

Development of a Warning System for Carpal Tunnel Syndrome

Kenya Freeman^A, Michael S. Wogalter^A, Jessica K. Hink-Eustace^A,
and Linda J. Frederick^B

^A*Department of Psychology*
640 Poe Hall, CB 7801
North Carolina State University
Raleigh, NC 27695-7801 USA

^B*Dept. of Safety & Environmental
Management*
West Virginia University
Morgantown, WV 26505-6070 USA

Abstract: Reports of Carpal Tunnel Syndrome (CTS) have increased dramatically in recent years. One potential way to reduce CTS incidence is to warn people to recognize early symptoms so that they may take corrective actions to limit their injury. The present research examines the kinds of words and statements that might comprise a warning that informs about the early symptoms of CTS and would motivate behavior to minimize further CTS development. Potential terms and statements, e.g., “throbbing” and “may require surgery,” were compiled based on earlier data from individuals with professional experience with CTS (including ergonomists, physical therapists, and hand surgeons). In the present study, laypersons rated signal words, symptoms, consequence statements, and instruction statements with respect to producing an effective warning about CTS. The data collected in this study could serve as a partial basis in determining the components of a warning label.

1. Introduction

The growth of repetitive motion injuries such as Carpal Tunnel Syndrome (CTS) in recent years has been attributable to increased use of keyboards and other computer input devices. In 1995, CTS comprised 65% of all occupational injuries, afflicting over 5 million Americans [2]. Since 1987 there has been a 700% increase in the number of people with repetitive motion injuries [3]. This rise coincides with the dramatic increase of the number of people who are using computers at work and at home [4]. The costs associated with CTS are lost work hours and wages, health care costs, and permanent physical damage [5].

One potential method to lessen CTS injury is to use warnings to increase user awareness, to inform people of ways that lead to proper keyboard use, and ultimately to help reduce the number of repetitive motion injuries. Currently several manufacturers place CTS warnings on the underside of keyboards or in a separate brochure or manual [5]. Most of these lack information on the symptoms of CTS as well as the indications of developing CTS. Thus, CTS warnings are probably not as effective as they could be. Because CTS symptoms may develop gradually, those affected may not be aware that they are developing the syndrome until it is severe and it has begun to negatively affect productivity, comfort, safety and/or health [6]. Without treatment or intervention and with continued trauma, the damage can be permanent [6]. The present study attempts to evaluate potential component terms and phrases for a CTS

warning. The materials were in part derived from existing CTS literature and data from Frederick et al. [1] who used experts on CTS (e.g., ergonomists, physical therapists, and hand surgeons).

2. Method

Participants

Participants were 15 individuals from Raleigh-Durham, North Carolina area. The mean age of the participants was 21 (SD = 2.71). Seven of the participants were female.

Materials and Procedure

Prior to making the ratings of the words and phrases, participants were given a detailed description of CTS including the physiological bases, the kinds of behavior that produces the syndrome, the signs and symptoms as the syndrome progresses, and the potential consequences. The description was based on a literature review of CTS as well as input provided by the professionals who had extensive experience in research and treatment of the disease [1]. The purpose of the description was to familiarize the participants with CTS so that they would be able to evaluate the potential warning components in the task that followed.

Participants were told that their task was to rate a set of potential warning components that would be useful in making computer users aware of the symptoms, consequences, and ways to avoid CTS.

Participants were provided four separate categorized lists of potential warning components: signal words, symptoms of CTS, consequences, and instructions. Each list was on a separate page so that participants could rate the stimuli on a 7-point scale regarding effectiveness in communicating warning information about CTS (1 for "not effective" to 7 for "most effective"). The specific stimuli are shown in Tables 1 to 4.

3. Results

Tables 1 to 4 contain the mean ratings and standard deviations for signal words, symptoms, consequences and instructions statements ordered according to rated effectiveness. Analysis of variance was used to examine the ratings of the four sets of warning components. All were significant ($ps < .05$).

Table 1 shows the mean effectiveness ratings for the signal words. The term WARNING was rated as the best signal word in the list.

Table 2 shows the mean effectiveness ratings for the symptoms of CTS. The symptoms "pain," "burning," "throbbing," and "cramping," were rated the highest in the list.

Table 3 shows the consequences of CTS. The four highest rated consequences were "May produce permanent disability," "May require surgery," "May result in chronic pain and discomfort," and "May result in long term disability."

Table 4 shows the mean effectiveness ratings for instruction statements. The ones considered most effective were "Keep wrists straight," "Take a short break from typing at least every hour if possible," "Sit in a comfortable chair that supports your back," and "Serious consequences can be prevented with early treatment."

4. Discussion

The goal of this study was to examine the ratings of warning statements that had been previously rated by CTS experts [1]. Laypersons were used as participants in this study. While it might seem that experts on CTS would be more appropriate to evaluate the warning components, the participants are the potential target audience for the warning and they were given training on CTS prior to making their evaluations. The training was based on material

from published literature and from experts on CTS. Therefore, the participant had a meaningful basis for their judgments.

This study makes progress towards the goal of developing an effective warning. An informative warning has the potential of reducing the likelihood of serious CTS development by conveying the early symptoms, the potential consequences, and instructions. Early recognition of symptoms may help to instigate corrective actions to limit injury.

Table 1
Mean Effectiveness Ratings of Selection of Signal Words

<i>Signal Words</i>	<i>Mean Ratings</i>	<i>Standard Deviation</i>
Warning	5.40	1.12
Danger	5.27	1.98
Caution	4.67	1.84
Please Read	3.07	1.94
Be Careful	2.87	1.73

Table 2
Mean Effectiveness Ratings of Selection of Symptoms

<i>Symptom(s)</i>	<i>Mean Ratings</i>	<i>Standard Deviation</i>
Pain	6.33	1.18
Throbbing	5.33	1.80
Cramping	5.33	1.05
Soreness	5.07	1.62
Discomfort	4.73	2.09
Muscle Fatigue	4.53	1.81
Numbness	4.53	1.92
Having to shake your hands to work out the tightness	4.53	2.10
Having to massage hands to relieve pain or discomfort	4.40	1.99
Stiffness	4.40	1.68
Weakness	4.20	1.61
Burning	4.07	1.62
Swelling	3.93	2.05
Pain at night	3.80	1.94
Tingling	3.73	1.67
Tenderness	3.60	1.30

The ratings could be useful for creating prototype warnings for CTS. An example is shown in Figure 1. CTS warnings could be placed on keyboards or other computer input devices in locations where there is available surface area and where the equipment user can see it. A label on a keyboard or monitor may be restricted in size, because of space limitations, therefore only a selected set of component statements could be used. Ratings such as those in the present study can provide input into decisions regarding which statements would receive priority.

Prototype warnings could then be evaluated through a set of iterative, usability-type studies to produce an effective warning system for CTS.

Table 3
Mean Effectiveness Ratings for Consequences

<i>Consequences</i>	<i>Mean Ratings</i>	<i>Standard Deviation</i>
May result in long term disability	6.60	.632
May result in chronic pain and discomfort	6.60	.737
May require surgery	6.60	.737
May produce permanent disability	6.47	.915
May cause partial disability of hand and wrist	5.80	1.32
May diminish ability to do activities of daily living	5.27	1.53
May not be able to use hands and arms effectively any longer	5.07	1.91
May limit physical abilities	5.00	1.32
May lose ability to grasp	4.33	1.99
May result in difficulty grasping	4.13	2.23
May decrease grip strength	3.87	1.69
May affect productivity and safety	3.60	2.03
May need to change work habits or type of work	3.60	2.23
May result in difficulty handling small objects	3.53	1.51
May lose strength	3.47	1.89
May result in weakness	3.40	1.77

Table 4
Mean Effectiveness Ratings for Instructions

<i>Instructions</i>	<i>Mean Ratings</i>	<i>Standard Deviation</i>
Serious consequences can be prevented with early treatment	5.47	1.46
Take a short break from typing at least every hour if possible	5.47	1.64
Early attention to symptoms can prevent serious problems	5.40	1.45
Avoid resting on your wrists while typing	5.27	1.67
Keep wrists straight	5.27	1.71
Sit in a comfortable chair that supports your back	5.20	1.32
Keep forearms approximately parallel to the floor	5.07	1.71
Adjust chair height and, if possible, table height	4.87	1.69
Change positions frequently	4.27	1.53
Avoid slumping your shoulders	4.13	1.69
Use a light touch on the keys	4.00	1.93
Seek medical attention	3.93	2.46
Don't pound keys or mouse button	3.87	1.85
See your health care provider	3.13	2.07
Request an ergonomic evaluation of your workstation	3.07	2.02

WARNING:

You may have early signs of Carpal Tunnel Syndrome (CTS) if you have some of the following symptoms in your hands, wrists, and arms:

- Pain (worse at night)
- Throbbing
- Muscle fatigue
- Soreness
- Numbness
- Cramping

Serious consequences can be Prevented with early treatment.

CTS may:

- result in long-term disability
- result in chronic pain and discomfort
- require surgery

What to do to avoid CTS:

- Take a short break from typing at least every hour if possible
- Avoid resting on your wrists while typing
- Keep wrists straight
- Sit in a comfortable chair that supports your back.

Figure 1: Possible warning based on ratings data.

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