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Mobile app-etite: Consumer attitudes towards and use of mobile technology in the context of eating behaviour

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Abstract

Understanding how consumers use mobile devices and mobile applications to support their eating behaviour, such as creating grocery lists, gathering meal ideas and ordering food from restaurants, is important for business, marketing and health professionals who seek to reach consumers through mobile technology. This study identified segments of users and non-users of food-related technology and described differences in their demographic characteristics, food-related app use and interest in food-related app functionality. Results revealed that 22 per cent of participants were highly engaged with technology and food, while just 12 per cent were disengaged from both. The remaining two-thirds of participants were evenly split between those who were engaged with technology and food generally but were ambivalent about food-related apps, and those who were utilitarian in their approach to food and disengaged from food-related apps. There were segment differences based on age such that younger adults (ages 18–34) were more likely to be engaged with technology and food than older adults (ages 55+). Technology and food-engaged segments reported the highest levels of use of select food-related apps, but even well-known apps were not highly used, indicating room for market expansion. Findings are discussed in the context of app development, digital advertising and nutritional health interventions.

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Introduction

Internet-connected mobile devices (eg smartphones, tablet computers, smart watches) and mobile applications ('apps') are becoming ubiquitous parts of modern life, yet little is known about how consumers use mobile technology to support their eating behaviour, such as grocery shopping, meal planning, cooking and eating at restaurants. As of January 2014, nearly 60 per cent of adults in the United States owned a smartphone and 42 per cent owned a tablet computer.¹ At least half of adult cellphone users have downloaded apps onto their mobile device(s).² Apps are software

programs that serve numerous functions, including communication, productivity, entertainment, shopping, social networking and tracking health behaviours.³

Influencing food purchasing

Previous research has described consumers' general app use^{3–5} and their use of apps for health tracking⁶ and weight loss.^{7–9} Fewer studies have examined app use in the context of everyday choices about purchasing and consuming food. In 2014, US consumers spent \$765.1 bn at food-at-home retailers (eg grocery stores) and \$624.8 bn on food-away-from-home retailers (eg restaurants).¹⁰ Business and health professionals who seek to influence consumers' food purchasing decisions through digital marketing would benefit from additional insight about the characteristics of users and non-users of food-related mobile applications. The current study addressed this gap in the literature by conducting an online survey with a large, diverse sample of adult mobile device owners.

Growing consumer spend on apps

Consumer engagement with mobile devices and apps

There is a substantial and growing market for mobile apps.¹¹ Most commercially available mobile devices come pre-installed with several apps (eg internet browsing, calendar, weather) and users can download additional apps from distributors such as Google Play, Apple's iOS App Store and the Amazon AppStore. At the end of 2014, Google Play offered ~1.43 million apps for consumers to download, Apple's iOS App store offered ~1.21 million and the Amazon Appstore offered ~293,000.¹² One study recently found that mobile device users downloaded an average of nine apps per month.¹³ Apps may generate revenue through pay-per-download, in-app purchases and/or in-app advertising models.¹¹ During the first week of January 2015 alone, consumers worldwide spent nearly \$500 m in Apple's App store.¹⁴ Furthermore, overall revenues from mobile content, including mobile applications, has been estimated to surpass \$65 bn by 2016.¹⁵

Daily demands of feeding

As apps become increasingly diverse, understanding consumer attitudes towards and use of specific categories of apps, including food-related apps, becomes increasingly important to business, marketing and health professionals trying to engage new and existing consumers.^{16,17} There is scant empirical evidence on how the internet and mobile technology support consumers in meeting the daily demands of feeding themselves and their families, such as using digital displays to facilitate recipe preparation¹⁸ or ordering at restaurants.^{19,20} Research is needed that describes consumers' attitudes towards and use of food-related mobile technology and apps, such as apps that support users in planning, purchasing and socially sharing meals and snacks. Food and drinks are popular topics on social media and are the top content shared on Pinterest,^{21–23} which can be accessed via mobile applications. In 2012, 60 per cent of adults reported tracking their weight, diet or exercise routines, but less than 10 per cent of adults reported using their mobile device to do so,⁶ suggesting that this category of app has market expansion potential.

Decision to download and use apps

Previous research suggests that demographic characteristics of consumers are associated with the likelihood of downloading apps.

Younger, more educated, wealthier and non-rural-dwelling adults are more likely to download apps, as are Black, non-Hispanic adults.² In 2013, 77 per cent of 18–29 year olds in the United States downloaded apps, compared to 59 per cent of 30–49 year olds, 33 per cent of 50–64 year olds and just 14 per cent of adults over the age of 65.² Less is known about the mechanisms that underlie consumers' decisions about whether to download and consistently use food-related apps.

Predictors of intention to use

Theoretical frameworks offer more mechanistic insight into why some, but not all, consumers adopt new technologies such as purchasing mobile devices or downloading apps. The Technology Acceptance Model^{24,25} (TAM) and its extensions, unified theory of acceptance and use of technology (UTAUT²⁶ and UTAUT2),²⁷ suggest that the following factors predict consumer intention to engage with new technologies: value, ease of use, social norms and pressures, resources available to the individual, hedonic motivation, perceived price value, previous experience, and habit. These factors predicted behavioural intention to use mobile internet technology in a sample of 1,512 adults in Hong Kong,²⁷ for example.

Curiosity and desire for knowledge

Similar to the TAM and its extensions,^{24–27} consumer values theory²⁸ proposes that purchase intent is predicted by perceived utility (ie practical value), social influence and hedonic motivation. Consumer values theory goes on to suggest that purchasing behaviour is influenced by epistemic values, meaning that consumers are likely to purchase products that stimulate curiosity and/or help them acquire knowledge.²⁸ Consumer values theory also asserts that values are context-specific (eg a restaurant finder app may be more useful in a new city than it is in a familiar one).²⁸ Wang *et al.*²⁹ found support for the consumer values framework such that conditional value predicted behavioural intention to use mobile applications as mediated by functional, social, emotional and epistemic values in a sample of 282 primarily young adults in Taiwan. Together, these theories suggest that information about consumers' attitudes (ie perceived values) and behaviours (eg previous experiences with apps, habits) may be more useful than demographic factors alone in explaining why some but not all consumers engage with food-related mobile technology and applications.

Study aims

Segments and profiles of users

The first goal of the current study is to use a segmentation analysis approach³⁰ to identify discrete segments of mobile device users based on their self-reported attitudes and behaviours related to technology in general, food and nutrition topics, and internet, mobile device and app use in food contexts. Our second goal is to describe the segment profiles based on their demographic characteristics, use of well-known food-related apps, and attitudes towards food-related app functionality and mobile digital marketing. Potential applications of this study include identifying potential customers who could be targeted through marketing efforts for new and existing apps; informing the development and redesign of food-related apps; generating novel ideas for in-app advertising; and identifying intervention opportunities to improve nutritional health.

Participants**Methodology**

An external sampling company, Survey Sampling International LLC, recruited 615 participants between 29 December 2013 and 2 January 2014. Eligible participants were 18 years of age or older, used a mobile device, such as a smartphone or tablet computer, and had at least one app installed on their primary mobile device. Recruitment priority was given to individuals who were at least 75 per cent responsible for the grocery shopping and meal planning for their household. Participants were recruited to reflect approximately the 2014 United States Census Bureau statistics on gender, age, race/ethnicity and geographic region.³¹ Participants also reported their marital status, the number of children in the household, education and household income. Descriptive statistics are reported in Table 1.

Measures**Mobile device and application use**

Participants reported what type of mobile device(s) they owned, the number of mobile applications they had on their primary mobile device, and whether they had a favourite food-related app.

Segmentation variables

A series of questions assessed participants' current attitudes and behaviours related to food, technology and the use of mobile applications in food contexts (eg preparing meals and snacks, grocery shopping, dining

Table 1: Participant demographic characteristics

Demographic attribute:		<i>N = 615 n (per cent)</i>
Gender	Male	310 (50)
	Female	305 (50)
Age	18–24 years of age	81 (13)
	25–34 years of age	116 (19)
	35–44 years of age	133 (22)
	45–54 years of age	111 (18)
	55–64 years of age	122 (20)
	65+ years of age	52 (8)
Marital status	Married	345 (56)
	Not married	270 (44)
Children <18 years in household	Yes	266 (43)
	No	349 (57)
Race/ethnicity	White/Caucasian	422 (69)
	Black/African American	74 (12)
	Asian/Pacific Islander	24 (4)
	Hispanic/Latin American	74 (12)
	Other race/ethnicity	18 (3)
	High school diploma or less	107 (17)
Education	Some college	194 (31)
	College graduate	197 (32)
	Some graduate work or post-grad degree	117 (29)
Income	Less than \$35,000	126 (20)
	\$35,000–\$49,999	93 (15)
	\$50,000–\$74,999	142 (23)
	\$75,000–\$99,999	100 (16)
	\$100,000+	154 (23)
	Prefer not to answer	21 (3)

out). All items were rated on a five-point Likert scale ranging from 'Strongly agree' (1) to 'Strongly disagree' (5) or 'Always' (1) to 'Never' (5). Consistent with the previously described theoretical models^{24–28} and supporting empirical research,^{27,29} this study segmented participants based on their responses to these questions. Pearson correlations and factor analyses were run separately for attitudinal and behavioural items to identify cohesive groups of items that measured the same constructs and to eliminate items that performed poorly.

Attitudinal and behavioural factors

The correlation and factor analysis results supported two attitudinal factors:

- *Attitudes towards technology* (eight items; Cronbach's $\alpha = 0.87$; eg 'Technology helps make my life more organized').
- *Attitudes towards food and nutrition* (six items; Cronbach's $\alpha = 0.82$; eg 'I enjoy seeking out new recipes').

And three behavioural factors:

- *Digital food exploration* (eight items; Cronbach's $\alpha = 0.92$; eg 'I post pictures of dishes that I cook myself on my social networking profile').
- *Digital food-related information seeking* (five items; Cronbach's $\alpha = 0.83$; eg 'I look up reviews of restaurants before deciding whether or not to try them').
- *Food-related mobile device and app use* (16 items; Cronbach's $\alpha = 0.96$; eg 'I use more than one app while grocery shopping'. See Appendix.)

Subscale mean scores were calculated for each participant.

Segmentation profile variables

Participants reported their demographic characteristics and their awareness and use of five popular food-related mobile applications: Pinterest, Instagram, allrecipes, OpenTable and Yelp. Responses were categorical and included 'Currently use regularly', 'Have on my device, but rarely use', 'Have heard of, but have not used' and 'Have never heard of/Not familiar'. These five apps were selected because they represent a range of possible food-related behaviours: exploring and saving food and drink-related web content (Pinterest); socially sharing ones' own and browsing others' personal food and drink photos (Instagram); searching for recipes (allrecipes); exploring and placing reservations at restaurants (OpenTable); and discovering new food and drink locations through geo-location and reading reviews (Yelp).

Interest in food-related apps

Participants responded to five hypothetical scenarios relevant to food-related mobile applications and marketing. Questions probed participants' attitudes towards:

- *Mobile ordering*: 'Imagine that you are standing in line at your favourite fast food restaurant. How interested would you be in the ability to order items from your mobile device?'
- *Mobile payment*: 'How interested would you be in the ability to pay your restaurant or grocery bill using ONLY your mobile device?'

- *Product source*: ‘Imagine you are in the produce aisle looking for some fresh fruit to make your favourite dessert. How interested would you be in the ability to scan a quick response (QR) or bar code and learn about the origin/source of the product you are considering?’
- *Product-specific recipe ideas*: ‘How interested would you be in the ability to scan a QR or bar code and pull up a new recipe using the ingredient you were scanning?’ and
- *Nutrition-based product recommendations*: ‘Imagine you are in the snack aisle looking for something to purchase. How interested would you be in an app that recommends healthier options based on the item you are thinking about purchasing?’

Responses were rated on a five-point scale, ranging from ‘Very interested’ (1) to ‘Not interested at all’ (5).

Analyses

Descriptive statistics

Calculating clusters and profiles

Frequencies, means and standard deviations were calculated for the demographic, mobile device use and app use variables.

Segmentation analysis

A two-stage cluster analysis procedure was used.³² First, a hierarchical cluster analysis (Ward’s method) was performed to approximate the number of clusters.³³ Second, two possible cluster solutions were explored using *k*-means clustering.³⁴ The final number of clusters was decided based on conceptual clarity of the cluster centres.

Segmentation profiles

Chi-square tests of independence examined segment differences based on demographic characteristics and food-related app use. To explore whether segments differed in their interest in food-related mobile application functionality or mobile marketing, a one-way ANOVA with post-hoc Bonferroni contrasts analyses was performed. Analyses were conducted using IBM SPSS version 22.

Results

Mobile device and application use

Smartphones were the most common mobile device, used by 91 per cent of participants ($n = 559$), with 48 per cent ($n = 294$) owning Android phones, 35 per cent ($n = 215$) owning iPhones and less than 10 per cent owning Blackberry, Windows or other brands of smartphones. Sixty-five per cent of all participants ($n = 401$) owned a tablet and 38 per cent ($n = 233$) owned an eReader. Participants reported an average of 25.59 apps on their primary mobile device ($SD = 26.80$; Range = 0–200). Seventy-three per cent of participants ($n = 449$) reported having a food-related app on their mobile device.

Segmentation analysis

A four-cluster solution

The results of the two-step clustering procedure supported a four-cluster solution. The *k*-means cluster centres for the attitudinal and behavioural constructs are shown in Table 2.

App-disengaged Food Utilitarians

Segment 1 contained 33 per cent of participants (*n* = 205). This segment was characterized by slightly favourable attitudes towards technology and food and nutrition topics, and sometimes-to-often using technology to seek out information about food. However, they rarely used digital technology to explore or socially share food, and rarely used food-related apps. Due to participants' seemingly utilitarian views towards the intersection of food and mobile technology, this segment was labelled 'App-disengaged Food Utilitarians'.

Food-focused App Experimenters

Segment 2 contained 33 per cent of participants (*n* = 203). These participants reported highly favourable attitudes towards technology and food and nutrition topics (eg enjoy experimenting with new foods), and reported often using digital technology to seek information about food (eg read restaurant reviews). However, they only sometimes used mobile devices and apps to explore and socially share food, and only sometimes using apps to support day-to-day eating behaviour. For these reasons, this segment was labelled 'Food-focused App Experimenters'.

App-engaged Food Lovers

Segment 3 contained 22 per cent of participants (*n* = 132). These participants reported highly favourable attitudes towards technology in general (eg enjoy the convenience of online ordering) and food and nutrition topics (eg believe that food preparation is an expression of art). They also reported often-to-always using digital technology to explore and share food ideas (eg share food photos on social media) and to seek information about food (eg read product reviews). They often used apps in the context of everyday eating behaviour (eg use apps to create a grocery

Table 2: *K*-means cluster centres by segment on attitudes and behaviours involving technology and food

Segment name	Cluster center (<i>M</i>) values				
	Attitudes towards technology	Attitudes towards food and nutrition	Digital food exploration	Digital food-related information seeking	Food-related mobile device and app use
App-disengaged Food Utilitarians (<i>n</i> = 205)	2.70	2.52	4.15	2.44	4.17
Food-focused App Experimenters (<i>n</i> = 203)	2.07	1.97	2.97	1.94	3.16
App-engaged Food Lovers (<i>n</i> = 132)	1.41	1.39	1.80	1.37	1.99
App- and Food-disengaged (<i>n</i> = 75)	3.56	3.20	4.68	3.84	4.68

Note: Responses were rated on a five-point scale, ranging from 'Strongly agree' (1) to 'Strongly disagree' (5) or 'Always' (1) to 'Never' (5). Thus, *lower* scores represent *higher* levels of endorsement; (*N* = 615).

list, plan weekly menus, check prices in store, share product reviews). Thus, they were labelled 'App-engaged Food Lovers'.

App- and Food-disengaged

Segment 4 was the smallest segment and contained 12 per cent of participants ($n = 75$). These participants reported ambivalent-to-negative attitudes towards technology and food and nutrition topics (eg disagree that meal time is a social event), and reported sometimes-to-rarely using technology to gather information about food. They also reported rarely-to-never using mobile technology to explore or share food, and rarely-to-never used food-related apps. As such, they were labelled 'App- and Food-disengaged'.

Segmentation profiles

Demographics

Segments were not significantly different based on gender, race/ethnicity, household income or marital status (data not shown); however, there were significant differences in age (see Table 3). More 18–34 year olds ('Millennials') were classified as 'Food-focused App Experimenters' and 'App-engaged Food Lovers', whereas more older adults ages 55–64 and 65+ were classified as 'App- and Food-disengaged' or 'App-disengaged Food Utilitarians' ($p < 0.001$).

Presence of children

There were also significant segment differences based on whether children below 18 years of age were present in the household ($p < 0.001$). This relationship maintained significance even when only participants between 18 and 44 years of age were included, suggesting that having children in the household did not simply reflect age differences. More participants 18–44 years of age who reported having children in the household were 'App-engaged Food Lovers' and fewer were 'App-disengaged Food Utilitarians' compared to participants 18–44 years of age who did not have children in the household (see Table 4).

Food-related app use

There were significant segment differences in their awareness and use of Pinterest, Instagram, allrecipes, OpenTable and Yelp (see Table 5). Consistent with the attitudinal and behavioural responses that classified them by segment, 'App-engaged Food Lovers' reported the highest levels of current use across all apps examined, followed by 'Food-focused App Experimenters'. 'App-disengaged Food Utilitarians' and 'App- and

Table 3: Results of chi-square test and descriptive statistics for segment by age

Segment name	Age n (per cent)				
	18–34	35–44	45–54	55–64	65+
App-disengaged Food Utilitarians ($n = 205$)	48 (23)	40 (20)	35 (17)	53 (26)	29 (14)
Food-focused App Experimenters ($n = 203$)	90 (44)	47 (23)	30 (15)	32 (16)	4 (2.0)
App-engaged Food Lovers ($n = 132$)	53 (40)	36 (27)	29 (22)	11 (8)	3 (2.3)
App- and Food-disengaged ($n = 75$)	6 (8)	10 (13)	17 (23)	26 (35)	16 (21)

Notes: χ^2 (12, $n = 615$) = 100.07, $p < 0.001$, Cramer's $V = 0.23$; ($N = 615$).

Table 4: Results of chi-square tests and descriptive statistics by segment based on children in the household

Segment name	Children <18 years of age in the household <i>n</i> (per cent)	
	Yes	No
App-disengaged Food Utilitarians (<i>n</i> = 88)	36 (20)	52 (34)
Food-focused App Experimenters (<i>n</i> = 137)	66 (38)	71 (46)
App-engaged Food Lovers (<i>n</i> = 89)	65 (37)	24 (15)
App- and Food-disengaged (<i>n</i> = 16)	9 (5)	7 (5)

Notes: χ^2 (12, *n* = 330) = 20.86 p < 0.001, Cramer's V = 0.25); Limited to participants 18–44 years of age (*n* = 330).

Table 5: Results of chi-square test and descriptive statistics by segment based on current use of selected food-related mobile applications

Segment name	<i>n</i> (per cent)				
	Currently use Pinterest ^a	Currently use Instagram ^b	Currently use allrecipes ^c	Currently use OpenTable ^d	Currently use Yelp ^e
App-disengaged Food Utilitarians (<i>n</i> = 205)	31 (15)	25 (12)	30 (15)	9 (4)	31 (15)
Food-focused App Experimenters (<i>n</i> = 203)	73 (36)	57 (28)	62 (30)	28 (14)	61 (30)
App-engaged Food Lovers (<i>n</i> = 132)	61 (46)	70 (53)	73 (55)	34 (26)	73 (55)
App- and Food-disengaged (<i>n</i> = 75)	3 (4)	2 (3)	3 (4)	1 (1)	1 (1)

^a χ^2 (12, *n* = 615) = 148.62, p < 0.001, Cramer's V = 0.28).

^b χ^2 (12, *n* = 615) = 196.16, p < 0.001, Cramer's V = 0.33).

^c χ^2 (12, *n* = 615) = 201.84, p < 0.001, Cramer's V = 0.33).

^d χ^2 (12, *n* = 615) = 130.41, p < 0.001, Cramer's V = 0.27).

^e χ^2 (12, *n* = 615) = 190.88, p < 0.001, Cramer's V = 0.32).

Notes: Numbers in parentheses indicate column percentages; (*N* = 615).

Food-disengaged' participants rarely-to-never used these apps. Even among the most engaged segment, 'App-engaged Food Lovers', current use of these food-related apps peaked at only 55 per cent. OpenTable appeared to have particularly low current use, and was endorsed by just 1–26 per cent of each segment.

There were significant segment differences in their interest in food-related app functionality and mobile digital marketing (p < 0.001). 'App-engaged Food Lovers' reported the highest level of interest across all categories — they were somewhat-to-very interested in using mobile technology and/or apps to facilitate ordering food, paying for food, learning the source of ingredients within products, obtaining product specific recipe ideas and getting nutrition-based product recommendations. 'Food-focused App Experimenters' were somewhat interested in these features, while the 'App-disengaged Food Utilitarians' and 'App- and Food-disengaged' segments were neither interested nor disinterested, or

Interest in food-related apps and mobile marketing

somewhat disinterested. Across all segments, participants reported the most interest in apps that would facilitate ordering food.

Discussion and future directions

The goal of this study was to identify and describe segments of consumers who were using or not using mobile technology and applications in the context of typical eating behaviour (eg during dinner preparation, while grocery shopping, to gather recipe ideas, to share food photos on social media). We identified four unique consumer segments based on their attitudes towards technology; attitudes towards food and nutrition; use of the internet and mobile devices to explore and socially share food; use of the internet and mobile devices to seek information about food/restaurants; and use of mobile devices and apps to support everyday food-related tasks.

Twenty-two per cent of participants were characterized as having highly-favourable attitudes and behavioural engagement with technology and food — they enjoyed activities such as sharing photos of their meals online with their social networks, browsing the web for recipes, using apps while grocery shopping and ordering food from their mobile devices. This segment may perceive food-related apps as being easy to use, practical, enjoyable and social. These individuals may be among the first to target for interventions that aim to improve nutritional health through apps and mobile websites, for example by making healthy food options among the easiest to order, promoting social sharing of nutritious meal selections, and allowing customers to learn more about the ingredients and nutrition information of their meal choices.

Thirty-three per cent of participants were classified as being interested in food (eg reading restaurant reviews, socially sharing food photos, recipe browsing), but were only occasionally using apps to support these food-related interests. This segment may respond to mobile digital marketing or nutritional health interventions that are situated within the contexts that they are already going to, for example, including branded food products within recipes that are shared on familiar recipe websites (eg allrecipes) or partnering with social media influences (eg highly followed Instagram or Pinterest users) to promote healthy foods and evidence-based nutrition information.

Another 33 per cent of participants were not highly interested in exploring food online or using food-related apps, yet reported somewhat favourable attitudes towards technology generally and used online sources to find out more information about food (eg read product and restaurant reviews). This segment may be most interested in food-related apps that are perceived to have practical or price value, such as saving time or money. These individuals may also be motivated to adopt mobile applications that help them easily meet health-related goals, such as tracking their weight, counting calories, or time-efficient, healthful meal planning.

Recent data from the Pew Research Center suggests that Pinterest and Instagram are increasingly popular social media platforms.³⁵ Our results suggest that approximately one in two 'Food-engaged App lovers' used the

**Segments and mobile
behaviour**

**Engaged with
technology and food**

**Promoting healthy
options**

Practical value of apps

**Pinterest and
Instagram**

Parents more engaged than non-parents

mobile apps for Pinterest and Instagram, while approximately one in three 'Food-engaged App Experimenters' used these apps. Pinterest and Instagram, which have functional, social and hedonic value, may be platforms that business, marketing and health professionals could target first to reach consumers with food-related marketing.

Consistent with previous research on mobile application use² and social media engagement³⁵ in the United States, younger participants were more engaged with technology and apps in the context of food. However, our findings also suggested that among younger adults, parents (ie individuals living with children below 18 years of age) had more favourable attitudes towards technology and food compared to non-parents. Feeding children is an important and potentially time-consuming parenting task with important implications for children's health and weight status, particularly during infancy and early childhood.^{36,37} Parents may be more engaged with technology and food compared to non-parents because they have the added responsibility of feeding their children as well as themselves. Future studies should continue to explore this relationship, as parents have expressed interest in mobile devices as a way to learn more about feeding their children, which may be an opportunity to intervene for childhood obesity prevention.³⁸

In-store technology

In a 2015 report, the National Restaurant Association identified in-store tablet computers and mobile applications as technology trends for consumers, restaurateurs and chefs.³⁹ Our findings suggest that consumers may be most interested in apps that facilitate food ordering.⁴⁰ This has important implications for health policies related to menu labelling requirements regarding nutrition information. Posting information about the caloric, fat and sugar content of meals within the check-out or final ordering screen with opportunities to swap items for healthier choices may be one opportunity to improve nutritional health. Another mobile ordering feature could show consumers how their order compares to federal nutritional guidelines to encourage customers to select healthier meals. Future studies should identify consumer segments that are currently using or interested in using apps that target nutrition, as well as what app functionalities predict sustained healthy eating behaviour.⁴¹

Influencing health choices

Only 12 per cent of participants were characterized as disengaged from both technology and food, which suggests that developing and marketing mobile application functionality or mobile digital marketing campaigns that appeal to users' interest in either domain is likely to have broad appeal.¹¹ That said, professionals aiming to improve health might need to assess individuals' interest in mobile technology prior to recommending apps for nutritional health. Future research should explore whether there are specific mobile application functions that would make consumers who are currently ambivalent about apps intend to use them, or whether other factors such as perceived ease of use or price values, which were not fully explored in this study, are more important. Finally, additional research should investigate how a combination of mobile touch points (eg a coupon for a free item, mobile ordering and mobile payment) influences food purchasing decisions.⁴²

Highly food-involved consumers**Strengths and limitations**

This study is among the first in the academic literature to explore the intersection of mobile technology and typical eating behaviour. This theory- and data-driven research provides critical foundational knowledge of consumers' attitudes towards and use of mobile devices and apps in food-related contexts upon which future studies may build.⁴³

There are a few limitations of this study that should be considered when interpreting the results. Participants were recruited based on their responsibility for meal planning and grocery shopping in their household; thus, these results may only be generalized to individuals who are highly involved with household food purchasing decisions. This study relied on self-report data for mobile application use, rather than data collected from mobile devices, which would be a more precise method of measurement. Given that this is a novel area of research, the questionnaire items were developed specifically for this project and would benefit from further validation, even though Cronbach's α met and exceeded acceptable levels (>0.70).

Measuring technology use and eating

Additionally, attitudinal and behavioural constructs were moderately-to-highly correlated (Pearson's r ranging from 0.58 to 0.87, $p < 0.001$), suggesting that we segmented participants based on closely related constructs. Future studies should develop measures of consumers' use of mobile technology specifically to support eating behaviour based upon the constructs included in the TAM,^{24,25} its extensions^{26,27} and consumer values theory,^{28,29} such as practical value, price value, perceived ease of use, social norms and pressures and previous experience.

Mobile marketing opportunities**Conclusions**

Mobile devices and apps are increasingly part of daily living, including contexts in which consumers make decisions about what, where and how much to eat or feed their families. As consumers adopt apps to support them in purchasing, preparing and consuming food, it is important that business, marketing and health professionals understand how apps impact consumer choices. Our findings suggest that consumers who are highly engaged with mobile technology and food are most likely to be young adults and parents. Across all consumers, mobile ordering was an appealing functionality. The results from this study may be applied to strategic digital marketing campaigns and the development of new mobile applications within the business and health promotion sectors.

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Appendix

Table A1:

Construct	Items
Attitudes towards technology ^a	<ul style="list-style-type: none"> ● I am willing to take surveys on my mobile device. ● I am interested in watching videos on my mobile device. ● I like to keep my personal pages updated with information about my life. ● I wish there was one app for all my needs. ● Technology helps make my life more organized. ● My mobile device is an extension of my personality. ● I like the convenience of being able to make reservations from my mobile device. ● I like the convenience of being able to place an online order using my mobile device.
Attitudes toward food and nutrition ^a	<ul style="list-style-type: none"> ● I enjoy seeking out new recipes. ● I like to experiment with new foods. ● Mealtime is a social event. ● Food preparation is an expression of art. ● It's important for me to be able to look up the nutritional content of restaurant or grocery items. ● The source where my food is coming from is important to me.
Digital food exploration ^a	<ul style="list-style-type: none"> ● I post pictures of dishes I have in restaurants on my social networking profile(s).

Table A1: (Continued)

Construct	Items
	<ul style="list-style-type: none"> ● I post pictures of dishes that I cook myself on my social networking profile(s). ● I contribute to a food blog. ● I look for inspiration on Pinterest and other social media sites. ● I track my food intake on my mobile device (ie keep a food diary). ● I use my mobile device to locate local farmers' markets. ● I use my mobile device to locate healthier meal options. ● I look for apps that help me manage my weight.
Digital food-related information seeking ^a	<ul style="list-style-type: none"> ● When I find a food item I like, I typically recommend it to people I know. ● I look up reviews of restaurants before deciding whether or not to try them. ● I look up recommendations of dishes within restaurants I visit before deciding whether or not to try them. ● I look up menus using my mobile device for restaurants I am considering or planning to visit. ● Before purchasing a product online, I typically read online reviews submitted by others.
Food-related mobile device and app use ^b	<ul style="list-style-type: none"> ● I use more than one app when grocery shopping. ● I use more than one app for my dining out experience. ● I look actively for the next great food app. ● I scan QR codes on products or advertisements that interest me. ● I share my opinions about products and services by posting reviews and ratings online. ● I plan a weekly menu on my mobile device before heading to the grocery store. ● I create a shopping list on my mobile device before heading to the grocery store. ● I monitor my food's expiration dates using my mobile device. ● I use my mobile device to locate food items on the shelves within my preferred store. ● While in the store, I check item availability and pricing at other locations. ● While in the store, I research information about products I am thinking of purchasing. ● While in the store, I call or text a family member or friend about a product I am thinking of purchasing. ● I look up reviews of products I am thinking about purchasing while I am in the store. ● While in the store, I purchase items on my mobile device if I find them at a better price somewhere else. ● I use my mobile device to look up measurement conversions while cooking (ie # of teaspoons in a tablespoon). ● I use an app that allows me to store all of my shopper card information in my mobile device for easy access when shopping.

^aPrompt: 'How much do you agree or disagree with the following statements?' Rating scale:

1 = 'Strongly agree'; 2 = 'Somewhat agree'; 3 = 'Neither agree nor disagree'; 4 = 'Somewhat disagree'; 5 = 'Strongly disagree'.

^bPrompt: 'Thinking about the following statements, please indicate how frequently or infrequently you do each action'. Rating scale: 1 = 'Always'; 2 = 'Often'; 3 = 'Sometimes'; 4 = 'Rarely'; 5 = 'Never'.