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Identifying users of traditional and Internet-based resources for meal ideas: An association rule learning approach

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ABSTRACT

Increasing home cooking while decreasing the consumption of food prepared away from home is a commonly recommended weight management strategy, however research on where individuals obtain ideas about meals to cook at home is limited. This study examined the characteristics of individuals who reported using traditional and Internet-based resources for meal ideas. 583 participants who were ≥50% responsible for household meal planning were recruited to approximate the 2014 United States Census distribution on sex, age, race/ethnicity, and household income. Participants reported demographic characteristics, home cooking frequency, and their use of 4 traditional resources for meal ideas (e.g., cookbooks), and 7 Internet-based resources for meal ideas (e.g., Pinterest) in an online survey. Independent samples *t*-tests compared home cooking frequency by resource use. Association rule learning identified those demographic characteristics that were significantly associated with resource use. Family and friends (71%), food community websites (45%), and cookbooks (41%) were the most common resources reported. Cookbook users reported preparing more meals at home per week ($M = 9.65$, $SD = 5.28$) compared to non-cookbook users ($M = 8.11$, $SD = 4.93$; $t = -3.55$, $p < 0.001$). Resource use was generally higher among parents and varied systematically with demographic characteristics. Findings suggest that home cooking interventions may benefit by modifying resources used by their target population.

1. Introduction

One commonly recommended strategy for the prevention and treatment of obesity is to reduce the consumption of food prepared away from home (e.g., at fast food restaurants) by increasing the consumption of food prepared at home (Institute of Medicine (IOM), 2012; Smith, Ng, & Popkin, 2013; U.S. Department of Agriculture and U.S. Department of Health and Human Services, 2010). However, little is known about the resources that individuals use to facilitate home cooking, such as where they obtain information about cooking skills, meal ideas, or recipes (Reicks, Trofholz, Stang, & Laska, 2014). The information included in these resources could influence individuals' decisions about whether to eat at home or away from home, as well as the nutritional quality of foods prepared at home (Pope, Latimer, & Wansink, 2015; Schneider, McGovern, Lynch, & Brown, 2013). The rapidly evolving information landscape calls for new research on this topic; Internet-based resources such as websites, social media, and mobile applications may be emerging resources for information about home cooking (Doub, Small, & Birch, 2016; Schneider et al., 2013). In order for interventions to strategically disseminate evidence-based nutrition materials that promote healthy food preparation, research is needed on the prevalence of the use of both traditional (e.g., cookbooks) and Internet-based (e.g., Pinterest) resources and the demographic characteristics of the individuals who access them. Research is also needed on how engagement with different resources is associated with home cooking frequency to determine

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whether resources are used more for entertainment or implemented in home food preparation (Pope et al., 2015).

1.1. Background

Even though spending on food away from home has increased (USDA Economic Research Service, 2014), the majority of calories are still consumed at home (Smith et al., 2013). In 2007–2010 nearly half of adults in the United States reported that dinner was cooked in their household 6–7 nights per week (Wolfson & Bleich, 2014). The amount of time that individuals spend on food preparation each day has remained stable since the mid 1990's (Smith et al., 2013). Increased time spent on home cooking has been associated with better dietary quality (Larson, Perry, Story, & Neumark-Sztainer, 2006; Monsivais, Aggarwal, & Drewnowski, 2014; Wolfson & Bleich, 2014) and lower body mass index, particularly among individuals who are overweight (Kolodinsky & Goldstein, 2011). Higher cooking self-efficacy has been related to more vegetable purchases (Winkler & Turrell, 2010) and less consumption of processed convenience foods (e.g., frozen pizza) (Hartmann, Dohle, & Siegrist, 2013; van der Horst, Brunner, & Siegrist, 2011). However, a recent study of low-income Supplemental Nutrition Assistance Program participants found that fruit and vegetable consumption was low even within households that had a higher frequency of home food preparation, suggesting that not all foods prepared at home are highly nutritious (Wolfson & Bleich, 2015).

There is some evidence that the frequency of home food preparation varies by demographic characteristics. Even though women still spend more time on food-related tasks overall (e.g., grocery shopping, cooking; Bureau of Labor Statistics, 2013; Smith et al., 2013; Wolfson & Bleich, 2014) men have increased the amount of time they spend cooking while it has decreased among women (Khandpur, Blaine, Fisher, & Davison, 2014; Smith et al., 2013). Previous research suggests that the frequency of home food preparation varies by race, ethnicity, and cultural factors (Virudachalam, Long, Harhay, Polsky, & Feudtner, 2014; Wolfson & Bleich, 2014). Data from the 2007 and 2008 National Health and Nutrition Examination Survey (NHANES) indicated that Black households cooked 4.4 dinners at home per week, White households cooked 5.0 dinners, Hispanic households with a reference person born in the United-States cooked 4.9 dinners, and Hispanic households with a reference person born outside of the United States cooked 5.9 dinners (Virudachalam et al., 2014). Lower household income was associated with always (6 or 7 times per week) or never (0 or 1 times per week) cooking dinner at home, whereas having dependents or living with a partner was associated with cooking dinner at home at least sometimes (≥2 times per week; Virudachalam et al., 2014). The current study extends this previous research by examining whether there are demographic differences in the sources from which individuals obtain ideas about meals to prepare at home, which may in turn be associated with the frequency of home food preparation.

Few empirical studies have examined where individuals access information about home cooking (Pope et al., 2015). Even formal home cooking interventions have received limited evaluation (Reicks et al., 2014). This is an important area of research because previous studies found that having few meal planning resources or ideas about what foods to prepare at home were barriers to family meals (Fulkerson, Story, Neumark-Sztainer, & Rydell, 2008) and decreased adherence to dietary intervention recommendations among individuals at risk for Type 2 diabetes (Brekke, Sunesson, Axelsen, & Lenner, 2004). Limited data on where individuals access information related to home cooking and whether resource use leads to increased home cooking frequency prevents dietary health professionals from effectively intervening with these resources (Bentley et al., 2014). The Internet has introduced new ways for individuals to access and share information. In 2015, 84% of all adults in the United States used the Internet (Perrin & Duggan, 2015). Although demographic divides in Internet use are decreasing, Internet use is still lower among individuals who are older, have lower household incomes, or are African American or Hispanic (Perrin & Duggan, 2015). The extent to which individuals from varying demographic backgrounds obtain meal ideas from Internet-based resources is currently unknown. Even though food is a popular topic on websites and social media such as Facebook (Freeman et al., 2014) and Pinterest (Gilbert, Bakhshi, Chang, & Terveen, 2013) the current study is among the first to examine the prevalence of use of online resources for meal ideas. In 2014, 71% of online adults used Facebook and 28% of online adults used Pinterest, many of whom reported daily or at least weekly use (Duggan, Ellison, Lampe, Lenhart, & Madden, 2015). Internet-based resources (e.g., food community websites, food blogs) may be widely used and potentially influential sources of meals ideas that could be leveraged for the dissemination of evidence-based information.

The mechanisms through which information about food and meal ideas is transmitted within various resource types may influence the contexts and contents of the information obtained. For example, cookbooks contain a finite set of recipes and are likely to be accessed at home, where as Internet-based resources such as food community websites (e.g., AllRecipes.com) and social networking sites (e.g., Facebook, Pinterest) allow users to continuously explore options and could be accessed anywhere that the user has access to an Internet-connected device (e.g, laptop, Smartphone). Table 1 contains potential mechanisms for obtaining food-related information and meal ideas from traditional and Internet-based resources. One purpose of the current study is to situate the use of newer, Internet-based meal idea resources such as food blogs and select social networking sites among traditional resources such as cookbooks and grocery store handouts to better understand where individuals currently obtain meal ideas.

1.2. Study aims

This descriptive study has three aims. First, it assesses the prevalence of use of traditional and Internet-based meal idea resources overall and by each resource individually. Second, it examines how the use of certain meal idea resources is associated with the frequency of home food preparation. Third, it explores how demographic characteristics are associated with the use of meal idea resources overall and by each resource individually.

2. Methods

2.1. Participant recruitment

615 participants were recruited between December 29, 2013 and January 2, 2014 by an external sampling company, Survey Sampling International, LLC, to complete an online survey on eating behavior and mobile technology. Participants were recruited to approximate the 2014 United States Census demographic characteristics (US Census Bureau, 2014) on sex, age, race and ethnicity, income, and geographic region. To be eligible for the study, individuals had to be 18 years of age or older and use a mobile device such as a smartphone or tablet computer. Recruitment priority was given to individuals who were at least 75% responsible for the grocery shopping and meal planning for their households. Participants who reported being at least 50% responsible for meal planning in their household were included in the current study

Table 1
Example mechanisms for obtaining food-related information and meal ideas from traditional and Internet-based resources.

Resource	Mechanisms for obtaining food-related information and meal ideas
Family and friends	In-person and computer-mediated conversations related to food (e.g., discussing recipes prepared); Shared eating experiences (e.g., traditional family meals); Social norms (e.g., observed food choices)
Cookbooks	Text and images of food; Recipes; Cooking education (e.g., text and/or photos explaining a cooking method such as sautéing)
Grocery store handouts (e.g., weekly flyers)	Text and images related to food; Coupons and/or discounts for advertised food items; Recipes; Recommended shopping lists
Coupon books (e.g., newspaper inserts)	Text and images related to food; Coupons and/or discounts for advertised food items; Recipes; Recommended shopping lists
Food community websites (e.g., AllRecipes.com, Delish.com)	Text, images, and/or videos of food; Recipes; Recipe reviews and comments (e.g., palatability, suggested recipe modifications); Food-related advertisements (e.g., "native" advertising that is paid for by an external company but designed to look like content from the original source, advertisements displayed on the sides of the webpage)
Company-branded websites (e.g., Kraft.com, Cambpells.com)	Text, images, and/or videos of food; Recipes; Coupons for specific food items; Food-related advertisements (e.g., advertisements displayed on the sides of the webpage)
Nutrition interest websites (e.g., Atkins.com, PaleoPlan.com)	Text, images, and/or videos of food; Recipes; Coupons for specific food items; Food-related advertisements (e.g., "native" advertising that is paid for by an external company but designed to look like content from the original source, advertisements displayed on the sides of the webpage)
Facebook	Text, images, and/or videos of food shared by Facebook friends and/or "liked" brands and organizations; Hyperlinks to recipes or food items on external webpages shared by Facebook friends; Food-related advertisements (e.g., "sponsored" posts that are paid for by companies to be displayed to select Facebook users based on previous behavior on Facebook, advertisements displayed on the sides of the webpage)
Pinterest	Text and images related to food shared by other Pinterest users the user intentionally follows (may include brands) or pins that are algorithmically recommended to the user based on previous behavior on Pinterest; Food-related advertisements (e.g., "promoted" pins that are paid for by companies to be displayed to select Pinterest users based on previous behavior on Pinterest)
Food blogs	Text, images, and/or videos of food; Recipes; Food-related advertisements (e.g., sponsored posts that have been paid for by an external company for the blogger to produce, "native" advertising that is paid for by an external company but designed to look like content from the original source, advertisements displayed on the sides of the webpage)
Food-related mobile applications (e.g., Yummly)	Text, images, and/or videos of food; Recipes; Coupons for specific food items; Food ordering and delivery functionality (e.g., browsing menus and/or placing an order for home delivery)

($N = 583$).

2.2. Measures

2.2.1. Demographic characteristics

Participants reported the following demographic information: Sex (Male; Female); Age (18–35 years; 35–54 years; 55 years or older); Marital status (Married; Not married); Employment status (Employed full-time; Employed part-time; Homemaker; Student; Retired; Not employed); Household income (less than $35,000; $35,000 to $49,000; $50,000 to $74,000; $75,000 or more); and whether there were children younger than 18 years of age in their household (Child $\leq$ 18 years of age in the household; No child $\leq$ 18 years old in the household). Race and ethnicity were collected using the following categories: White/Caucasian, Black/African American, Hispanic/Latin American, Asian/Pacific Islander, Native American or Alaska Native, mixed racial background, or other. Participants were asked to select the category that best described their race/ethnicity. Income data were missing from 3% of participants ($n = 16$). All other data were complete.

2.2.2. Home food preparation and meal idea resources

Participants were asked a specific question about the average number of meals they prepared at home per week, immediately followed by a more general question about where they obtained meal ideas (i.e. "Where do you get your meal ideas?"). Participants indicated which resources they used for meal ideas from a list of 4 traditional resources: Family and friends; Hardbound or softbound cookbooks; Grocery store handouts; and Recipes from a coupon book, and 7 Internet-based resources: Company-branded websites (Kraft.com, Campbells.com, etc.); Food community websites (Allrecipes.com, Delish.com, etc.); Special nutrition interest websites (Atkins.com, PaleoPlan.com, etc.); Pinterest; Facebook; Food blogs; and Food-related mobile applications ("apps; " e.g., Yummly). During survey administration, all 11 resources were displayed together (i.e. they were not divided into traditional or Internet-based subcategories) and participants could select as many resources as applied. Due to the exploratory nature of this study, participants were also given the option to indicate if they used a resource that was not listed (i.e. "Other") and write in a unique response. Each meal idea resource was recorded as endorsed (1) or not endorsed (0). An overall resource use score was calculated for each participant by summing the endorsed resources.

The list of meal idea resources was generated through a social media audit, which is a qualitative method similar to a grounded theory approach that is commonly used in market research to generate preliminary insight into a topic (Patton, 2002; Quesenberry, 2015). A pair of Bachelor-level research assistants that were trained in consumer behavior research and supervised by the fourth author searched multiple web search engines (e.g., Google, Yahoo), and social media platforms (e.g., Twitter, discussion forums) for key words and phrases relevant to the acquisition of food-related information and meal ideas (e.g., "ideas for dinner," "I got this idea for lunch from …"). Search results (e.g., text, images, and videos from social media platforms and blog posts) were systematically recorded and evaluated for relevance to the acquisition of food-related information and meal ideas iteratively throughout the social media audit. Searches were conducted until no additional resources were identified. Due to constraints on survey length, 11 resources were purposively selected for the survey to represent a range of traditional and Internet-based resources. Face validity for each resource was established through review and agreement among a larger research team that consisted of experienced Bachelor- and Master's-level consumer behavior researchers and was supervised by the fourth author. The "Other" option was included in the survey to capture resources that were less prevalent or absent from the list generated using the social media audit.

2.3. Data analytic plan

Descriptive statistics were calculated on participant demographic characteristics, the number of meals prepared at home per week, and the use of meal idea resources overall and by each resource individually. Independent samples t-tests and one-way analysis of variance (ANOVA) tests were conducted to explore how demographic characteristics were associated with overall use

of meal idea resources. To examine the relationship between the overall use of meal ideas resources and home food preparation frequency, a Pearson correlation was calculated for the overall number of resources used and the number of meals prepared at home per week. Results were considered significant at $p < 0.05$.

Independent samples *t*-tests examined differences in the number of meals prepared at home per week by use of each of the 11 meal idea resources individually. A Bonferroni correction (Armstrong, 2014) for the 11 conducted tests was applied to a significance value of $p < 0.05$, resulting in a conservative significance value of $p < 0.004$. Results that were significant at the $p < 0.05$ level but were not significant after correction were identified as trends that may merit further exploration in future studies. Analyses for the above questions were conducted in SPSS version 23 (IBM Corp, 2015).

Association rule learning was used to explore demographic characteristics associated with resource use. Association rule learning is an established data mining technique that identifies how discrete variable values co-occur within datasets (Agrawal, Imielinski, & Swami, 1993). Each variable value is represented as observed or not observed for each participant in the data (e.g., uses cookbooks or does not use cookbooks; is female or is not female). Variable values that co-occur at in at least a specified proportion of the data set (i.e. "support") are grouped together into "itemsets" (e.g., uses cookbooks *and* is female) using a selected algorithm such as the apriori algorithm (Borgelt & Kruse, 2002). Rules (i.e. "If x is observed, then y is also observed") are then generated from the itemsets based on their confidence level (i.e. the proportion of times the x occurs that y also occurs). "Lift" is one measure that indicates whether a rule adds knowledge about the likelihood of observing a variable value. Lift values greater than 1.0 indicate that the dependent variable (y) is more likely to be observed when the independent variable(s) (x) are also observed compared to when the dependent variable (y) is ever observed within the dataset (Merceron & Yacef, 2008). Association rules analyses were conducted using the package 'arules' (Hahsler, Grün, & Hornik, 2007) within the R statistical analysis programming environment (R Development Core Team, 2008).

Prior to generating association rules, the full dataset ($N = 583$) was divided in half into a training set ($n = 291$) and hold-out testing set ($n = 292$). Training data were used for initial data exploration and rule generation. Support and confidence values were manually optimized to identify high confidence, high frequency rules within the training data. Ultimately, closed frequent itemsets (Pasquier, Bastide, Taouil, & Lakhal, 1999) were generated using the apriori algorithm (Borgelt & Kruse, 2002) at a support value of 5%, (i.e. the pattern of variable values was observed in at least 5% of the dataset; approximately $n = 15$ participants). Rules were generated that met a confidence level of 50% (i.e. in at least 50% of the cases that x was observed, y was also observed). Only those rules that included only demographic characteristics as independent variables and one of the 11 meal idea resources individually as dependent variables were examined. Rules that were redundant (i.e. rules that were a superset of other rules that had the same or greater lift) were removed to simplify rule interpretation.

Rules that were generated from the training data were then tested against the hold-out testing set using one-sided Fisher's exact tests to assess their generalizability (Hahsler & Hornik, 2008). The null hypothesis of Fisher's exact test is that there is no association between the independent variable(s) and the dependent variable included in the rule. Rules were evaluated as significant if the Fisher's exact value reached a significance value of $p < 0.05$, which was corrected for multiple tests using a Bonferroni correction for the number of rules generated for each resource (Armstrong, 2014). Rules that were significant at the $p < 0.05$ level but were not significant after correction were identified as trends that may merit further exploration in future studies.

3. Results

3.1. Participant characteristics

Of the 583 participants, half (51%) were female. The majority (68%) were White/Caucasian, 12% were Black/African American, and 12% were Hispanic/Latin American. Few participants identified as Asian/Pacific Islander, Native American or Alaska Native, mixed racial background, or other. Thus all of these categories were grouped together as "Other" (7% total). About a third (32%) of the participants were 18–34 years old, 41% were 35–54 years old, and 27% were 55 years of age or older. Nearly 45% of participants were married and over half had a child in the household who was younger than 18 years of age (hereafter referred to as "parents.") Over half (53%) of the participants were employed full time. 11% were employed part-time, 11% were homemakers, 7% were students, 12% were retired, and 6% were unemployed. Incomes ranged from less than $35,000 (21%), $35,000 to $49,000 (16%), $50,000 to $74,000 (23%), and over $75,000 (38%). Compared to the full sample ($N = 615$), participants who were at least 50% responsible for meal planning in their household (i.e. "meal planners;" $N = 583$) were more likely to be female ($\chi^2 = 6.22$, $p = 0.013$) and less likely to have a missing value for household income ($\chi^2 = 17.67$, $p < 0.01$). There were no other demographic differences.

3.2. Demographic characteristics associated with overall meal idea resource use

On average, participants reported using approximately 4 meal idea resources ($M = 3.91$, $SD = 2.61$) with a range of 0–11. Results of the independent samples *t*-tests and ANOVA analyses examining overall resource use revealed that females reported using more meal idea resources ($M = 4.13$; $SD = 2.66$) compared to males ($M = 3.68$; $SD = 2.55$; $t = -2.11$, $p = 0.035$). Adults over 55 years of age used fewer meal idea resources ($M = 3.18$, $SD = 2.51$) compared to adults 18–34 years of age ($M = 4.34$, $SD = 2.51$) and 35–54 years of age ($M = 4.07$, $SD = 2.68$; $f(2, 580) = 9.27$, $p < 0.001$). Parents reported higher overall use of meal idea resources ($M = 4.71$, $SD = 2.86$) compared to non-parents ($M = 3.29$, $SD = 2.12$; $t = -6.56$, $p < 0.001$; equal variances not assumed). There were no differences in reported overall resource use based on marital status, employment status, household income, or race/ethnicity.

3.3. Use of meal idea resources and home food preparation

The prevalence of use of each meal idea resource among all participants and by select demographic characteristics are reported in Tables 2 and 3. The most frequently reported resources were family and friends, food community websites and cookbooks. Few participants reported obtaining meal ideas from special nutrition interest websites. Only 8% of participants ($N = 46$) indicated they used an "Other" meal idea source, generating 48 written responses that represented 17 unique types of resources. The most commonly reported resource was oneself ($N = 21$; 4%); these participants reported they used their own cooking experience and creativity to come up with meal ideas. All other sources of meal ideas were endorsed by less than 1% of participants and included home food availability (i.e. ingredients present in the kitchen), TV, newspaper, magazines, recipes on package labeling, in-store deals/promotions, and coworkers. Resources that were generated through the "Other" response option were not included in further analyses due to the low prevalence of use.

Table 2
Prevalence of ever using a meal idea resource: Prevalence among all participants and prevalence by sex and age.

Resource	Users *n* (%)					
	All participants	Female	Male	18–34Y	35–54Y	55Y+
	N = 583	*n* = 296	*n* = 287	*n* = 188	n = 237	*n* = 158
Family and friends	411 (71%)	215 (73%)	196 (68%)	139 (74%)	163 (69%)	109 (69%)
Cookbooks	236 (41%)	131 (44%)	105 (37%)	72 (38%)	91 (38%)	73 (46%)
Grocery store handouts	193 (33%)	97 (33%)	96 (33%)	63 (34%)	75 (32%)	55 (35%)
Coupon books	187 (32%)	95 (32%)	92 (32%)	53 (28%)	90 (38%)	44 (28%)
Food community websites	263 (45%)	147 (50%)	116 (40%)	95 (51%)	117 (49%)	51 (32%)
Company-branded websites	203 (35%)	117 (40%)	86 (30%)	62 (33%)	95 (40%)	46 (29%)
Nutrition interest websites	81 (14%)	39 (13%)	42 (15%)	30 (16%)	36 (15%)	15 (10%)
Facebook	195 (33%)	108 (37%)	87 (30%)	75 (40%)	89 (38%)	31 (20%)
Pinterest	147 (25%)	100 (34%)	47 (16%)	66 (35%)	62 (26%)	19 (12%)
Food blogs	174 (30%)	91 (31%)	83 (29%)	82 (44%)	66 (28%)	26 (17%)
Food-related apps	192 (33%)	85 (29%)	107 (37%)	78 (42%)	80 (34%)	34 (22%)

Table 3
Prevalence of ever using a meal idea resource: Prevalence among all participants and prevalence by parenting status and household income.

Resource							
	All participants	Parent	Non-parent	Income <35k	Income 35–49k	Income 50–74k	Income 75k+
	N = 583	*n* = 257	*n* = 236	*n* = 122	*n* = 91	*n* = 134	*n* = 220
Family and friends	411 (71%)	184 (72%)	227 (70%)	77 (63%)	73 (80%)	94 (70%)	156 (71%)
Cookbooks	236 (41%)	112 (44%)	124 (38%)	36 (30%)	37 (41%)	55 (41%)	97 (44%)
Grocery store handouts	193 (33%)	98 (38%)	95 (29%)	37 (30%)	32 (35%)	44 (33%)	74 (34%)
Coupon books	187 (32%)	103 (40%)	84 (26%)	28 (23%)	25 (28%)	49 (40%)	78 (36%)
Food community websites	263 (45%)	133 (52%)	130 (40%)	55 (45%)	39 (43%)	60 (45%)	101 (46%)
Company-branded websites	203 (35%)	122 (48%)	81 (25%)	39 (32%)	34 (37%)	53 (40%)	71 (32%)
Nutrition interest websites	81 (14%)	49 (19%)	32 (10%)	8 (7%)	12 (13%)	20 (15%)	37 (17%)
Facebook	195 (33%)	119 (46%)	76 (23%)	50 (41%)	34 (37%)	41 (31%)	63 (29%)
Pinterest	147 (25%)	88 (34%)	59 (18%)	38 (31%)	25 (28%)	27 (20%)	50 (23%)
Food blogs	174 (30%)	94 (37%)	80 (25%)	28 (23%)	30 (33%)	41 (31%)	69 (31%)
Food-related apps	192 (33%)	108 (42%)	84 (26%)	31 (25%)	26 (29%)	45 (34%)	84 (38%)

Participants reported preparing an average of 8.73 meals at home per week ($SD = 5.13$). There was a positive correlation between overall use of meal idea resources and the number of meals prepared at home per week ($r = 0.12$, $p < 0.01$). Participants who used cookbooks for meal ideas reported preparing more meals at home per week ($M = 9.65$, $SD = 5.28$) compared to participants who did not use cookbooks ($M = 8.11$, $SD = 4.93$; $t = -3.55$, $p < 0.001$, equal variances not assumed). Pinterest users were somewhat more likely to prepare more meals at home per week ($M = 9.59$, $SD = 5.17$) compared to those who did not use Pinterest ($M = 8.44$, $SD = 5.10$), however this result did not maintain significance after correcting for multiple tests ($t = -2.36$, $p = 0.02$). Similarly, company-branded websites users were somewhat more likely to prepare more meals at home per week ($M = 9.33$, $SD = 5.24$) compared to participants who did not use company-branded websites ($M = 8.42$, $SD = 5.05$) but this results also failed to maintain significance after correcting for multiple tests ($t = -2.05$, $p = 0.04$).

3.4. Demographic characteristics associated with individual resource use

112,297 closed frequent itemsets were initially generated at a support value of 5% from which 574,934 rules were drawn at a confidence level of 50%. Rules were then subset such that only demographic characteristics were included as independent variables and each of the meal idea resources were included as dependent variables. The number of rules generated for each of the traditional meal idea resources was: cookbooks ($N = 17$), family and friends ($N = 19$), grocery store handouts ($N = 3$), coupon books ($N = 7$). The number of rules generated for each of the Internet-based meal idea resources was: food community websites ($N = 21$), company-branded websites ($N = 9$), Facebook ($N = 7$), food-related mobile applications ($N = 4$), food blogs ($N = 1$), Pinterest ($N = 3$). No rules were generated for special nutrition interest websites; the low prevalence of these websites made it impossible for any rule to pass the minimum support threshold.

The results of the Fisher's exact tests examining whether the rules that were generated in the training data were significant in the test data are shown in Table 4. Compared to all study participants, White mothers were significantly more likely to use food community websites, Facebook, and Pinterest for meal ideas. Young (i.e. 18–34 year old) parents were more likely to use Facebook, while young parents or parents with higher incomes (i.e. household income > $75,000) were more likely to use food-related mobile applications. Married women, parents who were employed full-time, and White parents were more likely to use company-branded websites. Trends are noted within Table 4. No rules reached significance or trended for coupon books or food blogs, implying that these rules may have been the result of over fitting to the training set and not generalizable to the larger population.

4. Discussion

This study aimed to describe the resources that individuals use to facilitate home cooking, specifically where they obtained ideas about meals to prepare at home. On average, participants reported using approximately four meal idea resources, indicating that many individuals rely on multiple sources of information when making decisions about what meals to prepare and consume at home.

Table 4
Significant and trend association rules predicting meal idea resource use from demographic traits.

Meal idea resource	Demographic predictors	Support	Confidence	Lift	Fisher's exact value
Family and friends	Income 35–49k	12.4%	72.0%	1.09	0.010†
Family and friends	Not married	27.8%	68.1%	1.04	0.020†
Cookbooks	Female, White, 35–54 years old	7.90%	52.3%	1.36	0.019†
Cookbooks	Female, White, Income > 75k	5.50%	51.6%	1.34	0.029†
Grocery store handouts	Parent, Not married	5.50%	53.3%	1.62	0.027†
Food community website	Parent, Female, White	7.90%	52.3%	1.21	0.002*
Food community website	Parent, Income 50–74k	5.50%	51.6%	1.19	0.040†
Food community website	Parent, 35–54 years old	13.1%	52.1%	1.20	0.045†
Company-branded websites	Employed full-time, Female, Married	6.19%	50.0%	1.46	0.000*
Company-branded websites	Parent, White	14.8%	51.8%	1.50	0.003*
Company-branded websites	Parent, Employed full-time	13.4%	52.7%	1.53	0.004*
Company-branded websites	35–54 years old, Employed full-time, Female	9.97%	50.0%	1.46	0.022†
Company-branded websites	Parent, Income 50–74k	6.19%	58.1%	1.69	0.029†
Facebook	Parent, White, Female	7.90%	52.3%	1.54	0.000*
Facebook	Parent, 18–34 years old	7.56%	55.0%	1.62	0.001*
Facebook	White, 18–34 years old	8.59%	55.6%	1.62	0.016†
Facebook	White, Income < 35k	6.53%	51.4%	1.50	0.021†
Food-related apps	Parent, Income > 75k	8.93%	51.0%	1.61	0.002*
Food-related apps	Parent, 18–34 years old	7.21%	52.5%	1.66	0.012*
Pinterest	Parent, White, Female	7.90%	52.3%	2.27	0.000*

Note: * = significant after Bonferroni correction; † = trend at $p < 0.05$.

While traditional resources such as family and friends and cookbooks were among the most prevalently used resources, Internet-based resources such as food community websites were also highly utilized. In fact, most resources were endorsed by at least 25% of participants with the exception of special nutrition interest websites. Special nutrition interest websites may attract a more limited population because they focus on specific dietary concerns (e.g., gluten-free cooking), whereas the other resources provide more general cooking recommendations.

Participants prepared approximately 9 meals at home per week on average. Reported use of cookbooks was positively associated with home cooking frequency. There were similar trends for Pinterest and company-branded website use. Individuals who use cookbooks, Pinterest and/or company-branded websites for meal ideas may enjoy cooking and already be more likely to prepare more meals at home. It is also possible that these resources have specific components that facilitate behavioral action such as building cooking skills through step-by-step food preparation instructions (Rotheram-Borus et al., 2009). Although food consumed at home tends to be healthier than food consumed away from home (Fulkerson et al., 2011), previous research suggests that the portion sizes of recipes included in popular cookbooks have become larger over time, which may increase the amount of energy that individuals who prepare these recipes consume (Wansink & Payne, 2009; Young & Nestle, 2002). Dietary health professionals could intervene by contributing nutritious recipes that align with the United States Department of Agriculture Dietary Guidelines for Americans to cookbooks, Pinterest, and company-branded websites (U.S. Department of Agriculture and U.S. Department of Health and Human Services, 2010).

Association rule learning effectively identified patterns of demographic characteristics that were associated with the use of some meal idea resources. Parents, particularly White mothers, were the most engaged with some Internet-based resources including company-branded websites, Facebook, and Pinterest. Parents who are stressed and have less time to devote to meal planning and home cooking tend to be more likely to purchase food from fast food restaurants (Neumark-Sztainer et al., 2014; Parks et al., 2012). Disseminating information through these Internet-based resources about how to save time and minimize potential stressors associated with home cooking (e.g., recommending nutritious meals that are quick to prepare, offering strategies for managing children's mealtime behaviors) may increase home cooking frequency among parents.

Notably, single parents were somewhat more likely to report using grocery store handouts (e.g., weekly flyers) for meal ideas, which may indicate that grocery store handouts could be targeted to promote nutritious home food preparation among single-parent families. One study found that when grocery store flyers contained a recipe with messages that primed consumers to make healthy choices (i.e. the recipe was labeled as “healthy” and displayed the number of calories) overweight and obese consumers purchased fewer snack foods (e.g., cookies, candies, chips; Papies, Potjes, Keesman, Schwinghammer, & van Koningsbruggen, 2014). This suggests that framing meal ideas as healthy within grocery store handouts could positively influence overall dietary patterns among certain users.

4.1. Directions for future research

There is theoretical and empirical evidence to suggest that trust influences decision making in online (Lagan, Sinclair, & Kernohan, 2010; Metzger & Flanagin, 2013; Sparks, Perkins, & Buckley, 2013) and off-line contexts (Lee & Lin, 2011; Rempel & Rempel, 2004), yet research on the role of trust in determining whether an individual takes action on information obtained from various meal ideal resources is lacking. As published texts, cookbooks are likely to be perceived as trustworthy, particularly if the reader recognizes the author (e.g., celebrity chef). Company-branded website are likely to evoke trust due to brand familiarity, at least among current consumers (Ha & Perks, 2005). Meal ideas that are obtained from family and friends, whether they are transmitted through Internet-based resources such as social media or through in-person conversations or experiences, may be perceived as more trustworthy because of their personal connection (Igarashi et al., 2008). The review feature included for recipes submitted to many food community websites may increase or decrease trust in a recipe depending on the nature of the review, as has been shown on online reviews of restaurants (Zhang, Ye, Law, & Li, 2010). Future studies should assess whether trust in a meal idea resource predicts behavioral action towards home cooking (e.g., grocery store purchases and preparation of the recommended meal at home).

Eating behavior is influenced by numerous factors such as taste, convenience, price, health goals, and social norms (Cruwys,

Bevelander, & Hermans, 2015; Hall, Hammond, & Rahmandad, 2014; Higgs, 2015; Nestle et al., 1998). There is some evidence that there are individual differences in the extent to which these factors predict eating behavior (Byrd-Bredbenner, Abbot, & Cussler, 2008; Glanz, Basil, Maibach, Goldberg, & Snyder, 1998), but less is known about how individuals make decisions about what foods they prepare at home. Data on the frequency and context of access of meal idea resources are needed to better understand their influence on decisions related to food purchasing and home cooking. For example, food community websites may be utilized weekly during meal planning, whereas grocery store handouts may be utilized multiple times per week within stores during point-of-sale decision making. Some individuals may use cookbooks to remind themselves of recipes they have prepared before and access online sources (e.g., food blogs) to generate new meal ideas. Empirical research on this topic could inform the optimal contexts and timing for the dissemination of evidence-based information that promotes healthy dietary patterns and increased home cooking.

Despite a long-standing call for research on the full ecology of influences on consumer decision making (e.g., individual attitudes and preferences, peer and family influences, food-related advertising; Hoyer, 1984), relatively few empirical studies have explored how individuals make purchasing decisions in the context of numerous competing influences (Lysonski & Durvasula, 2013). This line of research is relevant to home food preparation because food purchases necessarily precede home cooking. Research that explores the cognitive and behavioral processes involved in transitioning from obtaining a meal idea to preparing that meal at home is needed. For example, an individual could initially get a meal idea from a food photo viewed on Facebook, proceed to search for similar meal ideas on Pinterest, which directs him/her to a food community website for a specific recipe. The individual could then consult a weekly grocery store flyer to identify whether any of the required ingredients are on sale and if they are, decide to purchase the necessary ingredients to prepare the meal at home. This scenario illustrates that users may navigate through multiple meal idea resources before ultimately preparing the meal. Empirical research could be conducted to model the sequence of cognitive and behavioral events that lead from meal ideation to at-home food preparation.

Future studies should also explore how resources promote the initiation and maintenance of home cooking through the technical capabilities that their media afford (e.g., food photography, videos of ingredient preparation, printable coupons; Buykx & Petrie, 2011). Consistent use of a grocery list has been associated with lower BMI and healthier dietary quality (Dubowitz, Cohen, Huang, Beckman, & Collins, 2015). It may be that resources that allow users to easily document the list of ingredients that are necessary to prepare a recipe at home facilitate home food preparation (e.g., tear out grocery list in a grocery store handout, list making features within a food-related mobile application). Skill building has also been shown to be an effective intervention technique across domains (Rotheram-Borus et al., 2009). Online resources in particular lend themselves to visual instructional tutorials that could build cooking self-efficacy, which has been associated the nutritional quality of foods consumed at home (Hartmann et al., 2013; Winkler & Turrell, 2010).

Finally, assessing user exposure to food-related advertising while accessing meal idea resources is important given previous research that suggests food-related advertising is associated with increased thoughts about food and desire to eat, particularly among individuals who are overweight and obese (Harris, Bargh, & Brownell, 2009). Indeed, a recent cross-sectional study found that body mass index (BMI) was higher among young adult women who watched cooking shows and cooked from scratch more frequently (Pope et al., 2015). Food-related advertisements that are displayed alongside or embedded within the content that a user was intentionally seeking may prompt the user to purchase and/or prepare a meal that is different from the one he/she originally intended. Longitudinal studies should assess meal idea resource use, exposure to food-related advertising, home cooking frequency, BMI, and the types and portion sizes of foods prepared at home to further explore associations between the use of meal idea resources and obesity risk.

4.2. Limitations

There are a few limitations to this study related to data collection. First, the data collected were cross-sectional, which prevents casual inference. Longitudinal, experimental studies could test whether assigning individuals to use certain resources for meal ideas increases home cooking frequency. Additionally, a single-item, participant-reported measure assessed the frequency of home food preparation. Further, home food preparation and meal ideas were not well defined within the survey items. Previous research has demonstrated that there is heterogeneity in individual definitions of cooking (Wolfson, Bleich, Smith, & Frattaroli, 2016). Some participants may have included meals that are consumed at home but are primarily convenience foods that do not require any cooking (e.g., cereal and milk). Similarly, individuals may have interpreted meal ideas to more broadly include ideas for any food that they consume at home (e.g., using food-related mobile applications to order food for home delivery). Future studies should develop and validate survey measures of home food preparation and meal ideas.

Survey items regarding the sources of meal ideas may not have adequately captured the nuance of the transmission and acquisition of meal ideas. For example, the survey item regarding the use of family and friends as a source of meal ideas did not address the means through which meal ideas were obtained (e.g., in-person communication, online communication, shared experience). Some highly accessed online social media platforms such as Instagram and YouTube were not included in the list of meal idea resources, which may have contributed to under-reporting of these platforms. Given the high prevalence of food-related content on these on Instagram (Guidry, Messner, Jin, & Medina-Messner, 2015; Holmberg, Chaplin, Hillman, & Berg, 2016) and YouTube (Cerri, Fisher, & Taheri, 2012), future studies should more readily assess their use as a source of meal ideas. Diary studies that are administered using prompting techniques, such as ecological momentary assessment, combined with data collected through monitoring the webpages and mobile applications accessed on their device may improve the accuracy of this line of research (Borgogna et al., 2015).

Finally, the study participants were primarily White and employed full-time, which may have limited the capacity to find significant association rules that predicted resource use among non-White and/or differently employed (e.g., student, homemaker, unemployed) participants. All participants were Internet users, thus results may not generalize to individuals who do not access the Internet. Studies that include a larger sample of more diverse participants are needed to better characterize the use of meal idea resources among individuals who are at the highest risk for obesity, including lower-income, ethnic minority populations (Gortmaker & Taveras, 2014; Ogden, Carroll, Kit, & Flegal, 2014).

5. Conclusions

Individuals who are seeking ideas about meals to prepare at home should have access to resources that promote nutritious, appropriately portioned meals that increase cooking self-efficacy

(Birch, Savage, & Fisher, 2015; Hartmann et al., 2013; Winkler & Turrell, 2010). Incorporating evidence-based nutrition content into the resources that individuals already access is a translational science opportunity for researchers and dietary health professionals (Rotheram-Borus, Swendeman, & Chorpita, 2012; Spoth et al., 2013). There is evidence that food marketers use social media to promote their brands (Freeman et al., 2014) and this study showed that approximately one-third of participants obtained meal ideas from company-branded websites. Thus, dietary health professionals who are interested in promoting home cooking should also engage with Internet-based resources for meal ideas by contributing their own content and establishing partnerships with social media influencers who already have audiences on these platforms (Goodman, Booth, & Matic, 2011; Tobey & Manore, 2014). Further research on the quality of nutrition information and cooking methods included in highly accessed meal idea resources including food community websites and cookbooks is needed. Studies conducted along the lines of research recommended in this manuscript could inform the development of novel interventions that promote nutritious, home-cooked meals through both traditional and Internet-based resources.

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