Noise and Society
Edited by D. M. Jones and A. J. Chapman

Chapter 9

The Social Psychology of Noise

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Increased attention in the late 1960s and early 1970s to noise as a social problem stimulated the initial interest of social psycholosists in noise research. Since then, groups of social psycholosists have made contributions to two rather different bodies of noise literature. The first body of research is rather traditional in nature viewing sound level as a possible determinant of interpersonal behaviour. This work grew out of an interest in the impact of urban stressors on the social interactions of city residents. It is thus primarily concerned with determining the relationship between sound level and behaviours that are often considered characteristic of urban dwellers, for example, failure to help a stranger (cf. Milgram, 1970). The second, less traditional body of noise research, views noise exposure in the context of the larger social and cognitive environment. This ecological approach focuses on the effects of the meaning of the sound and the psychological properties of the situation rather than on the role of the physical parameters of the sound alone. Although psychologists studying noise have often indicated an awareness of the importance of contextual factors in predicting noise effects, research on noise and human performance, health, and even interpersonal behaviour rarely take these factors into account. This chapter is an attempt to provide an overview of these two bodies of research. In both cases the empirical work is considered in the light of existing theoretical explanations and speculations.

The effects of noise on social behaviour

Although psychologists have studied the relationship between noise and human performance for over half a century, it is only recently that there has been interest in the impact of noise on interpersonal behaviour. The research relating noise to interpersonal behaviour has dealt primarily with the relationship between the sound levels of distracting background sounds and one's sensitivity to others, especially one's willingness to give aid both during and immediately following noise exposure. A limited amount of research has also examined the effects of sound level on other social behaviours, for example aggression, attraction, and interpersonal judgment. In this section we review this research literature and provide a number of theoretical explanations for reported effects.

Helping behaviour

Correlational and experimental studies on the effects of exposure to high-intensity noise on the granting of small favours have been conducted in a number of naturalistic settings. In an early study, Korte *et al.* (1975) used sound level, as well as traffic count, pedestrian count, and the number of visible 'public' buildings to specify rural and urban areas characterized as having either high or low environmental inputs (sound levels of high- and low-input areas were not specified). Three field measures of helpfulness were used: responding to a request for a street interview, noticing and calling a confederate's attention to a dropped key, and offering assistance to a bewildered confederate with maps in hand. Regardless of whether the area was in a city or small town, people in low-input areas were more likely to grant an interview and offer assistance to the confederate than people in high-input areas. Although the percentage of pedestrians calling the confederate's attention to the key was also higher in the low-input than in the high-input areas, the difference was not statistically significant. It should be emphasized that while sound level was a major aspect of the operational definition of 'high' and 'low' input, this study did not directly examine the effects of noise *per se* on helping behaviour. A study whose conditions were based solely on sound level (Boles and Hayward, 1978), similarly found that fewer subjects granted an interview in noisy (above 70 dB(A)) areas than in areas which were quiet (below 70 dB(A)). It is worth noting that since both of these studies were correlational, the differences in helping may be attributable to differences between the types of people in the high and low noise environments rather than to variations in noise level.

Page (1977) reported a series of field experiments that also suggest that helping decreases as noise intensity increases. In the first study, a woman carrying an armload of books dropped a deck of index cards in front of students walking alone through a campus tunnel. A tape of construction noise was played in the tunnel at 100 dB(A) or 80 dB(A). In a third condition the noise tape was not played (ambient level, 50 dB(A)). Although subjects in the ambient level (no noise) condition helped most often, the effect of noise on helping did not reach statistical significance.

A follow-up study was conducted near a city-centre construction project (Page, 1977). Pedestrians walking past when construction jackhammers were in use (92 dB(A)) were assigned to the high-noise condition while those walking past when the jackhammers were not in use (ambient level of 72 dB(A)) were assigned to the low-noise condition. The measure of helping was obtained by having a confederate drop a small package in the path of a subject and continue as if she had not noticed. Less helping behaviour (both physically retrieving the package and/or orally calling the confederate's attention to the dropped package) occurred in the high- than low-noise condition.

Page argues that decreased helping under noise in these studies may have occurred because the noise 'distracted' the subjects, who thus failed to notice dropped packages, index cards, or other items. Hence, Page (1977) designed a final study to determine if noise level affected helping when distraction was not a factor. The site and noise levels were the same as used in the preceding study. In this case, however, a confederate emerged from a phone booth and directly requested change for an offered quarter. Although the difference was small, a significantly higher proportion of low- than high-noise subjects responded in some way (either checking for change or saying they had no change) to the confederate's request. Thus, Page concluded that it is not distraction alone which results in decreased helping under noise. In interpreting these results one should note, however, that sound level was confounded with the type of noise; that is, the 92 dB noise was the sound of a jackhammer while the 72 dB background sound was primarily traffic noise. It is thus possible that other characteristics of the jackhammer noise (e.g. intermittency, high spectral components), in addition to its higher intensity, could be wholly or partly responsible for these results. It should also be noted that subjects who simply said they had no change were coded as helpers. Therefore, unlike other studies discussed in this section, these results may reflect the effects of noise on the probability of merely responding to the confederate as opposed to actually engaging in a helping behaviour.

It is possible that the lack of helpfulness under noise found by Page (1977) in the final experiment may have been simply due to masking—subjects' inability to hear the request for help because of the loud background noise. Likewise, Korte *et al.*'s (1975) finding that fewer subjects in a high input area would grant a street interview could be due to subjects not hearing the request for help or being unwilling to engage in a conversation with someone in such a noisy environment. A simple 'desire to escape' explanation could also account for some of the observed effects. Particularly, one might want to avoid stopping and helping since it would result in prolonged exposure to the noise. Results of a laboratory study reported by Mathews and Canon (1975), however, suggest that the desire to escape loud noise does not provide a broadly applicable explanation for these effects. While waiting for the experiment to 'begin', male subjects were exposed to white noise at either 85 dB(C) or at 65 dB(C), or to the ambient room level of 48 dB(C). Waiting with them was a confederate 'subject' who, when called by the experimenter to leave the room for his turn, dropped his books and papers. Only 37% of those exposed to 85 dB(C) noise helped the confederate pick up the dropped material, whereas a significantly greater proportion of those exposed to ambient or 65 dB noise offered help (72% and 62% respectively). If escaping the noise was subjects' highest priority, one would expect that those exposed to loud noise would have helped the confederate along on his way. Otherwise, they would have to remain in the noisy waiting room for a longer period of time—until the confederate had finished participating in the study. Thus the 'escape' explanation cannot account for these results.

The focusing of attention that is said to occur under conditions of information overload (Cohen, 1978) and/or arousal (Broadbent, 1971; Easterbrook, 1959) also provides a possible explanation for some of the effects reported above. More precisely, the noise is viewed as causing subjects to focus their attention on the most salient aspects of a situation and thereby to neglect subtle interpersonal cues. Cohen (1978) has argued that attentional focusing can affect the probability of responding in three ways. (1) The cue that suggests that a helping response may be required (the distress cue) is not even perceived. (2) The distress cue is perceived, but a lack of available attention makes the person incapable of evaluating its significance. (3) The distress cue is perceived and evaluated, but aiding the person in need requires attention that is not available, or that is being reserved for an ongoing activity judged more important.

Three studies have been designed specifically to test the proposition that decreased helping during noise occurs because the noise causes persons to focus their attention on more salient aspects of the situation. In a field experiment reported by Mathews and Canon (1975), pedestrians walking down a residential street encountered a male confederate who dropped several books from his armload of boxes. The presence or absence of noise was provided by either having a nearby lawnmower run at 85 dB(C) or not (ambient level, 50 dB(C)). In half the cases, there was a subtle cue suggesting the legitimacy and degree of need for assistance—a cast on the confederate's arm, while in the remaining cases the confederate did not wear a cast. Subjects were less likely to aid the person who had dropped a pile of books when the lawnmower was running than when it was not. Moreover, the cast increased helping under ambient conditions but did not affect the frequency of helping under noise.

Although this effect can be attributed to attentional focusing, that is, ignoring a subtle interpersonal cue (the cast) under noise, alternative explanations such as desire to escape, or subjects helping less because they are experiencing a negative affective state caused by the noise, are also possible. Direct evidence that focusing occurs in similar situations has, however, been provided by two recent studies. In a study conducted by Korte and Grant (1980) in Scotland, pedestrians in either high (mean of 75 dB(A)) or low (mean of 70 dB(A)) traffic noise conditions, were approached by an interviewer/experimenter who asked if they had noticed anything unusual in the preceding city block. (Although the differences in noise levels were small, the investigators report that the mean levels were significantly different.) In fact, a confederate was either carrying a bright yellow teddy bear and standing near a sign 'Attention—Project in Progress' or wearing a pink party hat and standing near a tree full of balloons. In the high-noise condition fewer pedestrians admitted to having noticed the unusual surround than in low-noise conditions. Apparently, the high-noise subjects either did not find the circumstances unusual, or they had focused their attention to the point of not seeing and/or not remembering the unusual confederate. An 'escape' explanation for these results cannot be ruled out, however, for Korte and Grant report that high-noise pedestrians moved more quickly and gazed straight ahead longer than low-noise pedestrians. The correlational nature of the study, again, suggests the possibility of differences in the types of subjects in the high- and low-noise environments.

A more stringent test of the effects of noise on sensitivity to task-irrelevant, or peripheral social cues is reported in a laboratory study by Cohen and Lezak (1977). Subjects were presented with six stimuli, each consisting of two slides presented side by side. One of the slides contained a nonsense syllable, and the other (the social cue slide) pictured a person or persons engaged in an interaction or task. Subjects were told that they were to remember the nonsense syllables in the order that they were presented and that any other visual or auditory stimulation occurring during the experiment was part of an effort to determine the effects of distraction on memory. After stimulus presentation, half of the subjects were given the expected recall test for the nonsense syllables. The remaining subjects were administered a memory recognition questionnaire that required them to choose the 'correct' descriptions of the social slides. Subjects viewed the stimuli either under 95 dB(A) random intermittent noise or in quiet. For all subjects, half of the social cue slides portrayed a person(s) in distress, and the other half pictured a calm person(s). Although noise did not affect memory for the nonsense syllables (task-relevant cues), social cue slides (task-relevant cues), regardless of whether they depicted calm or distressed persons, were remembered less well under noise than under quiet. Thus, it appears that peripheral cues were not processed (or at least not remembered) under conditions of noise, and that the probability of these peripheral cues being processed was not affected by their meaning (distress/calm).

While not all the studies reviewed in this section manipulated the presence or absence of a specific social cue, it is possible that individuals who were exposed to noisy conditions focused their attention on their own personal tasks and needs, and did not perceive or otherwise process the cue that help was needed. For example, subjects in the high-input areas of the Korte *et al.* (1975) study may have offered less help because they did not evaluate the maps as a cue that the confederate was lost. Similarly, subjects in Page's (1977) field studies might have been so intent on carrying out their own tasks that they did not perceive, evaluate, or respond to the dropped index cards, or package. While an attentional focusing hypothesis provides a reasonable explanation for the observed lack of helping under high noise in many of these studies, we cannot at this time rule out other explanations. Moreover, recent research on focusing of attention under conditions of loud noise raises questions about the reliability of the focusing effect (e.g. Forster and Grierson, 1978; Loeb and Jones, 1978; Smith and Broadbent, 1980).

As summarized in Table 9.1, there is fairly consistent evidence that persons are less likely to offer aid when exposed to extraneous noise above 80 dB(A) than when in a relatively quiet environment. It is noteworthy that all of the studies on the effects of noise on helping have been concerned with relatively low-effort helping responses whose performance has little consequence for either the helper or the person in need. It is thus possible that more serious problems would elicit higher levels of helping in noisy as well as quiet settings.

As discussed above, decreased helping in noise may be attributable to masking, a negative affective state induced by the noise, a desire to escape the noise as quickly as possible, noise distracting the subject from the helping situation, or a focusing of one's attention resulting in a neglect of the subtly expressed needs of others. It is likely that there is no unitary explanation for these effects. That is, the reason for relative insensitivity to others under noise may vary across studies with one or more of the proposed mechanisms operating in each situation. Research that defines the situations under which each of these mechanisms operate would help clarify the role of noise in interfering with interpersonal behaviour.

Helping after noise termination Two studies have reported decreased helping after exposure to unpredictable, uncontrollable noise has been terminated. In an experiment by Sherrod and Downs (1974) subjects performed a proofreading task while tracking the occurrence of a digit. While working on these tasks, subjects were either presented with a soft 'soothing-simulated-seashore' background or with a very loud distracting recording of Dixieland jazz together with a voice reading non-relevant prose (sound levels were not reported). In a third condition, subjects were exposed to the loud distracting recording but were told that they could terminate the distracting stimulation if they found it necessary (perceived control). After departing from the 20-minute experiment, subjects were confronted by a second experimenter who asked for help in pretesting some experimental materials by completing a number of simple mathematical problems. The measure of helping behaviour was the number of problems the subject voluntarily attempted after being left alone by this second experimenter. Subjects who had heard the soothing-simulated-seashore attempted twice as many problems as those who had been exposed to the distracting noise, with perceived control subjects working an intermediate number. Thus, exposure to uncontrollable loud noise decreased post-stimulation helping. Moreover, the addition of control over termination of the noise partially ameliorated these effects.

In a study conducted in Israel, Yinon and Bizman (1980) manipulated both task success and noise levels. A general finding in the helping literature has been that more subjects help after experiencing success than failure (cf. Berkowitz and Connor, 1966; Isen, 1970; Moore *et al.*, 1973). To assess whether noise might distract individuals from their feelings of success/failure, Yinon and Bizman had subjects work on matrix problems for 10 minutes while exposed to either 50 dB SPL or 74 dB SPL white noise. Half the subjects in each noise condition worked on easy problems and received positive feedback from the experimenter (success), the other half received negative feedback while working insoluble problems (failure). After the experiment, subjects were approached by an American student asking for help with homework assignments. The dependent measure was the amount of time subjects offered to schedule helping this confederate. Almost five times as much time was volunteered by those exposed to low noise than those exposed to high noise. Also, the success–failure manipulation had no effect on the helping measure under high noise conditions; however, under low noise, successful subjects volunteered twice the amount of time to help than did failure subjects. It was concluded that high-noise subjects did not experience the feelings of success or failure, as such, because they attributed their arousal to the loud noise, rather than to their performance.

These post-noise decreases in helping behaviour have been attributed both to feelings of helplessness following exposure to an uncontrollable aversive event (cf. Cohen, 1980b; Glass and Singer, 1972; Seligman, 1975) and to post-noise deficits in arousal (Poulton, 1978) or attentional span (cf. Cohen, 1978, 1980b). Sufficient data are not, however, available to distinguish between these and other explanations.

Aggression

Evidence on the relationship between noise and aggression is sparse but consistent. Existing laboratory studies clearly indicate that while loud noise itself is not sufficient to enhance aggressive behaviour, noise will increase aggression in those who are already predisposed to aggress by having been angered or placed in the presence of an aggressive model.

Two studies found increased aggression during noise for angered subjects. In a study by Donnerstein and Wilson (1978), an experimental confederate intentionally angered half of the subjects by telling them that they had done poorly on a laboratory task and by giving them a number of painful shocks. The confederate gave the remaining subjects a positive evaluation and only

Table 9.1. Studies of helping behaviour during noise exposure

Authors	Year	Setting	Type of noise	Noise levels	Helping behaviour	Results	Communication required
Korte, Ypma, Toppen	1975	Filed	Ambient (traffic, urban)	LOW combined with other 'input' HIGH measures	1. Grant a street interview 2. Retrieve dropped key 3. Offer directions to lost confederate	1. Significantly less help in noise 2. Not significantly different 3. Significantly less help in noise	1. Yes 2. No 3. Yes
Boles and Hayward	1978	Filed	Ambient (traffic, urban)	LOW—70 dB(A) and below HIGH—71 dB(A) and above	Grant a street interview	Less helping in high noise	Yes
Page (exp. I)	1977	Field	Taped jack-hammer sounds	LOW—ambient level, 50 dB(A) MODERATE—taped noise, 80 dB(A) HIGH—taped noise, 100 dB(A)	Retrieve dropped index cards	Trend towards less helping as noise level increased	No

Page (exp. II)	1977	Field	Jack-hammer, traffic noise	LOW—traffic noise, 72 dB(A) HIGH—jackhammer, 92 dB(A)	Retrieve dropped package or call attention to dropped package	Significantly less helping (combined physical/verbal help) in high noise	Not required for physical help
Page (exp. III)	1977	Field	Jack-hammer, traffic noise	LOW—traffic noise, 72 dB(A) HIGH—jackhammer, 92 dB(A)	Check for change for a quarter or say 'no change' versus ignoring request	Significantly less helping (checking for or saying 'no change') in high noise	Not required for physical help
Mathews and Canon (exp. I)	1975	Lab	White Noise	NO—ambient level, 48 dB(C) LOW—white noise, 65 dB(C) HIGH—white noise, 85 dB(C)	Retrieve dropped materials	Significant linear relation between increased noise and decreased helping	No
Mathews and Canon (exp. II)	1975	Field	Lawn mower	LOW—ambient level, 50 dB(C) HIGH—lawn mower, 87 dB(C)	Retrieve dropped books	Main effect for noise Main effect for cast Interaction noise × cast	No

one shock. Subject and confederate then switched roles, with the subject now in the role of shock-giver. As expected from research on the conditions that lead people to behave aggressively, the angry subjects administered more intense shocks to the confederate than did subjects who had not been angered. Moreover, when a recording of 95 dB(A) white noise was played during the shock session, angered subjects administered more severe shocks than their counterparts exposed to 55 dB(A) white noise. The noise level did not affect the intensity of the shocks administered by the non-angered group. Thus, the high-intensity noise facilitated ongoing aggressive behaviour in individuals who were predisposed to aggression because of anger and frustration but not in their non-angered counterparts.

Similar results were found by Konĕcni (1975). After being either angered or left alone by a confederate, subjects were given an opportunity to shock the confederate on 50 trials of a 'creativity task'. During these trials, subjects were either not exposed to noise, or exposed to simple 73 dB tones, simple 97 dB tones, complex 73 dB tones, or complex 97 dB tones. Subjects who were not angered administered the same level of shock regardless of the noise level. When subjects had been angered, however, increases in either loudness or complexity of tones resulted in increased numbers of administered shocks. Again, noise increased aggression only for those predisposed to aggress because they had been angered.

Subjects predisposed to aggress as a result of witnessing others' aggressive behaviours similarly show increased aggression in the presence of noise but not in quiet. In an experiment by Geen and O'Neal (1969), half the subjects watched an aggressive prize-fight film, while the other half saw a non-aggressive sports film. After the film, subjects communicated their evaluation of a confederate's work by giving the confederate electric shocks. Half the subjects in each film condition were also exposed to 2 minutes of 60 dB white noise at this time. It is noteworthy that 60 dB was specifically chosen for this experiment based on pre-testing for a non-noxious but 'arousing' level of noise. Despite the fact that subjects in different conditions did not differ in their self-reported anger, the greatest total shock (number and intensity combined) was given by subjects who both watched the aggressive film and were exposed to the noise. Again, noise alone did not produce increased aggression; noise increased aggression only for those subjects exposed to the aggressive film.

The results of these studies are usually attributed to a noise-induced increase in arousal or drive that is presumed to be an underlying factor in aggression. However, independent evidence of increased arousal in noise exposed subjects is mixed and inconclusive (e.g. Geen and O'Neal, 1969; Konĕcni, 1975).

Only one study (Donnerstein and Wilson, 1976), has investigated post-noise aggression. In their experiment, subjects completed a mathematics task either during quiet, during exposure to unpredictable bursts of 95 dB(A) white noise, or during white noise that subjects perceived they could terminate. (Perceived control subjects were told that they could terminate the noise at any point during the experiment by merely saying the word 'terminate' over the intercom). Following 7 minutes of noise exposure, half the subjects were angered (by the person they would later aggress against) and half of the subjects were not angered, as in the experiment by Donnerstein and Wilson (1976) reported earlier. Later, when subjects evaluated the confederate's performance by administering shocks, angered (but not non-angered) subjects lacking control over the noise demonstrated an increase in aggression. The level of aggression for those with perceived control was no different than that of those not exposed to noise. These results indicate that aversive noise can facilitate post-noise aggression, and that this aggression is not solely a function of irritability produced by noise, but is also dependent upon some form of aggressive instigation. Moreover, these findings (as well as those of Sherrod and Downs, 1974, discussed in the earlier section, on helping behaviour) are similar to work on the after-effects of noise on performance, indicating that perceived control over the termination of the noise lessens or completely eliminates noise after-effects (cf. Cohen, 1980b; Glass and Singer, 1972).

Attraction and interpersonal judgment

The reinforcement–affect model of evaluative response, put forth by Byrne and Clore (1970), predicts that, over time, any neutral stimulus or person associated with rewarding or punishing environmental stimuli elicits the same pleasant or unpleasant feelings as the environment with which that person has been associated. Research with environmental stressors other than noise (e.g. heat) has shown that aversive environmental conditions do decrease attraction to others (cf. Griffitt and Veitch, 1971). However, the results of studies where attraction to others in noise is examined are equivocal, at best.

For example, in a study reported by Bull *et al.* (1972) subjects performed a variety of tasks in either 84 dB of mechanical noises, or under ambient conditions, 40 dB. Among the tasks, subjects were shown two attitude questionnaires allegedly completed by other students. These questionnaires were constructed to indicate either 75% (similar) or 25% (dissimilar) agreement with the subject's own pre-measured attitudes. Subjects were asked to rate the attractiveness of the students whose questionnaires they had read. Although subjects were more attracted to similar others than to dissimilar others, noise level did not affect judgments.

In a study reported by Sauser *et al.* (1978), subjects' judgments were found to be affected by sound level. In this study, groups of undergraduate men worked on a simulated personnel management task in 70–80 dB(A) office noise or in quiet, 50–57 dB(A). Subjects in the noise condition were told that the noise, a recording of general office sounds (typewriters, 'phones, conversation, rustling papers, and people moving) would be played in order to simulate an office environment as closely as possible. Subjects read other materials for 20 minutes and then were presented with resumés of five recently hired subordinates. Their task was to recommend starting salaries for each employee. The mean salary recommended by those working in the noise was almost $1000 lower than that recommended by their quiet counterparts.

Mixed results are reported in studies of the effect of noise on interpersonal distance—sometimes considered to be a non-obtrusive measure of attraction. In an early study (Mathews *et al.*, 1974), subjects were exposed to either 80 dB(C) or 57 dB(C) white noise while approaching a confederate who was sitting in a waiting room (conversation was prohibited). Regardless of sex, noise decreased the distance at which individuals stood and sat in relation to one another. Although decreased interpersonal distance may indicate increased attractiveness, it may also merely reflect expected difficulty in communicating. A similar study by Bell and Barnard (1977), designed to assess the effects of heat and noise on interpersonal spacing, failed to replicate this effect. Instead, males exposed to noise preferred more distance than those in quiet, while females exposed to noise preferred more proximity between themselves and others. Thus while data for females in both studies indicate the possibility of increased attraction under noise, inconsistent findings are reported for males.

As noted earlier, a number of theorists have proposed that the amount of information one can process is restricted under high noise conditions (cf. Broadbent, 1971; Cohen, 1978). One effect of attentional focusing is to over-simplify and distort perceptions of complex social relationships (Cohen, 1978). Thus, it requires less attention to view the relationship between two groups as either clearly positive or clearly negative than it does to view the more subtle similarities and differences between groups. A similar distortion of information can likewise occur in the perception of individuals. Gross cues such as group membership are likely to be over-emphasized, because attention is not available to process and interpret a wider range of information. Thus exposure to loud noise may result in over-simplified or extreme judgments instead of a shift towards negativity.

Evidence of noise-induced distortion in the perception of individuals is provided in a study reported by Siegel and Steele (1980). College students read a biographical sketch and completed an interpersonal judgment questionnaire about a target person. The sketch was written in such a way that a cohesive, integrated picture of the person did not emerge; furthermore, the sketch provided no information relevant to the judgment questionnaire.

The questionnaire asked subjects to estimate the likelihood that the target person would engage in certain behaviours (e.g. forge a cheque) or possess specific traits (e.g. be considerate). The 'noise' condition in this experiment involved not only 70 dB of construction noise, but also the experimenter's purposeful shuffling of papers and an argument with a confederate. Subjects exposed to the chaotic, noisy condition gave more extreme responses to the judgment questionnaire and were more sure of their responses in comparison to their quiet counterparts. There were no differences between conditions in assessed 'liking' of the target person. The results were interpreted as evidence that noise can lead individuals to judge others impulsively.

In a follow-up study, Siegel and Steele (1980) manipulated only sound level. A tape of white noise bursts peaking at 90 dB with a 65 dB background was used for half the subjects (noise condition) while the remaining half were not exposed to noise. In order to assess whether the tendency towards, extreme interpersonal judgments under noise would occur with less erratic target persons than those used in the preceding study, the target was a stable student with academic difficulties. Half the subjects in each condition were also given additional information about the target's statement that would lead them to attribute the academic problem to the target's situation, rather than disposition. Subjects filled out interpersonal judgment scales as in the preceding study. In addition, recall for statement information was measured. There were no differences among conditions in retention of experimental information. Again, subjects in the noisy condition made more extreme judgments of the target than subjects in the quiet condition. While subjects in the noise condition were not sensitive to the situational cues, subjects in the quiet condition assigned significantly less responsibility to the target when they had been given situational explanations for the behaviour than when they had not been given access to this information. Thus subjects exposed to noise behaved as if they were focusing their attention and thus ignoring incidental information. However, given that noise occurred throughout the experimental sessions of both studies, it is impossible to conclude whether the noise affected the processing of the information (e.g. encoding or retrieval) or the process of making and reporting a judgment.

A third study by Siegel and Steele (1979) also suggests that noise may cause people to distort and over-simplify complex social relationships. Subjects in this experiment watched a tape of two people playing a competitive word game for money. In the tape, the person losing the game (the loser) clumsily knocked over the solutions of the winning player, thus making it impossible to assess the winner's points. Half the subjects saw a tape with the loser wearing a cast. For the other half the loser wore no cast. In each of the cast/no-cast conditions, half the subjects were exposed to 92 dB(A) random intermittent white noise while half were not exposed to any extraneous noise. When asked to allocate payments to the game-players in the film, noise subjects allocated a higher proportion of the winnings to the loser than did quiet subjects. Hence, subjects exposed to noise behaved as if they were focusing their attention and thus ignoring information that would result in a fairer allocation of the winnings.

In sum, although there is some evidence that short-term exposure to high-intensity noise influences interpersonal judgments, the evidence is mixed. Hopefully, further research will help clarify the role of noise in such decisions.

Interpersonal judgments after noise termination Rotton *et al.* (1978) reported increased difficulty in differentiating between people who occupy different roles following both increased task load and noise exposure. While adding numbers, subjects were exposed to either 80 dB(A) of conglomerate noise bursts or to the ambient noise level, 43 dB(A). Within each noise condition, one-quarter of the subjects heard an 80 dB(A) lecture, one-quarter heard the 80 dB(A) lecture and were told they would have to recall it, and one-quarter were told to recall the lecture but were later relieved of the recall test. The remaining quarter of the subjects did not hear the lecture. Following exposure to noise, an interpersonal discrimination test was completed by each subject. The test involved the rating of 10 persons (e.g. self, best friend) on each of 10 dimensions (e.g. good–bad, interesting–dull). Both noise and task demands significantly reduced subjects' ability to differentiate the characteristics of people occupying different roles. Particularly, they tend to rate everyone similarly in terms of valence. Thus it appears that post-stimulation insensitivity to social cues can be induced by either high task load or an 80 dB(A) distracting noise.

Other interpersonal behaviours

Although there has not been a consistent effort to focus on any social behaviour other than helping and interpersonal judgments, there are a number of naturalistic studies that suggest that exposure to high-intensity noise may affect a wide range of interpersonal behaviours. For example, in a field study designed to assess the impact of a highway to be constructed near a college campus, Ward and Suedfeld (1973) found that noise affected a variety of group processes. In their study, 18 students volunteered to live in a college dormitory for 1 week. During this week, one-third of the students were exposed to the usual ambient noise levels of 40–50 dB, one-third were subjected to traffic noise at 63–66 dB, while the remaining third were exposed to 67–70 dB traffic noise. The noise was broadcast over loudspeakers outside the dormitories. From careful observation of their daily structured activities it was found that subjects exposed to the high noise spent the most time in the assigned group discussions where consensus was the assigned objective, and spoke faster than the other two groups. During these discussions the high-noise group also expressed more disagreement relative to agreement, showed more tension, exhibited more uncertainty by repeatedly asking for other people's opinions, and were more inclined towards irrelevant dramatization than the other groups.

Although the authors attributed the negative impact of noise on group discussions to the 'heightened negative affect in the high sound level conditions', they reported no difference between noise and quiet conditions in physiological arousal as measured by heart rate. The authors' explanation for the increased discussion time and speech rate was that it might have been necessary in order to transmit information in the speech-masking noise of the traffic.

Damon (1977) studied the effects of traffic noise on a residential housing project in a lower-income neighbourhood of Boston. The layout of the project was such that noise intensities varied from normal urban levels of 70 dB(A) around the interior buildings, to very high levels (averaging 80 dB(A) during the day-time) around units at the periphery of the project which were exposed to heavy traffic. Residents in the noisy area were arrested more often, were less likely to take care of their entry ways, and were more likely to be truant and absent from school than their quieter area counterparts. Numbers of clinic visits were no different for noisy or quiet area residents These associations, of course, do not imply that the noise caused the increase in arrests and other measures. Unfortunately, differences between the noisy and quiet areas in family size, density, and age suggest some fairly salient alternative causal hypotheses.

A study by Appleyard and Lintell (1972) investigated the effects of traffic noise on the residents of three residential streets in a middle-income San Francisco neighbourhood. The streets differed in the amount of traffic (light, moderate, heavy) and in associated noise levels. Residents of the lightly trafficked street were found to have three times as many friends and twice as many acquaintances as residents of the heavily trafficked streets. There was substantially more casual social interaction on the lightly trafficked street than on the other two, with virtually no sidewalk activity on the street with heavy traffic. People on the noisiest street also reported that the street was a lonely place to live, while those on the quietest street perceived their street as a friendly and sociable area.

Average length of residence on each street also bore evidence of people's reluctance to be a part of a noisy environment (8, 9.2, and 16.3 years for heavily, moderately and lightly trafficked streets, respectively). Cohen *et al.* (1980) similarly found higher turnover in noisy than similar (education, race, number of children) non-noisy areas. It is noteworthy that the patterns of social behaviour reported by Appleyard and Lintell may have been affected by the type of people who chose (or were forced to) live on the street, as well as by the level of traffic noise.

It seems likely that decreased social interactions in the form of neighbourhood 'chit-chat' on noisy streets may be wholly or partly due to one's expectation that communication would be awkward and difficult under noisy conditions. For example, Bragdon (1971) has noted that persons living in aircraft overflight areas are reluctant to visit others, or even talk on the 'phone, due to their expectation that aircraft overflights will inhibit casual conversation.

There are, however, a number of other possible explanations for Appleyard and Lintell's (1972) results. People may find the noise outside too aversive to spend any time there. Alternatively, the noise may cause a negative affective state resulting in a decrease in their desire to interact with others; finally, the noise may cause people to focus on their own problems, ignoring other people altogether. It is noteworthy that Appleyard and Lintell's (1972) use of only one street to represent each noise level presents a serious problem in terms of determining whether these streets are representative of the population of streets with similar noise levels.

In sum, there is evidence that increases in ambient sound levels are associated with decreases in various forms of interpersonal sensitivity. This interference has been attributed to a variety of mechanisms including, among others, masking, increased arousal, information overload, and shifts in mood. Unfortunately, since the reviewed studies generally employed rather unsophisticated measures of the sonic environment, it is difficult to make any definitive statements about a dose threshold for these effects.

The social and cognitive context in which noise occurs

As noted earlier, social psychologists have made important contributions in studying the role of cognitive and social contexts in moderating the impact of high-intensity noise. Although others concerned with the non-auditory effects of noise have indicated a tacit awareness of the role of contextual factors, work on the effects of noise on human performance, health, and even interpersonal behaviour rarely takes these factors into account. Instead, there is an emphasis on the role of the physical parameters of sound, especially sound level, in producing a particular response (the noteworthy exception is the work on community noise annoyance). An emphasis on the intensity of sound is functional in that its goal is to provide information on maximum acceptable sound levels for particular environments and particular outcomes. However, increasing evidence suggests that such an emphasis provides inadequate and often misleading conclusions about the relationship between sound and behaviour.

The following discussion provides an overview of the empirical and theoretical work on the role of cognitive and social context in moderating the sound–behaviour relationship. Our discussion emphasizes the importance of the meaning of sound as opposed to its physical parameters. This is not a thorough review of the relevant literature but an overview of some of the cognitive approaches that have been employed in studying noise. The areas of research discussed include the roles of privacy, personal control, attribution, attitudes, and expectancies in mediating one's response to sounds that are potentially stressful. It is important to note that these areas of research do not represent mutually exclusive categories or theories. In many cases, data cited in one section could be appropriately reviewed in another. Moreover, the theoretical perspectives are interrelated, and one theory can often be viewed as a subset or extension of another. The overriding common aspect of all these data and theories is that they unanimously suggest the important contribution of the meaning of a situation in determining a stress-related response.

Privacy

The desire for privacy has been proposed as an important determinant of negative stress reactions to sound. In general, privacy is viewed as the freedom to decide on the social activity in which one participates (Klausner, 1971, p. 130). Even unwanted passive interactions, such as hearing or being heard by others, are viewed as invasions of privacy that can result in increased annoyance and distress. For example, Berendt (cited in Klausner, 1971, p. 124) argues that people do not want to hear their neighbours, nor do they want their neighbours to hear them. This is supported by community surveys that consistently find that sounds made by others are viewed as more annoying than the sounds produced by oneself (cf. Cohen. 1969; Klausner, 1971). Moreover, others' sounds are especially intrusive if they contain meanings that one would rather not hear. For example, a survey of noise conditions in a hospital (Goodfriend and Cardinell, 1963) found that one of the most prevalent sources of noise annoyance was staff conversation in the hall. Patients found these sounds objectionable, not because of the sound level, but because of the information they conveyed including descriptions of other patients' conditions, symptoms, and so on. Another prevalent source of noise annoyance was the sound of other patients in distress, including moaning and calling for a nurse. Similar results are reported in a study of the role of the meaning of sound in determining its effect on physiological response. Chotolos and Goldstein (1967) assessed hospital patients' responses to a variety of sounds including weeping, tolling bells, and doors slamming. Physiological responses, including heart rate, digital temperature, and skin resistance, were primarily determined by the associations one made with these sounds. For example, there was a marked increase in heart rate following a recording of a man crying for help, whereas no such increase followed music. Thus it appears that the meaning of an intrusive sound is central in determining the degree of both one's annoyance and one's physiological response.

Predictability

It is a common assumption in the psychological stress literature that unpredictable stressors are more stressing than predictable ones. In terms of Lazarus' (1966) model of the stress appraisal process, unpredictable sound would be evaluated as a greater threat than predictable sound because it is more difficult to develop strategies to cope adequately with unpredictable than predictable sound.

Studies of the effects of noise on performance support the view that the predictability of the sound moderates sound–behaviour relationships. For example, subjects working on simultaneous tracking and digit-recall tasks show performance degradation on a secondary task (digital-recall) under unpredictable noise but not under predictable noise (Finkelman and Glass, 1970). When compared with predictable noise, unpredictable noise also results in greater variability of performance across subjects in paper-and-pencil tasks (Sanders, 1961), and a reduction in complex psychomotor performance (Eschenbrenner, 1971). Glass and Singer (1972) also report that deleterious effects of noise on tasks administered after stimulation is terminated occurs only when the high-intensity sound is unpredictable (see review of replications of this work in Cohen, 1980b). Moreover, they record initially higher levels of autonomic response for subjects exposed to unpredictable noise as opposed to those exposed to predictable noise. It is important to note that they found that predictability was a more important determinant of noise after-effects than was the intensity of the sound (108 dB(A) versus 56 dB(A)). Moreover, after-effects occur whether predictability is manipulated by presenting random *versus* fixed intermittent noise bursts or signalled (by a light) versus unsignalled bursts.

Similar support for the role of sound predictability in determining the impact of noise is reported in a review of the industrial noise literature by Welch (1979; also see Cohen and Weinstein, 1981). Welch reports that morbidity among workers exposed to sound above 85 dB(A) tends to be greater under unpredictable intermittent, impulse sound rather than under periodic, continuous, or relatively steady sound.

Personal control

A number of recent papers have emphasized that feelings of control over one's environment are central in determining the effects of a stressor on behaviour and health (e.g. Averill, 1973; Cohen *et al.*, 1979; Glass and Singer, 1972). It is important to note that control theorists often attribute stress to one's lack of control *per se*. That is, the physical stressor's role in the process is to elicit these feelings of helplessness. This is an important distinction, for it suggests that reactions attributable to perceived losses of personal control should be similar for a wide variety of stressors.

Cognitive control has been implicated as a central determinant of the impact of noise on both behaviour and health. For example, the adverse post-stress effects that follow loud, unpredictable noise are substantially reduced if the subjects believe they have control over the termination of the noise (Glass and Singer, 1972; see review by Cohen, 1980b). Increased control over high-intensity noise also results in an initially lower level of physiological response. Moreover, studies of the learned helplessness phenomenon, in which subjects are administered escapable or inescapable bursts of high-intensity sound, similarly indicate that post-stimulation deterioration of task performance occurs only after inescapable sound exposure (e.g. Hiroto, 1974; Krantz *et al.*, 1974). Two studies mentioned earlier (Donnerstien & Wilson, 1976; Sherrod and Downs, 1974) also provided subjects with the perception of control over termination of loud noise. The reader should recall that despite the fact that subjects did not actually terminate the noise, the feeling that they possessed such control ameliorated post-noise deficits.

There are a number of correlational studies of the association between community noise and behaviour, and between community noise and health, that are also consistent with the argument that control moderates the effects of noise. For example, Graeven (1975) finds that residents reporting an inability to control noise in their environment are more annoyed than those reporting control. Moreover, in a literature review, Cohen *et al.* (1979) suggest that community noise is most likely to have a detrimental impact on people from susceptible population groups—those characterized by a general lack of control over their environmental outcomes. Examples of such groups are the very young, the old, the poor, and the institutionalized.

Direct evidence for the hypothesis that community noise is related to a susceptible population's perceptions of helplessness is reported in a paper by Cohen *et al.* (1980). Elementary schoolchildren attending school under the air corridor of a busy urban airport tended to behave in a helpless manner by giving up on cognitive tasks more often than similar children attending quiet schools. Children attending noise-impacted schools also performed more poorly on a puzzle-solving task and had higher systolic and diastolic blood pressure than those attending quiet schools. Thus children continually exposed to uncontrollable noise in their home or school manifest signs of helplessness.

Attributions

Attribution processes have also been proposed as important determinants of one's response to a potential stressor. For example, one may view perceived noise in terms of Schachter's theory of emotion (Schachter, 1964; Schachter and Singer, 1962). According to this approach, one perceives a sound as noise only when a non-specific state of arousal is attributed to the sound (cf. work on crowding by Keating, 1979, and by Worchel and Teddlie, 1976). Both factors—arousal and the interpretation of the physical arousal as being due to sound—are necessary. An interesting twist of this theory is that the state of arousal may or may not actually be caused by intrusive sound; it will, however, be experienced as noise if, even mistakenly, it is attributed to the sound. Unfortunately, there are no existing studies demonstrating that attributing arousal actually caused by another source to sound causes noise effects. There is suggestive evidence, however, that the effects of other arousing stimuli can be lessened or eliminated when noise is provided as an alternative cause. That is, evidence exists that noise may be sometimes blamed for arousal caused by other sources. For example, Harris and Huang (1973) report less help for a women in pain when loud noise is presented while viewing the woman. Presumably, the subjects were less upset by the woman's suffering when they could misattribute their arousal to the noise. Moreover, as noted earlier, noise can increase aggression in angered persons (Donnerstein and Wilson, 1976; Koněcni, 1975); presumably because noise-induced arousal is missatributed to anger. Thus, noise may have an impact on social behaviour when arousal, from other sources, is misattributed to the noise and when arousal from noise is misattributed to other sources.

Attitudes about the stressor and its source

The community noise literature suggests that one's attitudes about a stressor, the purpose it is serving, and those responsible for it, are important mediators of stress response. These data could be viewed as support for any of the approaches presented so far, and provide strong support for the argument that the meaning of a sound is a central determinant of its effects.

Although social surveys often report a positive relationship between noise intensity and the average level of felt annoyance, intensity alone seldom explains more than one-quarter of the variance in individual annoyance reactions (cf. McKennel, 1973). The major determinants of annoyance, often explaining over half of the variance, are the respondents' attitudes and beliefs about the noise source. A summary of the community noise literature (Borsky, 1969, 1980) suggests that annoyance is heightened when: (a) the noise is perceived as unnecessary; (b) those responsible for the noise are perceived as unconcerned about the exposed population's welfare; (c) the respondent dislikes other aspects of the environment; (d) the respondent believes that noise is harmful to health; or (e) the noise is associated with fear. This list is abstracted from several social surveys, and the operative factors affecting annoyance reactions vary from one study to another. Nevertheless, attitudes and expectancies concerning the sound are consistently more important determinants of individual annoyance than the acoustic properties of the sound.

A striking example of the impact of attitudes on noise annoyance is presented in an attempt by Cerderlöff *et al* (1967), Residents of an area surrounding a Swedish Air Force base were sent a souvenir book commemorating the 50th anniversary of the Royal Swedish Air Force. The book led the residents to think that their neighbours all felt that the Air Force was of vital importance to the country. Surveys conducted several weeks later, and even several years later, found that this group was less annoyed by aircraft noise than a control group drawn from the same community. Thus, redefining the importance of the noise source drastically reduced annoyance reactions.

Expectancies

One's beliefs and expectancies about effects of noise are also important determinants of the effects of high-intensity sound on behaviour. In an early study, Mech (1953) showed that the effects of noise on performance could be altered by providing subjects with different pre-test expectancies about the 'usual' effects of noise on work efficiency. The group of subjects expecting detrimental effects did in fact show loss, whereas those expecting improvement improved.

Context in laboratory studies of noise

It seems intuitively reasonable that placing individuals in a room and playing 85–110 dB blasts of noise in their ears will affect their behaviour. Certainly noise at these intensities does interfere with communication. Yet these situations do not consistently nor, oddly enough, even, usually create noticeable stress responses (cf. Cohen, 1980a; Kryter, 1970; Stokols, 1978). To understand why such apparently aversive situations are not necessarily stressing, we need to evaluate the total experimental setting in an attempt to determine the meanings of both the situation and the potential stressor for the subject.

There are a number of factors that are usually present in experimental settings that are likely to lower the probability of the situation being defined as threatening (cf. Cohen, 1980a). First, participants in studies are aware that exposure to the noise will last for a short period. Second, there is an implied contract between the experimenter and the subject that suggests no harm will come to the subject during the experimental procedure. Third, the subject has chosen to participate in the study, usually after receiving a description of the stressor involved. Fourth, high-intensity sound, which may have its effects in many cases because of the inappropriateness in a particular situation is viewed as legitimate in a laboratory setting. Thus, in many cases, the social context of a laboratory study may serve to lessen the potentially stressing nature of the noise exposure.

In sum, there is considerable evidence that the social and cognitive context in which one is exposed to high-intensity noise is an important determinant of its effects on one's behaviour and health. Data on the ways in which context affects the meaning of the noise, and consequently its impact, are sparse. However, it is likely that a better understanding of the role of these contextual factors is requisite to any real advance in the understanding of the effects of high-intensity noise on non-auditory behaviour and health.

Acknowledgment

Preparation of this chapter was supported by a grant from the National Science Foundation (BNS 7923453). The authors are indebted to Hal Arkes, Laura Feldman, Alyn Stanton, and Drury Sherrod for their comments on an earlier draft.

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