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KNOWLEDGE CONCERNING HEALTH FACTORS AND COGNITIVE PERFORMANCE: DEVELOPMENT AND EXPERT VALIDATION OF A PERCEPTIONS QUESTIONNAIRE

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DEVELOPMENT AND EXPERT VALIDATION OF A PERCEPTIONS QUESTIONNAIRE

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ABSTRACT

The promotion of brain health is often perceived through an illness model, as research tends to focus on risk reduction in regards to neurodegenerative disease. However, research indicates that healthy individuals can potentially improve their cognitive performance through the adoption of health-promoting behaviors such as diet, exercise, and the management of chronic medical conditions (e.g. Type 2 Diabetes, high blood pressure, or high cholesterol). It is less clear how well this message has been disseminated to the general public. The current study aims to advance a critical foundation for brain health research by developing a questionnaire to assess public beliefs regarding the impact that diet, exercise, and physical health have on the protection, maintenance, and improvement of cognitive performance in both younger and older adults. After developing initial items based on a review of the current literature, undergraduate students and experts provided quantitative and written feedback which contributed to the development and refinement of the final items. This questionnaire addresses an important gap in the current resources available to researchers, and will allow for the measurement of beliefs regarding lifestyle factors and brain health, which will inform the development of future interventions aimed at behavior change.

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Chapter 1

Introduction

Cognitive impairment is common among adults of advanced age (Robertson, Savva, & Kenny, 2013). However, cognitive difficulties are not restricted to the elderly, but rather can occur at any age, due to a wide range of both modifiable and uncontrollable causes, with symptoms ranging from minimal to severe. Indeed, improvement of brain health need not only be understood through an illness model. Healthy individuals can potentially improve their cognitive performance through the adoption of health-promoting behaviors, as research (discussed herein) indicates that certain lifestyle factors and habits may enhance and protect cognitive performance for various populations.

Lifestyle Factors Impact Cognitive Performance

Exercise and Physical Activity. Positive short- (acute) and long-term (chronic) exercise habits can serve as protective factors for cognitive abilities, and may even improve cognitive performance in younger and older adults. Research suggests that physical activity can improve cognitive performance and potentially reduce the risk of developing cognitive decline later in life. In Blondell, Hammersley-Mather, and Veerman's (2014**)** meta-analysis**,** the authors reported a 14% lower risk of developing dementia in older adults who reported high levels of exercise, as contrasted with low-exercising older adults. In their meta-analysis, Sofi et al. (2011) also reported a protective effect of high exercise levels (HR = 0.62, 95% CI [0.54, 0.7], $p < 0.001$). Additionally, the authors reported protective effects from low to moderate levels of physical activity (Sofi et al., 2011). Similar results were obtained in a 2014 meta-

analysis examining the impact that various modifiable factors have on cognition. Beydoun et al. (2014) found that exercise appeared to be a neuroprotective factor, as a large majority of included studies (21 out of 24) reported that physical activity was associated with lower rates of cognitive decline and protected against poorer cognitive function overall.

In addition to serving as a potentially neuroprotective factor, exercise could possibly serve as a non-pharmacological intervention for older adults experiencing cognitive impairment**.** Ströhle et al.'s (2015) meta-analysis examined improvement in cognition among Alzheimer's patients who were enrolled in exercise interventions. The authors found that exercise was associated with a moderate to large (SMCR = 0.83, 95% CI [0.59, 1.07]) pooled effect size, which exceeded the small pooled effect size seen with medication (SMCR = 0.23, 95% CI [0.20, 0.25]). In their meta-analysis, Groot et al. (2016) reported that physical activity interventions involving aerobic exercises significantly improved cognitive performance in patients with dementias of varying etiologies. Likewise, Zhu et al.'s (2015) meta-analysis noted significant improvements in Mini Mental Status Examination scores and verbal fluency scores in Alzheimer's disease patients who had participated in some form of physiotherapy. For patients with Mild Cognitive Impairment (MCI), exercise also shows promise as a potential intervention. In their meta-analysis**,** Wang et al. (2014) reported that MCI patients demonstrated significant improvement in global cognitive functioning after participating in exercise programs when compared to non-exercise control groups.

The benefits of exercise are not limited to clinical populations, as exercise can also potentially improve current cognitive performance in healthy older adults. Among

cognitively intact older adults (ages 65 and over), who by virtue of advanced age are at increased risk for cognitive decline, physical activity appears to have positive cognitive impacts. For example, Erickson et al. (2011) found that an exercise training program seemed to reduce age-related brain density loss in the hippocampus. The subjects in this study, who participated in moderate-level exercise for 3 days per week over a 1-year period, showed a mean 2% increase in hippocampal volume over their baseline; a change that was not demonstrated in non-exercising controls, who instead experienced a 1.4% decrease in hippocampal volume (Erickson et al., 2011). The authors noted that this 2% increase in hippocampal volume was effective in reversing normal age-related volume loss by approximately 1 to 2 years. Furthermore, this increase was also associated with an improvement in spatial memory (Erickson et al., 2011).

Kelly et al. (2014**)** investigated the impact of aerobic, resistance, and Tai Chi training on cognitive performance of healthy older adults. Their meta-analysis showed a significant positive association between resistance training and performance on measures of reasoning in comparison to stretching/toning control groups. Additionally, Tai Chi significantly improved attention and processing speed when compared to non-exercising controls (Kelly et al., 2014). These findings are also supported by Wayne et al.'s (2014) meta-analysis, which found that participants who engaged in Tai Chi exercises demonstrated a moderate improvement in executive functioning over non-exercising controls ($g = 0.51$, $p < 0.01$).

Similar positive changes have also been reported in cognitively healthy young to middle-aged adults. Such results have been demonstrated following both a single brief period of exercise, and also after chronic (long-term) exercise exposure. In their meta-

analysis, Chang, Labban, Gapin, and Etnier (2012) found that exercise increased cognitive performance while the participant was actively exercising (g = 0.101, 95% CI [0.041, 0.160], $p < 0.001$), right after a period of exercise (g = 0.108, 95% CI [0.069, 0.147], $p < 0.001$), and even after a longer period of time post-exercise (g= 0.103, 95% CI [0.035, 0.170], $p < 0.001$). Similarly, Lambourne and Tomporowski's (2010) meta-analysis reported that exercise-induced arousal appeared to improve performance on rapid decision making and automatized behaviors while exercising. The authors also found that performance on speeded tasks improved significantly immediately after exercising, as did memory storage and retrieval (Lambourne & Tomporowski, 2010). In their meta-analysis, McMorris and Hale (2012) reported that processing speed improved immediately after exercising (g = 0.14, $p < 0.01$). They hypothesized that this effect (although small) could be due to increased arousal while actively exercising (McMorris & Hale, 2012). Similarly, in a meta-analysis that examined the effects of long-term aerobic exercise, Smith et al. (2010) reported moderate improvements in attention and processing speed, executive function, and memory.

Diet and Cognitive Performance. Dietary patterns are also associated with levels of cognitive performance, and may offer neuroprotective benefits later in life. The Mediterranean diet (a dietary pattern used frequently in the literature as a model for healthful eating habits) appears to demonstrate a positive association with cognitive performance. Martinez-Lapiscina et al. (2013) found that participants following a 6.5-year interventional Mediterranean diet demonstrated higher neurocognitive performance when compared to a low-fat control diet. Additionally, in their review, Petersson and Philippou (2016) found that most studies that met their inclusion criteria reported an

association between adherence to the Mediterranean diet and decreased risk of cognitive impairment and dementia. In their meta-analysis, Psaltopoulou et al. (2013) reported that high adherence to the Mediterranean dietary pattern was associated with a lower risk for cognitive impairment (RR = 0.60, 95% CI [0.43, 0.83]). Similarly, in their literature reviews, both Alles et al. (2012) and Lourida et al. (2013) reported that adherence to the Mediterranean diet was consistently associated with a lower risk of developing cognitive decline and dementia. In their meta-analysis, Singh et al. (2014) reported that participants in the highest tertile of Mediterranean diet adherence had a 33% less risk of developing Alzheimer's disease.

Indeed, the Mediterranean diet appears to be neuroprotective. A key component of this dietary pattern is its strong emphasis on high percentages of fruit and vegetable consumption relative to total calorie consumption. Investigated in isolation, fruit and vegetable consumption also appears to offer significant neuroprotective benefits. In a review of 19 epidemiological studies, Lamport, Saunders, Butler, and Spencer (2014) found that 17 of the studies reported a positive association between the amount of fruit and vegetable consumption and cognitive performance in older adults, suggesting that fruit and vegetable consumption could potentially offset age-related cognitive decline. Additionally, in their review, Loef and Walach (2012) reported that five out of six studies found that higher consumption of vegetables was associated with a reduced risk for both dementia and cognitive impairment.

Public's Perception of Cognitive Impairment

Scientific research seems to make a relatively strong case for an association between healthful lifestyle practices and positive cognitive status. However, it is less

clear how well this message has been disseminated to the general public. Presenting health-related information regarding the impact of certain lifestyle behaviors on cognition could potentially affect the decisional balance of individuals considering behavior change. Additionally, it is important to understand the extent to which the general public believes they have control in improving their cognition through the adoption of healthy lifestyle behaviors. This belief is key, as the assessment of self-efficacy could help identify individuals who are more likely to adopt healthful lifestyle behaviors and benefit from intervention.

Currently, it appears that the general public is only minimally aware of the link between lifestyle choices and cognitive health. Anderson, McCaul, and Langley (2011) reported that older adults were more likely than younger adults to believe that Alzheimer's disease was preventable, and hence to take preventative measures. Furthermore, older adults were more likely than younger adults to cite lifestyle factors as potential causes for Alzheimer's disease, whereas younger adults were more likely to cite hereditary factors, aging, and brain dysfunction (Anderson, McCaul, & Langley, 2011). Similarly, while Low and Anstey (2009) reported that 72% of their participants (community dwelling adults) believed that it was possible to reduce the risk of developing dementia, only 31% endorsed healthful eating habits and 30% exercise as potential methods for risk reduction**.** Additionally, only 34% of the participants believed there was a link between heart disease and dementia, indicating a lack of awareness of the association between cognitive and physical health (Low & Antsey, 2009). Wu, Goins, Laditka, Ignatenko, and Goedereis (2009) found that focus group participants indicated they would be reluctant to make lifestyle changes unless they were shown proof that

certain lifestyle behaviors could impact cognitive performance, expressing doubt about the link between health behaviors and a decreased risk of developing Alzheimer's disease (Wu et al., 2009). Overall, preliminary research appears to indicate that the general public is hesitant to accept that lifestyle factors could impact cognitive function, and that younger adults might be more likely to endorse non-modifiable factors (i.e. genetics or age) as main contributory factors in cognitive performance.

Theoretical Framework

Social Cognitive Theory. Social Cognitive Theory (developed by Alfred Bandura) is a model of behavior change that describes how self-efficacy beliefs interact with outcome expectations, goals, and perceived barriers/facilitators to engender behavior change (Bandura, 1998). At the core of this model is the concept of perceived self-efficacy. Self-efficacy refers to an individual's beliefs about the ability to change behavior. The stronger this belief, the more likely an individual will initiate and maintain health-promoting behaviors (Bandura, 1998). Self-efficacy is an important predictor of behavioral change leading to short and long-term success across various lifestyle factors (e.g. weight loss and exercise) (Kelly, Zyzanski, & Alemagno, 1991; Strecher, McEvoy, DeVellis, Becker, & Rosenstock, 1986). Self-efficacy is thought to moderate the benefit of health behavior knowledge, as those who are low in self-efficacy, but high in knowledge tend to benefit less from that knowledge than those with higher self-efficacy (Rimal, 2000).

In addition to self-efficacy expectations, Social Cognitive Theory also relates to outcome expectations, which are beliefs concerning how the effects of particular habits and behaviors potentially contribute to a desired health outcome. According to this

theory, an individual will consider physical expectations, which relate to the direct pros and cons of adapting a certain behavior (Bandura, 2004). When one is considering adopting particular health behaviors, they are more likely to initiate behaviors that bring self-satisfaction and increase self-worth and are less likely to begin behaviors that lead to self-dissatisfaction.

Transtheoretical Model. The Transtheoretical Model (TTM) provides another approach to the current line of research. According to this model, individuals pass through stages of change (precontemplation, contemplation, preparation, action, maintenance, and termination) when deciding whether or not to pursue behavioral change (Prochaska & Velicer, 1997). Of interest to the current study is the concept of consciousness raising, which relates to an individual's acquisition of knowledge regarding a particular health behavior. This process of change includes interventions to increase awareness, such as media campaigns, feedback or bibliotherapy (Prochaska, Redding, & Evers, 2008). As the eventual goal of the present research is to effect behavior change, it is important to first determine the level of pertinent knowledge among the general public, as that will indicate how much improvement may be required before targeted interventions can occur, and will allow for future assessment of the efficacy of these interventions.

Purpose of the Study

Little research has examined the general public's beliefs about maintaining and enhancing cognitive functioning and brain health through lifestyle choices and health maintenance. Instead, most research focuses on perceptions regarding the dementias and other cognitive disorders. Given research showing potential benefits of healthy lifestyle

choices on such functions, emphasis should also be placed on the protection, maintenance, and improvement of cognitive performance. The current study aims to advance a critical foundation for research on brain health by developing a questionnaire to assess public perceptions and knowledge about the impact lifestyle and health-related factors (i.e. diet, exercise, and physical health) have on the protection, maintenance, and improvement of cognitive performance in both younger and older adults.

As there appears to be a lack of established questionnaires designed to address the topic of perceptions relating to brain health and physical factors, the current study sought to develop such a measure by addressing two research questions:

1. After first developing a comprehensive list of initial items based on a review of current literature, how will undergraduate students perceive the items in terms of clarity and content?

   Hypothesis: During cognitive interviewing, undergraduate students will identify terms they are familiar with, in addition to unfamiliar terms that need to be defined. Additionally, they will assist with the identification of items that may not be clearly worded, as well as satisfactory items that need little to no adjustment.

2. How will professionals within the field of brain health and lifestyle factors rate the clarity, relevance, and accuracy of the items?

   Hypothesis: The expert raters will identify items that are sufficiently clear, accurate, and relevant, in addition to providing feedback on items with low accuracy, and will identify items that may be confusing to future participants.

Chapter 2

Methods

Introduction

This chapter details how participants were recruited, and explains the measures used for this study. Additionally, the methods used to review quantitative and qualitative feedback participants provided will be explained at the conclusion of the chapter. This study followed a mixed-methods design using qualitative data, in addition to supplementation through quantitative analysis. Following initial item development, refinement followed two phases: first, I conducted cognitive interviewing with participants to analyze perceived themes in the items and to identify areas of potential misunderstanding. Second, expert raters evaluated items, thereby facilitating both further establishment of content validity of the potential items and improvement upon the items' clarity and relevance.

Recruitment

To recruit for the cognitive interviewing portion of the study, an announcement regarding the opportunity to participate was sent to undergraduate listservs at the University of Rhode Island. Additionally, department chairs from Animal Science, Biology, Chemical Engineering, Communication Studies, and Criminology were asked to distribute an announcement to their students regarding the opportunity. Eligibility requirements included being at least 18 years old and English speaking. Potential participants contacted the investigator to schedule the interview, and both verbal and written consent was obtained before the cognitive interviewing began. Students potentially received class credit for research participation as compensation in accordance with class requirements.

Expert raters included researchers who studied the effects of lifestyle factors on brain health. A review of the literature assisted in identifying experts with research experience in the field of brain health (i.e. first author on a published meta-analysis on a relevant topic, or first and last if only two authors conducted the study). Additionally, faculty from the University of Rhode Island who were familiar with the subject matter were contacted with a description of the study and were provided access to the survey. All potential expert raters were encouraged to nominate peers whom they believed to be sufficiently knowledgeable in the study of diet, exercise, or medical conditions and brain health. The expert raters received the survey via Qualtrics, and consent was obtained through the use of an informed consent page preceding the survey. Only when reviewers indicated their consent could they proceed to the survey. No compensation was provided.

Participants and Setting

Participants in the cognitive interviewing portion of the study included 9 undergraduate students enrolled at the University of Rhode Island from a diverse range of majors. In total, 73 expert raters were contacted and 9 reviewed the items; the expert raters completed their review of the items without compensation.[1]

Participant Demographics. A total of 9 undergraduate students at the University of Rhode Island participated in the study. They came from diverse majors: 2 from psychology, 1 from economics, 1 from criminal justice, 3 from biology/biochemistry/biological sciences, and 2 whose majors were undeclared. Overall, 6 students were freshman and 3 were sophomores. Requests for participation were sent

[1] I would like to extend my thanks to all the raters who volunteered to provide valuable feedback on the items. Their contributions are greatly appreciated.

to 73 expert raters of whom 9 agreed to provide feedback for the individual items. In total, 5 experts rated the exercise items, 2 rated nutrition, and 2 rated the chronic medical conditions items. One participant held a master's degree, and all others held PhD degrees, and years of experience in the field of brain health ranged from 4 to 25 years (mean of 11 years of experience). These raters came from various disciplines (e.g. kinesiology, nutrition, psychology, neuropsychology, and neuroscience) that investigated the effects of lifestyle factors on brain health. Research interests included non-pharmacological interventions for dementia, physical activity and its impact on health outcomes, the health impacts of Type 2 diabetes, and the associations between physical and mental health. Additionally, the expert raters included professors at the University of Rhode Island who were involved in a research group pertaining to dementia prevention through the adoption of healthy lifestyle behaviors.

Measures

Brain Health Perceptions Questionnaire: The questionnaire being developed consists of items addressing research-supported concepts in brain health. Items on the questionnaire are categorized into three major topic domains (i.e. nutrition, physical activity/exercise, and chronic medical conditions). The initial iteration included 49 items within three subscales: 15 nutrition items, 16 physical activity items, and 18 chronic medical condition items. Each item on the completed questionnaire will be on a 5-point Likert sale (1 = strongly agree, 2 = disagree, 3 = neither agree or disagree, 4 = agree, and 5 = strongly agree).

Procedure

Item Development. The preliminary draft of the questionnaire was created using current scientific knowledge regarding the relationship between brain health and lifestyle factors. A review of recent meta-analyses was conducted to inform item development. Searches took place between October 2017 and February 2018 using PubMed. Inclusion criteria included studies published during the past 5 years (2013-2018) that utilized randomized controlled designs. Search terms included combinations of "cognition," "cognitive," "cogn*," "dementia," "Mediterranean Diet," "vege*," "fruit," "healthy diet," "Diabetes," "obesity," "Metabolic Syndrome," "Western Diet," "exercise," "high cholesterol," and "high blood pressure."

Cognitive Interviewing. The procedure for cognitive interviewing was based on guidelines established by Willis (1999). The investigator met individually with participants to conduct one-on-one cognitive interviewing sessions. Participants were given the original 49 items and were first instructed to answer each item on a 5-point Likert scale as if they were taking the survey as it will be administered to the final participants. Then, the participants rated their confidence in their answer on a 5-point Likert scale (1 indicating they had low confidence in their answer, 5 indicating they were very confident). The purpose of rating was to ascertain whether the wording of the item contributed to low confidence ratings. After providing their answer and their confidence rating, the participants were then asked targeted probes regarding the particular item. Sample questions included asking the participant to explain their confidence rating, rephrase the item, describe the theme of the item, and/or explain what information they used to answer the item. Additionally, participants were asked to define key terms in the

items. Participants' responses were transcribed verbatim; no identifying information was associated with their responses.

Expert Rater Feedback. Once the items had been modified to incorporate feedback from the cognitive interviews, the adjusted questionnaire was sent to expert raters to assist with further item refinement. Each expert was asked to rate the items using a 4-point Likert scale (1 indicating an inadequate item, 2 indicating the item needs improvement, 3 for a sufficiently developed item, and 4 for a well-developed item) on the following three dimensions: accuracy, clarity, and relevance. Accuracy relates to the veracity of the items based on current scientific knowledge, clarity refers to how understandable the item is, and relevance allows raters to judge how pertinent the item is to the goals of the survey; i.e., assessing knowledge pertaining to the relationship between brain health, lifestyle factors, and chronic medical conditions. In addition to the quantitative feedback, the expert raters also provided written feedback for each of the items at their discretion.

Data Analysis

Item Development: Review of the Literature. The development of the Brain Health Perceptions Questionnaire was based on information gathered from a qualitative review of the literature regarding the impact of lifestyle factors on brain health. The process of topic development and initial item generation was based on current scientific literature; item inclusion in the final draft was based on the researcher's decision-making.

Analysis of Item Development: Cognitive Interviewing with Undergraduates. Mean and standard deviations were calculated for the confidence ratings for each individual item. An item was considered to be poor (i.e. participants were not confident

in their answer) if the mean rating of that item was 3.0 or lower. These items were further reviewed, and the participants' qualitative answers were analyzed to determine the cause of their low confidence. If the confidence arose from lack of knowledge about key terms, language or terminology (as indicated by participants' responses during probing), definitions were included within the questionnaire. If participants identified low confidence in their answer due to uncertainty regarding the relationship between the lifestyle factor (diet, exercise, or medical conditions) and brain health, the item was not changed.

If the participants suggested a rephrasing of an item that still maintained the theme of the item and also suggested a more person-appropriate wording, their feedback was incorporated into the final item. Additionally, if multiple participants suggested consistent changes or alterations, their feedback was considered during the review process.

Analysis of Item Development: Expert Feedback. For each of the three scales rated by the expert raters (accuracy, clarity, and relevance), the mean and standard deviation of each item was calculated and the level of interrater agreement (IA) on each item analyzed. To calculate the interrater agreement, the number of experts rating an item as either sufficient or well developed (i.e. either a 3 or 4) was divided by the total number of experts who rated that item. Based on similar quantitative metrics [Lawshe's (1975) Content Validity Ratio, and Grant and Davis's (1997) Interrater Agreement], acceptable levels for rater agreement ranged from 0.70 to 0.80. Items with ratings lower than 0.70 on at least one of the domains were reviewed and then either rewritten to improve the question quality or removed if the item was deemed to be weak in all

domains. If the interrater agreement for an item was less than or equal to 0.4 on any of the three dimensions (indicating that less than half of the experts rated the item as sufficient), the item was discarded. If the interrater agreement for any of the dimensions was 0.5-0.6, that item was reviewed more thoroughly, as it suggested a lack of consistent agreement among the expert raters.

Chapter 3

Results

Introduction

Within this section, the results of the three phases will be reviewed. First, I report the quantitative results from the literature review conducted while developing the items. Then, I address the two research questions based on the results of both the cognitive interviewing portion and the expert feedback stage, and report the feedback received during each stage.

Item Development

A review of the literature was conducted to aid with item development. Initial search results included 24,769 studies. Of these, the researcher screened 794 titles and abstracts to select for meta-analyses from the past 5 years that investigated the impact of diet, exercise, or physical health on brain health. A total of 146 meta-analyses were reviewed for the purposes of this study, and items were written based on this information. This initial draft of the questionnaire was then used during the cognitive interviewing phase with undergraduate students. Overall, the initial questionnaire included 49 items, divided into three categories (nutrition, exercise, and chronic medical conditions). These categories were chosen to represent three main areas pertaining to general physical human health.

Research Question One

The first research question addressed during the study was: "*In what ways will the initial items need to be adjusted to improve content quality and clarity based on feedback undergraduate students provide*?" The researcher hypothesized that the undergraduate students would identify areas in which the questions were less comprehensible, and

would help identify terminology that might have been misunderstood by not only them, but more broadly by an unacceptably high percentage of the general public.

Consistent with this hypothesis, as a result of the cognitive interviewing, significant changes were made to the initial items. Of the original 49 items, 38 were retained after cognitive interviewing. See Table 1 for a side-by-side comparison of the initial items and items following cognitive interviewing. Wording was condensed, confusing terminology was changed or removed, and certain duplicate items were removed or combined with similar items. Some duplication was retained, as redundancy would be helpful in clarifying the most appropriate wording during later stages. During this phase, changes were considered when more than one participant identified a similar observation, or a participant identified an area of gross misunderstanding. Examples of reasons for changing items included misunderstanding the theme of the item, identification of a poorly worded item, or indication that an item contained unfamiliar languages or terms.

Additionally, multiple words and phrases were used to refer to cognition throughout this phase of development; this variety allowed the researcher to understand which wording the general public would best understand. See Table 2 for a list of phrasing used, and examples of how the undergraduate participants defined each term. Of the five variations used, the phrase “thinking abilities” was chosen to represent cognition, as undergraduate responses indicated that they viewed this phrase in a similar fashion as cognition.

During the cognitive interviewing phase, four main themes were identified: lack of knowledge, using intuition, using personal experience, and preference for specific or

broad items. These themes included strategies that the participants used to answer the items, as well as common difficulties with the original items. The first theme, *lack of knowledge*, related to items that included definitions that were unknown to participants, generally indicated when a participant asked for a definition, or told the investigator, "I don't know what that means." Most commonly, undergraduate students' confusion or lack of knowledge regarding Type 2 Diabetes, Mild Cognitive Impairment, the MIND diet, and the Western and Mediterranean diets. However, when prompted to explain what they believed these terms meant, the participants' guesses were often similar to the actual definition of the term. For example, multiple participants indicated that the Western Diet was a diet focusing on meat and simple carbohydrates frequently consumed by individuals living in the United States. Similarly, multiple participants indicated that the Mediterranean diet was a healthy dietary pattern characterized by consumption of fish, whole grains, and olive oil. The undergraduate students were less correct when stating what they believed Mild Cognitive Impairment represented; for example, one participant believed it meant a reduction in the risk of developing dementia.

Often, participants would *use their intuition* when answering an item. This theme become apparent when participants felt that their answers "just sounds right" or indicated that they answered a certain way because good habits often go with good results (or poor habits with poor results). For example, one participant remarked "it makes a lot of sense" that an unhealthy diet will impact someone's physical health (including brain health). Another participant believed dementia resulted from an unhealthy diet; others stated that a healthy diet will help an individual "function at a higher level." Occasionally, participants would express low confidence in their answers, for example, stating that they

felt as though they "wanted to agree with it" in regards to items that addressed an association between good habits and good results, or poor habits and negative results.

Participants also indicated that they used *personal experience* to answer the items. Multiple participants noted that that they observed how certain lifestyle factors seemed to impact their loved one's cognition (e.g., stating that their grandparents do yoga and appear to be mentally sharp). Others remarked about how exercise helps them study more efficiently, and that their "brain feels less foggy after exercise." One participant commented on his experience with club sports, observing that while he had poor nutrition (due to rapid weight loss and poor vitamin levels), he did not notice a change in his thinking skills.

Lastly, participants were generally equally split about their preference over *specific or broad* items. 63% of participants indicated that they preferred items that were narrow in focus (e.g. an item that inquired about the effects of exercise on attention), whereas 37% felt that items that had a broader focus (e.g. inquired about the effects of exercise on thinking abilities) increased their confidence in their answers. Feedback from participants suggested that specific items were easier to answer due to less ambiguity. One participant noted that precise terminology was a "better way to communicate" as the specific nature made it easier to answer. Other participants believed that broader terminology was more appropriate, as it "encompasses more" and was therefore easier for them to answer.

Table 1

Comparison of Changes Made as a Result of Cognitive Interviewing

Original Item	Final Item after Cognitive Interviewing
Diet	
An unhealthy diet can increase my risk of developing dementia as I get older	Having an unhealthy diet can increase the risk of developing dementia later in life
Having a healthy diet can help me prevent a decline in thinking abilities as I age	Eating a healthy diet may slow the decline in thinking abilities that comes with normal aging
Having low levels of certain vitamins (B12, iron) can make it harder to think clearly	(Deleted)
The Mediterranean Diet can help reduce the risk of developing dementia later in life	The Mediterranean diet can help reduce the risk of developing dementia later in life
The Mediterranean Diet can help me keep my brain healthy as I age	The Mediterranean Diet is a good diet for brain health
Eating a standard Western Diet can potentially make it more difficult to think clearly	The Western diet is a poor diet for brain health
The typical Western Diet has a negative impact on overall brain health	(Deleted)
Following a diet high in fruits and vegetables can help me prevent cognitive disorders as I age	Regularly eating a lot of fruits and vegetables may help reduce the risk of developing dementia later in life
Regularly eating fruits and vegetables can help improve my memory	Regularly eating a lot of fruits and vegetables may help improve memory abilities
Regularly eating fruits and vegetables can help me pay attention to tasks	Regularly eating a lot of fruits and vegetables may make it easier to pay attention to everyday activities, such as work tasks, reading or chores

Table 1 (Continued)

Consuming nutrient dense foods (for example, fruits and vegetables) regularly can slow cognitive decline	Regularly eating a lot of fruits and vegetables may slow the decline in thinking abilities that comes with normal aging
Regular consumption of seafood can potentially prevent cognitive decline	Seafood is good for brain health
Regular consumption of seafood can delay cognitive decline	(Deleted)
Regularly eating foods containing added sugar can increase my risk of developing dementia later in life	Regularly eating foods high in added sugar can increase the risk of developing dementia later in life
The MIND diet (Mediterranean-DASH Intervention for Neurodegenerative Delay) is specifically tailored to keep my brain healthy	(Deleted)
Exercise	
Exercise has the potential to improve thinking abilities in people with dementia	Exercise can improve thinking abilities in people with dementia
Exercise can help improve performance in specific cognitive abilities, such as attention, learning and memory	Exercise can help make it easier to pay attention while doing everyday tasks, such as work tasks, reading, or chores
	Exercise can help many people learn more easily
	Exercise can help many people improve their memory.
Both strength training and aerobic exercising can potentially improve thinking abilities at any age	(Deleted)
Older adults who report lifelong exercise habits demonstrate slower rates of cognitive decline than older adults who were less active throughout their life	Exercise can help improve thinking abilities for older adults (ages 60 and older).
Routinely doing brisk walking can help keep my brain healthy	(Deleted)

Table 1 (Continued)

Regular yoga practice can help improve cognitive performance	Doing yoga can help improve thinking abilities in younger (ages 18-30) adults.
	Doing yoga can help improve thinking abilities in older (age 60 and older) adults.
Yoga can help me improve my thinking skills in areas such as memory and attention	(Deleted)
Gentle exercise programs (such as Tai Chi) can help older adults keep their memory sharp	Gentle exercise can help older adults delay a decrease in their memory abilities that comes from normal aging.
My thinking abilities can improve immediately after exercising	(Deleted)
I can pay attention more easily right after exercising.	It is easier to pay attention right after exercising.
Regularly exercising can help me improve my memory	Regular exercise can help improve memory abilities
Regularly exercising can help me learn information more easily	(Deleted)
By staying active throughout my life, I can help keep my brain sharp as I age	(Deleted)
Regular exercise habits can help me slow down a decline in my thinking skills as I age	Regular exercise habits can help slow down the loss of thinking abilities that comes from aging
Physical activity could possibly help individuals with Mild Cognitive Impairment reduce their risk of developing dementia.	(Deleted)
Young and middle-aged healthy adults can improve their memory by regularly exercising	Exercise can help improve thinking abilities for younger adults (ages 18-30).
	Exercise can help young adults (ages 18-30) improve their memory abilities.
	Middle-aged adults (ages 30-50) can improve their memory abilities with regular exercise

Table 1 (Continued)

Medical Conditions	
Diabetes (Type 2) can have a negative impact on my cognitive performance	Some individuals with Type 2 Diabetes might have reduced thinking abilities
Having Type 2 Diabetes can increase my risk of developing dementia later in life	Having Type 2 diabetes can increase the risk of developing dementia later in life
Type 2 diabetes can make it more challenging to remember things	Some individuals with Type 2 Diabetes might have reduced memory abilities.
Having Type 2 diabetes can hurt my thinking skills	(Deleted)
Having poorly controlled blood sugar levels can make it harder to remember things	(Deleted)
Type 2 diabetes can negatively affect certain thinking skills related to attention	Having Type 2 diabetes can potentially make it harder to pay attention while doing everyday tasks, such as work tasks, reading, or chores
It can be harder to focus and pay attention when I have Type 2 Diabetes	(Deleted)
Having high cholesterol levels during middle adulthood can increase my risk of developing Alzheimer's disease later in life	Middle-aged adults (ages 30-50) with high cholesterol are more likely to get Alzheimer's disease later in life when compared to middle-aged adults with normal cholesterol levels
High cholesterol levels in midlife can increase my risk of developing cognitive decline later in life	Middle-aged adults (ages 30-50) with high cholesterol are more likely to lose some of their thinking abilities later in life
Keeping my blood pressure in the healthy range can potentially help protect my thinking abilities as I age	Having healthy blood pressure may slow the decline in thinking abilities that comes with normal aging
In mid- and late life, having high blood pressure could potentially make it harder to remember things	Middle-aged adults (adults in their 30's to 50's) with high blood pressure are at a greater risk for memory decline
	Older adults (adults in their 60's and older) with high blood pressure are at a greater risk for memory decline
Being obese can increase my chance of developing dementia later in life	Being obese increases the risk of developing dementia later in life

Table 1 (Continued)

I will have a greater chance of developing dementia if I am obese at midlife	(Deleted)
Being obese can make it harder for me to remember things	Being obese is associated with having poorer memory
Being obese can make it harder for me to pay attention	Being obese is associated with having poorer attention
In obese individuals, losing weight can help improve thinking skills such as attention and memory	(Deleted)
Thinking skills improve after weight-loss surgery in obese individuals	In obese people, thinking abilities improve after weight-loss
Being obese can negatively impact higher level thinking abilities, such as attention, impulse-control, and planning abilities	(Deleted)

Table 2

Examples of Definitions for Key Terms Provided by Undergraduate Participants

Original Term	**Examples of Definitions**
Thinking Abilities	Memory, being able to think
	To solve or assess something
	Being able to process any information that is given to you
	Critical thinking, retaining information that you've learned
	Concentration, thought processes, memory, attention span
Cognitive Performance	Thinking, using your brain
	Daily performance, being able to be awake, Thinking performance
	Concentration, memory clarity and thoughts
	Being able to think clearly and have a clear mind
	Attention, learning, abstract thinking
Thinking Skills	Memory, learning
	Ability to understand, assess, and solve things
	Thinking skills; being aware of your surroundings, thinking between right and wrong
	Being able to recall things
	Thought process, clarity, understanding
Specific Cognitive Abilities	Memory
	Awareness and assessing, problem solving
	Thinking, recalling, processing new information
	School activities, going to school; things you do on a daily basis
	Traits such as critical thinking, communication
Think Clearly	Not taking a long time to think of something
	Being able to work through ideas or concepts or problems without confusion
	Make logical decisions, be able to recall things, having a sharp memory
	A lack of fogginess, or ability to apply yourself when needed
	Being able to concentrate, evaluate your thoughts and put them into good words

Research Question Two

How will professionals within the field of brain health and lifestyle factors rate items' clarity, relevance, and accuracy? During the second phase of data collection, expert raters provided quantitative and qualitative feedback on each of the items. Interrater agreement scores were calculated for accuracy, clarity, and relevance for each of the individual items.

Tables 3, 4, and 5 provide a summary of the items changed during the expert review process, the mean and standard deviation of the experts' ratings for each item, as well as the Interrater Agreement (IA) for each of the domains per item. The IA is a measure of strength of the item, as it represents the number of raters who scored the item as a 3 or 4, divided by the total number of raters for that item. Items with an IA score of 1 indicate that all raters scored the item as 3 or 4, suggesting that it is sufficiently well-developed; items with an IA score of 0 indicate that all of the raters scored the item as either a 1 or a 2, suggesting that the item is not well-developed on that domain. Of the original 38 items that were reviewed during Phase 2, 33 items met the specified interrater criterion of 0.5 and were therefore retained. Most of the 5 deleted items lacked sufficient expert approval on accuracy, either indicated by receiving an IA score of less than 0.5, or through written feedback. For the remaining 33 items, expert written feedback proved helpful in modifying wording to increase clarity. Additionally, raters identified items that suggested causality when none was indicated by the literature; these items were changed to indicate an association between variables, as opposed to direct causality, to broaden the scope of the statement. Multiple raters suggested the phrase "thinking abilities" was too vague and could be interpreted variably by participants. To address this concern and

standardize the meaning for participants, the survey will be refined to include the definition of "thinking abilities." To see the final questionnaire items resulting from the changes made during the expert review process, refer to Table 6.

Table 3

Summary of Changes Resulting from Expert Feedback and Interrater Agreement Scores per Domain for Nutrition Items

Original Item	**Item**	**Mean/SD**
Having an unhealthy diet can increase the risk of developing dementia later in life.	Having an unhealthy diet can increase the risk of developing dementia later in life.	Accuracy: 4/0 IA = 1
		Relevance: 4/0 IA = 1
		Clarity: 3.5/0.5 IA = 1
Eating a healthy diet may slow the decline in thinking abilities that comes with normal aging.	Eating a healthy diet may slow the decline in thinking abilities that comes with normal aging.	Accuracy: 4/0 IA = 1
		Relevance: 4/0 IA = 1
		Clarity: 3.5/0.5 IA = 1
The Mediterranean diet can help reduce the risk of developing dementia later in life.	The Mediterranean diet can help reduce the risk of developing dementia later in life.	Accuracy: 4/0 IA = 1
		Relevance: 4/0 IA = 1
		Clarity: 4/0 IA = 1
The Mediterranean Diet is a good diet for brain health.	The Mediterranean Diet is good for brain health.	Accuracy: 4/0 IA = 1
		Relevance: 4/0 IA = 1
		Clarity: 3.5/0.5 IA = 1
The Western diet is a poor diet for brain health.	The Western diet is poor for brain health.	Accuracy: 4/0 IA =1
		Relevance: 4/0 IA = 1
		Clarity: 3.5/0 IA = 1

Table 3 (Continued)

Regularly eating a lot of fruits and vegetables may help reduce the risk of developing dementia later in life.	Eating fruits and vegetables can reduce the risk of developing dementia	Accuracy: 4/0 IA = 1
		Relevance: 4/0 IA = 1
		Clarity: 3/0 IA = 1
Regularly eating a lot of fruits and vegetables may slow the decline in thinking abilities that comes with normal aging.	Regularly eating a lot of fruits and vegetables may slow the decline in thinking abilities that comes with normal aging.	Accuracy: 4/0 IA = 1
		Relevance: 4/0 IA = 1
		Clarity: 3/0 IA = 1
Regularly eating a lot of fruits and vegetables may help improve memory abilities.	Regularly eating a lot of fruits and vegetables may help improve memory.	Accuracy: 4/0 IA = 1
		Relevance: 4/0 IA = 1
		Clarity: 3.5/0 IA = 1
Regularly eating a lot of fruits and vegetables may make it easier to pay attention to everyday activities, such as work tasks, reading or chores.	Regularly eating a lot of fruits and vegetables may make it easier to pay attention to everyday activities, such as work tasks, reading or chores.	Accuracy: 4/0 IA = 1
		Relevance:4/0 IA = 1
		Clarity: 4/0 IA = 1
Seafood is good for brain health.	(Deleted)	Accuracy: 4/0 IA = 1[2]
		Relevance: 4/0 IA = 1
		Clarity: 4/0 IA = 1
Regularly eating foods high in added sugar can increase the risk of developing dementia later in life.	Regularly eating foods high in added sugar can increase the risk of developing dementia	Accuracy: 4/0 IA = 1
		Relevance: 4/0 IA = 1
		Clarity: 3.5/0.5 IA = 1

[2] Only one rater provided quantitative feedback for the accuracy domain on this item, the other rater provided verbal feedback suggesting a lack of sufficient research to support this item.

Table 4

Summary of Changes Resulting from Expert Feedback and Interrater Agreement Scores per Domain for Exercise Items

Original Item	Final Item	Mean/SD
Exercise can improve thinking abilities in people with dementia.	Exercise can improve thinking abilities in people with dementia.	Accuracy: 3.0/0.89 IA = 0.6
		Relevance: 3.6/0.49 IA = 1
		Clarity: 3.4/0.8 IA = 0.8
Exercise can help make it easier to pay attention while doing everyday tasks, such as work tasks, reading, or chores.	Exercise can help make it easier to pay attention while doing everyday tasks, such as work tasks, reading, or chores.	Accuracy: 3.0/0.63 IA = 0.8
		Relevance: 3.4/0.49 IA = 1
		Clarity: 3.40/0.8 IA = 0.8
Exercise can help many people learn more easily.	Exercise can help many people learn more easily.	Accuracy: 3.25/0.43 IA = 1
		Relevance: 3.5/0.5 IA = 1
		Clarity: 3.5/0.5 IA = 1
Exercise can help many people improve their memory.	Exercise can help many people improve their memory.	Accuracy: 3.25/0.43 IA = 1
		Relevance: 3.5/0.5 IA = 1
		Clarity: 3.75/0.43 IA = 1
Exercise can help improve thinking abilities for younger adults (ages 18-30).	Exercise can help improve thinking abilities for younger adults (ages 18-30).	Accuracy: 3.4/0.49 IA = 1
		Relevance: 3.60/0.49 IA = 1
		Clarity: 3.4/0.8 IA = 0.8
Exercise can help improve thinking abilities for older adults (ages 60 and older).	Exercise can help improve thinking abilities for older adults (ages 60 and older).	Accuracy: 3.6/0.8 IA = 0.8
		Relevance: 3.6/0.49 IA = 1
		Clarity: 3.4/0.8 IA = 0.8

Table 4 (Continued)

It is easier to pay attention right after exercising.	It is easier to pay attention right after exercising.	Accuracy: 3.0/0.71 IA = 0.75
		Relevance: 3.40/0.8 IA = 0.75
		Clarity: 3.4/0.8 IA = 0.75
Regular exercise can help improve memory abilities.	Regular exercise can help improve memory abilities.	Accuracy: 3.2/0.75 IA = 0.75
		Relevance: 3.4/0.8 IA = 0.8
		Clarity: 3.4/0.8 IA = 0.8
Regular exercise habits can help slow down the loss of thinking abilities that comes from aging.	Regular exercise can slow down the loss of thinking abilities that can come with aging	Accuracy: 3.0/0.89 IA = 0.8
		Relevance: 3.2/0.75 IA = 0.8
		Clarity: 3.20/0.75 IA = 0.8
Exercise can help young adults (ages 18-30) improve their memory abilities.	Exercise can help young adults (ages 18-30) improve their memory abilities.	Accuracy: 2.75/0.43 IA = 0.6
		Relevance: 3.20/0.75 IA = 0.8
		Clarity: 3.2.0.75 IA = 0.8
Middle-aged adults (ages 30-50) can improve their memory abilities with regular exercise.	Middle-aged adults (ages 30-50) can improve their memory abilities with regular exercise.	Accuracy: 3.0/0.63 IA = 0.75
		Relevance: 3.2/0.75 IA = 0.8
		Clarity: 3.20/0.75 IA = 0.8
Doing yoga can help improve thinking abilities in younger (ages 18-30) adults.	(Deleted)	Accuracy: 1.75/0.43 IA = 0
		Relevance: 3.2/0.75 IA = 0.8
		Clarity: 3/0.63 IA = 0.8
Doing yoga can help improve thinking abilities in older (age 60 and older) adults.	(Deleted)	Accuracy: 1.8/0.4 IA = 0
		Relevance: 3.2/0.75 IA = 0.8
		Clarity: 3/0.63 IA = 0.8

Table 4 (Continued)

Gentle exercise can help older adults delay a decrease in their memory abilities that comes from normal aging.	Staying active can help older adults delay decreases in memory that may come with aging.	Accuracy: 2.8/0.98 IA = 0.4
		Relevance: 3.4/0.8 IA = 0.8
		Clarity: 3.2/0.75 IA = 0.8

Table 5

Summary of Changes Resulting from Expert Feedback and Interrater Agreement Scores per Domain for Chronic Medical Condition Items

Original Item	**Final Item**	**Mean/SD**
Some individuals with Type 2 Diabetes might have reduced thinking abilities.	Some individuals with Type 2 Diabetes might have reduced thinking abilities.	Accuracy: 3.5/0.5 IA= 1
		Relevance: 4/0 IA =1
		Clarity: 3/1 IA = 0.5
Having Type 2 diabetes can increase the risk of developing dementia later in life	Having Type 2 diabetes can increase the risk of developing dementia later in life	Accuracy: 4/0 IA = 1
		Relevance: 4/0 IA = 1
		Clarity: 4/0 IA = 1
Some individuals with Type 2 Diabetes might have reduced memory abilities.	Some individuals with Type 2 Diabetes might have reduced memory abilities.	Accuracy: 3.5/0.5 IA =1
		Relevance: 3.5/0.5 IA = 1
		Clarity: 3.5/0.5 IA = 1
Having Type 2 diabetes can potentially make it harder to pay attention while doing everyday tasks, such as work tasks, reading, or chores.	(Deleted)	Accuracy: 2.5/1.5 IA = 0.5
		Relevance: 2.5/1.5 IA = 0.5
		Clarity: 2.5/1.5 IA = 0.5

Table 5 (Continued)

Middle-aged adults (ages 30-50) with high cholesterol are more likely to get Alzheimer's disease later in life when compared to middle-aged adults with normal cholesterol levels.	Middle-aged adults (ages 30-50) with high cholesterol are more likely to get Alzheimer's disease later in life when compared to middle-aged adults with normal cholesterol levels.	Accuracy: 3.5/0.5 IA = 1
		Relevance: 3.5/0.5 IA = 1
		Clarity: 3/1 IA = 0.5
Middle-aged adults (ages 30-50) with high cholesterol are more likely to lose some of their thinking abilities later in life.	Middle-aged adults (ages 30-50) with high cholesterol are more likely to lose some of their thinking abilities later in life.	Accuracy: 3.5/0.5 IA = 1
		Relevance: 3.5/0.5 IA = 1
		Clarity: 3/1 IA = 0.5
Having healthy blood pressure may slow the decline in thinking abilities that comes with normal aging.	Maintaining healthy blood pressure may slow the decline in thinking abilities that may come with aging.	Accuracy: 3/1 IA = 0.5
		Relevance: 3/1 IA = 0.5
		Clarity: 2.5/0.5 IA = 0.5
Older adults (adults in their 60's and older) with high blood pressure are at a greater risk for memory decline.	Adults over 60 years old with high blood pressure are at greater risk for memory decline.	Accuracy: 3/1 IA = 0.5
		Relevance: 4/0 IA = 1
		Clarity: 4/0 IA = 1
Middle-aged adults (adults in their 30's to 50's) with high blood pressure are at a greater risk for memory decline.	Middle-aged adults (30-59 years old) with high blood pressure are at greater risk for memory decline.	Accuracy: 3.5/0.5 IA = 1
		Relevance: 3.5/0.5 IA =1
		Clarity: 3.5/0.5 IA = 1

Table 5 (Continued)

Being obese increases the risk of developing dementia later in life.	Being obese is associated with an increase in the risk of developing dementia later in life.	Accuracy: 2.5/1.5 IA = 0.5
		Relevance: 2.5/1.5 IA = 0.5
		Clarity: 2.5/1.5 IA = 0.5
Being obese is associated with having poorer attention.	Being obese is associated with having poorer attention.	Accuracy: 4/0 IA = 1
		Relevance: 4/0 IA = 1
		Clarity: 4/0 IA = 1
Being obese is associated with having poorer memory.	Being obese is associated with having poorer memory.	Accuracy: 3.5/0.5 IA = 1
		Relevance: 3.5/0.5 IA = 1
		Clarity: 3.5/0.5 IA = 1
In obese people, thinking abilities improve after weight-loss.	(Deleted)	Accuracy: 3/1 IA = 0.5
		Relevance: 3.5/0.5 IA = 1
		Clarity: 3.5/0.5 IA = 1

Table 6

Final Questionnaire Items

Item
1. Having an unhealthy diet can increase the risk of developing dementia (a decrease in thinking abilities that leads to impairments in daily functioning) later in life.
2. Eating a healthy diet may slow the decline in thinking abilities (for example, attention or memory) that comes with normal aging.
3. The Mediterranean diet (dietary pattern that is characterized by a low consumption of red meat, sweets, and saturated fat, and a high intake of fruits, vegetables, whole grains, and olive oil) can help reduce the risk of developing dementia later in life.

Table 6 (Continued)

4. The Mediterranean diet is good for brain health.
5. The Western diet (a dietary pattern that is characterized by a high consumption of red meat, processed and packaged foods, and sugar, and a low intake of fruits and vegetables) is poor for brain health.
6. Eating fruits and vegetables can reduce the risk of developing dementia
7. Regularly eating a lot of fruits and vegetables may slow the decline in thinking abilities that comes with normal aging.
8. Regularly eating a lot of fruits and vegetables may help improve memory.
9. Regularly eating a lot of fruits and vegetables may make it easier to pay attention to everyday activities, such as work tasks, reading or chores.
10. Regularly eating foods high in added sugar can increase the risk of developing dementia
11. Exercise can improve thinking abilities in people with dementia.
12. Exercise can help make it easier to pay attention while doing everyday tasks, such as work tasks, reading, or chores.
13. Exercise can help many people learn more easily.
14. Exercise can help many people improve their memory.
15. Exercise can help improve thinking abilities for younger adults (ages 18-30).
16. Exercise can help improve thinking abilities for older adults (ages 60 and older).
17. It is easier to pay attention right after exercising.
18. Regular exercise can help improve memory abilities.
19. Regular exercise can slow down the loss of thinking abilities that can come with aging

Table 6 (Continued)

20. Exercise can help young adults (ages 18-30) improve their memory abilities.
21. Middle-aged adults (ages 30-50) can improve their memory abilities with regular exercise.
22. Staying active can help older adults delay decreases in memory that may come with aging.
23. Some individuals with Type 2 Diabetes (a medical condition in which the body does not use insulin properly to regulate blood glucose/sugar levels) might have reduced thinking abilities.
24. Having Type 2 diabetes can increase the risk of developing dementia later in life
25. Some individuals with Type 2 Diabetes might have reduced memory abilities.
26. Middle-aged adults (ages 30-50) with high cholesterol are more likely to get Alzheimer's disease later in life when compared to middle-aged adults with normal cholesterol levels.
27. Middle-aged adults (ages 30-50) with high cholesterol are more likely to lose some of their thinking abilities later in life.
28. Maintaining healthy blood pressure may slow the decline in thinking abilities that may come with aging.
29. Adults over 60 years old with high blood pressure are at greater risk for memory decline.
30. Middle-aged adults (30-59 years old) with high blood pressure are at greater risk for memory decline.
31. Being obese is associated with an increase in the risk of developing dementia later in life.
32. Being obese is associated with having poorer attention.
33. Being obese is associated with having poorer memory.

Chapter 4

Discussion

Introduction

In this section, the results of the study will be discussed in relation to the research questions and hypotheses. These findings will then be compared and contrasted to previous research and explored in relation to similar works. Then, I will discuss the limitations of, and future directions for, the current study, focusing on the planned line of research that will follow from this foundational study. The implications of this broader line of research will be presented. Lastly, the section will conclude with final remarks.

Purpose of the Study

The purpose of the current study was to develop the Brain Health Perceptions Questionnaire, a questionnaire designed to assess the general public's perceptions of the impact that diet, exercise and chronic medical conditions have on brain health. To that end, a review of the literature was conducted to develop the initial items, as it was crucial to understand the general consensus of research about the specified content domains before attempting to write the original items. To ensure that the questionnaire was easy to understand by those not familiar with this field of study, and to ensure general comprehensibility, the investigator conducted in-person cognitive interviews with undergraduate students. The survey was further refined using both quantitative and written feedback from experts in the field of lifestyle factors and brain health. Through these three phases, the final survey was developed.

Research Question One

The first research question focused on the changes following undergraduate student feedback. Cognitive interviewing generated significant changes in the original

items. Items were removed due to poor comprehensibility, terminology was identified that requires definitions, and confusing and/or field-specific verbiage was altered. Additionally, themes emerged that allowed the investigator to summarize student feedback and apply it to later iterations of the items. Overall, the total item count was reduced from 49 to 38, and the researcher gained an understanding of how individuals not familiar with this research perceived the item content.

Research Question Two

The second research question focused on the changes made to the items based on feedback from researchers in the field of brain health. These researchers were identified through a review of the literature, selecting researchers who had published at least one meta-analysis focusing on the impact that exercise, diet, and/or chronic medical conditions could have on brain health. Additional experts were identified through research groups at the University of Rhode Island. Overall, the experts assigned consistent and favorable ratings to the clarity and relevance of most items. In contrast, greater variation was seen across accuracy ratings, with items altered in line with the feedback received. Items that were identified as being inaccurate by greater than 30% of raters (i.e. received an interrater agreement score of less than 0.7) were either revised to reflect written feedback, or removed entirely if interrater agreement fell below 0.5. Out of the original 38 items the experts reviewed, 33 were retained for the final version of the survey.

Similarities and Differences Relative to Previous Research

The development of the Brain Health Perceptions Questionnaire was based on research pertaining to the impact of lifestyle factors on brain health; however, no

previously developed questionnaire was used as a foundation for developing individual items. Currently, few surveys or questionnaires exist that assess public perceptions regarding lifestyle factors and brain health. Instead, most research in this area uses focus group to gather data. For example, both Price et al. (2011) and Wilcox et al. (2009) conducted focus groups with older adults to understand their perceptions of physical activity, nutrition, and cognitive health. Although focus groups are valuable in understanding the general public's beliefs and perceptions, they are limited in their ability to sample a wide range of participants due to physical and other limitations (e.g. needing to meet with participants in person). Additionally, participants may potentially influence the opinions of other members of the focus group, thus impacting the results of the study. Therefore, a questionnaire has the advantage of gaining access to a larger and potentially more diverse, representative, and unbiased samples of participants.

To my knowledge, the present brain health questionnaire has undergone more extensive, formal, psychometric development than other available methods. Clearly, the accuracy of the individual items is important when assessing public perceptions; however, it is equally important to verify that the same items are easy to understand and are relevant to the aims of the questionnaire. The current study contributes to the literature by providing quantitative ratings for each item across three domains (accuracy, clarity, and relevance), in addition to supplementation from cognitive interviewing and written feedback from experts.

The current study also adds to the literature by focusing on perceptions regarding dementia reduction in addition to general brain and cognitive health. Previous work focuses on understanding participants' perceptions regarding physical activity/nutrition

and brain health; however, a majority of these studies limited the content domain to reducing risk. For example, Friedman et al. (2015) conducted a review of studies assessing the public's perceptions regarding brain health. Of the 34 studies included in their review, only 8 addressed the impact of lifestyle factors on normal functioning, whereas 16 addressed Alzheimer's disease, 15 broadly dementia, and 5 mild to moderate impairment (some content overlap was present). The current study seeks to broaden the scope of the literature and future inquiry by developing a questionnaire that can be used to investigate perceptions regarding both healthy and impaired cognitive functioning.

Limitations

Generally, most items received favorable feedback from raters; almost all items were rated highly on both clarity and relevance. However, a number of limitations should be considered. First, comprehensive demographic data were not collected for the undergraduate participants; although age, education, and major were recorded, ethnicity and race were not. Additionally, using undergraduate students for an initial round of content validation raises certain concerns. In particular, while this population provided valuable feedback, and assisted with the identification of problematic items and areas in need of further development, the extent of generalization to the wider population is an open question as item review was conducted with a small and fairly select sample. Based on the feedback received, however, it was clear that the undergraduate students were not familiar with many of the key survey topics. Therefore, their feedback provided useful information regarding the clarity of the items, as it became apparent that many terms will need to be defined on the final survey.

A final limitation is the small pool of expert raters who participated in the second phase of item review. In total, two experts reviewed the nutrition items, two experts the chronic medical condition items, and five experts the exercise items. During a three-month period, the survey was distributed to 73 experts, yet only a small percentage responded. There were two characteristics of the study that limited the amount of engagement from potential expert raters. First, no compensation was provided. Second, the length of the survey and the encouragement to include qualitative feedback could have limited participation. Even though the small sample for two out of the three dimensions that were assessed poses a potential limitation in regards to validation, it does still provide multiple perspectives from knowledgeable reviewers. At the minimum, it certainly seemed clear to the investigator that feedback from these raters was informative and of major assistance.

Future Directions

Future studies should focus on further improving the content validation and the psychometric validity of the Brain Health Perceptions Questionnaire. More specifically, to improve generalizability, cognitive interviewing with a more demographically diverse population should be conducted. Although the current validation with undergraduates is deemed to be sufficient for initial purposes, an increase in participants will further improve content validation. Similarly, content validation will be improved by receiving feedback from broader array of experts.

The questionnaire developed in this study is intended to provide one foundation for programmatic research focused on changing population-wide behavior to positively impact brain health. Therefore, future studies will utilize this questionnaire with the goal

of assessing the knowledge and beliefs of general populations. Detecting and correcting misunderstandings that could be corrected through various public health efforts could potentially change many lives for the better. An initial step in moving this work forward could be to conduct pilot testing with an undergraduate population as a part of a public health initiative present within the university setting. Future studies will then disseminate the questionnaire to a wider population base. These studies will then include additional self-efficacy scales in addition to the Brain Health Perceptions Questionnaire, in order to investigate the relationship between level of knowledge and self-efficacy, as this will further inform future interventions.

Conclusion

Brain health is important at any age. Before certain population-level interventions can be initiated to engender behavior change and improve lifestyle factors in order to improve brain health, it is important to first understand how the general public perceives the relationship between physical factors and brain health. Currently, research has focused on the impact that certain lifestyle behaviors have on reducing the risk of developing dementia and other neurodegenerative diseases. Similarly, research into the perceptions and beliefs of the general public regarding this information have mainly focused on beliefs about how physical health impacts the development of neurodegenerative disorders. There is a gap in the literature regarding a broader perspective, as few studies have investigated perceptions and beliefs about general brain health across the lifespan.

To address this gap, the purpose of the current study was to develop a tool to help researchers measure participants' beliefs regarding lifestyle factors and brain health.

Through a review of the literature and initial content validation with a panel of expert raters and cognitive interviews with content-naïve participants, the current questionnaire includes a variety of items that address multiple key components regarding the relationship between brain health and chronic medical conditions or lifestyle factors. Although the current survey is a work in progress, it seeks to address an important gap in the current toolkit available to researchers. When considering the pros and cons of behavior change, it is crucial to understand the public's knowledge regarding these factors. If future studies utilizing this questionnaire find that the public, or substantial portions of individuals, lack sufficient awareness about the link between brain health and other components of physical health, future work could seek to increase this knowledge. Additionally, it is valuable to understand what knowledge the general public considers motivating when contemplating behavior change. It is possible the knowledge that brain health is impacted by physical health is highly motivating; for example, perhaps the knowledge that routine aerobic exercise can help decrease the risk of developing dementia later in life is sufficient to evoke behavior change in significant portions of the public. This knowledge is crucial, and will better inform future public interventions.

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