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Authors
Miller, Lisa M Soederberg
Sutter, Carolyn
Wilson, Machelle D
et al.

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Assessment of an e-Training Tool for College Students to Improve Accuracy and Reduce Effort Associated with Reading Nutrition Labels

Lisa M. Soederberg Miller, PhD[1], **Carolyn Sutter, PhD**[2], **Machelle D. Wilson, PhD**[3], **Jacqueline J. Bergman, PhD**[4], **Laurel A. Beckett, PhD**[3], and **Tanja N. Gibson, MS**[1]

[1]Department of Human Ecology, University of California, Davis, One Shields Avenue, Davis, CA 95616; USA; Tel 530-752-3955; Fax 530-752-5660; lmsmiller@ucdavis.edu; tngibson@ucdavis.edu

[2]Family Resiliency Center, University of Illinois, Urbana-Champaign, 904 W. Nevada Street, Urbana, IL 61801; USA; carolyns@illinois.edu

[3]Department of Public Health Sciences, University of California, Davis, One Shields Avenue Davis, CA 95616; USA; mdwilson@ucdavis.edu; labeckett@ucdavis.edu

[4]Nutrition Department, University of California, Davis, One Shields Avenue, Davis, CA 95616; USA; jjbergman@ucdavis.edu

Abstract

Objective: Nutrition labels are often under-utilized due to the time and effort required to read them. We investigated the impact of label-reading training on effort, as well as accuracy and motivation.

Participants: 80 college students (21 males and 59 females).

Methods: The training consisted of a background tutorial on nutrition followed by three blocks of practice reading labels to decide which of two foods was the relatively better choice. Label-reading effort was assessed using an eye tracker and motivation was assessed using a 6-item scale of healthy food-choice empowerment.

Results: Students showed increases in label-reading accuracy, decreases in label-reading effort, and increases in empowerment.

Conclusions: The nutrition label e-training tool presented here, whether used alone or as part of other wellness and health programs, may be an effective way to boost students' label reading skills and healthy food choices, before they settle into grocery shopping habits.

Keywords

Nutrition; Health Education; Clinical Medicine

Correspondence to: Lisa M. Soederberg Miller.

The data contains identifying information which could potentially risk student privacy. Limited data will be made available upon reasonable request.

INTRODUCTION

Nutrition labels are ubiquitous, appearing on most packaged foods, thereby providing an ideal opportunity to promote healthful food choices and energy intake levels. Although nutrition label use is associated with many positive outcomes including consuming a healthier diet and trying to lose weight [(1-3)], many individuals avoid using labels because they are too difficult or time consuming to read [(4)]. College students, in particular, are at risk for nonuse. A review of the literature on nutrition label use among college students and young adults (ages 18 to 30 years) indicates that 63.5% of respondents reported that they rarely use nutrition labels [(5)]. Reasons for nonuse include: using labels to select foods would be annoying, buying foods regardless of nutrition content, and avoiding labels due to time constraints [(6-8)] . Given the college years are associated with increased risk of consuming a poor quality diet and gaining weight quickly [(9,10)], it is important to explore ways to decrease the burden associated with reading labels.

The Capability, Opportunity, and Motivation Behavior System Model (COM-B)[(11,12)] proposes that opportunity, along with capability and motivation, are 3 pillars underlying behavior. A similar model has been used to characterize communication effectiveness within the consumer behavior literature [(13)]. Capability related to nutrition label use could be improved through simplifying the information in the nutrition label to decrease the ability needed to interpret the information [(14)]. Front-of-package (FOP) symbols (e.g., traffic light symbols, facts up front) have been shown to promote more accurate interpretation of information relative to the detailed information found on the nutrition facts panel [(15-21)]. Evidence from studies utilizing measures of perceptions, visual attention, and comprehension indicates that consumers report stronger preferences for, or are more likely to view, FOPs relative to nutrition facts panels [(20, 22, 23)]. Moreover, data from functional magnetic resonance imaging study show that FOPs made salient through color signaling activate brain regions responsible for self-control [(24)]. In general, these data show that FOPs may be play a role in promoting label reading capability by simplifying -and drawing attention to -nutrition information. A potential drawback is that, unlike nutrition facts labels, FOPs are voluntarily provided on food packages in the US and the types of nutrients listed are at the discretion of the manufacturer. There is also some evidence suggesting that even these abbreviated forms of information may have no impact on purchasing intentions, cause confusion among consumers, or detract from other important information [(22, 25-27)].

Another approach to improving capability involves teaching individuals how to read nutrition facts labels. This approach also capitalizes on opportunity - in the form of existing widespread, reliable, and uniform information – and potentially increases motivation to the use nutrition information on labels. The Information-Processing framework argues that capability and motivation interact as individuals learn new skills [(28)]. Specifically, cognitive resources (attention) act as a reinforcing link between capability and motivation as training progresses. Support for capability-motivation interactions is evident in research showing that new skills foster feelings of empowerment [(29-31)]. Label reading training that promotes capability and motivation, while at the same time, reduces the burden associated with understanding label information would be ideally suited to reducing label use barriers. Findings and theory in the cognitive science literature have shown that, through focused practice, individuals develop skills that are efficient (accurate and fast) and require less effort to use [32]. This is because intense practice facilitates the development of automatic processes, which are relatively fast and effortless compared to more controlled processes [33, 34], that are often required to understand the various types and amounts of nutrients on a nutrition label.

Past research using a practice-based approach to label-reading training has shown significant increases in the comprehension processes underlying label reading as well as feelings of empowerment associated with selecting healthful foods [31, 35]. Aside from general measures indicating an overall reduction in time across practice sets, effort associated with training has not yet been assessed. In the present study, we examined the effects of label reading practice on effort using eye tracking methodology, which has been employed in past studies examining nutrition label use [35-38]. We were particularly interested in determining whether focused practice reduces the effort associated with comparing nutrition labels to arrive at a relatively more healthful choice. In order to select the more healthful choice, individuals must be capable of distinguishing between meaningful nutrient differences across the food choices and minor differences, which can be challenging even when relying on simplified (i.e., FOP) labels [25]. A secondary goal was to replicate past findings on the effects of training on label reading accuracy, perceptions of empowerment, and usability of the web-based tool.

METHODS

Sample

The sample consisted of 80 college students (21 males and 59 females) who received college credit for their participation. Eligibility criteria included the ability to speak English fluently, lack of vision impairment and eye disease, and ability to sit still using a chin rest to enable us to track eye movements. The study took place across 2016 and 2017 and was performed in accordance with the Declaration of Helsinki with ethical approval from the university's Institutional Review Board and written informed consent provided by all participants.

Materials and Equipment

Food Label Use.—Self-reported food label use was assessed using the item [39]: "I'd like you to think about the labels on many food products that list ingredients and provide nutrition and other information. When you buy a product for the first time, how often do you read this information?" with responses on continuous frequency scale (1=low; 100=high).

Training.—The core of the nutrition label training tool was a focused-practice task. The practice task consisted of three blocks of 24 nutrition label questions designed to teach individuals the difference between a tiny insignificant difference between nutritious qualities of foods and a significant difference within the context of one's daily diet [35]. After each question, participants received accuracy feedback (i.e., correct or incorrect), and after each block, were given their total score (percent correct) for the block.

Prior to the practice task, there were 3 segments designed to provide background for the practice task: 1) a 20-minute narrated slide presentation covering basic information about nutrition including major nutrients and their role, energy, nutrient sources in foods and diet-health relations; 2) an overview of the information available on a food label (e.g., the different types of nutrients and metrics); and 3) an orienting task designed to place the nutrition label in the context of the food label by asking participants to locate a specific piece of information on the nutrition label, ingredient list, or front of package.

Eye Tracker.—Effort was assessed using an EyeLink 1000, a video-based, tower-mounted eye tracker from SR Research Ltd, to monitor eye movements. The eye tracker samples eye-position x, y coordinates at a rate of 2000 Hz with an average accuracy of .25 −.50 degrees. For this study, we assessed fixation sequences that reflect location and order of eye fixations to capture effort expended on reading labels. Specifically, we operationalized effort in terms of the number of times individuals compared the two nutrition labels, that is, the number of left-to-right and right-to-left fixation sequences (sweeps) *between* labels as well as the number of times they made *within* label fixation sequences. Past work has found that fixation sequences are an informative metric of label reading processes that are sensitive to individual differences in ability and age [(40)]. Fixation sequences were measured as between or within label as the sum of sweeps in a block (i.e., summarized at the block level).

Empowerment.—We used a healthful food-choice empowerment measure based on prior research [(31)] to assess perceptions of ability and willingness to use nutrition information and choose healthful foods, and current and desired levels of understanding of nutrition information. The measure had 6 items that were averaged to form an overall score. Responses were made on continuous scale (0-low to 100-high). The measure was administered immediately before and after training.

Usability.—We assessed students' perceptions of the tool's effectiveness and usability modeled on past work assessing usability of online tasks [(41)]. Responses were made on a scale from 0–100. General questions assessed the extent to which the tool was: 1) not useful/very useful); 2) difficult/easy to use, 3) boring/enjoyable to use, and 4) extent to which users felt they possessed the computer skills needed to perform the tasks (no/yes). In addition, specific questions assessed the extent to which: 5) the information in the background tutorial was old/new and 6) the information in the focused practice was old/new; 7) the background tutorial affected learning (didn't learn/learned a lot); 8) the focused practice affected label reading skills (didn't improve/improved a lot). To inform future studies with more extensive training, we also asked participants to indicate whether they felt their label reading skills would improve with more practice (not at all likely/very likely).

Procedure—Participants completed a questionnaire with demographic, food label use, and empowerment measures. Participants then received a 20-minute tutorial designed to familiarize them with basic nutrition information, an overview of the information presented on a nutrition label, and an orienting task that required participants to locate a specific piece of information on one of three areas of the food label (nutrition label, ingredient list, or front of package). This was followed by label reading training, consisting of 3 blocks of label reading practice (24 questions per block). Questions consisted of comparing the nutrition labels of two foods presented side-by-side on a computer screen and selecting (using a mouse) the label that represented the relatively more healthful option. Participants were randomly assigned to one of two instruction conditions prior to beginning the label reading training to determine whether providing detailed feedback in the instructions affected training progress relative to accuracy feedback only (correct, incorrect). In the accuracy-only instruction condition, participants were told whether they were correct or incorrect after each sample question whereas in the detailed instruction condition, participants were shown the question with the correct choice marked to highlight important differences between the two labels. For both instruction conditions, accuracy feedback (correct, incorrect) was presented immediately after each question and eye movements were monitored across the training. At the end, participants completed the empowerment measure again and the usability survey.

Statistical Analyses—We used hierarchical logistic regression modeling to test for the effects of training on accuracy at the question level, and mixed effects models to test for effects of training on fixation sequences (to capture effort), controlling for sex and self-reported food label use. We used repeated measures ANOVA to test for effects of training on empowerment, controlling for sex, food label use, and the instruction treatment. Usability was assessed using summary statistics across all participants. Statistical analyses were performed using SAS® software version 9.4 (SAS Institute, Cary, NC) except for the usability analyses, which were performed in SPSS version 25 (IBM). A p-value of less than .05 was used to determine significance in all analyses. We were unable to obtain usable data from the eye tracker for 10 participants (2 males, 8 females) and omitted these individuals from the analyses. Participant characteristics of the final sample are shown in Table 1.

RESULTS

Label Reading Accuracy

Students' accuracy increased significantly with practice block ($p<.001$, Figure 1). The odds of a correct answer increased by about 25% in the second block compared to the first block (average score block 1 = 70% compared to 75% for block 2, Odds Ratio (OR) = 1.24, 95% Confidence Interval (CI) = 1.06, 1.45)); and by almost 50% in the third block (average score 78%) compared to the first (OR = 1.46, 95% CI = (1.25, 1.7)) with an almost 20% increase in the odds in the third block compared to the second (OR = 1.18, 95% CI = (1.003, 1.39)). There were no differences between those who reported using food labels versus those who did not ($p=.54$), nor between males and females ($p=.13$). There was no instruction condition effect on accuracy ($p=.21$).

Effort (Eye Tracking Fixation Sequences, "Sweeps")

Effort decreased with practice as evident in significantly fewer fixation sequences, or sweeps, in later blocks of practice ($p<.001$), both for between and within label fixations (Figure 2). Students made more sweeps within labels than between labels ($p<.001$) and the rate of improvement was steeper for between- compared to within -fixation sequences (block by type interaction $p=.039$). The instruction condition had a significant effect on decreasing the number of fixation sequences, with those who received detailed feedback having on average 60 fewer sweeps than those who did not ($p<.001$). Students averaged (mean (standard deviation)) 644 (276) within label sweeps in block 1, decreasing to 538 (249) in block 2, and 480 (206) in block 3. Students averaged 255 (105) between label sweeps in block 1, decreasing to 223 (107) in block 2, and 205 (93) in block 3. Thus, accuracy increased with training while the number of sweeps between and within labels decreased, respectively. Females made on average 45 fewer sweeps than males (p=.02) but there was no significant effect of food label use on effort (p=.20).

Empowerment

The nutrition label training had a significant effect on empowerment as reflected by an increase in average empowerment scores from 69.8 (SD=16.4) pre-training to 74.8 (SD=14.1) post-training (p<.001). There was a significant pre-post interaction with food label use (p=.02) such that, at pre-test, those who reported using food labels scored on average 13.8 points (SE=3.25) higher than those who did not (p<.001) whereas, at post-test, the difference was 7.8 points (SE=3.1). There were no significant effects of sex (p=.44) nor instruction condition (p=.46) on empowerment.

Usability

Overall, ratings regarding the training tool were positive with a mean rating of 69.4 (SD=24.5) for ease of use (difficult/easy), 61.0 (SD=22.0) for enjoyable (boring/enjoyable), 69.6 (SD=23.6) for usefulness (not at all useful/very useful); and 83.0 (SD=15.7) for having the necessary computer skills (no/yes). Regarding specific components of the training, students' perceptions were similar regarding the extent to which they learned from the nutrition background tutorial, 66.6 (SD=27.3), and improved their label reading skills from the focused practice, 68.9 (SD=26.9). However, they were more likely to report that the focused practice offered new information (old, new), 71.1 (SD=25.8), than the background tutorial 49.0 (SD=27.4). In general, individuals felt their label reading skills were likely to improve with more practice, 68.9 (SD=26.9).

COMMENT

Given that college students are unlikely to read nutrition labels if reading is effortful,[6, 8] it is important to identify ways to reduce effort surrounding label use, while at the same time, increasing label reading accuracy. Data reported here demonstrate that label reading practice, delivered through a web-based tool, can reduce effort required to read labels. The study also replicated earlier work showing that practice increases label reading accuracy and empowerment, especially for those who reported using food labels [31, 35]. Consistent with the COM-B model, the training can be useful in bolstering both capability and motivation, helping college students make healthful food choices when presented with the opportunity to utilize food labels [11, 12].

These findings add to a growing literature on web-based nutrition interventions designed to teach college students about nutrition and improve their dietary decision making [42, 43]. Although past studies sometimes include nutrition label training, details on the tasks are rarely provided making it difficult to build upon this work. In one study, researchers compared the efficacy of a web-based and in-person nutrition education program for low-income adults that included a module on label reading skills [44]. They showed that self-reported nutrition label use was the one area that failed to show improvement in the web-based delivery group and suggested that personal interactions may be needed to increase food label use. Although it is difficult to know why the label reading education was less effective when delivered via the web given differences in samples and approach, the present study offers an alternative web-based approach to label reading training that increases accuracy while decreasing effort and could be added to interventions designed to impact label use as well as dietary behaviors more broadly defined.

The training task used in the present study resembles computer games in which players learn to navigate the problem space on their own, through practice and feedback but no explicit instructions regarding what to pay attention to [45]. This type of implicit learning task appears to be one way to motivate and teach college students how read food labels. Findings presented here suggest that this approach also reduces effort associated with understanding the nutrition information on labels. It could be that healthful habit formation is fostered by underlying implicit learning processes such as these.

Limitations

Results from the current study represent a convenience sample of college students who may have been motivated to engage in label training to receive course credit. A larger randomized study with college students across campuses would provide important generalizability information. Moreover, training conducted over several months would help uncover the conditions under which training leads to changes in the use of nutrition labels and in food purchase decisions on a regular basis, whether used alone and in conjunction with other wellness programs or medical nutrition therapy. Despite these limitations, the potential of this low-cost and scalable e-training tool warrants a closer look to determine if it can add value to college students' well-being and enhance the effectiveness of other approaches to promoting student health.

Conclusions

The data presented here indicate that a practice-based e-training tool reduces effort needed to understand nutrition label information while increasing accuracy and empowerment, which may translate into increased frequency of using food labels, both on packaged foods and at restaurants. Importantly, the nutrition label training affected accuracy, effort, and empowerment both for those who already use nutrition labels and those who do not, suggesting that training may help to narrow the gap between the groups in their perceived ability to manage their own nutrition (empowerment). Food choice skills are important among college students because they are at greater risk for weight gain[9, 10], and may be developing new skills to make independent food choices as they transition to college and away from the family home. Web-based forms of nutrition education are promising because they are acceptable to users[46, 47] and have wide reach. Programs that offer focused practice, such as the one described here, can promote automaticity of label reading processes and reduce the burden associated with understanding nutrition information on food labels. Combining practice with more personalized nutrition counseling may be a particularly effective way to help individuals make healthy food choices reduce prevalence of overweight and obesity.

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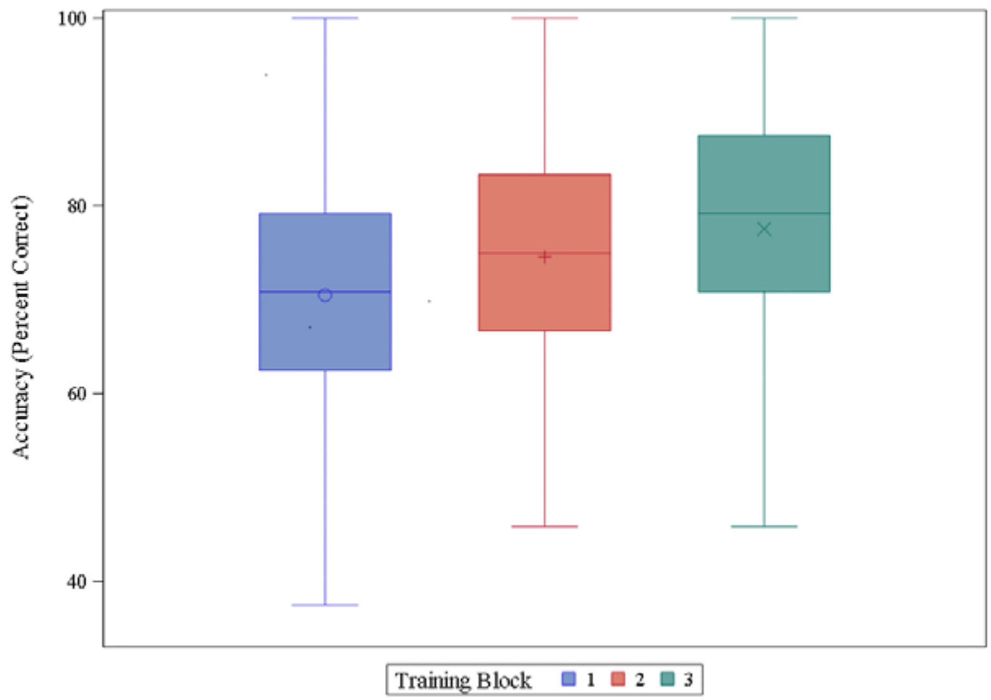

Figure 1.
Box and whisker plot of percent accuracy for each block of training. Bars represent the range from the minimum and maximum values observed in the data set. P-values for block effect <.001.

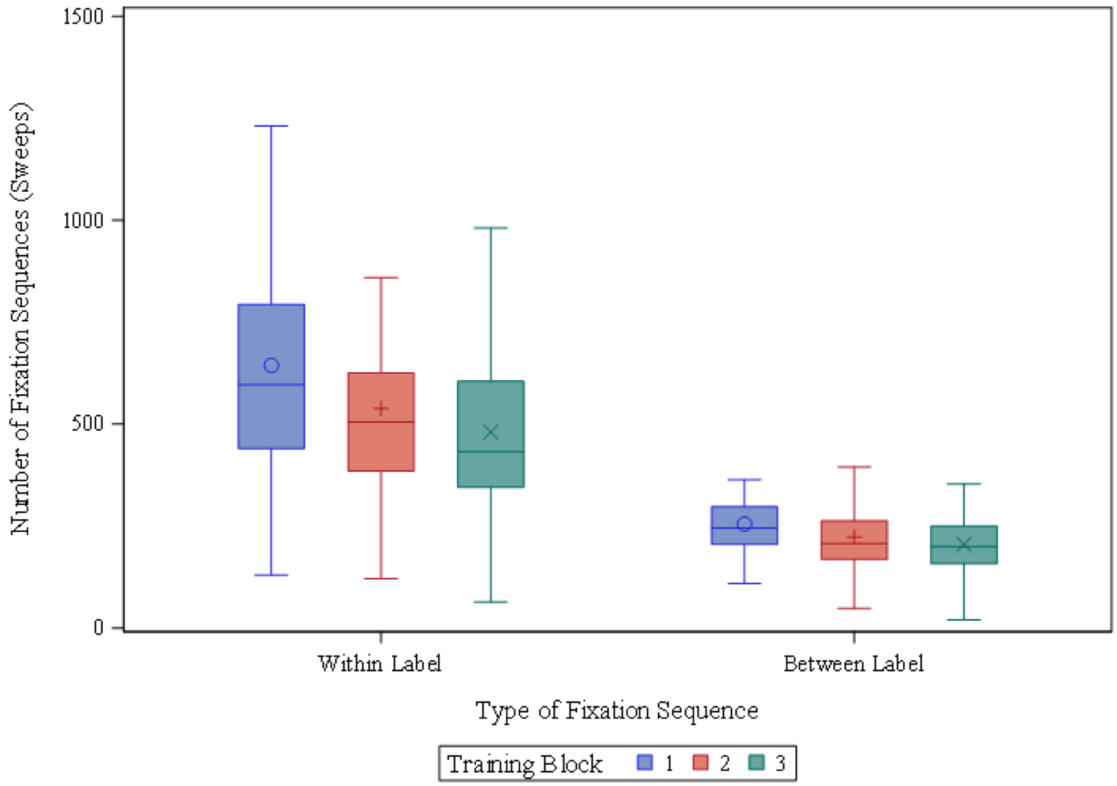

Figure 2.
Box and whisker plots of the number of within (left) and between (right) label fixation sequences (sweeps) for each block of training. Bars represent the range from the minimum and maximum values observed in the data set. P-values for block effect <.001.

Table 1.

Participant Characteristics (n=70)

Variable (Units)	Mean	SD
Age (18-26 years old)	19.9	2.0
Education (years)	14.2	1.3
	Percent	**SE**
Sex (female)	73	5
Hispanic (yes)	27	5