Factors Affecting Learning During Health Education Sessions

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Background noise and interruption were examined for their effects on learning health information. The final sample consisted of 48 college students randomly assigned to one of four conditions in a pretest-posttest, double-blind, 2 × 2 experiment comparing noise (noise/no noise) by interruption (interruption/no interruption). Students viewed one of four videotapes about safe antibiotic use and then completed the posttest. The group watching the videotape with no distraction learned significantly more than the group watching the videotape with noise and with interruption. The results suggest that distraction during health teaching adversely affects the ability to learn health information.

Keywords: *health teaching; disruption; environment*

The ability for health care consumers to comprehend and to retain health information provides the foundation for safe and effective self-care. Although extensive literature exists regarding

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effective ways to teach health information (e.g., Johnson, 1999; Redman, 2001), there remains a paucity of research examining how factors such as limited time, noise, interruptions, and change in teachers might affect the ability to learn health information. Because health teaching often takes place under less than ideal conditions, it is important to critically examine how commonly occurring factors might affect learning. Factors supported as significantly decreasing learning might be targeted in efforts to improve learning outcomes. The purpose of the current study was to test how background noise and being interrupted affect learning health information.

According to cognitive learning theory, a schema or mental representation is used to organize, retain, and recall information (Markus & Zanjonc, 1985). Interference with the input of information would theoretically decrease the ability to cognitively process the information and, ultimately, to retain and to recall the information. No significant effect was found for the effects of distraction on listening to a series of unrelated sentences. Distraction was provided either in the form of counting out loud or of receiving low-level shocks. A significant negative effect was supported when reading the content, suggesting that reading might take greater cognitive effort than listening (Margolin, Griebel, & Wolford, 1982). The researchers suggest that the effect of the distraction task needs to be a function of the difficulty of the task with which the learner is involved. Rieber (1996) reinforced this point by conducting a study testing the effects of the distraction of an animated spaceship for fifth-grade students learning Newton's law of motion during computer-assisted instruction. No significant difference in learning was supported between students in the distraction condition as compared to students not distracted by the spaceship animation. Students in the distraction conditions actually took significantly less time to view the instruction than did students in the nondistraction condition.

Few studies have examined factors that might inhibit learning in health care settings. Sedation, pain, lack of knowledge of medical terminology, inconsistent instructions by providers, high nurse workload, and waiting were barriers to effective discharge education for middle-age lumbar surgical patients (Holmes & Lenz, 1997). Recall of postoperative pacemaker instructions was significantly greater for patients who were taught 3 hours after the last Midazolam dose than for those taught 1 hour afterward (Schuster et al., 1999). Anecdotal evidence from patients with coronary artery disease suggests that some inpatients might have more difficulty reading patient education materials in the hospital setting because of noise and activity (Gregor, 1984). The change in retention of information immediately after learning and 2 weeks later was significantly better for parents who were not distracted by their well children during antibiotic teaching for their ill child (Huckabay, 1992). The previous studies provide insight into a variety of factors that might decrease learning. Only Schuster et al. (1999) included a controlled measure of the inhibiting factor, the dose of Midazolam. What remains unclear from the previous studies is how much distraction adversely affects learning under similar circumstances.

Background noise and interruption of teaching frequently occur during health teaching. Both factors present a form of distraction for the learner. Little is known about how the combination of these two distracters might affect learning health information. The current study tested the following hypotheses:

Hypothesis 1: Learners in the noise condition will score significantly lower on the knowledge test than will learners in the no-noise condition.
Hypothesis 2: Learners in the interruption condition will score significantly lower on the knowledge test than will learners in the no-interruption condition.
Hypothesis 3: Learners in the noise-and-interruption condition will score significantly less on the knowledge test than will learners in the no-noise or no-interruption condition.

METHOD

DESIGN

A pretest-posttest, double-blind, 2×2 factorial experiment comparing interruption (interruption/no interruption) by noise (noise/no noise) was used to test the hypotheses.

Sample. Seventy-eight college students participated in the study. A sample size of at least 68 is required for a four-group analysis of variance with a power of .80, level of significance of .05, and η^2 of .15 (Polit & Hungler, 1999). The students had a mean age of 21.4 years (SD = 6.21), with a range of 17 to 49 years of age. The typical participant was a White (79.5%), female (83.3%), nursing major (71.8%) who had not taken a college-level microbiology course (61.5%) but who had taken antibiotics before (100%). Additional racial composition included 10.3% African American, 3.8% Latino, 2.6% Asian, 1.3% multiracial, and 2.6% other. A total of 12 different college majors and a group of undeclared majors were represented, ranging from premedicine to philosophy. The students reported that 46.2% of them had been previously taught about safe antibiotic use. Table 1 contains the descriptive composition for each of the four groups.

INSTRUMENT

Demographic Data Record. The Demographic Data Record was a 7-item, investigator-designed instrument developed to measure basic demographic variables. Three additional items examined exposure to prior teaching about antibiotic resistance that might affect learning about antibiotic resistance. The items addressed if a college-level microbiology course had been taken, if antibiotics had been taken before, and if any prior antibiotic teaching had taken place.

Antibiotic Resistance Test. The Antibiotic Resistance Test (ART) was composed of 13 multiple-choice items that measured comprehension of the content taught in the videotapes. The questions addressed symptoms of a viral illness (n = 2), general antibiotic resistance (n = 5), microbiology (n = 3), and pharmacology (n = 3) issues related to antibiotic resistance. Each question had a choice of four possible responses. For example, Question 5 stated, “Which of the following illnesses can be cured by antibiotics?” Possible responses included cold, flu, mono, or strep throat, with the correct answer strep throat. Content validity for the ART was established by submitting the ART for review by two doctoral students in nursing with expertise in instrument development. Revisions were made based on the reviewers’ recommendations. Test-retest reliability for the current study was $r = .44$, $p < .001$, with the educational

Table 1
*Descriptive Group Means, Standard Deviations, and Frequencies (*N *= 78)*

	Group			
Variable	No Distraction	Interruption	Noise	Interruption and Noise
Age (*M*, *SD*)	20.4 (3.19)	19.7 (2.25)	24.1 (8.88)	20.7 (6.36)
Pretest (*M*, *SD*)	7.8 (2.02)	7.8 (1.86)	8.0 (1.80)	6.9 (1.61)
Gender (% female)	85.0	73.3	90.9	81.0
Major (% nursing)	85.0	66.7	68.2	66.7
Micro. (% taken)	30.0	33.3	68.2	19.0
Race (% White)	80.0	80.0	77.3	81.0

NOTE: Micro. = microbiology.

videotape affecting knowledge and a brief 10 minutes between testing.

ANTIBIOTIC-RESISTANCE TEACHING INTERVENTION

The antibiotic-resistance teaching intervention was conducted using a 5-minute videotape developed specifically for the study. Video learning has been found to be effective (Zvara, Mathes, Brooker, & McKinley, 1996). The content included basic information about symptoms of viral illnesses, microbiology about bacteria and about viruses, antibiotics, and prevention of antibiotic resistance. Two experts, one with a Ph.D. in pharmacology and the second a primary care nurse practitioner with a Ph.D., reviewed the videotape script prior to developing the videotape and found the content to be accurate, complete, and clearly presented for college-age students. An excerpt from the videotape script illustrates the information provided in the videotape.

> It is important for all of us to understand that while antibiotics can be lifesaving for a bacterial infection, they do not kill viruses. An estimated 20%-50% of the antibiotics prescribed in the United States are unnecessary. To find a solution for the antibiotic resistance problem, we must decrease the two main causes of overuse of antibiotics. One cause is the overprescribing of antibiotics; the second is not taking the antibiotic correctly. . . . If your nurse or doctor decides that you need antibiotics for a bacterial infection, such as strep throat, be sure to take the antibiotics as directed. When you stop an antibiotic before all of the med-

ication is taken, you may be leaving a few of the bacteria alive and well in your body. Some of these bacteria might change or mutate because they have been exposed to a less than lethal dose of the antibiotic. Be sure to take the full course of antibiotic and do not save any antibiotic. Don't use someone else's antibiotic, and don't offer your antibiotic to another person.

PROCEDURE

The study was approved for human protection by the university institutional review board. After obtaining informed consent, participants were randomly assigned to one of the four conditions using a table of random numbers. Participants were told that the study was about the effectiveness of teaching about antibiotic resistance. This mild deception was necessary to control for the possible confound of unconsciously assisting the researchers to support the hypotheses (Rosenthal, 1966). Demographic information was then gathered, including age, race, gender, college major, previous antibiotic education, history of antibiotic use, and whether a college-level microbiology course had been taken. The ART was administered as a pretest to measure preexisting knowledge about the antibiotic content.

On completion of the pretest, student participants watched a 5-minute videotape of a nurse teaching about safe antibiotic use. Each student watched precisely the same information, but the videotape differed according to the condition. The treatment-condition videotape contained no distractions. The noise-only-condition videotape contained a constant, low-level background noise of hospital sounds, such as footsteps, movement of a stretcher, or paper rustling. A sound track of hospital sounds obtained from a radio station was electronically added to the videotape and muted to a low level of barely perceptible noise. The interruption-condition videotape contained two instances of the nurse speaking in the videotape being briefly interrupted by her ringing cellular telephone. The noise-and-interruption condition included both of the previously described distractions. The videotapes were labeled either A, B, C, or D so that the trained data collectors would remain unaware of participants' conditions.

This study examined factors affecting the ability to learn health care information for later recall and use. Transfer of information to long-term memory is required to recall information for later use. Immediately after watching the video, participants were instructed to write out their food intake during the past 24 hours on a blank sheet of paper provided by the data collector. Working memory can store only 7±2 chunks of information (Carroll, 1986; Miller, 1956). The diet-recall task required the information learned while watching the videotape to be transferred into long-term memory to be recalled.

Following completion of the diet recall, the ART was administered again as a posttest. On completion of the posttest, the participants were debriefed. Participants were asked what they thought the study was about. One participant guessed the hypothesis. Data from that participant was not included in the analyses. The full study was described to the participants with an explanation of why the deception was necessary. Participants were requested not to discuss the study with anyone else until the study was completed. Participants were thanked for their assistance and given additional printed health information about the interactive effect of antibiotics with alcohol and with birth-control pills.

DATA ANALYSIS

Preliminary analyses were conducted to determine if random assignment to groups was effective and included analysis of variance for age and for the pretest score. Group differences for gender, college major, race, and previous antibiotic teaching were examined, with cross-tabulation analysis using the chi-square statistic. Hypotheses 1 through 3 were tested together with an analysis of covariance (ANCOVA), using the pretest as the covariate to test group differences in learning safe antibiotic use. A second ANCOVA that controlled for the confound of previous microbiology education included only participants who had not had a previous microbiology course. Post hoc Scheffe testing was used to identify the source of the significant group difference.

FINDINGS

Preliminary analyses revealed no significant group differences for age, $F(3, 74) = 2.15$, $p < .10$; gender, $\chi^2(3, N = 78) = 2.12$, $p < .55$; nursing versus other majors, $\chi^2(3, N = 78) = 2.33$, $p < .51$; White versus other races, $\chi^2(3, N = 78) = 0.10$, $p < .99$;

previous antibiotic teaching, $\chi^2(3, N = 78) = 4.26$, $p < .24$; or pretest scores, $F(3,74) = 5.02$, $p < .22$. There was a significant difference between the groups for having taken a college-level microbiology course. More participants in the noise-only condition had taken a microbiology course than had participants in treatment condition, interruption condition, or the noise-and-interruption condition, $\chi^2(3, N = 78) = 12.33$, $p < .006$. Table 1 contains the group frequencies for having a previous microbiology course and the gender, major, and race distributions. Table 1 also contains the means and standard deviations for age and for pretest scores across the four groups.

Hypotheses 1, 2, and 3 tested the main effect of noise, the main effect of interruption, and the interaction effect of noise and interruption on learning health information. No significant differences in posttest scores were supported between the no-distraction treatment group ($M = 11.4$, $SD = 1.10$), the interruption group ($M = 10.4$, $SD = 2.13$), the noise group ($M = 11.1$, $SD = 1.81$), or the noise-and-interruption group ($M = 9.9$, $SD = 1.90$), $F(3, 73) = 2.29$, $p < .09$. None of the three hypotheses was supported.

A second ANCOVA was conducted omitting participants who had taken a college-level microbiology course. The results supported a significant difference between the groups, $F(3, 43) = 2.92$, $p < .05$, partial $\eta^2 = .17$. Table 2 contains the means and the standard deviations for the group posttest scores. Post hoc Scheffe testing supported a significant difference in posttest scores between the no-distraction treatment group and the group with both noise and interruption, $p < .05$. The revised analysis supported Hypothesis 3, but the main effect of noise and disruption, Hypotheses 1 and 2 remained insignificant.

DISCUSSION

Noise and interruption hindered learning about safe antibiotic use in healthy college students who had previously taken antibiotics. The experiment was carried out under conditions that controlled for many confounding factors such as different teachers, content, frequency, and magnitude of the disruption. The difference in the mean scores was small, but a lack of understanding in any one of the areas could place a person at risk. For example, understanding the increased chance of nau-

Table 2
Means and Standard Deviations for Group Posttest Scores (N = 48)

Group	*n*	*M*	*SD*
No distraction	14	11.3	1.14
Interruption only	10	9.7	2.21
Noise only	7	10.9	0.90
Interruption and noise	17	9.6	1.80

sea and of vomiting might influence a student to avoid drinking alcohol while on antibiotic therapy.

The study contained experimental realism with distractions common during health teaching. The noise manipulation was composed of low-level hospital noise. The interruption manipulation consisted of two brief telephone calls. Learners consisted of healthy college students learning a relevant topic during a brief, 5-minute teaching session. Testing the distraction effect under fairly optimal conditions for the learner provided a conservative test for the effects of noise and of interruption.

The results must be examined within the context of the study limitations. The study took place in a university rather than in a health care setting. Health care and university environments might introduce vastly different intrapersonal factors that encourage or inhibit learning. Participant anxiety might be more likely to occur in some health care situations, such as discharge teaching from the emergency department than in a university setting. A single site, not multiple sites, was used, further decreasing the generalizability of the findings. The teaching was presented completely by videotape. No teacher-learner interaction took place, which, under other circumstances, might have clarified misperceptions and enhanced learning. Student participants might not have been motivated to learn. The participants did not have a current health care need regarding safe antibiotic use and might not have watched the videotape as attentively as if they had an actual self-identified learning need. Prior exposure to safe antibiotic use also might have decreased the interest in attending to the videotaped information. The final sample size of 48 was small, increasing the possibility of spurious results.

Direct measurement of prior pharmacology education was not obtained and might have affected the ability to correctly answer some questions. The microbiology and pharmacology content related to antimicrobials was combined within one course for the nursing majors, who comprised 71.8% of the participants in the study. The effect of prior pharmacology education was partially controlled by removal of students who had taken a prior microbiology course.

APPLICATION

General implications for conducting health teaching with healthy young adults include conducting health teaching in an environment with minimal distractions and providing follow-up health teaching when learning occurs under less optimal conditions. Minimizing distractions can be as simple as closing the door to decrease hallway noise or placing telephones and pagers on vibrate during teaching sessions. Teaching in noisy hallways or in public areas should be avoided. Whether the teaching is formal or informal, there is more to teaching than sharing content. Fostering an environment conducive to learning increases the potential to learn. More efficient learning might require less teaching time.

Ways to decrease environmental distractions may differ across settings. Each setting may have different environmental distractions, whether telephones or televisions. People teaching health information should assess the environmental distractions present, develop plans to decrease the factors, complete a cost-benefit analysis for each option, implement changes, and evaluate the effectiveness of the changes for health-learning outcomes. In many cases, increased sensitivity to the potential negative impact of distractions might be enough to alter teaching practices on an individual basis (e.g., routinely closing the door whenever teaching takes place).

The effects of the learning environment have been tested in only a few health care studies and deserve further examination. Replication of the study in a health care environment where one distraction (i.e., noise or interruptions by people or by telephone) is manipulated at a time might further clarify whether the findings are applicable to health care settings. Testing the effect of multiple teachers might clarify how consistency of information affects learning. Different patient outcomes could be examined, including the potential for more efficient and more effective learning, avoidance of misunderstandings about self-care, decrease in patient anxiety, and increase in health care satisfaction. Nursing outcomes could also be tested, including increased work satisfaction and decreased workload.

Health education empowers people with information. The modest results from the current study are consistent with previous research about the negative effect of distraction on learning health information (Gregor, 1984; Huckabay, 1992). Distraction during health teaching might decrease learning. Greater effort should be made to create environments with minimal distraction, especially when understanding the health information is critical.

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