Disruption of Writing by Background Speech: A classroom experiment

Alan Kabanshi[1] Marijke Keus van de Poll[1] , Robert Ljung[1] & Patrik Sörqvist[1,2]

[1] Department of Building, Energy, and Environmental Engineering, University of Gävle, SE-80176 Gävle, SWEDEN, marijke.keus@hig.se

[2] Linnaeus Centre HEAD, Swedish Institute for Disability Research, Linköping University, Linköping, SWEDEN

ABSTRACT

Irrelevant background speech impairs cognitive capabilities such as writing. Laboratory studies wherein participants were tested alone in sound attenuated rooms, showed that ordinary speech, even with relatively low intelligibility (Keus van de Poll, Ljung, Odelius, Sörqvist, 2014), is more distracting than meaningless speech (Sörqvist, Nöstl, & Halin, 2012). Yet, so far research has paid little attention to the manifestation of these effects in classroom environments. The aim of the present study was to investigate the effects of irrelevant background speech on writing in a realistic classroom setting. The hypothesis was that irrelevant background speech would have distracting effects on text production, especially on writing fluency and typing errors. In an experimental within-subjects design, college students (in groups of 10-12 participants), sitting in a classroom, were asked to write short essays (5 minutes per essay) in the software program scriptlog. One essay was written in silence and one in the presence of background speech. As expected, background speech had a (slight) effect, although more participants are needed to increase the experimental power. Comparisons with previous studies on the effects of speech on writing are made and future directions are discussed.

INTRODUCTION

Irrelevant background speech has the power to impair cognitive abilities, even when the speech is deliberately ignored (Colle & Welsh, 1976; Marsh & Jones, 2010; Salamé & Baddeley, 1982; Sörqvist, 2010a, 2010b). The effects typically take the form of decreased work satisfaction (Sundstrom, Town, Rice, Osborn & Brill, 1994), decreased performance and increased work-related stress (Babisch, 2003; Smith, 1991). Thus, undesired background speech can challenge health and become a barrier for cognitive development, learning and cognitive performance, especially when working in classrooms or open-office environments wherein background speech, like talking children, students or colleagues, is common.

As writing is a representative and common skill in school and open office environments, recent studies have focused on the effects of irrelevant background speech on writing. For instance, Sörqvist, Nöstl and Halin (2012) found that meaningful speech is detrimental to writing performance in comparison with meaningless speech or silence. Keus van de Poll, Ljung, Odelius and Sörqvist (2014) studied these impairing effects of meaningful speech on a more detailed level by manipulating Speech Transmission Index (STI), which is a physical measure of speech transmission quality. STI specifies the level of speech intelligibility is in different transmission channels and it varies between 0.00 and 1.00. An STI of 0 means that all speech intelligibility is lost and an STI of 1 means that speech

intelligibility is perfect. Among others factors, STI depends on reverberation time, echoes, speech level, and background noise level. Keus van de Poll et al. (2014) used speech masked by noise to create five different STI conditions varying from very low speech intelligibility to very high speech intelligibility, and found that background speech impairs writing at relatively low STI levels (STI = 0.34). The impairing effects were manifested as impaired writing fluency (the sum obtained when adding deleted characters to the total number of characters in the final edited text) and an increased number of pauses longer than five seconds. In Sörqvist et al. (2012), spelling errors were also increased in the presence of background speech.

In Sörqvist et al. (2012) and Keus van de Poll et al. (2014), participants were tested individually, sitting in front of a computer in a sound attenuated room. As noise and background speech are very common in classroom and open office environments, the present study investigated if the documented effects of speech on writing can be replicated in more realistic environments like classrooms. The expectations were that irrelevant background speech would impair writing fluency and increase typing errors. The present study is part in a larger project about the acoustical and environmental effects on cognitive performance.

METHODS

Participants

A total of 20 students (mean age = 21.20 years, SD = 3.05) at the University of Gävle participated in the study. All participants had completed Swedish compulsory school and high school. The participants received a cinema ticket for participation.

Apparatus and materials

Sound - The irrelevant speech consisted of a story about a fictive culture called “Ansarierna” (The Ansarians). It was spoken in a male voice and binaurally recorded using an artificial head (Head Acoustics HMS IV) in an anechoic chamber. The sound stimuli were presented through headphones (Sennheiser HD 202) at approximately 60 dBA, corresponding to the sound level of a conversation within 1–2 m.

Writing task - The participants were asked to write four stories in two sound conditions. The stories were associated with different target-words displayed on a computer screen. The target words were the names of different objects (i.e., ball, bicycle, ice cream and TV). The objects were presented in the same sequential order to all participants, whereas the order of the conditions was counterbalanced between participants. The onset and the offset of the target-word and the sound were synchronized. The time limit for each story was set to five minutes. After 5 minutes a voice instructed to stop writing and go to the next assignment. The computer software ScriptLog was used to obtain data. This program is developed for real-time analysis of the writing process and it registers all keyboard activity. This makes it possible to replay the writing sequence for real-time analysis and to extract relevant statistics automatically by using the built-in functions.

Dependent variables – Three dependent variables were extracted using ScriptLog: the total number of spelling errors in the final edited text, the total number of characters in the final edited text and the number of characters deleted during the writing process. The sum of the last two variables was calculated and defined as writing fluency.

Design and procedure

A within-subjects design was used. The participants sat in small groups (10-12 participants at a time) with separate tables in a laboratory room which was transformed into a classroom setting, where participants were sitting with individual tables, four rows with three tables in line. The size of the room was 7.2m x 8.4m. Participants sat in front of a laptop. They wore headphones during the whole experiment. The writing task was introduced by a practice phase of 30 s so the participants would get acquainted with the task and the procedure. The target-word "teddybear" was presented in this practice phase. The practice phase was followed by the speech and silence conditions. The sound conditions were counter balanced across the target words. Participants were instructed to write as much, as fast and as accurate as they could, to write stories associated with the presented word and to ignore the sounds in the headphones. A filler task of finding hidden figures was done between the tasks. The experiment took about 30 minutes to complete.

RESULTS AND DISCUSSION

No significant effects were found. However, the mean value of writing fluency in the silent condition was higher than the mean value in the noise condition (*M* = 765.35 and 739.10 respectively) which indicates that writing fluency indeed is impaired by background speech. In Keus van de Poll et al. (2014), the difference in writing fluency between the conditions with lowest intelligibility (STI = 0.08) and highest intelligibility (STI = 0.71) was about twice as big as in the present study (*M* = 845.21, STI = 0.08; *M* = 799.07, STI = 0.71). In Sörqvist et al. (2012), the difference in writing fluency between silence and background speech was even larger (*M* = 756.69, silence; *M* = 669.13, background speech). Against this background, it seems justified to assume that a larger sample in the present study would have revealed a significant effect of background speech.

Future directions

A number of factors should be considered in future studies to obtain more reliable results with an attempt to be representative for "real world" settings. Instead of using headphones, loudspeakers should be used to acknowledge the influence from spatial factors. Also, longer writing sessions are needed to quantify the magnitude of the effects for writing sessions with more realistic durations.

REFERENCES

Babisch W. (2003). Stress hormones in the research on cardiovascular effects of noise. Noise & Health, 5, 1–11.

Colle, H. A. & Welsh, A. (1976). Acoustic masking in primary memory. Journal of Verbal Learning & Verbal Behavior, 15, 17–32.

Keus van de Poll, M., Ljung, R., Odelius J. & Sörqvist, P. (2014). Disruption of writing by background speech: The role of Speech Transmission Index. Applied Acoustics, 81, 15-18.

Marsh, J. E. & Jones, D. M. (2010). Cross-modal distraction by background speech: What role for meaning? Noise & Health, 12, 210–216.

Salamé, P. & Baddeley, A. D. (1982). Disruption of short-term memory by unattended speech: Implications for the structure of working memory. Journal of Verbal Learning and Verbal Behavior, 21, 150–164.

Smith A. (1991). A review of the non-auditory effects of noise on health. Work Stress, 5, 49–62.

Sundstrom E, Town JP, Rice RW, Osborn DP & Brill M. (1994). Office noise, satisfaction, and performance. Environment and Behavior, 26, 195–222.

Sörqvist, P. (2010a). High working memory capacity attenuates the deviation
effect but not the changing-state effect: Further support for the duplex-mechanism account of auditory distraction. Memory & Cognition, 38, 651–658.

Sörqvist, P. (2010b). The role of working memory capacity in auditory distraction: A review. Noise & Health, 12, 217–224.

Sörqvist P, Nöstl A, Halin N. (2012). Disruption of writing processes by the semanticity of background speech. Scandinavian Journal of Psychology, 53, 97–102.