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The meaning of 'fruits' and 'vegetables'

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Abstract

Objective: Fruit and vegetable consumption is a focus of research and nutrition education; yet, there is no universal agreement on the meaning of 'fruits' and 'vegetables'. Our objective was to describe survey respondent perceptions about a set of foods with regard to whether the food is a fruit, vegetable or something else.
Design: Three cross-sectional studies.
Setting: Two small studies involving cognitive interviewing sessions; and one large self-administered population survey.
Subjects: US adults in two small studies (n 55 and 80) and one large survey (n 3312), all with multiple race/ethnicities.
Results: Perceptions varied. In the survey, rice was considered a vegetable by about 20 % of respondents. In one small study, Spanish speakers were more likely to consider rice a vegetable, and Chinese speakers less likely, than were English speakers. Black beans were frequently classified as something other than vegetable or fruit. Among Hispanics, Spanish speakers were less likely than English speakers to consider beans a vegetable. Overall, tomatoes were classified as both fruit and vegetable, and these perceptions varied by race/ethnicity.
Conclusions: Substantial disagreement among the fruit, vegetable and other food domains highlights the importance of clearly defining the desired constructs. Foods that require specific instruction include rice, dried beans, potatoes, tomatoes and fruits and vegetables in mixtures and condiments. For measurement, additional questions or explanations may be needed to clarify which foods are of interest. For communication, the global message to increase consumption of fruit and vegetables should be reinforced with specific guidance.

Keywords
Fruit and vegetables
Dietary assessment
Nutrition education
Dietary guidance
Cognitive research

Fruit and vegetable intake is the focus of widespread research interest in health. Yet, single precise meanings of the terms 'fruits' and 'vegetables' are not universally shared. Although there is a botanical definition of fruit, there is none for vegetables. Various classification systems have been suggested, for example, on the basis of botanic families, colours and edible parts of plants[1] and on the basis of food composition profiles[2]. However, health professionals have not adopted a universal classification system. Definitions of fruits and vegetables according to health professionals and consumers are heavily influenced by cultural customs and norms related to food selection and preparation. Even within a particular country, consumers vary widely in the categories they use to describe various foods. For example, potatoes are often thought of as starches rather than as vegetables; vegetarians may think of legumes primarily as proteins rather than as vegetables.

Lack of common agreement within and across countries has led to varying operational definitions in guidelines and guidance. For example, the USA[3,4] and Australia[5] include potato as a vegetable, whereas the World Cancer Research Foundation has in the past excluded potato (and other starchy tubers) in its recommendations to increase vegetable intake[6].

In the USA, the definition and recommended amounts of fruit and vegetables were set out in the 2005 Dietary Guidelines for Americans[3] (and are consistent with the recently released report of the Dietary Guidelines Advisory Committee on the Dietary Guidelines for Americans, 2010)[4]. These guidelines recommend two cups of fruit and two-and-a-half cups of vegetables per day (reference category: 8368 kJ (2000 kcal) energy intake). The US Department of Agriculture (USDA) maintains the MyPyramid

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Equivalents Database (MPED) that includes information about each food in terms of both fruit and vegetable cup equivalents consistent with definitions in the dietary guidelines[7].

Further characteristics of fruits and vegetables may be considered in particular nutrition educational programmes. For example, Fruits & Veggies – More Matters (formerly, the 5 A Day programme), which is a partnership among various organizations including Produce for Better Health, the Centers for Disease Control and Prevention, and the National Cancer Institute[8], considered the preparation method and thus does not count French fries or other fried vegetables as vegetables[9].

Clear communication about fruits and vegetables is necessary for effective questionnaire-type assessments and dietary guidance. For example, an FFQ assessing fruits and vegetables requires specific wording of the food categories queried. Likewise, dietary guidelines and guidance require clear specification of the foods and amounts recommended. Thus, it is important to understand the various ways in which individuals perceive and define fruits and vegetables and to understand the relationships of these perceptions with demographic factors, such as sex, age, race/ethnicity and region or country of residence. A nuanced understanding of these perceptions could inform the development and modification of effective assessment and educational tools.

Earlier research on respondent perceptions with regard to fruits and vegetables is very limited. Wolfe *et al.*[10] conducted cognitive interviews of thirty-one adults – white, African American and Hispanic – in upstate New York to evaluate how three brief measures of fruit and vegetable consumption were understood and interpreted. They found that most respondents did not consider jam, fruit toppings or pickle relish to be fruit or vegetables, but many counted lettuce or tomato on hamburger as a vegetable, and fruit in fruit pies as fruit. Fruit and vegetables in casseroles were inconsistently classified.

The current paper presents and interprets data on the perceptions of individuals in the USA about whether selected foods are fruit or vegetables and, to the extent possible, relationships of these perceptions with race and ethnicity. We report a series of studies, beginning with two small studies and ending with a large population survey. We integrate the data from all in our interpretation of results.

Methods

Studies

Study 1: US National Center for Health Statistics–US National Cancer Institute cross-cultural cognitive test

In 2004, the National Center for Health Statistics (NCHS) and the National Cancer Institute (NCI) in the USA conducted fifty-five cognitive interviews (small-scale qualitative investigations designed to detect sources of error in survey questions[11]) to assess cross-cultural variation in survey response processes for a range of items relating to general health status, health conditions and cancer risk factors. Study participants were self-reported Hispanic and non-Hispanic respondents in urban and rural/suburban locations (Washington, DC, and two locations in northwest Ohio). Respondents were recruited through newspaper advertisements, flyers and by word of mouth. Nineteen self-reported Hispanics of multiple subgroups residing in the USA were interviewed in Spanish, and thirty-six non-Hispanics were interviewed in English (twenty-three male and thirty-two female, age ranging from 18 to 88 years with a mean age of 48·3 years). Interviews in the Washington, DC area were conducted in the Questionnaire Design Research Laboratory at the NCHS. Ohio interviews were conducted either in the respondent's home or in a private room of a community facility. After the interview, all respondents were remunerated $US 35. The institutional review boards of the NCHS and the NCI approved the study.

Following the cognitive interview, respondents were given a one-page, self-administered questionnaire in their own language that listed fourteen food items, chosen to reflect potential cultural differences in classifying fruit and vegetables. For each item, respondents were asked whether it was (i) a fruit, (ii) a vegetable or (iii) something else. No interviewer assistance was provided.

Study 2: US National Cancer Institute cross-cultural cognitive test

In 2005, NCI contracted with Westat Inc. (Rockville, MD, USA), a survey research firm, to conduct cognitive interviews of proposed dietary questions to be fielded in the 2005 US National Health Interview Survey Cancer Control Supplement[12–14]. The interviews were aimed at further refining the translations and their cultural appropriateness. The dietary instrument included twenty questions about a wide range of dietary factors. Interviews were conducted with eighty respondents who reported their primary language as Spanish (n 36)[10], Korean (n 13), Chinese (n 13) or English (n 18). Participants were recruited from four cities in three regions to ensure that the study included respondents from a range of national backgrounds. English-speaking respondents were recruited from Westat's proprietary database of study volunteers, all born in the USA and not Westat employees. Participants were remunerated $US 60. Interviews were conducted in metropolitan Washington, DC (n 36), Miami, FL (n 9), San Jose, CA (n 9) and Los Angeles, CA (n 26). Overall, 49 % of respondents were male; ages ranged from 19 to 74 years, with a mean age of 45·6 years. The institutional review boards of Westat and the NCI approved the study.

At the completion of the in-person cognitive interview, respondents were given a one-page self-administered questionnaire in their own language. Questions asked respondents to judge: (1) whether each of the thirteen

food items listed was (i) a vegetable, (ii) a fruit, (iii) something else or (iv) a food they never heard of; (2) whether each of five food items listed was either a vegetable or contained a vegetable (yes or no); and (3) whether each of seven food items listed was either a fruit or contained a fruit (yes or no). These food items were similar to those asked in study 1, but were expanded to include additional items expected to be difficult to classify. No interviewer assistance was offered.

Study 3: Food Attitudes and Behaviors Survey

In 2007, survey participants were recruited through quota sampling of households in Synovate's Consumer Opinion Panel[14]. Sampled panel members (*n* 5803) were mailed a recruitment letter attached to a Food Attitudes and Behaviors (FAB) Survey in English, along with a $US 5 incentive; 3397 respondents completed the FAB Survey. Of those completing the survey, 3312 reported their race/ethnicity and were included in these analyses. About 40 % of the participants were male; 29 % were 18–34 years of age, 37 % were between 35 and 54 years and 33 % were ≥55 years. About 4 % were Hispanic; 66 % were non-Hispanic white; 25 % reported that they were non-Hispanic black; and 3 % reported being of another race. The institutional review boards of the NCI and Westat approved the study.

Respondents were asked to judge whether each of seven foods listed was a vegetable, fruit or something else. 'Not sure' was a fourth response option. These foods were similar to those asked in the earlier studies, but were more limited in number in order to limit respondent burden. Classification perceptions were analysed separately by sex, race/ethnicity and level of overall fruit and vegetable consumption, as assessed by an eight-item fruit and vegetable intake screener[15]. The data were weighted by sex, race/ethnicity, age, education and income based on individual-level 2000 US Census data. All statistical analyses were conducted using 'PROC survey' commands in the SAS statistical software package version 9·2 (SAS Institute Inc., Cary, NC, USA).

Foods queried

Of the items queried in all three studies, seven were common to all: tomato, black beans, rice, potato, ketchup, grape jelly and tofu. (The smaller studies 1 and 2 queried a number of other foods as well.) Tomatoes, black beans, rice and potatoes were chosen because they were expected to reflect differences in judgements, and in addition might be classified differently in different cultures. Tofu was chosen to reflect differences in perceptions among cultures because of different pre-existing knowledge about the food. Other foods that may not be typically grouped with whole fruit or vegetables were included to assess whether people perceived them to be or to contain fruits or vegetables. These foods included some that are generally consumed as a flavouring agent (grape jelly), as a condiment (ketchup), and in studies 1 and 2 only, in small quantities (raisins), as a mixture, either with large amounts of fruit/vegetable (pizza, beef stew) or with small amounts of fruit (yoghurt with fruit), or processed into another form (cornbread, potato chips).

Results

Study 1: US National Center for Health Statistics–US National Cancer Institute cross-cultural cognitive testing: English and Spanish

Table 1 presents the results of study 1. Respondents generally agreed that corn and bell pepper are vegetables, but fewer agreed on tomato, potato, yam, salsa and peanuts, which received varied designations as fruit, vegetable or something else. Respondents disagreed substantially in their perceptions on rice, black beans, ketchup, grape jelly, jicama and tofu. Overall, a third of respondents considered rice to be a vegetable (58 % considered it as something else); 58 % considered ketchup a vegetable (35 % considered it as something else) and 71 % considered grape jelly to be a fruit (25 % considered it as something else). More than half of the participants had not heard of or did not know how to judge tofu and jicama. Differences by language were clear: most English speakers reported never having heard of jicama, whereas most Spanish speakers reported never having heard of tofu. Non-Hispanics were more apt to judge that tomato is a fruit than were Hispanics. Hispanics were more likely to judge that black beans are something else than were non-Hispanics, who generally reported that black beans are a vegetable. Non-Hispanics overwhelmingly judged yam to be a vegetable, but some non-Hispanics reported yam to be a fruit or something else.

Study 2: US National Cancer Institute cross-cultural cognitive testing: Spanish, Korean, Chinese and English

Tables 2 and 3 present the results from study 2. This study group was more diverse than that in study 1, and included Korean and Chinese speakers in addition to Spanish and English speakers. Accordingly, the results reflect this greater diversity. Overall, without considering race/ethnicity, respondents generally agreed on perceptions for corn and bell pepper, and agreed less for potato, rice and ketchup (Table 2). They disagreed substantially on peanuts, yams, grape jelly and jicama.

As in study 1, perceptions differed distinctly by language of interview. Jicama was unknown for the majority of Chinese, Korean and English speakers; tofu was unknown for the majority of Spanish speakers. Spanish, Korean and Chinese speakers tended to judge tomato as a vegetable, whereas the majority of English speakers judged it a fruit. A majority of Spanish speakers considered rice a vegetable, whereas a majority of the other three groups considered it as 'something else'. This contrasts with results from study 1,

Table 1 Percentage defining food as vegetable, fruit or something else, or responding 'never heard of/don't know': NCHS–NCI cross-cultural cognitive testing, 2004

	Total (*n* 55)				English (*n* 19)				Spanish (*n* 19)			
	Vegetable	Fruit	Something else	Never heard of/don't know	Vegetable	Fruit	Something else	Never heard of/don't know	Vegetable	Fruit	Something else	Never heard of/don't know
Food	%	%	%	%	%	%	%	%	%	%	%	%
Corn	96·4	0·0	3·6	0·0	100·0	0·0	0·0	0·0	94·4	0·0	5·6	0·0
Tomato	78·2	20·0	0·0	1·8	63·2	31·6	0·0	5·3	86·1	13·9	0·0	0·0
Peanut	16·4	7·3	69·1	7·3	21·1	0·0	73·7	5·3	13·9	11·1	66·7	8·3
Black beans	66·7	0·0	27·8	5·6	83·3	0·0	16·7	0·0	58·3	0·0	33·3	8·3
Rice	34·5	0·0	58·2	7·3	31·6	0·0	68·4	0·0	36·1	0·0	52·8	11·1
Potato	83·6	0·0	12·7	3·6	78·9	0·0	15·8	5·3	86·1	0·0	11·1	2·8
Bell pepper	94·5	1·8	1·8	1·8	89·5	5·3	0·0	5·3	97·2	0·0	2·8	0·0
Ketchup	58·2	3·6	34·5	3·6	52·6	0·0	47·4	0·0	61·1	5·6	27·8	5·6
Jicama	10·9	21·8	14·5	52·7	0·0	5·3	0·0	94·7	16·7	30·6	22·2	30·6
Grape jelly	3·6	70·9	25·5	0·0	5·3	63·2	31·6	0·0	2·8	75·0	22·2	0·0
Salsa	79·6	3·7	14·8	1·9	77·8	5·6	11·1	5·6	80·6	2·8	16·7	0·0
Tofu	21·8	0·0	20·0	58·2	36·8	0·0	36·8	26·4	13·9	0·0	11·1	75·0
Yam	76·4	10·9	5·5	7·3	94·7	0·0	0·0	5·3	66·7	16·7	8·3	8·3

NCHS, National Center for Health Statistics; NCI, National Cancer Institute.

Table 2 Percentage defining food as vegetable, fruit or something else, or responding 'never heard of/don't know' by language of interview: NCI cross-cultural cognitive testing, 2005

	Total (*n* 80)*				English (*n* 18)*				Spanish (*n* 36)*				Korean (*n* 13)*				Chinese (*n* 13)*			
	Vegetable	Fruit	Some-thing else	Never heard of/ don't know	Vegetable	Fruit	Some-thing else	Never heard of/ don't know	Vegetable	Fruit	Some-thing else	Never heard of/ don't know	Vegetable	Fruit	Some-thing else	Never heard of/ don't know	Vegetable	Fruit	Some-thing else	Never heard of/ don't know
Food	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%
Corn	85·9	1·3	11·5	1·3	100·0	0·0	0·0	0·0	77·1	2·9	20·0	0·0	83·3	0·0	16·7	0·0	92·3	0·0	0·0	7·7
Tomato	70·1	29·9	0·0	0·0	38·9	61·1	0·0	0·0	82·9	17·1	0·0	0·0	76·9	23·1	0·0	0·0	72·7	27·3	0·0	0·0
Peanut	26·0	14·3	58·4	1·3	22·2	5·6	72·2	0·0	30·3	24·2	42·4	3·0	15·4	15·4	69·2	0·0	30·8	0·0	69·2	0·0
Black beans	55·3	4·0	40·8	0·0	77·8	0·0	22·2	0·0	48·5	6·1	45·5	0·0	41·7	8·3	50·0	0·0	53·9	0·0	46·2	0·0
Rice	19·0	3·8	77·2	0·0	16·7	0·0	83·3	0·0	31·4	5·7	62·9	0·0	7·7	7·7	84·6	0·0	0·0	0·0	100·0	0·0
Potato	80·0	2·5	16·3	1·3	88·9	5·6	5·6	0·0	86·1	0·0	13·9	0·0	61·5	7·7	30·8	0·0	69·2	0·0	23·1	7·7
Bell pepper	82·7	2·7	14·7	0·0	100·0	0·0	0·0	0·0	79·4	5·9	14·7	0·0	90·9	0·0	9·1	0·0	58·3	0·0	0·0	41·7
Ketchup	24·7	5·2	74·9	5·2	22·2	11·1	61·1	5·6	35·3	5·9	55·9	2·9	8·3	0·0	83·3	8·3	15·4	0·0	76·9	7·7
Jicama	21·6	28·4	9·5	40·5	22·2	16·7	5·6	55·6	15·2	54·6	9·1	21·2	9·1	0·0	18·2	72·7	50·0	0·0	8·3	41·7
Grape jelly	2·6	30·8	62·8	3·9	0·0	22·2	77·8	0·0	2·9	38·2	58·8	0·0	0·0	23·1	76·9	0·0	7·7	30·8	38·5	23·1
Salsa	28·6	3·9	59·7	7·8	50·0	0·0	50·0	0·0	26·5	5·9	64·7	2·9	25·0	8·3	66·7	0·0	7·7	0·0	53·9	38·5
Tofu	17·1	0·0	61·8	21·1	27·8	0·0	72·2	0·0	6·3	0·0	43·8	50·0	23·1	0·0	76·9	0·0	23·1	0·0	76·9	0·0
Yam	58·4	10·4	16·9	14·3	94·4	5·6	0·0	0·0	50·0	20·6	5·9	23·5	75·0	0·0	25·0	0·0	15·4	0·0	61·5	23·1

NCI, National Cancer Institute.
*Cell sizes for individual foods vary slightly because of missing data.

Table 3 Percentage reporting that the food is or contains a vegetable or fruit by language of interview: NCI cross-cultural cognitive testing, 2005

Food	Total (*n* 80)*	English (*n* 18)*	Spanish (*n* 36)*	Korean (*n* 13)*	Chinese (*n* 13)*
Is this a vegetable or does it contain vegetables?					
Cornbread	66·3	77·8	63·9	53·9	69·2
Potato chips	64·6	72·2	72·2	50·0	46·2
Pork with beans	61·5	61·1	68·6	33·3	69·2
Pizza with cheese	16·5	33·3	11·4	15·4	7·7
Beef stew	33·8	83·3	19·4	38·5	0·0
Is this a fruit or does it contain a fruit?					
Apple	100·0	100·0	100·0	100·0	100·0
Plantain	73·8	66·7	83·3	30·8	100·0
Koolaid	5·3	0·0	6·3	7·7	7·7
Raisins	91·3	100·0	86·1	100·0	84·6
Strawberry jelly	72·2	72·2	80·0	53·9	69·2
Yoghurt with fruit	78·8	88·9	75·0	84·6	69·2
Salsa	26·0	27·8	15·2	46·2	30·8

NCI, National Cancer Institute.
*Cell sizes for individual foods vary slightly due to missing data.

which found similar proportions of English and Spanish speakers classifying rice as a vegetable. Whereas the majority of English speakers considered black beans a vegetable, a majority of the other three groups considered it as 'something else'. Chinese and Koreans were less likely to perceive potatoes as a vegetable than were other groups. Perceptions about yams were different from those about potatoes. Yams were less known among Chinese and Spanish speakers than among the other groups; a fifth of Spanish speakers judged yam to be fruit, and a quarter of Korean speakers and two-thirds of Chinese speakers judged yam to be 'something else'.

Table 3 presents the results for perceptions about mixtures, processed foods and some individual foods. All participants agreed that apple is a fruit; most also agreed that raisins are a fruit. Processing a food apparently affected perceptions. Although 86 % of respondents considered corn a vegetable, only 66 % considered cornbread to be or to contain a vegetable. Similarly, 80 % of respondents considered potato a vegetable, yet only 65 % considered potato chips to be or to contain a vegetable. Most respondents did not consider pizza with cheese as containing vegetables (83 %), even though 70 % had classified tomatoes as a vegetable. English speakers were more likely than other groups to perceive that pizza contains vegetables. This may reflect cultural eating differences (pizza with *v.* without tomato sauce), lack of knowledge or, perhaps, a biased question (perhaps 'pizza with cheese' suggests 'white pizza', which has no tomato sauce). Beef stew elicited widely varying perceptions by language of interview: 83 % of English speakers considered it to have vegetables, compared with <40 % of all other language groups. Interestingly, there were different perceptions for salsa, depending on the way the question was worded. When asked to consider whether salsa is a vegetable, fruit or something else, only 4 % considered it to be a fruit. However, when asked whether salsa is a fruit or contains a fruit, 26 % said yes.

Study 3: US National Cancer Institute Food Attitudes and Behavior Survey

Table 4 presents the results from the large FAB Survey (*n* 3312). Although the majority of participants defined black beans and potatoes as vegetables, a sizeable number (23 % for black beans and 13 % for potatoes) classified them in other ('fruit' and 'something else') categories. None of the foods listed in the survey was defined by the majority of participants as a fruit; however, interestingly, almost 40 % of participants defined grape jelly as a fruit. Most participants defined ketchup, rice, grape jelly and tofu as something else or were unsure; 21 % of the sample classified rice as a vegetable and 26 % classified ketchup as a vegetable.

There were no statistically significant differences in the classifications made of the foods among the three race/ethnicity groups. The one exception was tomatoes, which 65 % of the non-Hispanic blacks defined as a vegetable, compared with 49 % of whites and 50 % of Hispanics. In addition, there was no statistically significant difference among race/ethnicity groups in the classification of ketchup; overall, 26 % classified ketchup as a vegetable and 11 % classified it as a fruit. Perceptions did not vary significantly by sex, or by level of fruit and vegetable consumption.

Discussion

The classification of fruits and vegetables is largely 'in the eye of the beholder'. Thus, people of different languages, cultures and familiarity with foods may define fruits and vegetables very differently. The present paper highlights the complexities inherent in both measuring and communicating about the general terms 'fruit' and 'vegetable'. It is the first to present extensive data about classification perceptions of whether a type of food is a fruit or a vegetable.

It is not surprising that respondents in our three studies had variable perceptions in classification of particular foods into the broad categories of fruit and vegetables.

Table 4 Weighted percentage defining food as vegetable, fruit or something else; or responding 'not sure'; or unreported, by race/ethnicity: Food Attitudes and Behaviors Survey, 2007

	Total (unweighted *n* 3312)*				White, non-Hispanic (unweighted *n* 2187)				Black, non-Hispanic (unweighted *n* 834)				Hispanic (unweighted *n* 133)			
Food	Vegetable %	Fruit %	Something else %	Not sure/ unreported %	Vegetable %	Fruit %	Something else %	Not sure/ unreported %	Vegetable %	Fruit %	Something else %	Not sure/ unreported %	Vegetable %	Fruit %	Something else %	Not sure/ unreported %
Tomato†	51·1	47·2	0·3	1·3	49·3	49·2	0·3	1·2	64·5	32·5	0·7	2·3	49·9	47·7	0·4	2·0
Black beans	72·4	0·8	22·5	4·3	72·5	0·7	22·6	4·2	71·9	0·7	22·6	4·9	69·8	0·9	23·8	5·4
Rice	20·9	0·4	72·3	6·3	20·7	0·4	73·0	5·9	21·6	0·1	69·4	8·9	21·1	0·9	67·6	10·3
Potato	84·6	0·9	12·5	1·9	84·8	0·8	12·7	1·7	82·3	0·4	13·5	3·8	86·5	1·9	8·7	2·9
Ketchup	26·3	10·7	55·9	7·1	26·2	11·1	56·3	6·4	27·9	8·3	53·9	9·9	20·0	10·2	56·8	12·9
Grape jelly	0·6	39·7	54·4	5·3	0·7	39·1	55·3	5·0	0·7	43·0	48·2	8·2	0·3	31·5	61·4	6·8
Tofu	14·6	0·9	56·5	28·0	14·2	0·7	57·6	27·4	15·1	2·1	47·0	35·8	14·9	0·8	53·9	30·4

*Total includes those with other race/ethnicity.
†$P \leq 0{\cdot}05$ when responses to food definitions (categorized as vegetable, fruit or something else/not sure/unreported combined) were compared among non-Hispanic whites, non-Hispanic blacks and Hispanics using the Wald χ^2 test statistic.

Whereas respondents generally agreed on a few foods – over all studies, respondents consistently (>80 %) classified corn, green pepper and potato as vegetables – they disagreed on most other foods. More respondents classified tomato as a vegetable than as a fruit, but a substantial number labelled it a fruit. Many classified grape jelly as a fruit, but some classified it as 'something else' (other than fruit or vegetable). Many foods – black beans, salsa, ketchup, tofu, rice and peanuts – were classified as either a vegetable or as 'something else' (other than fruit or vegetable). Of particular importance in assessment and communication is the finding that many respondents did not consider blacks beans to be a vegetable, yet many considered rice to be a vegetable.

Various factors appeared to affect classification. All studies showed consistently that classification perceptions were affected by knowledge of and familiarity with the food and how the food was consumed. Not surprisingly, vegetables and fruit consumed in mixtures and in small quantities (as condiments or additions) led to the most ambiguity in classification.

Although classification perceptions for Hispanics and non-Hispanic whites were similar in study 3, there were important differences in studies 1 and 2. In study 3, in which Hispanics answered questions in English, most classified black beans as a vegetable, similar to whites (and blacks). In studies 1 and 2, Spanish speakers classified black beans as something else (other than fruit or vegetable) just as frequently as they classified them as a vegetable. Similarly, in study 3, 21 % of Hispanics classified rice as a vegetable, whereas in studies 1 and 2, 36 % and 31 %, respectively, did so. For Hispanics, classification may have been affected by acculturation as reflected in the language spoken. Of the Hispanics approached in studies 1 and 2, only those whose primary language was Spanish were enrolled, and the questionnaire was administered in Spanish. Study 3 had no such objective; the questionnaire was administered only in English.

The studies on which the present analysis was based have several limitations. First, the set of foods queried in each study was limited, and only seven foods were common across all three studies. In addition, the judgements we asked respondents to make required a forced choice (is it fruit or vegetable or something else?), whereas an open-ended response may have revealed more nuanced perceptions. In addition, the context of the classification task was detached from that of making decisions related to food choice, and may not be representative of classification under naturalistic circumstances. For example, someone who reports grape jelly as a fruit, rather than as a vegetable or something else, may not necessarily consider grape jelly as counting towards daily fruit consumption for purposes of healthy eating. The population differences that we observed (e.g. Hispanic/non-Hispanic) could be not only due to differences in levels of acculturation, as discussed, but also due

to other factors, including the particular translations of foods and category names into languages other than English, or confounding by demographic variables. Finally, our first two studies contained small sample sizes (although appropriate, given their qualitative emphasis). However, our third study (FAB) included a large sample size and thus the ability to examine the data for potential confounders; yet, classifications were not found to be related to sex or to overall level of fruit and vegetable intake. A major strength of our study is the investigation of a novel topic area, previously unexplored in the literature. Further, two of the studies had a wide range of racial and ethnic groups and the third study had a large sample size.

Conclusions

These results highlight the inherent vagueness and complexity of the terms 'fruit' and 'vegetable' and the considerable variability in interpretation by the US public. This has implications for both assessment and nutrition education. Because there is substantial disagreement between the fruit/vegetable domain and other foods, it is important to clearly define the desired constructs. Foods that require specific instruction include rice, dried beans, potatoes, as well as fruit and vegetables in mixtures and condiments. There was also disagreement in classification between the fruit and vegetable domains, particularly for tomatoes and dried beans.

For dietary assessment, additional questions or explanations may be needed to clarify which foods are being queried. For example, dried beans and potatoes can be asked as separate questions, rather than being grouped within other larger categories of vegetables, thus avoiding confusion by the respondent. A general question about other vegetables should specify to not include rice[13]. For communication, the global message to increase consumption of fruit and vegetables could be reinforced with specific guidance. USDA's MyPyramid dietary guidance[7] associated with the 2005 Dietary Guidelines[3] is consistent with this principle; specific subgroups of vegetables are highlighted, and examples of fruit and vegetables are given. The Fruits & Veggies – More Matters campaign promotes the benefits of consuming fruit and vegetables, as well as other important information regarding shopping, cooking, storing and portion sizes of fruit and vegetables[8]. However, the current communication resources for Fruits and Veggies – More Matters do not clearly define for consumers what actually constitutes a fruit or a vegetable. Research has shown that knowledge of the fruit and vegetable recommendation to consume five or more servings per day is associated with greater consumption[16]. Similarly, clearly delineating and disseminating information on the definition of fruits and vegetables to consumers could ultimately help to increase fruit and vegetable intake in the American public.

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