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***OBM Network News* publishes news, brief articles, book reviews, and information related to Organizational Behavior Management (OBM) and Applied Behavior Analysis (ABA).**

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The Effects of Different Inter-Prompt Intervals on Safe Behavior

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INTRODUCTION

Over the past 20 years, computer use has become increasingly common, both in work places and private residences (Gerr, Monteilh, & Marcus, 2006). This increase has been associated with a greater incidence of work-related musculoskeletal disorders (WMSD) resulting from repetitive typing (Wilkens, 2003). Factors contributing to the onset of WMSD include the work station set-up, poor postural habits, and the number of hours spent typing on a computer. The Occupational Safety and Health Administration (OSHA) recommends the use of an ergonomic adjustable workstation in addition to sitting in a neutral position as ways to reduce stress and strain on the muscles, tendons, and skeletal system, thus reducing the risk of musculoskeletal disorders (OSHA, 2008). However, there is evidence that the use of an adjustable work station is not enough to reduce the risk of musculoskeletal disorders (Green & Briggs, 1989; Montreuil, Laflamme, Brisson, & Teiger, 2006).

Prompts have been used to increase or decrease a variety of behaviors—seat belt use (e.g., Van Houten, Malenfant, Austin, & Lebbon, 2005), attendance (e.g., Turner & Vernon, 1976), home accident prevention (e.g., O'Reilly, Green, & Braunling-McMorrow, 1990)—and are a possible method to predispose workers to initiate postural change. In organizational settings, prompts are commonly used to produce appropriate responses (Johnson, Redmon, & Mawhinney, 2001). Monitoring and prompting of employees can be challenging in large organizations, especially in those that employ many isolated workers. The monitoring of certain continuous behaviors, such as sitting or typing, also presents a challenge. Much time and effort would be required of a supervisor to monitor the performance of all his/her subordinates. Therefore, self-management may be preferable in today's organizations (Johnson et al., 2001). Cooper, Heron, and Heward (2007) refer to the use of response prompts, such as reminders, as one of the simplest, most effective, and most widely applied self-management techniques.

To the extent of our knowledge, no prior studies have been conducted that evaluate the effects of inter-prompt intervals (IPIs). The purpose of this study was to seek the least frequent prompt that did not disrupt the flow of behavior, and to determine the optimal IPI, that which yields the highest level of safety performance and highest degree of productivity. The current study evaluated and compared the effectiveness of various IPIs on safe sitting behavior. Safe sitting behavior involved several postural variables; this study used the definitions offered by OSHA (2008) as guidelines for operational definitions. Participants were stationed in an ergonomically adjusted desk and were prompted to self-monitor their sitting posture. Four different IPIs (2, 5, 7, and 10 min), and a control condition (no prompts) were examined, in a between groups design, to compare the effects of different IPIs on safe sitting behavior. It was expected that the percentage of safe behavior would be higher for the groups that received prompts than for the no-prompt group.

METHOD

Participants

Fifty undergraduate students participated in this study. Participation fulfilled a laboratory requirement.

Materials, Setting and Duration

The study was conducted in laboratory cubicle located on a college campus. In the cubicle, a desktop computer was set on an ergonomically safe workstation. A video camera was mounted on the wall, visible to participants. The camera was angled to capture a lateral view of the participant's body while he/she typed. Data were recorded using a computer program that took pictures of the participants every 180 s. Sessions lasted approximately 1 hr, and the participants were required to attend two sessions with a maximum of a one-week interval between sessions.

Pretest, Safety Criteria, and Criteria for Remaining in the Study

The participants were asked to demonstrate their ability to type without looking at the keyboard by copying a 100-word paragraph into a Microsoft Word document. Those who completed the task successfully were given the consent form and were randomly assigned to one of five conditions. A block randomization procedure was used to control for order and sequence effects. Next, they were given a safety handout containing the postural variables definitions of safe sitting behavior and were asked to demonstrate it to the experimenter. Corrective feedback was not provided. In order to continue in the study, the participants had to exhibit safe behavior during 70% or less of the baseline sessions for at least one postural variable.

Randomization

Participants were assigned to the different conditions using a block randomization procedure. A block consisted of the five conditions set in any sequential order. There were ten blocks, with five participants in each. The experimenter randomly arranged the block conditions in a such a way that no condition was repeated until all five conditions had been run at least once.

Independent Variable

The independent variable was the duration of the interval between prompts to self-monitor (inter prompt interval (IPI)), and it had five levels: 2 min, 5 min, 7 min, 10 min, and no prompts.

Dependent Variable

The dependent variable was the percentage of safe sitting behavior. For the purposes of this study, all postural variables (head/neck, back, arms, hand/wrists, legs, and feet) were scored, but the participants needed to meet a maximum of 70% safety on at least one of these variables to move to the intervention phase. The definitions of safe postures were based on the Occupational Safety and Health Administration (OSHA, 2008) guidelines, and can be found through this link: http://www.osha.gov/SLTC/etools/computerworkstations/index.html

Secondary Measures

Accuracy and productivity were taken as secondary measures.

Design

A 2X5 mixed factorial design was used to compare the differential effects of IPIs—2 min, 5 min, 7 min, 10 min, and no prompts—on safe behavior (baseline x intervention).

Procedure

Baseline – During baseline, the participants were asked to copy a text of about 1000 words into a Microsoft Word document. No prompts were provided while the participants typed.

No-prompt condition – Participants assigned to the no-prompt condition were exposed to the same procedures as in baseline.

Two-minute condition – Participants assigned to the two-minute condition were asked to type a pre-assigned text with about 1000 words. While participants typed, on the center of the computer screen, a prompt that read "Check your posture" popped up at fixed 2 min intervals and it remained on the screen for 5 s. The prompts were provided regardless of the safety of the participant's behavior. The participant was not able to type while the prompt was on the screen.

Five-minute condition – The same procedures for the 2 min condition were in effect, but the interval at which prompts popped up on the screen was 5 min.

Seven-minute condition - The same procedures as the previous two conditions were in effect, with the IPI changed to 7 min.

Ten-minute condition - The IPI was 10 min; all other procedures remained the same as in the 2, 5, and 7 min conditions.

Data Collection

The computer program took a photo of the participant's full body every 180 s. The saved photo was examined and evaluated, and each postural variable was marked "S" for safe samples, and "U" for unsafe. The number of safe samples (S) divided by the total number of data points, multiplied by 100% was equal to the safety percentage, per postural variable. The postural variable that met the safety criterion (70% safe or less) during baseline was the participant's safety score for the session. The mean safety score per group was used for graphing and for data analysis. That is, in the 2 min condition, for example, the mean safe percentage of all participants in session one was graphed as the data point for session one in this group.

Interobserver Agreement

Interobserver agreement (IOA) was 93% (*SD*=6.0, *range*= 75% to 100%). IOA was calculated for all sessions on a point-by-point basis by dividing the total number of agreements by the total number of agreements and disagreements per session, and multiplied by 100%.

Data Analysis

Differences across group means were analyzed using a (2X5) mixed factorial ANOVA test. The factors were session type (baseline or intervention), and group (no prompt, and 2, 5, 7, and 10 min inter-prompt interval). Visual inspection of group graphs was also conducted.

RESULTS

The results show that the percentage of safe sitting behavior increased for all groups during the intervention. Figure 1 shows the relationship between IPI and safe posture. Safe performance was higher in all the prompt conditions than in the no-prompt condition, with the exception of the 2 min condition. The highest levels of safety performance were observed in the five-minute condition, followed by the ten-minute condition. Despite the observed increases in safe performance, the differences between groups were not statistically significant, F (1, 4) = 0.30, p = 0.88, nor was there a significant interaction, F (1, 45) = 0.26, p = .90. However, a mixed-factorial ANOVA indicates that there is a significant difference between session type (baseline and intervention) for all groups F (1, 4) = 30.00, p < .0001.

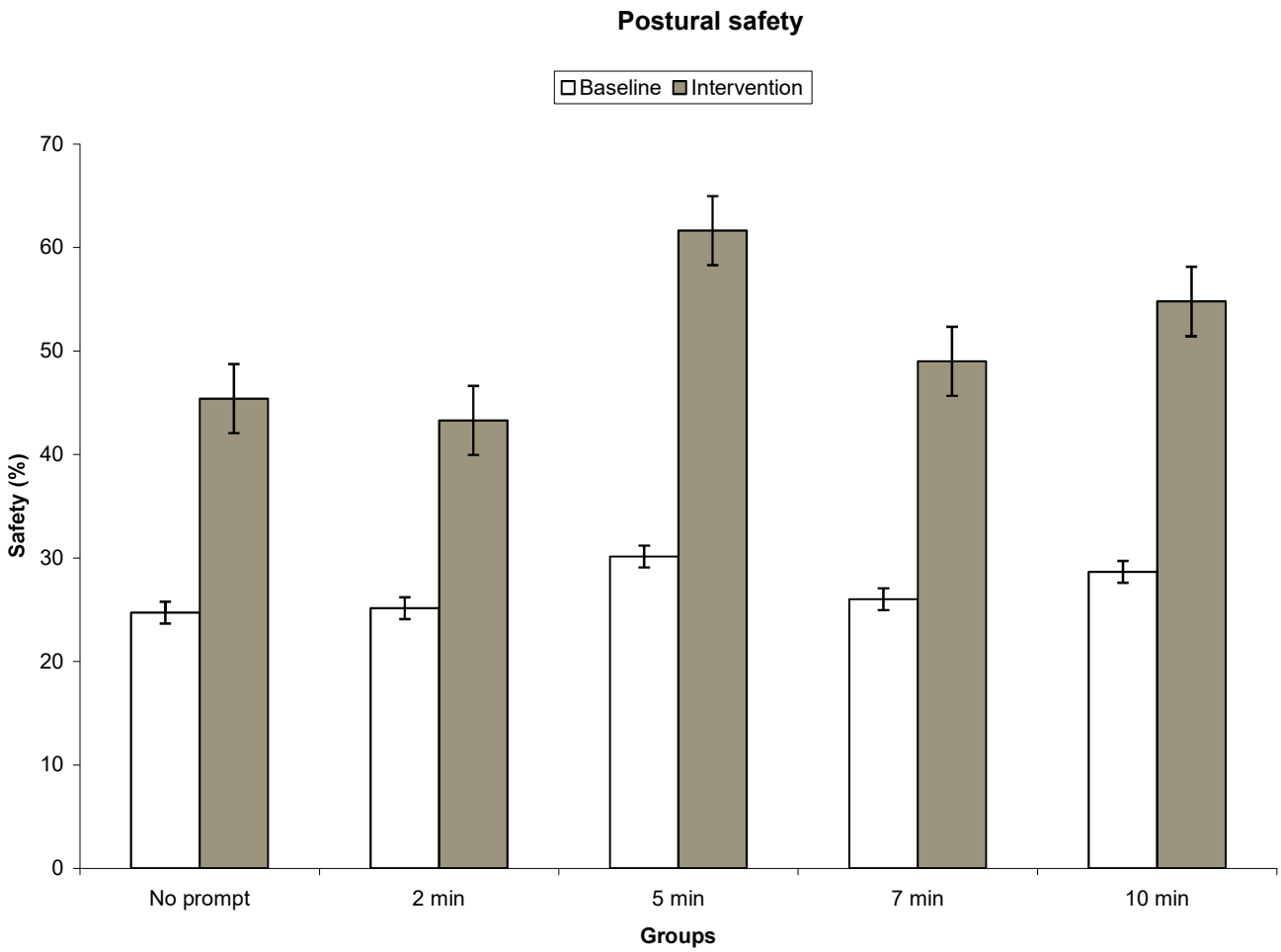

Figure 1. The effect of IPI of prompts to self-monitor on safe sitting behavior.

Figures 2 and 3 depict levels of productivity and typing accuracy for the different groups, respectively. Productivity and accuracy were not affected by the intervention. There was no significant difference between the five groups in either session types. A mixed factorial ANOVA indicates that there was no significant difference in productivity levels between groups, F (4, 94) = 0.33, p = 0.85, or across session types, F (1, 94) = 0.40, p = 0.52. No significant difference in accuracy levels either between groups, F (4, 94) = 1.81, p = 0.18, or between sessions, F (1, 94) = 0.69, p = 0.70, was found.

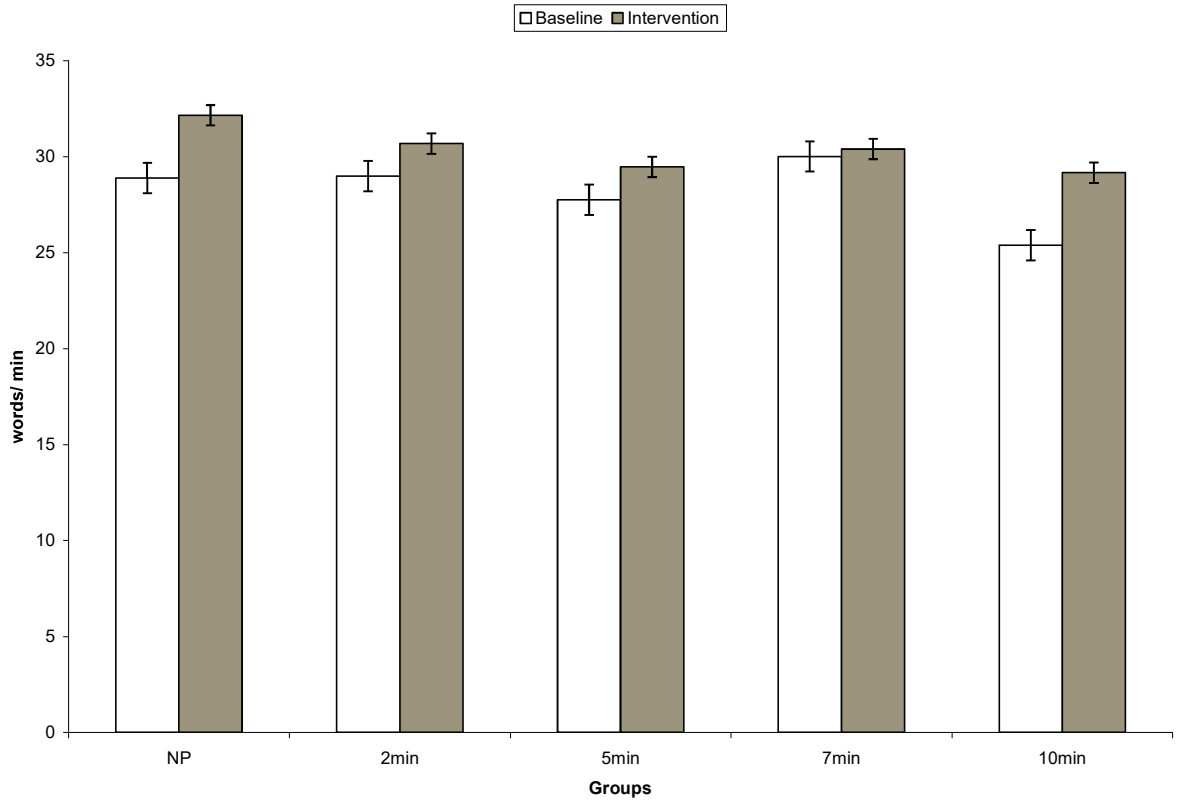

Figure 2. Levels of productivity as a function of IPIs.

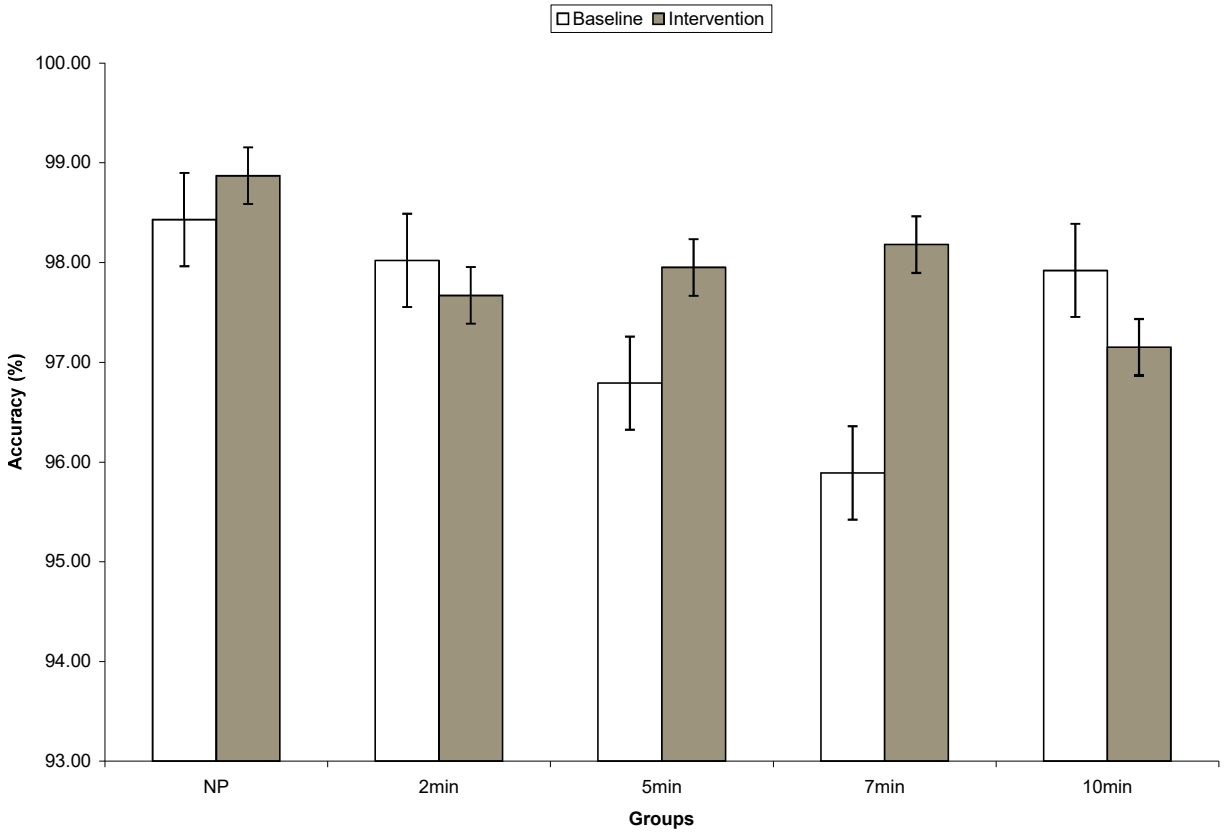

Figure 3. Accuracy levels per group.

DISCUSSION

The current study was conducted to evaluate whether different IPIs have differential effects on safe sitting behaviors, and to uncover the optimal IPI that would ensure highest safety, productivity, and accuracy levels. It was expected that a significant difference would be found between session types (baseline and intervention), and between groups (no prompt, 2, 5, 7, and 10 min intervals). The present findings indicated that, although the effects of session type were significantly different (i.e., intervention sessions yielded higher levels of safety than baseline sessions), no significant difference among the groups was found. Therefore, we can say that the prompts did not control the change in safety levels observed in the intervention session. It is not clear, however, what caused this change. Below, a number of reasons that might explain the lack of differentiation between groups is discussed.

There was substantial variance in the within-group data, for all five groups, across baseline and intervention sessions. Table 1 shows the mean and standard deviations per group across baseline and intervention. The participants received instructions on how to sit safely after the pre-test, before the baseline session, only. It is possible that the instructions had a greater effect on the participants' posture than the prompts themselves. By reading the instructions, and demonstrating the posture to the experimenter, the participants may have created their own rule about how to sit. Agnew and Redmon (1993) define rules as "function-altering, contingency specifying stimuli". If participants did indeed create a rule, that rule may have been in disagreement with the instructions (i.e., the angle interval considered "safe" could be different from what the instructions indicated) in such a way that the participants would still sit unsafely during the intervention, regardless of the prompts. For instance, for the leg position, the instructions indicated an angle between 90-110 degrees as safe, however, a participant may have considered angles between 89-111 degrees safe. Since a different rule would be created by each participant, and not by the experimenter, the large variance in performance within groups might be explained by the variance in the rules. Offering corrective feedback during the pre-test phase, while the participants demonstrate their posture to the experimenter, could ensure the formation of more homogeneous rules.

Table 1
Mean and Standard Deviation per Group and a function of Session Type

	Session Type			
Group	Baseline		Intervention	
	Mean	SD	Mean	SD
NP	25.41	21.27	46.91	39.89
2 Min	27.16	14.42	46.91	28.53
5 Min	30.12	22.92	61.62	34.28
7 Min	27.70	22.45	53.40	35.29
10 Min	30.36	14.19	50.66	25.76

Posture varies in novel settings, and it is natural to move and adjust one's posture when sitting on a new couch, or at a different environment. This fidgety tendency combined with reactivity to the experimental settings may have masked the true levels of safe posture during baseline. The increase in performance observed during intervention sessions may have been independent from the intervention, in such a way, that even in the absence of prompts, a significant change in safe sitting behavior could occur. A way to avoid this possibility would be to have a larger number of baseline and intervention sessions, thereby making it possible for a more stable pattern in the participants' posture, and any change in it, to be observed.

Some postural variables are known to be extremely hard to change without consequences (e.g., Gravina, Austin, Schoedtder, & Loewy, 2008). That is due to the habit forming nature of posture, and to the covert reinforcement that these habitual postures may offer to the individual, e.g., more comfort, less pain. Variability in the number of postural variables for which each participant met criterion (one to five) may have contributed to the large variance in the data within groups, which may have caused a ceiling effect. For instance, if the only postural variable that met criterion was the head, it would be unlikely to change without the use of consequences (;Rost, 2008; Tittelbach, 2008). As a result, there would be very little chance for that particular postural variable to change as a function of prompts only. Likewise, if the only variable to be used was the feet, it is conceivable that the participant might have scored 0% safe during the baseline by keeping the feet resting on the chairs wheels instead of flat on the floor, and during intervention phase reached 100% safe, by keeping the feet flat on the floor. Even in the absence of prompts, this would be a typical way in which behavior might vary.

It is known that operant behavior is controlled by its consequences. The present manipulation involved no tangible experimenter-defined consequences. Amato-Zech, Hoff, and Doepke (2006) were able to demonstrate a change in behavior using prompts as the sole intervention; however, the target behavior (self-monitoring of on-task behavior) has naturally occurring, non-programmed consequences (e.g., the check marks on the self-monitoring forms) that might serve as reinforcers. It is possible that prompts alone are not enough to change behavior. In changing sitting behavior, it may be necessary to combine prompts with some form of feedback about each participant's posture.

Something other than the prompts produced the reliable increase in safety levels observed in the intervention session. Further research is necessary in order to uncover what may have caused this change. One possibility is that the postural definitions presented on the instructions before the baseline session somehow hindered the participants' performance during the baseline session. It would be necessary to partially replicate this study, using a mixed-factorial design, where the presence or absence of instructions with postural definitions would be manipulated in combination with a manipulation of presence or absence of prompts in order to assess this.

Future research should also attempt to clarify what the effects are of varying the stimulus properties of a prompt (e.g., visual versus auditory). A single subject design would be appropriate and may help avoid possible problems related with reactivity to the experimental setting. Using multiple-baselines across participants would also allow for comparison between different prompt properties, such as inter-prompt intervals and prompt mode (e.g., visual, audible, tactile). In addition, it would allow for comparison between effects of prompts followed or not by consequences. Although there are many areas for possible research, the question remains: does the frequency and rate with which prompts are presented affect the accuracy of responding? Cooper, Heron, and Heward (2007) define prompts as supplementary antecedent stimuli used to occasion a correct response in the presence of discriminative stimuli that will eventually control the behavior. Therefore, if a prompt is an experimental operation, it would seem that the differential effects of its parameters should be defined and future research is necessary in order to establish such a definition.

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