Text and graphics: manipulating nutrition brochures to maximize recall

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Abstract

This study examined how altering text and graphics of a nutrition brochure could affect the ability to remember the content of the message. Two theoretical models were used to guide alterations: dual-coding theory and the communications model. Three brochure formats were tested: the original brochure containing abstract text and abstract graphics, a modified brochure with relatively concrete text and abstract graphics, and a relatively concrete text brochure with concrete graphics. Participants were divided into four age groups: 20–30, 40–50, 60–70 and over 70 years. Women were randomly assigned into each of the three experimental brochure formats or a control group. Participants completed recalled materials from the assigned brochures (the no treatment control group did not include a brochure) at two different sessions, 30 days apart. Data were content analyzed and results were compared using analysis of covariance to test differences by age and brochure types. Younger women (20–30 and 40–50 years) recalled more information than women over 60 years. More concrete nutrition education print materials enhanced recall of information presented immediately after reading the material; however, this effect was transient and lasted less than 30 days after a one-time reading. The implications of these data for communicating nutrition messages with print materials are discussed.

Introduction

Nutrition and health brochures have become popular vehicles for communicating lifestyle change messages to consumers throughout the country. Unlike other forms of educational media, brochures are diverse, inexpensive to create and produce, and easy to use with varied audiences. Although these reasons are fiscally sound and consequently important issues, the question of whether printed brochures are actually read, comprehended, retained and subsequently used appears to be unresolved. Because of the increased use of educational print materials, the intent of this project was to determine whether a widely used nutrition brochure was comprehended and remembered, and whether experimental alteration of the text and graphics could improve its comprehension and recall.

To date investigators have reported that characteristics of printed media such as topical content (Harris, 1989), readability (Cooley et al., 1995; Dollahite et al., 1996) and format features (Achterberg and Bradley, 1991; Adams and Hoffman, 1994; Watanabe et al., 1994) can influence how people receive, comprehend and react to brochure messages. Features of print materials that have been found to stimulate reader interest and attentiveness include paper weight, color, texture, print size and use of graphics or pictures (HarveyWebster, 1988; Michielutte et al., 1992; Adams and Hoffman, 1994). Bold print, colorful graphics, text high-
lighted in colored boxes, bold borders and specific points in text that are set out with dark bulleted dots have all been identified as ‘attention-getters’ (Shepherd et al., 1989; Achterberg and Bradley, 1991; Adams and Hoffman, 1994). However, with the exception of readability level (Cooley et al., 1995; Dollahite et al., 1996), little attention has been given to text construction or content.

Memorizing information has much to do with the ability to learn the information and/or perform a specific task (Schaie and Willis, 1996). Most studies of human learning abilities across the life span show that older individuals learn less rapidly than their younger counterparts. Usually, the apparent decline with age is found to be fairly regular, at least after age 40, with the young adults (20–40) performing best, the older adults (60 and older) performing worst and middle-aged adults (40–60) in-between (Schaie and Willis, 1996). As a result, this study included four age groups to examine whether brochure format or age influenced propositional recall.

The hypotheses developed for this project are: (1) more nutrition information will be retained by women who read relatively more concrete brochures versus more abstract brochures and (2) younger women will remember more information than older women regardless of brochure format.

Methods

Two theoretical models were used to guide brochure alterations: the communication model and dual-coding theory.

Communication model

Gillespie and Yarbrough’s communication model (Gillespie and Yarbrough, 1984; Gillespie, 1987) provided guidance in understanding the process of communicating nutrition information. Their model has two major components: inputs and responses. Inputs include nutrition communicator inputs as well as receiver inputs. Responses refer only to receiver responses and they include attention to the nutrition information inputs (or message), comprehension of the inputs, interaction (e.g. between receiver and communicator) and acceptance or rejection of the message. Attentiveness and interaction are important for comprehension to be attained. Acceptance or rejection of the message is the outcome of the communication process, and may be cognitive, behavioral and/or affective. For the purpose of this study, we focused on one specific outcome, information retention. It was hypothesized that nutrition inputs, if altered, could influence attentiveness, interaction and subsequent comprehension.

Dual-coding theory

Abstract words (e.g. justice, poetry, high-density lipoprotein) are not associated with any particular image or pictorial representation in one’s mind. Concrete words (e.g. table, apple) are associated with a particular image formed in one’s mind, and they describe real and actual things.

Dual-coding theory suggests that people have the ability to code information into memory in two ways, either by reading words (verbal coding) and/or by seeing pictures or meaningful graphics (image coding) that accompany the words (Paivio, 1991). Both systems of coding are unique in that verbal coding is considered by theorists to be more of an abstract coding mechanism, whereas image coding is more concrete (Paivio, 1991). It seems that when both coding systems can be employed, recall of information improves (von Eye et al., 1989; Ishi and Yamauchi, 1994). It should be noted, however, that both text and graphics exist on a continua of abstract to concrete.

Selection of a nutrition brochure

The goal in selecting an experimental brochure for use in this study was to identify an existing brochure, designed for general public use, that could have both text and graphics experimentally changed to improve comprehension and recall.
The US Dietary Guidelines is a nationally distributed, multiple editions brochure used by many state and federal programs as well as profit and not-for-profit health care providers. Research conducted by Achterberg and Bradley (Achterberg and Bradley, 1991) for the USDA examined the recall and comprehension of seven bulletins about the US Dietary Guidelines. They found the bulletins to be written at the Grade 13 level and concluded that the content was difficult to understand by certain types of learners. In addition, their research described the information presentation as abstract enough to leave many of the tested participants confused about the nutrition information after reading the bulletin than before.

The most confusing guideline brochure was Avoid Too Much Saturated Fat and Cholesterol with Eat Adequate Starch and Fiber ranking second (Achterberg, 1991) relative to the number of consumer misconceptions before and after reading the bulletin. In addition, total baseline knowledge about the latter guideline’s content was extremely poor. Achterberg and Bradley (Achterberg and Bradley, 1991) also tested the usefulness of the single colored hexagons that accompany the USDA Guideline text and noted that readers found this graphic confusing. An independent review of popular women’s magazines revealed that starch, fiber, complex carbohydrates and sugar were regularly featured in articles between the years 1987 and 1990. As a result of these findings, the material selected for alteration was the brochure Nutrition and Your Health: Dietary Guidelines for Americans, HG-232 (Eat Adequate Starch and Fiber and Avoid Too Much Sugar) (USDA/DHHS, 1985).

**Text decomposition**

The original USDA brochure was considered abstract and in need of alteration due to its relatively abstract text and abstract graphics (AA). Alterations of the brochure were intended to produce two new forms: The CA form (concrete text/abstract graphics) where the abstract text (low imagery) was replaced by concrete text (high imagery) while keeping the abstract graphics; and the CC form (concrete text/concrete graphics) where both abstract text and abstract graphics were replaced by concrete text and concrete graphics.

Alteration was guided by the theory and methodology associated with dual-coding theory (Turner and Greene, unpublished; von Eye et al., 1989; Paivio, 1991). First, the two texts of the guidelines were decomposed into propositions according to Turner and Greene’s (unpublished) text. Propositions are two or more concepts linked together by words, e.g. an ‘apple is red’ is a proposition about the concepts ‘apple’ and ‘red’. A sentence may include one or more propositions. The text of Eat Adequate Starch and Fiber had 20 sentences and 122 propositions. For Avoid Too Much Sugar there were 24 sentences and 118 propositions. Once the text was decomposed, it was systematically represented to allow for controlled manipulation of the text for recomposition purposes.

**Text development**

The steps taken to rewrite the original brochure guidelines were 3-fold. First, a list of concrete words was established that could replace more scientific or abstract words. For example, the word ‘fiber’ from the abstract text was exchanged for more concrete words such as ‘seeds, stems and leaves of plants’. Second, sentences were formulated to incorporate the concrete words. For example, the sentence, ‘Fiber is represented by indigestible plant parts’, became two sentences: ‘Fiber is a popular word that refers to that part of the plant that humans cannot digest. It provides bulk in our stomachs and intestines and when found in whole-grain breads, causes us to chew food more slowly’. Third, the same number of paragraphs were developed that had as near as possible the same number of sentences and propositions. Thus, the result was a more verbally concrete brochure with abstract graphics.

**Graphic alteration**

Whereas abstract text has been shown to decrease the number of recalled propositions (von Eye et al., 1989; Ishi and Yamauchi, 1994), abstract graphics have been shown to do little towards improving
comprehension of written material (Achterberg and Bradley, 1991). Research has demonstrated that meaningful graphics, i.e. those that relate to the concepts in the text, used in conjunction with text, allow readers to form pictures in their minds (Reed, 1992; Groninger et al., 1995). Senses are stimulated and the text becomes personalized. As a result, the pictures assist in facilitating textual memory retention, as readers are able to code text information both verbally and visually (Paivio, 1991).

Photographs for this study were selected based on cognitive theory (Paivio, 1991). The concrete words in the revised text were studied for meaning. To ascertain how the words could best be pictorially represented, a group of potentially useful photographs was gathered from slide collections, magazines, journals and advertisements. The investigators selected the photographs based on the key concepts in the guideline texts. A series of focus groups was conducted with representative members of the target audience to determine which six of 20 photographs best supported the text from a consumer perspective. Three colored photographs replaced colored hexagons to result in a more concrete brochure. Two of the photographs represented foods (one pictured different sugar candies, and one pictured fresh and dried fruits) and one photograph showed rotted teeth.

**Design**

All procedures were approved by a Committee for the Protection of Human Subjects at a major university. Participants were randomly selected from a list of approximately 5000 women who had attended a breast screenings clinic. Questionnaires were mailed to 2600 women (ages unknown) requesting interest in study participation. Responses from 438 (23.5%) women were received. Of those, 252 women met the following study criteria: (1) age (see below), (2) respondent was the primary grocery shopper and (3) she was available to meet on two separate occasions, 30 days apart. Eligible participants were screened and stratified into one of four age groups: 20–30, 40–50, 60–70 and over 70 years. These specific age groups were intentionally chosen to represent young, middle-aged, older and elderly women, and to be clearly separated in order to see distinct age differences. The two age groups, 60–70 years and over 70 years, were not separated in order to increase the sample size of the elderly group. The participants within age groups were randomly assigned into each of the three experimental brochure format groups (Table I). Ten women from each age group were assigned into a control group with only four very old in the control group due to smaller numbers. Interested women who did not meet the age group criteria were included in another study.

All eligible participants agreed to meet for two 1-h long sessions 30 days apart. Arrangements for their attendance was scheduled via telephone. A nearby hospital agreed to serve as the meeting site. Participants received $20.00 at the end of the second session.

**Session I**

At the first session, all women received an activity packet that contained the appropriate experimental brochure (AA, CA or CC), two cognitive complexity tasks (a word and food sorting task) and an activity sheet designed to determine the knowledge of participants of the nutrient content of different foods. Starch, sugar, fiber, fat and protein were the nutrients participants were asked to check for in a list of foods. Experimental test packets included guideline brochures about sugar and starch and fiber. Control group women received the same packet minus experimental brochures. Participants were instructed to carefully read the materials, follow all activity and recall instruction, and take as much time as they needed. All women had no prior warning of the need to pay attention to what they were reading. Instructions encouraged the recall of information in their own words without the need for complete sentences. A control group was included to assess knowledge gains on the topics that might be acquired from the popular media independent of the experimental brochures.

**Session II**

A total of 239 participants (94.8%) reconvened for a second session approximately 30 days later.
Table I. Final study design (N = 239) and participants distribution according to brochure format exposure after second meeting

<table>
<thead>
<tr>
<th>Age group</th>
<th>Format type</th>
<th>Abstract/abstract (n = 71)</th>
<th>Concrete/abstract (n = 70)</th>
<th>Concrete/concrete (n = 68)</th>
<th>Control (n = 30)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Young women (20–30 years)</td>
<td>19</td>
<td>18</td>
<td>18</td>
<td>9</td>
<td></td>
</tr>
<tr>
<td>Middle-aged women (40–50 years)</td>
<td>29</td>
<td>29</td>
<td>27</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>Older women (60–70 years)</td>
<td>19</td>
<td>16</td>
<td>16</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>Elderly women (&gt;70 years)</td>
<td>4</td>
<td>7</td>
<td>7</td>
<td>5</td>
<td></td>
</tr>
</tbody>
</table>

Activity packets containing all first meeting activities minus brochures were distributed. Participants were instructed to write down whatever they could remember from the brochures they read 30 days earlier. Instructions stated that complete sentences were not necessary and simple words or word phrases they could recall should be written.

Data analysis

All data were analyzed using SAS (SAS Institute, 1985). Only data from women who completed both Sessions I and II were included in the analysis. The number of accurately recalled propositions were tallied for both sessions and compared to the original number for each brochure. Each proposition had an assigned value of one point. After determining a propositional score for each participant based on von Eye et al.’s formula (von Eye et al., 1989), a random sample of test packets were given to another unbiased researcher familiar with propositional decomposition. The goal was to determine the accuracy and reliability of the propositional assessment.

Descriptive statistics included means for the entire sample. The number of propositions recalled at Sessions I and II for both experimental and control participants, the age groups, the three brochure types (AA, CA and CC) and personal characteristics were compared using analysis of variance (ANOVA) followed by a Tukey’s studentized range test (Neter et al., 1990). To test the change in the number of propositions recalled by subject at meeting 1 versus meeting 2, an analysis of covariance (ANCOVA) was used among the four age groups and the experimental brochure treatments. The propositional scores at the first meeting were considered the covariate. This analysis generated propositional scores at the second meeting scores corrected for the first meeting scores and the comparisons indicated whether the effects of the brochure format type or age group created a difference in recall.

Results

All women in the sample were Caucasian. Mean age of women in the 20- to 30-year-old group was 24 years (n = 64), in the 40- to 50-year-old group was 44 years (n = 95), in the 60- to 70-year-old group was 63 years (n = 57), and in the 70 years and older group was 74 years (n = 23).

The highest educational level most frequently cited by 20–30 year olds was the baccalaureate (BS) degree (28 participants), with high school second (15 participants) and technical school third (12 participants). The most frequently cited level of educational achievement in the 40–50 year age category was high school (32 participants), with the BS degree second (22 participants) and technical school third (17 participants). Women in the 60–70 year age group were most likely to finish school (20 participants); next were technical school (15 participants) and third BS degree (13 participants). The oldest group, those over 70 years, were most likely to finish high school (eight participants), second BS degree (seven participants) and third MS degree (three participants).

Propositional recall from Sessions I and II

Age had a statistically significant effect on propositional recall at both sessions, upon immediate recall.
Table II. A comparison of mean (SD) propositions recalled by age among treatment groups and the control group at Sessions I and II.

<table>
<thead>
<tr>
<th>Age group</th>
<th>Format type</th>
<th>Session I</th>
<th>Session II</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Abstract/abstract (n = 71)</td>
<td>43 (16.90)</td>
<td>17 (11.76)</td>
</tr>
<tr>
<td></td>
<td>Concrete/abstract (n = 70)</td>
<td>46 (16.68)</td>
<td>18 (12.46)</td>
</tr>
<tr>
<td>20–30 years</td>
<td>Concrete/concrete (n = 68)</td>
<td>57 (21.47)</td>
<td>22 (12.63)</td>
</tr>
<tr>
<td></td>
<td>Control (n = 30)</td>
<td>8 (9.17)</td>
<td>7 (6.80)</td>
</tr>
<tr>
<td>40–50 years</td>
<td>Session I</td>
<td>47 (14.99)</td>
<td>17 (9.23)</td>
</tr>
<tr>
<td></td>
<td>Session II</td>
<td>53 (18.16)</td>
<td>18 (10.08)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>56 (19.38)</td>
<td>20 (12.28)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>17 (12.29)</td>
<td>18 (15.44)</td>
</tr>
<tr>
<td>60–70 years</td>
<td>Session I</td>
<td>36 (12.06)</td>
<td>11 (7.23)</td>
</tr>
<tr>
<td></td>
<td>Session II</td>
<td>37 (16.84)</td>
<td>12 (9.11)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>46 (17.72)</td>
<td>16 (11.87)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>13 (13.08)</td>
<td>10 (7.00)</td>
</tr>
<tr>
<td>70 years</td>
<td>Session I</td>
<td>26 (19.11)</td>
<td>10 (4.08)</td>
</tr>
<tr>
<td></td>
<td>Session II</td>
<td>35 (9.60)</td>
<td>10 (9.19)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>38 (15.79)</td>
<td>14 (13.61)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3 (2.53)</td>
<td>5 (6.98)</td>
</tr>
</tbody>
</table>

a AA brochure significantly different from CC, P < 0.05.
b AA brochure significantly different from CC, P < 0.01.

(P = 0.0001) and also when they were simply asked to write down what they could remember 30 days later (P < 0.01) (Table II). A Tukey test revealed that 20–30 and 40–50 year olds recalled significantly more propositions at both sessions than did the older two groups (P = 0.05). These results support the hypothesis that younger women recall more information than older women.

Influence of brochure format on propositional recall

The type of brochure format was significant at Session I (F = 5.68, P < 0.01), but not at Session II (F = 2.08, P = 0.12), 30 days later. A Tukey test to determine which experimental brochure produced the difference revealed that participants who read the concrete brochure (CC) recalled more propositions than those who read the abstract brochure (AA) (P = 0.05). There were no differences between the CC and CA nor between the CA and the AA brochure formats. Table II describes the mean propositional recall of participants by age and format type compared to controls.

The data in Session I support the hypothesis that a concrete format stimulates a more positive recall performance in all groups. Women in each age group remembered three or four more propositions when they read CC brochures versus CA and four or five more propositions compared to the AA brochures.

The CA brochures promoted the second best recall rates in the 20–30 and 40–50 year age groups, whereas reading the AA brochures resulted in the lowest recall rates in all age groups. Although the 40–50 year olds surpassed the 20–30 year olds in actual propositional recall at Session I, it was not
Fig. 1. Mean number of propositions recalled by age and format type (see text) at Session I ($N = 239$).

Fig. 2. Mean number of propositions recalled by age and format type (see text) at Session II ($N = 239$).

Recall rates from Session II are nearly equal regardless of format type. Figure 1 describes the number of propositions recalled from Session I and Figure 2 describes the number of propositions recalled from Session II by age and format type. The control group is included for comparison.

**Control group versus treatment groups**

Women in the control group recorded significantly fewer ($P = 0.05$) propositions than did women reading any of the brochures at Session I. At the second session, control group women recorded a similar number of propositions as women who read brochures, with the exception of women who read CC brochures. A Tukey test revealed that participants who read CC brochures recalled more propositions at Session II than did control group women ($P = 0.05$).

In addition, there was no statistical significance in retention by format type ($P = 0.56$) nor was there a statistically significant interactive effect between age group and format type ($P = 0.92$). It appeared that each age group retained approximately 40% of the propositions learned at Session I, regardless of format type or amount of learning observed at Session I.

**Discussion**

Results of this study indicate that the more concrete nutrition education print materials are, the greater the opportunity for coding, retrieving and recalling the information after initial exposure to the materials. These findings are similar to previous research (von Eye *et al.*, 1989; Dirkx and Craik, 1992; Drose and Allen, 1994) where concrete sentences yielded an increase in propositional recall as opposed to the abstract sentences. At Session II recall rates were not statistically significant for age or brochure format type, which is similar to findings by Scammon (Scammon, 1977). In her study of consumer attitudes and behavior change, she found that a one-time exposure to ‘relatively unfamiliar’ information was not sufficient to create stable changes in knowledge. She suggests that multiple exposures to material and assessment of material familiarity are important to enhance change. Thus, in the case of this study, if a stimulus or cue had been provided in-between the two recall sessions, recall may have been improved.

The control group data helps explain whether the unfamiliarity with the guideline topics could have affected recall rates. Based on their responses, very little prior knowledge of these topics existed. In many cases, participants’ prior knowledge consisted of multiple misconceptions pertaining to starch and sugar which were resistant to change from reading the brochures. This fact became apparent at Session II when participants recalled incorrect propositions after having recalled them statistically significant. Recall rates from Session II are nearly equal regardless of format type. Figure 1 describes the number of propositions recalled from Session I and Figure 2 describes the number of propositions recalled from Session II by age and format type. The control group is included for comparison.

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correctly at Session I. Ajzen and Fishbein (Ajzen and Fishbein, 1980) stated that to increase the likelihood a person will take a message content under consideration, we have to change the primary beliefs that are functionally related to their present way of thinking. For example, in the brochure Avoid Too Much Sugar the text says ‘Sugar does not cause diabetes’. After reading the brochures at Session I, propositional recall reflected the text, i.e. ‘sugar does not cause diabetes’. However, at Session II, a large number of women recalled ‘Sugar causes diabetes’. The brochure statement proved to be in conflict with the original beliefs held by many participants. On the basis of this information it may be useful to consider which primary beliefs are strongest and construct a nutrition education message designed to change only one or two primary beliefs.

Although this project did not request participants to recall graphics, it is worth noting that graphics were recalled with detail. A photograph of rotten teeth appeared on the revised Avoid Too Much Sugar brochure. Unsolicited comments about that particular photograph indicate an enhanced ability to recall that segment of information. This finding agrees with the notion that ‘fear appeals’ are effective in promoting short-term behavioral change but not long term (Shannon and Rowan, 1987). The impact elicited by the graphic appeared transient, reflecting a short-term effect of a fear appeal and it may also contribute to explaining the short-term effects the concrete graphics had on memory.

Conclusions

Health education print materials are used by nutritionists, dietitians, health education specialists and others to assist in communicating nutrition messages or to supplement a lesson a client might have heard. The extent to which health information brochures are used is partially dependent on the perception of the health care provider as to whether the receiver ‘needs more information’. Very little data exist to document that information in the form of print handout materials has educational merit in terms of it actually being read, comprehended and retained. In most cases, health information brochures are developed and produced without input from the audience that the material is targeted for (Jacoby et al., 1977; Cardinal and Seidler, 1995).

In lieu of the formation of the year 2000 Dietary Guidelines Advisory Committee, findings from this and previous studies should be considered when preparing the Fifth Edition brochure of the Dietary Guidelines for Americans. Earlier work (Harvey Webster, 1988; Shepherd et al., 1989; Achterberg, 1991; Achterberg and Bradley, 1991) investigated which aspects of nutrition education print materials increase the likelihood of attending to material. The question of whether or not such print materials are attended to and subsequently comprehended as containing meaningful, remembered information to the reader was the central issue in this project.

One of the major conclusions drawn from this study is that more concretely written brochures were superior for coding and retrieving information directly after reading the print material. In every single test given to participants in this study, the original brochure with abstract words and abstract graphics performed worst on recall. Print materials need to be as concrete as possible in both text and illustrations. In today’s advanced technologies and increased popularity of and need for distance education (Moore and Kearsley, 1996), learning often becomes highly dependent on print materials and graphic illustrations. In order to promote learning and recall, it is essential to pay close attention to the readability, comprehensibility and clarity of print materials whether it be brochures, newsletters, study guides or World Wide Web site pages.

The study also clearly indicated that even though the concrete brochures promoted greater propositional recall rates in all age groups, they only had a transient effect of less than 30 days after a one-time reading. Whether the outcome would have changed with multiple readings is unknown. In addition, prior knowledge of specific topics plays a key role in the ability to code and retrieve information 30 days after exposure to educational materials. This fact promotes the idea that a single
intervention (reading brochures once) is not enough reinforcement for knowledge change. Future research needs to determine the effectiveness of print materials upon multiple readings in different settings in order to justify their use.

Although memory declines with age, concrete materials may have provided older participants more opportunity to use their years of experience and prior knowledge to help code new message content. Nutrition educators need to acknowledge that our clientele is increasing in age, and adapt materials and intervention strategies accordingly, i.e. build in more frequent exposures in smaller information chunks for older readers. Also, to maximize the power of communicating nutrition and health messages with print materials, dual-coding theory may be a useful tool in brochure construction. Both text and graphics for print materials should be carefully pre-tested with the target audience. Determination of appropriateness of materials, attention to materials and comprehensibility should be based on focus group and recall-based research as opposed to health professional interpretation.

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