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Not as easy as pie: Disentangling the theoretical and applied components of children's health knowledge

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Abstract

While there has been substantial research on children's dietary habits and physical activity level, there has been little work linking children's understanding of these concepts and how they apply them. This study aims to elucidate the association between two concepts that have not been distinguished in previous work; theoretical and applied health knowledge. Four-year-old children completed measures of theoretical and applied health knowledge regarding vegetables, fatty foods, physical, and sedentary activities. Results indicate that children's theoretical and applied health knowledge are distinct concepts that are positively associated. That is, children who accurately identify the relative health of foods and activities are more likely to be able to select foods and activities that promote their body's health.

Keywords

children's health knowledge; health concepts; food categories

Health and nutrition are essential concepts that young children must learn (see Rozin, 1990; Siegal & Peterson, 1999). Although there are potentially many ways to conceptualize health and nutrition, the goal of this study is to identify and investigate the relationship between two specific kinds of health knowledge, namely theoretical and applied health knowledge. In this study, theoretical health knowledge is defined as a conceptual understanding of health. For example, a child's knowledge that broccoli is healthy is based on a theoretical association that the child has made between broccoli and healthy foods. Applied health knowledge is defined as a practical understanding of how to promote one's own health. For example, a child's knowledge that he/she should eat broccoli for its health benefits is based on an applied understanding of the consequences that eating broccoli has on one's health. We believe that each kind of knowledge is central, and may contribute to the formation of a coherent concept of health and nutrition in young children. However, these two kinds of knowledge have not been distinguished in previous research.

Although there is a large body of research on preschool-aged children's dietary habits (e.g., see Aldridge, Dovey, & Halford, 2009; Faith, 2010) and level of physical activity (e.g., see Hinkley, Crawford, Salmon, Okely, & Hesketh, 2008; Tucker, 2008), there is limited research on young children's concept of health and nutrition. For example, some studies

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have found that by age 3- to 4-years, children have the ability to classify foods as healthy or unhealthy (Nguyen, 2008; Nguyen, 2007; Nguyen & McCullough, 2009; Nguyen & Murphy, 2003; see also Guérin & Thibaut, 2008 for findings on school-aged children). Research has also found that by age 4 years, children have the ability to infer that eating healthy versus unhealthy foods have different consequences for the human body (Nguyen, 2008). Finally, by age 5 years, children report that eating healthy foods helps the body grow (Slaughter & Ting, in press; see also Inagaki & Hatano, 2002; Wellman & Johnson, 1982 for findings on school-aged children).

While these studies make valuable contributions to the study of young children's concept of health and nutrition, they were not designed to examine whether children's theoretical and applied health knowledge relate to one another. As a result, these studies have tended to blend aspects of theoretical and applied understanding when examining health knowledge in children. Therefore, previous research has yet to clarify whether these two kinds of knowledge are distinct from one another, and if so, how they may be related. Clarifying this is not only pertinent to understanding young children's concept of health and nutrition, but may potentially contribute to health education programs. Focusing on children's health knowledge during the preschool years is ideal because it can help inform efforts to effectively build on the knowledge structures that young children already have once they begin formal education.

The aim of this study was to examine whether 4-year-old children's theoretical and applied health knowledge about foods and activities are distinct and, if so, how they relate to one another. The domains of food and activity were both included in this study to provide a more comprehensive examination of children's health knowledge. In the present investigation, theoretical health knowledge was operationalized as children's ability to correctly identify the relative health of vegetables and fatty foods as well as physical and sedentary activities. In contrast, applied health knowledge was operationalized as children's accurate endorsement of eating foods and participating in physical activities that would help them achieve a healthy body. Whereas these variables represent distinct constructs, it seems plausible to predict that they are related because a child's applied health knowledge may partially depend on the child's mastery of theoretical health knowledge. For instance, for a child to demonstrate applied knowledge that eating broccoli would promote his/her own health, the child would most likely already possess the more basic theoretical knowledge that broccoli is a healthy food. Thus, we predicted that young children's theoretical health knowledge and applied health knowledge would be distinguishable, and that the two constructs would be positively associated.

Method

Participants

The participants were 53 four-year-olds (30 males, 23 females, $M_{age} = 4.50$, $range = 3.88-4.96$, $M_{BMI} = 15.38$, $range = 13.30-18.30$) who were enrolled in a larger study on children's learning about health conducted in the Southeastern United States (McCullough, Noble, & Nguyen, 2009).

In addition, each child had one parent (49 mothers, 4 fathers, $M_{age} = 37.38$, $range = 25-51$ years) complete a brief demographics questionnaire. The majority of parents (96%) indicated that they were White, with 2% indicating Asian-American heritage and 2% indicating Native-American heritage. Seventy-three percent of the parents reported having a bachelor's or graduate degree and all parents reported completing a minimum of a high school degree or a general equivalency diploma. Parents reported that their children received an average of approximately two daily servings of vegetables and one serving of fatty foods

as well as daily opportunities for both physical and sedentary activities. These parental reports are generally consistent with previous research documenting food consumption patterns and activity levels in preschoolers (e.g., Kranz, Siega-Riz, & Herring, 2004; Tucker, 2008).

Materials

The materials included a 24 item measure of children's theoretical health knowledge about foods ("Is _ healthy or not healthy?") and activities ("Is _ exercise or not exercise?"). The materials also included a 24 item measure of children's applied health knowledge about these same foods ("To have a healthy body, would you eat _?") and activities ("To have a healthy body, would you _?"). Specifically, the measures focused on six vegetables (beans, broccoli, carrot, celery, corn, bell pepper), six fatty foods (bacon, cake, cheetos, doughnut, fudge, potato chips), six physical activities (biking, canoeing, playing on the jungle gym, playing soccer, playing tag, running), and six sedentary activities (reading a comic book, typing on the computer, playing a video game, watching a movie, watching television, writing a letter). The test questions for these measures were developed based on pilot data collected from an independent group of children to ensure that that they were comprehensible for young children. The items within the questions were also selected based on ratings provided by an independent group of young children and adults. The ratings indicated that these items were representative examples as well as palatable/enjoyable examples of their respective categories. Accompanying the measures were 4" x 5" color photographs of the vegetables, fatty foods, physical, and sedentary activities.

Procedure

Children were interviewed individually by a female researcher for approximately 10–15 minutes. First, to measure children's theoretical health knowledge, children were shown photographs of vegetables and fatty foods, one at a time, and were asked to identify whether they were healthy or unhealthy (e.g., "Are beans healthy or not healthy?; Is bacon healthy or not healthy?"). Children were also shown photographs of physical and sedentary activities, one at a time, and were asked to identify whether they were exercise or not exercise (e.g., "Is riding a bike exercise or not exercise?; Is reading a comic book exercise or not exercise?").

Next, to measure children's applied health knowledge, children were asked to indicate whether they would eat the vegetables and fatty foods or engage in the physical and sedentary activities to have a healthy body (e.g., "To have a healthy body, would you eat beans?"; "To have a healthy body, would eat bacon?"; "To have a healthy body would you ride a bike?"; "To have a healthy body, would you read a comic book?").

The vegetables, fatty foods, physical activities, and sedentary activities for both the theoretical and applied knowledge measures were presented to children in one of four random orders to ensure that the sequence of the items did not impact the results.

Results

For the theoretical knowledge questions, children's correct responses were assigned a "1" (i.e., responding "healthy" for the vegetables and physical activities and "not healthy" for the fatty foods and sedentary activities) whereas children's incorrect responses were assigned a "0." These scores were summed to provide a 24 item measure of children's theoretical health knowledge, with four subscales each containing six items representing knowledge about vegetables, fatty foods, physical activities, and sedentary activities, respectively. Thus, the maximum score for the measure of theoretical health knowledge is 24, with four subscales containing maximum scores of six points each.

Similarly, for the applied knowledge questions, children's correct responses were assigned a "1" (i.e., responding "yes" for the vegetables and physical activities and "no" for the fatty foods and sedentary activities) and incorrect responses were assigned a "0." These scores were also summed to provide a 24 item measure of children's applied health knowledge, with four subscales each containing six items representing applied knowledge regarding vegetables, fatty foods, physical activities, and sedentary activities, respectively. Thus, the maximum score for the measure of applied health knowledge is 24, with four subscales containing maximum scores of six points each. Please see Table 1 for the descriptive statistics for children's performance on the theoretical and applied knowledge subscales.

First, a Pearson correlation coefficient was calculated to examine the relationship between children's theoretical and applied health knowledge. Results indicate that the two variables are moderately to strongly correlated ($r = .719$, $r^2 = .517$), $p < .001$, such that as children's theoretical knowledge of health increases, their ability to accurately identify healthy behaviors increases as well. This is a robust finding, in that approximately 52% of the variance in applied health knowledge is accounted for by children's theoretical health knowledge. Thus, the two variables are related, yet it appears they remain separate and distinguishable constructs.

Next, we further examined the relationship between theoretical and applied health knowledge by conducting regression analyses in order to determine whether the previously described association remains intact once the child's age and BMI are taken into account in the analyses. We conducted five simultaneous multiple regression analyses using SAS PROC REG to determine the unique contributions of each predictor variable when entered together in a given model. This statistical approach enabled us to control for the child's age and body mass index (BMI) in each of our models to ensure that these variables would not confound our results. Please see Table 2.

The first regression equation was computed to determine whether children's overall applied health knowledge is related to their overall theoretical health knowledge. In other words, if children can correctly identify the relative health of foods and activities are they also more likely to accurately identify foods and activities that will help them achieve healthy bodies? The child's age and BMI were first entered as covariates to determine whether the third predictor, overall theoretical health knowledge, accounts for significant variance in children's overall applied health knowledge above and beyond their age and BMI. Results indicate that children's overall applied health knowledge is indeed related to their overall theoretical health knowledge ($p < .001$) and that this association exists above and beyond the variance accounted for by children's age and BMI. Together, these three variables accounted for 53% of the variance in children's applied health knowledge.

The next four multiple regression analyses focused on each of the theoretical and applied health knowledge subscales. To begin, the association between children's applied and theoretical health knowledge about vegetables was examined with a simultaneous multiple regression that included the child's age, BMI and theoretical knowledge about vegetables as the predictor variables with the child's applied health knowledge about vegetables as the outcome variable. The results indicate that children's theoretical health knowledge about vegetables uniquely predicts their applied knowledge about vegetables ($p = .008$) above and beyond the variance associated with the child's age or BMI. Together, these three variables accounted for 21% of the variance in children's applied health knowledge about vegetables.

Similar patterns of results were established for additional regression analyses examining the association between theoretical and applied health knowledge for fatty foods ($p < .001$),

physical activities ($p = .001$), and sedentary activities ($p < .001$), each of which accounted for unique variance above and beyond the child's age and BMI (see Table 2).

A brief note should be made about BMI in the regression analyses for vegetables and fatty foods. The results indicated that as BMI increases, children's knowledge of vegetables decreases and their knowledge of fatty foods increases. Because BMI was not the focus of this study, we can only speculate about these results. A possibility is that experience and familiarity with fatty foods versus vegetables may vary with increasing BMI (see also Hill, Wardle, & Cooke, 2009 for discussion).

Finally, although our study was not intended to provide a rigorous test of causality among these variables, our data do appear to provide preliminary support for our notion that a child's applied health knowledge may be partially dependent on the child's theoretical health knowledge. First, a paired sample t-test indicates that children were significantly more accurate in their use of theoretical health knowledge than applied health knowledge, $t(52) = 2.97, p = .006$. In addition, we compared each child's relative accuracy in theoretical versus applied health knowledge by creating a difference score (each child's theoretical health knowledge score was subtracted from his/her applied health knowledge score). Thus, a negative difference score indicates better performance on theoretical health knowledge. Seventy-two percent (38 out of 53) of children had a difference score that was either 0 or negative. The average difference score was -1.15 ($SD = 2.9$).

General Discussion

Presently, there is only a small body of research on children's health knowledge. Furthermore, previous studies examining children's health concepts have tended to blend aspects of theoretical and applied knowledge together as they were not designed to examine the distinct contributions of each (e.g., Guérin & Thibaut, 2008; Inagaki & Hatano, 2002; Nguyen, 2007; Nguyen, 2008; Nguyen & McCullough, 2009; Nguyen & Murphy, 2003; Slaughter & Ting, in press; Wellman & Johnson, 1982). The current study contributes to this literature by clarifying the distinction as well as the association between theoretical and applied health knowledge. The results reveal that as predicted, there is a positive association between young children's theoretical health knowledge and applied health knowledge of foods and activities. This positive association exists above and beyond the variance accounted for by children's age and BMI. Children who can accurately identify the relative health of foods (vegetables and fatty foods) and activities (physical and sedentary) are more likely to select foods and activities that promote their body's health.

It is important to note that this study was not designed to determine causality between children's theoretical and applied health knowledge, but rather is a first step in establishing that these constructs are distinct and that a positive association exists between these two kinds of knowledge. Our results offer preliminary support for the notion that applied health knowledge is based, in part, upon mastery of theoretical health knowledge, but future investigations are needed to more fully examine causality among these variables. Further research will also be needed to investigate other variables that may potentially contribute to young children's health knowledge (e.g., parental socialization strategies, Anliker, Laus, Samonds, & Beal, 1990, 1992; Birch, Fisher, & Grimm-Thomas, 1999). Similarly, this study was not designed to determine causality between children's health knowledge and health practices. Future investigations could provide insight into this multi-faceted issue by examining how children balance their theoretical and applied health knowledge with other types of information about foods and activities that may impact their health-related decisions and behaviors (e.g., hedonic assessments of foods, Fallon, Rozin, & Pliner, 1984; Lumeng, Cardinal, Jankowski, Kaciroti, & Gelman, 2008).

Finally, although children's BMI and age were not the focus of this study, it would be interesting for future research to examine a wider age range within the preschool years as well as a wider range of BMIs. This information would further elucidate the developmental trajectory of children's health knowledge and behaviors.

The results from the current study are relevant to the development of health education programs for young children. Presently such programs are scarce for preschool-aged children compared to school-aged children (see Contento, Randell, & Basch, 2002, for a review). The present study shows that health and nutrition is a complex concept that is comprised of different kinds of knowledge, and that by age 4 years children show signs of both theoretical and applied health knowledge. In order to facilitate children's development of a coherent concept of health and nutrition, it would be optimal for health education programs to emphasize both theoretical and applied knowledge, as opposed to one or the other. For example, in the present study, looking at Table 1, it is apparent that by age 4 years, children already have highly accurate theoretical knowledge of vegetables and physical activities, which is related to their highly accurate applied knowledge of these items. In contrast, children have relatively limited theoretical knowledge of fatty foods and sedentary activities, which is related to their limited applied knowledge of these items. Given the relation between children's theoretical and applied knowledge, a program that is designed to increase young children's understanding of fatty foods and sedentary activities could target both kinds of knowledge.

As we begin to disentangle young children's understanding of health, it is clear that two distinct and complementary pieces exist: a theoretical and an applied component. The present research is unique and important in that it reveals that children's health knowledge is perhaps more complex than previously recognized. This study represents a step toward a more comprehensive conceptualization of young children's health knowledge and behaviors. We hope that gaining clarity in how young children conceptualize health will ultimately assist with the development of health education programs for these children.

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Table 1

Descriptive Statistics for the Theoretical and Applied Knowledge Measures

Variable	Mean	SD
Overall Theoretical	16.09	4.12
Subscales		
Vegetables	4.98	1.24
Fatty Foods	2.94	1.98
Physical Activities	4.88	1.25
Sedentary Activities	3.28	2.19
Overall Applied	14.94	3.44
Subscales		
Vegetables	4.75	1.54
Fatty Foods	2.58	1.84
Physical Activities	5.05	1.16
Sedentary Activities	2.54	2.17

Table 2

Predictors of Children's Applied Health Knowledge

Predictor Variable	Child Overall Applied Health Knowledge ($R^2 = .53$)			
	<i>B</i>	<i>SE</i>	β	<i>p</i>
Child Age	.44	1.2	.04	.710
Child BMI	.31	.29	.11	.289
Child Overall Theoretical Knowledge	.58*	.08	.69	.000*
Predictor Variable	Child Applied Health Knowledge about Vegetables ($R^2 = .21$)			
	<i>B</i>	<i>SE</i>	β	<i>p</i>
Child Age	.51	.68	.10	.455
Child BMI	-.34*	.17	-.26	.045*
Child Theoretical Knowledge of Vegetables	.44*	.16	.36	.008*
Predictor Variable	Child Applied Health Knowledge about Fatty Foods ($R^2 = .59$)			
	<i>B</i>	<i>SE</i>	β	<i>p</i>
Child Age	-.30	.58	-.05	.602
Child BMI	.44*	.14	.29	.004*
Child Theoretical Knowledge of Fatty Foods	.64*	.09	.69	.000*
Predictor Variable	Child Applied Health Knowledge about Physical Activities ($R^2 = .27$)			
	<i>B</i>	<i>SE</i>	β	<i>p</i>
Child Age	.81	.49	.21	.105
Child BMI	-.17	.12	-.18	.166
Child Theoretical Knowledge of Physical Activities	.42*	.12	.45	.001*
Predictor Variable	Child Applied Health Knowledge about Sedentary Activities ($R^2 = .34$)			
	<i>B</i>	<i>SE</i>	β	<i>p</i>
Child Age	-.27	.88	-.04	.762
Child BMI	.40	.22	.22	.066
Child Theoretical Knowledge of Sedentary Activities	.51*	.12	.52	.000*

* $p < .05$