticism
Task complexity
Performance
Mental performance

ABSTRACT

Purpose: Traffic noise can impair mental performance. The aim of this study was to evaluate the impact of traffic noise on the participants' mental performance.
Methods: Thirty-five male students participated in this study. The Eysenck questionnaire was used to assess personality traits (neuroticism and extraversion) of the subjects. The participants were exposed to both quiet and traffic noise conditions and performed "S3"-type choice reaction time (CRT) test as a simple task, and "S1"-type determine test as a complex task using the Vienna Test System software.
Results: The results showed that, in simple task, the mean differences of motor time (p = .375) and reaction time (p = .316) were not statistically significant among stable/unstable individuals under quiet and under traffic noise conditions. In complex task, there was a significant difference in the number of correct response (p = .044) and incorrect response (p = .043) among stable/unstable individuals, while no such significant difference was found among other variables under study. None of the differences in the variables of simple and complex tests were statistically significant between introvert/extrovert under quiet and under traffic noise conditions (p > .05).
Conclusion: This study revealed that traffic noise had no effect on the performance of introvert/extrovert individuals in simple and complex tasks.

1. Introduction

Traffic noise is considered as one of the main sources of environmental health problems in large cities, which is causing a variety of problems including physiological psychological effects [1–5]. Regarding physiological disorders, noise has harmful effects on cardiovascular system, leading to high blood pressure, hearing loss, heart attack, disorders of the sympathetic nervous system, disorders of endocrine system, high levels of blood lipid, and an increase in noradrenalin level [5,6]. Psychological disorders caused by noise include stress, anxiety, impatience, sleep disorders, and impaired mental performance [7–9].

Mental performance can be defined as task management, respond speed, learning, and alertness [7]. Three groups of factors affecting mental performance are as follows: characteristics of sound, individual differences and type of the task [10]. There are complex and multidimensional relationships between mental performance and noise exposure, which have not completely been conceived [11]. Some studies have shown that exposure to noise impairs mental performance [12,13]. Others, however, have revealed that it improves mental performance [14]. A review study illustrated that from 58 studies on the effect of noise on mental performance, in 29 instances, noise had negative effects; in 22 instances, noise had no effect; and in 7 instances, noise improved the mental performance of individuals [15].

Researchers found that individual differences were responsible for some differences in mental performance. They argued that the validity of mental ability measures would increase by including personality traits as a criterion [16].

Extraversion and neuroticism are among the important individual differences. It is closely related to chronic cortical activity and refers to orientation toward external world which makes a person extremely attentive to what is happening around him and this causes his energy to be focused on individuals, things, and phenomena around him. Introversion, on the other hand, is the individual's tendency to focus on

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https://doi.org/10.1016/j.apacoust.2017.11.019
Received 28 August 2017; Received in revised form 14 November 2017; Accepted 20 November 2017
Available online 24 November 2017
0003-682X/

his internal world which makes him sensitive to his feelings and experiences. Eysenck believes that introverts have higher levels of arousal potential and their concentration is more affected than extraverts under noisy conditions [17]. Dobbs believes that introverts show lower cognitive efficiency than extraverts in cognitive performance test when exposed to noise [18]. Another study by Burtăverde et al., however, showed no significant difference between introverts and extraverts in mental performance 19].

Another factor affecting performance is the type of task. Performance as a subjective issue is built with a wide range of commonly used parameters such as judgment, decision-making, attention, and memory may be impaired under time pressure [20,21]. According to Hendy's model, time pressure could decrease the level of individual performance affects judgment of workload [21,22]. A study by Van Dijk revealed that noise caused adverse effects on tasks which require greater cognitive capacity and processing, but no change was observed in individuals' performance in simple tasks, and performance even improved in some cases [23]. Therefore, given the description above, the purpose of this study was to evaluate the effect of traffic noise on performance with regard to the roles of introversion and task complexity.

2. Material and methods

2.1. Introduction of the studied participant

Thirty-five students of Tehran University of Medical Sciences with an average age of 26.1 (± 2.19) years and normal hearing (audiometric test (MEVOX ASB15 Screening Audiometer)) participated in this study. It should be noted that all the participants signed the informed consent form. They were asked to have 8 full hours of sleep the night before the test and avoid drinking tea, coffee, chocolate, and caffeinated beverages in the hours before the test.

2.2. Place of study

This study was contacted in Trauma Research Centre Laboratory of Tehran University of Medical Sciences. For simulation the traffic noise in lab, the noise was recorded at 5 parts of Tehran streets by a Sony ICD MX20 voice recorder for about one hour and played back at the same level. Noise level was measured at the same time by a sound level meter.

2.3. Material

The personality trait of extra-/introversion was measured using the Eysenck Personality Inventory (EPI) in a standardized version for Iran [24]. This questionnaire consisted of 57 items with binary scale (yes and no). There were 24 items for extraversion, 24 items for neuroticism and 9 items for the subject's sincerity in answering. Each item was assigned 0 or 1 point in extraversion, neuroticism, and lying scales. If the sums of points were more than 12 in extraversion and 10 in neuroticism, the subjects were considered as extravert and neurotic (unstable), respectively. A summation score in the lying scale of more than four indicates lack of accuracy and honesty in answers.

The mental performance of the participants was measured using "S3"-type choice reaction time (CRT) test S3-type as a simple task, and "S1"-type determination determine test as a complex task, from the Vienna Test System software package [25]. Simple choice reaction time consists of two variables: mean reaction time and mean motor time. Mean reaction time refers to time between the appearance of the relevant stimulus and moment the finger leaves the rest button and mean motor time is time that elapse between the moment the finger leaves the rest button and the time the reaction button is pressed in response to relevant stimulus. Reliability (Cronbach's alpha) in the norm sample varies between 0.83–0.98 and 0.84–0.95 for reaction time and motor time, respectively. The determination test (DT) measures reactive stress tolerance and the associated ability to react. The test requires the respondent to use his cognitive skills to distinguish different colours and sounds, to memorize the relevant characteristics of stimulus configurations, response buttons and assignment rules, and to select the relevant responses according to the assignment rules laid down in the instructions and/or learned in the course of the test. The difficulty of the DT arises from the need to sustain continuous, rapid and varying responses to rapidly changing stimuli.

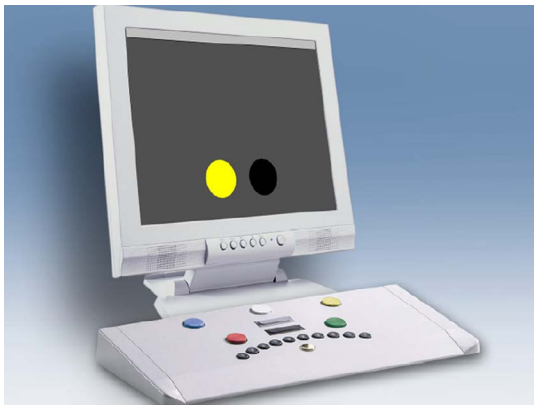

Fig. 1. Presentation screen of CRT test.

Noise level was measured at the same time by a sound level meter device (model: CEL-450).

2.4. Study procedure

The participant were divided to groups (n = 17 and 18), randomly. Before doing tests, one group (n = 18) was placed in a calm and quiet lab for an hour and the other group (n = 17) was exposed to traffic noise for an hour. Then both groups performed CRT and DT (Fig. 1). It is noteworthy that this process was repeated again after two weeks, with the difference that the 17-member group were placed in a quiet environment, and the 18-member groups were exposed to traffic noise before the tests. The response panel was used as the input device of computerized DT and choice reaction time tests. In DT, the respondent is presented with colour stimuli and acoustic signals. Participant reacts by pressing the appropriate buttons on the response panel [26,27] (Fig. 2).

2.5. Data analysis

After doing tests, the data were analyzed by SPSS-21 software.

3. Results

The average level of noise was 73 dB (A). The analysis of octave band center frequency in A-weighting is shown in Fig. 3.

The numbers of extraverted, introverted, stable, and unstable participants were 22, 13, 20, and 15, respectively. As shown in Table 1,

Fig. 2. Presentation screen of DT test.