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Behavioral Design Strategies Improve Healthy Food Sales in a Military Cafeteria

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Abstract

Purpose: This study examined the use of behavioral design strategies to improve healthier food sales.

Design: A quasi-experimental, one-group, repeated measures design examined changes in food sales following behavioral design adjustments.

Setting: United States military base hospital dining facility.

Subjects: U.S. military service members, retirees, and civilian employees.

Intervention: Behavioral design changes included placement, layout, messaging, default healthy bundling, a stoplight rating system, strategic positioning of healthy items on menu boards, and an increase in healthier snacks.

Measures: Food sales were assessed by point-of-sales data.

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Contributorship

All authors contributed to the 4 ICMJE authorship criteria as listed below:

- Substantial contributions to the conception or design of the work; or the acquisition, analysis, or interpretation of data for the work; AND
- Drafting the work or reviewing it critically for important intellectual content; AND
- Final approval of the version to be published; AND
- Agreement to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved

Declaration of Conflicting Interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Ethical Statement

Ethical approval

The Centers for Disease Control and Prevention Human Research Protection Office (CDC HRPO) declared this study exempt research, because no personally identifiable information was collected from participants and the study posed no risk to participants.

Analysis: T-tests examined total sales of each food adjusted weekly between baseline and intervention and intervention and post-intervention. 16 food items targeted by the intervention were examined. Weekly food sales were calculated for the 18-week baseline, 18-week intervention, and 9-week post-intervention. Further, analysis estimated negative binomial models for food item sales.

Results: The hospital dining facility served 600 to 900 meals per day. Weekly foods sales decreased during the intervention for desserts, cooked starches, hummus, and yogurt ($P \leq 0.01$). Sales increased during the intervention for fruit cups, cooked vegetables, vegetable and turkey burgers, grilled chicken, packaged salads, French fries, hamburgers, and hot dogs ($P \leq 0.02$).

Conclusion: This study demonstrates that a mixture of behavioral design strategies can be operationalized with reasonable fidelity and can lead to increases in the sales of some healthy foods in military worksites.

Keywords

military facilities; nutrition; military personnel; federal government; health behavior; diet; behavioral design; food service guidelines

Purpose

Inadequate diets and the attendant sequelae including nutrient deficiency, chronic disease, and excess weight are serious and costly personal and public health challenges.[1] This issue is of particular concern for groups critical to national security including the U.S. military, where nearly two-thirds of service members have overweight or obesity.[2,3]

Behavioral design uses cognitive, emotional, behavioral, and informational strategies to enable or incentivize people toward healthier behaviors, choices, and actions.[4] For example, the CDC released guidance in 2023 on using behavioral design in food service to make healthy choices default and easier.[5] Numerous reviews demonstrate positive effects of behavioral design on food selection, sales, and consumption, with some strategies and combinations of strategies having larger effects depending on the type of food, setting, and population.[6–11] Given that behavioral design strategies are often low-cost, minimally invasive, preserve alternate choices, and can be incorporated as permanent, they represent an opportunity to sustainably impart small effects over time across a population to improve dietary behaviors.

Evidence from military settings suggests that behavioral design strategies are effective in increasing healthier food choices.[12,13] In a review of nine environment-based interventions in military establishments from 1995 to 2016, eight showed improvements in dietary behavior. The most common strategies were increases in the availability of healthier foods, labelling, staff cooking courses, health education, and promotional materials.[14]

This study examined use of additional types and a larger number of behavioral design strategies than in previous trials to improve sales of healthier foods in a military hospital dining facility. Program fidelity and sustainability were assessed with process evaluation.

This paper follows the Transparent Reporting of Evaluations with Nonrandomized Designs (TREND) statement guidelines.[15]

Methods

Design and Sample

This study was conducted in a United States military hospital dining facility (DFAC) between August and December 2017. The DFAC is self-operated and open to the installation's 80,000 service members, families, contractors, retires, and civilian employees. This DFAC employs 60 federal staff and averages US$32.4 K in monthly sales. It serves 600–900 meals daily to 60% civilian hospital employees, 30% active military, and 10% other patrons (J. Hess, personal communication, August 1, 2017). Three-week rotating menu cycles provide different hot lunch options daily, while additional a la carte items are available daily.

The trial was a quasi-experimental, one-group, repeated measures design that tested behavioral design strategies to encourage green-coded (healthier) and discourage red-coded (less healthy) foods and beverages. Researchers and active-duty dietitians selected and modified strategies based on Go for Green (G4G), a Department of Defense (DoD) performance-nutrition initiative.[16] Strategies included:

- Pricing, promotion, and defaults
  - Featured "performance plate" (a healthier entreé and two green-coded side dishes)
- Product innovations
  - Addition of low-calorie sparkling water
- Placement and layout
  - Prominent menu board positioning
  - Prominent healthier food at salad bar and hot food stations
  - Green-coded hot vegetable at the short order grill
  - Fruit baskets at the point of sale
  - Easy access healthier grab n' go items
- Information
  - Improved color-coded labels
  - Communications messaging depicting healthy behaviors
- Organizational policy
  - Staff behavioral design training

Point-of-sales and environmental scan data were collected from April 2017 to March 2018 and analyzed to determine intervention impact and fidelity. Table 1 shows intervention stages.

The Centers for Disease Control and Prevention Human Research Protection Office (CDC HRPO) declared this study exempt research, because no personally identifiable information was collected from participants and the study posed no risk to participants.

Intervention

Go for Green (G4G).—The present study applied G4G 2.0 strategies, including stoplight color labeling, behavioral design, and an education and marketing campaign.[16] Although G4G 2.0 introduced menu revisions, the current study only tested behavioral design strategies and did not modify existing or include new recipes.

Color-Coding of Foods and Beverages.—From May–July 2017, over 200 foods and beverages were coded according to G4G 2.0 nutrition standards. Foods and beverage nutrition information were processed by the G4G's web-based algorithm, which assigns items into Red: Eat Rarely, Yellow: Eat Occasionally, or Green: Eat Often categories.[17] In cases where saturated fat content was missing from the recipe printouts, the web-based algorithm could not be used, and the appropriate color code was determined by DFAC dietitians.

Strategy Selection and Materials Development.—CDC researchers and DFAC dietitians selected eleven strategies from the G4G 2.0 based on feasibility of implementation (Table 2). Researchers and DFAC dietitians created daily menu and performance plate signs and color-coded tags. For example, lunch menus featured green-coded items on the on the menu corners, and as possible, a less expensive, green-coded item next to more expensive yellow- or red-coded items. Communication materials, such as posters and table tents, were printed from the Army Public Health Center's Health Information Products e-Catalog.[18] Fifteen different green-coded "performance plate" specials were created from existing menu items, one for each weekday during the 3-week menu cycle. Structural improvements included fruit baskets and bottled water at the checkout, installation of no- or low-calorie sparkling water machines, and a new beverage cooler wrap depicting healthier vending items. Placement strategies included moving green-coded entrees and vegetables to the first positions in the main hot line, placing a green-coded vegetable next to the French fries at the grill station, placing green-coded items at the beginning of the salad bar line, and moving green-coded refrigerated self-serve items (eg, bottled water, yogurt) to eye-level and front positions and red-coded items (eg, pies, sugar-sweetened beverages) to less visible positions.

Intervention strategies were designed to be implemented by DFAC staff as a part of their regularly scheduled work. DFAC staff training was led by dietitians prior to the intervention start date. A procedure manual outlining strategies was developed to standardize practices across DFAC staff. DFAC staff implemented the intervention during lunch services from August 21, 2017, to December 22, 2017. Due to miscommunication between researchers and cafeteria staff, the fruit basket intervention was prematurely implemented during the

fourth week of the baseline data collection period. Regular check-ins with CDC researchers, DFAC dietitians, and the food service manager served to address issues associated with program implementation. In the post-intervention period, staff were no longer trained or reminded to implement the intervention strategies but were not specifically instructed to cease implementing them.

Measures

Sales Data Collection.—Foods sales, the primary outcome, was assessed weekly from point-of-sales (POS) reports (MICROS Systems Inc, Oracle Corporation, Redwood Shores, CA). Intervention baseline POS reports were collected for the 18 weeks (6 menu cycles) from April to August 2017, implementation reports were collected for the 18 weeks from late August to December 2017, and post-intervention reports were collected for the 9 weeks (3 menu cycles) from late December 2017 to March 2018. Due to unintentional early implementation of the fruit basket strategy, baseline data period was only 3 weeks, the intervention period was 33 weeks, and the post-intervention period was 9 weeks. Mean sales volume for 16 healthy and less healthy food items that were expected to be impacted by the intervention were abstracted from sales data. These items included entrees (red, yellow, and green), hot vegetable and starch side dishes (grains, potatoes), grill station items (hamburgers/hotdogs, grilled chicken, vegetable/turkey burgers, and French fries), whole fruit, deserts (cakes, cookies, pies, and brownies), and self-serve refrigerated items (pudding, fruit cups, yogurt, hummus, and pre-packaged salads).

Analysis.—Data analysis was completed using SAS 9.4 and Stata 15.1 on weekly sales data (SAS Institute, Cary, NC) (StataCorp). Weekly food sales were calculated during the baseline, intervention, and post-intervention periods. Sales for each item were standardized by total sales volume to account for differences in overall sales over the study period. For each food outcome, the proportion of each food sold out of total foods sold during each menu cycle was multiplied by the average total number of foods sold per menu cycle. For example: (Actual # of green entreés sold in intervention week 1 / total # of all items sold in menu intervention week 1) * (overall total # of all items sold during entire study / 45 weeks total study duration). We compared mean weekly sales of each food outcome (adjusted for total weekly sales of all foods) between the baseline and intervention period and between the intervention and post-intervention period using t-tests.

Next, we estimated two negative binomial models for each food item. Model 1 was estimated over the baseline and intervention periods only (weeks 1–36) and included the following covariates: a two-way interaction between the intervention period indicator (=0 during baseline period, = 1 during intervention period) and continuous time trend (including main effects), total sales, the menu cycle week (1, 2, 3), and the special meals indicator (=1 if special meal occurred that week, = 0 otherwise). The immediate change from baseline to intervention was presented as the incidence rate ratio (IRR) and calculated as the exponent of beta-coefficient of intervention period indicator. The slope change from baseline to intervention period was presented as the IRR and was calculated as the exponent of beta-coefficient of the interaction effect between time trend and intervention period indicator. Model 2 was estimated over the intervention and post-intervention periods only (weeks 4–45

for whole fruit, weeks 19–45 for all other items) and included the following covariates: a two-way interaction between the post-intervention period indicator (=0 during intervention period, = 1 during post-intervention period) and continuous time trend (including main effects), total sales, the menu cycle, and the special meals indicator. The immediate change from intervention to post-intervention was presented as the incidence rate ratio (IRR) and calculated as the exponent of beta-coefficient of post-intervention period indicator. The slope change from intervention to post-intervention was presented as the IRR and was calculated as the exponent of beta-coefficient of the interaction effect between time trend and post-intervention period indicator.

Process Evaluation

Fidelity Data Collection.—Intervention implementation was assessed each menu cycle (3 weeks) using an environmental scan adapted from the Healthy Hospital Cafeteria Scan[19] and the Military Nutrition Environmental Assessment Tool (m-NEAT).[20] Study fidelity measures how well intervention strategies were delivered according to plan.[21] The modified scan was piloted by CDC researchers and DFAC staff and refined prior to the intervention. The environmental scan was completed during weekday lunch service three times during baseline, six times during the intervention, and twice during post-intervention. The same CDC researcher collected all scans to prevent inter-rater variability. We assessed the presence and placement of promoted ‘green’ foods/drinks, demoted ‘red’ foods/drinks, and communications materials (eg, posters, table tents). The scan also assessed the availability of color-coded tags correctly identifying items. Questions were binary (eg, yes/no), ordinal (eg, ≥5, 3–4, 1–2), or Likert-style (eg, Very Good, Good, Fair, Poor, Very Poor) for ease of data analysis. There was also an area to provide additional commentary on contextual factors (eg., staffing issues, quality of items). Scans were completed using a paper version and then entered in a web-based form built for the project (Epi Info, CDC, Atlanta, GA). Photographs of strategies were routinely taken to supplement fidelity data.

Fidelity Data Analysis.—Fidelity statistics (percentages) were calculated for baseline, intervention, and post-intervention periods, and was determined for availability, prominent placement, and presence and correct placement of color-coded labels for green-coded hot foods, grab n’ go vended items, drinks, chips, salad bar, and menu boards. Prominent placement was defined as placing the promoted items either first in line, near the register, or at eye-level. We totaled values for each of the scales (eg, Yes/No questions were coded as 1 or 0, while a 5-point Likert scale were assigned values of 4 to 0) and divided by the number of assessments to create a fidelity average. We then divided the average by the highest value (eg, 4 for a 5-point Likert Scale) to create a fidelity percentage. For example, in the ‘Salad Bar’ category, the average score for ‘prominent placement’ across assessments was 3.17 out of a possible 4, thus, the fidelity percentage was 79% (3.17/4 × 100). High fidelity was defined as having a mean percentage of 75% across all categories, as defined in prior intervention studies.[22,23] Moderate fidelity was defined as 50%–74% and low was 0%–49%.[23]

Results

Color coding of food items had no effect on sales in the intervention or post-intervention period regardless of the method of analysis (Tables 3 and 4). Weekly foods sales, adjusted only for total sales, decreased during the intervention for desserts (eg, cakes, cookies, pies, and brownies), cooked starches (eg, grain and potato dishes), hummus, and yogurt (Table 3). Sales increased during the intervention for fruit cups, cooked vegetables, vegetable and turkey burgers, grilled chicken, packaged salads, French fries, hamburgers, and hot dogs (Table 3). Post intervention sales decreased for whole fruit and pudding and increased for pre-packaged salads and French fries (Table 3).

Table 4 shows results for negative binomial models estimating the immediate change during the intervention and post intervention, as well as the differences in slope between baseline, intervention, and post intervention. Adjusted model 1 shows the intervention was associated with a positive immediate change in fruit cup sales and a negative slope change. The same pattern was found for pudding, veggie/turkey burgers, and packaged salads. Hot vegetables had no significant immediate change, but a small significant positive slope change. Desserts had no significant immediate change, but a significant negative slope change. Whole fruit had a positive immediate change and no significant slope change. Other items' sales were not significantly different in the intervention period, compared to baseline.

Adjusted model 2 show that desserts, fruit cups, yogurt, pudding, cooked starches, and veggie/turkey burgers had a negative immediate change and a positive slope change in post-intervention, compared to the intervention period. Hamburgers and hotdogs had a positive immediate and negative slope change in post-intervention, compared to the intervention period. Hot vegetables had a small but statistically significant negative change in slope only. Packaged salads had a positive change in slope only. There was a positive immediate change in grilled chicken sales in post-intervention, compared to intervention.

Process Evaluation Results

Implementation fidelity for availability, placement, and color-coded labels for individual foods and strategies suggest that intervention strategies were implemented with moderate to high fidelity during the intervention period (Table 5). Fidelity declined during post intervention but remained higher compared to the baseline period. Mean availability fidelity was 88% and decreased to 57% during post-intervention. Mean placement fidelity was 90% and decreased to 65% during post intervention. Mean labeling fidelity was 87% and decreased slightly to 83% during post-intervention.

Discussion

This study examined the effect of an 18-week behavioral design intervention in a U.S. Department of Defense hospital dining facility. Behavioral design strategies were selected to increase healthier food selection and decrease less healthy food selection and were applied with high fidelity. In line with these objectives, findings from the fully adjusted model show increases in sales of some healthier foods (whole fruit, fruit cups, packaged salads, and vegetable and turkey burgers) and one less healthy item, pudding (Table 4). During the

post-intervention fidelity decreased only slightly to 83% and among a variety of changes was a decreased sales of both fruit cups and vegetable/turkey burgers which had increased during the intervention (Table 4).

Previous trials have examined similar behavioral design strategies to improve dietary intake in military facilities, though with a more limited number of strategies than in the current study. For example, Arsenault et al examined the use of the G4G traffic-light colored labels in six U.S. Army bases, showing a decrease of fat intake for users vs non-users of the labels.[14,24] More recently Cole et al, 2018 examined the effect of nutrient-dense recipes, improved menus for performance, and placement strategies on diet quality and meal satisfaction at a Special Operations Forces Human Performance Program DFAC.[25] Cole et al[25] found that implementing the strategies was feasible and led to dietary improvements. However, unlike the current trial they relied solely on improving selection via the favorable placement of healthy items.

Behavioral design strategies influence selection by the way they interact with our cognitive systems.[4,26] A mix of strategies targeting both deliberate, rational decision-making and impulsive, automatic action-taking can guide healthy choices.[26] Many behavioral design strategies target the latter system, making choices easier, default, and normative by adjusting, for example, food placement, relative number of healthier foods, or foods in a bundle. These can be complimented with strategies that slow decision-making down and require deliberative effort such as opportunities to preorder meals or view posted calorie counts. Selecting a set of cognitively diverse behavioral design strategies for an intervention can be guided by feasibility, practicality, and monitoring. In the current study, for example, strategy selection was guided by existing sales, cafeteria layout, staffing considerations, consultation with staff dieticians, and price change limitations imposed by U.S. Army regulations.

The challenge for public health is how to operationalize behavioral design and make it a normative part of creating environments that facilitate healthy behaviors. A promising method is to include these strategies in facility design and food service contracts. For example, because many Americans consume food within institutional environments such as universities and worksites, the Federal Government has developed and promotes the use of food and nutrition guidelines in institutional settings, such as the Food Service Guidelines for Federal Facilities.[27] These guidelines specifically recommend behavioral design strategies to encourage the selection of healthier foods. They are designed to and have successfully been put into requests for food service proposals and subsequently incorporated into contractual agreements between institutional management and food service companies. The use of food service guidelines in this manner begins to normalize the alignment of the food environment with human dietary requirements as a best business practice.

Limitations of the current study included no randomization, control group, or measurement of foods consumed, only sales. It is also possible that over the study timeframe unmeasured outside factors changed dietary selection, such as seasonal eating patterns, although we made efforts to adjust for this statistically. Furthermore, behavioral design strategies may

differently affect each of the numerous steps involved in selecting and purchasing food. This study only measured how the collective intervention led to the purchasing step. This study did not resolve the effects of specific strategies, nor did it determine how these strategies influenced other outcomes on the causal path such as patron flow patterns, time spent eating, amount consumed, sharing of food, saving food for later, and food wasted. For example, the observed increase in sales of some less healthy items may have resulted from inadvertent layout changes that made these items more prominent. Finally, we were not able to examine sales of fountain drinks nor whole grain products, which were both targeted by the intervention but not able to be measured using available POS data.

In conclusion, this study demonstrates that a mixture of behavioral design strategies can be operationalized with reasonable fidelity and can lead to increases in the sales of some healthy foods in military worksites. This work adds to the literature on behavioral design interventions in military food settings and contributes to the evidence on the effectiveness of workplace cafeteria interventions and congregate food service settings more broadly. CDC continues to support the use of behavioral design strategies in the food service setting by providing guidance.

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References

1. Afshin A, Sur PJ, Fay KA. Health effects of dietary risks in 195 countries, 1990–2017: a systematic analysis for the Global Burden of Disease Study 2017. Lancet. 2019;393(10184):1958–1972. [PubMed: 30954305]
2. Smith TJ, Marriott BP, Dotson L, et al. Overweight and obesity in military personnel: sociodemographic predictors. Obesity. 2012;20(7):1534–1538. doi:10.1038/oby.2012.25 [PubMed: 22314620]
3. Meadows SO, Engel CC, Collins RL, et al. 2015 department of Defense health related behaviors survey (HRBS). Rand Health Q. 2018;8(2):5.
4. NCCOR. Health, Behavioral Design, and the Built Environment White Paper. Washington DC: National Collaborative on Childhood Obesity Research. 2016. Retrieved from: https://www.nccor.org/wp-content/uploads/2016/09/nccor-behavioral-design-whitepaper-final.pdf.
5. Center for Disease Control and Prevention. Apply Behavioral Design Strategies. Atlanta: Center for Disease Control and Prevention; 2023. Retrieved from: https://www.cdc.gov/nutrition/food-service-guidelines/strategize-and-act/applied-strategies.html.
6. Broers VJV, De Breucker C, Van den Broucke S, Luminet O. A systematic review and meta-analysis of the effectiveness of nudging to increase fruit and vegetable choice. Eur J Publ Health. 2017;27(5):912–920. doi:10.1093/eurpub/ckx085
7. Hollands GJ, Carter P, Anwer S, et al. Altering the availability or proximity of food, alcohol, and tobacco products to change their selection and consumption. Cochrane Database Syst Rev. 2019; 9:CD012573. doi:10.1002/14651858.CD012573.pub3
8. Arno A, Thomas S. The efficacy of nudge theory strategies in influencing adult dietary behaviour: a systematic review and meta-analysis. BMC Publ Health. 2016;16:676. doi:10.1186/s12889-016-3272-x

9. Bucher T, Collins C, Rollo ME, et al. Nudging consumers towards healthier choices: a systematic review of positional influences on food choice. Br J Nutr. 2016;115(12):2252. doi:10.1017/S0007114516001653 [PubMed: 27185414]
10. Cadario R, Chandon P. Which healthy eating nudges work best? A meta-analysis of field experiments. Market Sci. 2020;39:465–486. doi:10.1287/mksc.2018.1128
11. Vecchio R, Cavallo C. Increasing healthy food choices through nudges: a systematic review. Food Qual Prefer. 2019;78:103714. doi:10.1016/j.foodqual.2019.05.014
12. Belanger BA, Kwon J. Effectiveness of healthy menu changes in a nontrainee military dining facility. Mil Med. 2016;181(1):82–89. doi:10.7205/milmed-d-15-00027 [PubMed: 26741481]
13. Crombie AP, Funderburk LK, Smith TJ, et al. Effects of modified foodservice practices in military dining facilities on ad libitum nutritional intake of US army soldiers. J Acad Nutr Diet. 2013;113(7):920–927. doi:10.1016/j.jand.2013.01.005 [PubMed: 23419999]
14. Shaw AM, Wootton SA, Fallowfield JL, Allsopp AJ, Parsons EL. Environmental interventions to promote healthier eating and physical activity behaviours in institutions: a systematic review. Publ Health Nutr. 2019;22:1518–1531. doi:10.1017/S1368980018003683
15. Des Jarlais DC, Lyles C, Crepaz N, TREND Group. Improving the reporting quality of nonrandomized evaluations of behavioral and public health interventions: the TREND statement. Am J Publ Health. 2004;94:361–366. doi:10.2105/ajph.94.3.361
16. Consortium for Health and Military Performance and Uniformed Services University. Go for green background. Human Performance Resources by CHAMP. Retrieved from: https://www.hprc-online.org/nutrition/go-green/g4g-mission/background-paper-pdf (Retrieved March 23, 2024).
17. Consortium for Health and Military Performance and Uniformed Services University. Go for green. Human Performance Resources by CHAMP. Retrieved from: https://www.hprc-online.org/G4G-Coding-Calculator (Retrieved March 23, 2024).
18. Army Public Health Center. Health information products e-catalog. Retrieved from: https://ephc.amedd.army.mil/HIPECatalog/searchResults.aspx?c=0&s=0&f=0&l=0&t=go.for.green (Retrieved March 23, 2024).
19. Division of Nutrition, PA, and Obesity. Healthy Hospital Food and Beverage Environment Scan. Atlanta: Centers for Disease Control and Prevention (CDC). https://www.cdc.gov/obesity/hospital-toolkit/pdf/Healthy-Hospital-Food-Beverage-Scan.pdf (Retrieved March 23, 2024).
20. Military nutrition environment assessment Tool (M-NEAT). https://www.med.navy.mil/Navy-Marine-Corps-Public-Health-Center/Population-Health/Health-Promotion-and-Wellness/Healthy-Eating/Military-Nutrition-Environment-Assessment-Tool/ (Retrieved March 23, 2024).
21. Steckler A, Linnan L. Process Evaluation for Public Health Interventions and Research. 1st ed. San Francisco: Jossey-Bass; 2002.
22. Lee-Kwan SH, Goedkoop S, Yong R, et al. Development and implementation of the Baltimore healthy carry-outs feasibility trial: process evaluation results. BMC Publ Health. 2013;13(1):638. doi:10.1186/1471-2458-13-638
23. Gittelsohn J, Suratkar S, Song HJ, et al. Process evaluation of Baltimore Healthy Stores: a pilot health intervention program with supermarkets and corner stores in Baltimore City. Health Promot Pract. 2010;11(5):723–732. doi:10.1177/1524839908329118 [PubMed: 19144859]
24. Arsenault JE, Singleton MC, Funderburk LK. Use of the Go-for-Green nutrition labeling system in military dining facilities is associated with lower fat intake. J Acad Nutr Diet. 2014;114(7):1067–1071. doi:10.1016/j.jand.2013.12.013 [PubMed: 24507627]
25. Cole RE, Bukhari AS, Champagne CM, McGraw SM, Hatch AM, Montain SJ. Performance nutrition dining facility intervention improves special Operations soldiers' diet quality and meal satisfaction. J Nutr Educ Behav. 2018;50(10):993–1004. doi:10.1016/j.jneb.2018.06.011 [PubMed: 30172700]
26. Kahneman D Maps of bounded rationality: psychology for behavioral economics. Am Econ Rev. 2003;93(5):1449–1475.
27. Food Service Guidelines Federal Workgroup. Food Service Guidelines for Federal Facilities. Washington, DC: U.S. Department of Health and Human Services; 2017. Retrieved March 23, 2024, Food Service Guidelines for Federal Facilities (cdc.gov).

So What?

What is already known on this topic?

Behavioral design uses cognitive, emotional, behavioral, and informational strategies to incentivize healthier behaviors, choices, and actions. Given that these strategies are often low-cost, minimally invasive, preserve alternate choices, and can be incorporated as permanent, they represent an opportunity to sustainably impart small effects, over time, across a population to improve dietary behaviors.

What does this article add?

This study examined behavioral design strategies at a military hospital dining facility. Strategies included placement, layout, messaging, healthy bundling, stoplight rating system, strategic positioning of healthy items on menu boards, and an increase in healthier snacks. These behavioral design strategies were successfully operationalized and led to increases in healthy foods sales.

What are the implications for health promotion practice or research?

A promising method to operationalize behavioral design and make it a normative part of creating healthy food environments is to include these strategies in institutional food service contracts, such as in universities and worksites. The US Centers for Disease Control and Prevention has developed Food Service Guidelines for Federal Facilities, which includes behavioral design strategies, as a best business practice to normalize a healthy food environment.

Table 1.

Fort Gordon Intervention Stages.

Stage 1	Stage 2	Stage 3	Stage 4
Formative research and intervention strategies development	Baseline data collection	Intervention implementation	Post-intervention data collection and feasibility study
Oct 2016 - Apr 2017	*Apr - Aug 2017*	*Aug - Dec 2017*	*Jan - Mar 2018*
Intervention development meetings with DFAC dietitians	Re-coding of 200+ foods	Implementation of 11 behavioral design strategies with correction and reinforcement by cafeteria management[a]	Intervention strategies no longer reinforced or corrected by cafeteria management
Behavioral design strategy selection	Food service staff training	Environmental scans (n = 6) Point-of-sale data collection (weekly)	In-depth interviews with food service managers and staff
Menu board, color-coded labels, signage development	Environmental scans (n = 3)		Environmental scans (n = 2)
Implementation manual of procedures development	Point-of-sale data collection (weekly)		Point-of-sale data collection (weekly)

[a]implementation of the fruit basket component occurred in week 4 of the baseline data collection period; analysis of fruit basket component was adjusted to account for shorter baseline data period

Table 2.

Intervention Behavioral Design Strategies and Corresponding Outcome Measures.

Behavioral design strategy	Description	Corresponding outcome measures	Data collection duration
Menu board redesign	Green-coded menu items were listed in most prominent menu positions (toward the corners of the menu); stoplight coding was used to label food items on menu	Total sales per menu cycle Green-coded, yellow-coded, and red-coded entrees Pies and cakes Pudding and fruit cups Fresh fruit Hot vegetables Cooked starches	45 weeks; Apr 2017-Feb 2018
Color-coded tags	Red, yellow, and green labels indicated to choose infrequently, choose occasionally, and choose often, respectively. Labels placed at salad bar, hot station food items, fountain drink station, and vending items	Total sales per menu cycle Green-coded, yellow-coded, and red-coded entrees Pies and cakes Pudding and fruit cups Fresh fruit Hot vegetables Cooked starches	45 weeks; Apr 2017-Feb 2018
Featured performance plate	Hot meal of protein, whole grain/starch, low-fat vegetable, and fruit that conformed to ‘green’ healthy designation and changed daily (Mon through Fri)	Total sales per menu cycle Green-coded entrees Hot vegetables Fresh fruit	45 weeks; Apr 2017-Feb 2018
Hot station redesign	Green-coded items served first in line, followed by yellow- coded, then red-coded items	Total sales per menu cycle Green-coded, yellow-coded, and red-coded entrees Hot vegetables Cooked starches	45 weeks; Apr 2017-Feb 2018
Short order redesign	Green-coded items were placed in prominent positions. Steamed vegetables were placed next to French fries	Total sales per menu cycle Hot vegetables French fries Grilled chicken Vegetable and Turkey burgers	45 weeks; Apr 2017-Feb 2018
Salad bar redesign	Green-coded items moved to the beginning of the line, yellow-coded and red-coded items moved to the end	Procurement - weekly delivered inventory Raw salad vegetables (eg, salad mix, radishes, shredded carrots) Salad dressings Pasta/macaroni salad, potato salad, bean salad, tuna	Not evaluated in this study
Assorted fruit baskets	A minimum of 4 different whole fruits placed throughout the cafeteria, including in front of registers	Total sales per menu cycle Whole fruit (eg, bananas, apples, oranges, kiwi, pears)	45 weeks; Apr 2017-Feb 2018
Vending redesign	Increased # of facings for green-coded vending items (eg, fruit cups, water, diet sodas). Placement of green-coded items at or above eye-level	Total sales per menu cycle To-go salads Wraps and sandwiches Hummus and pretzels Fruit cups Pudding Yogurt Cookies, cakes, pies, and brownies	45 weeks; Apr 2017-Feb 2018

Behavioral design strategy	Description	Corresponding outcome measures	Data collection duration
Communications messaging	Posters and table tents encouraged healthier choices, especially fruits and vegetables	Total sales per menu cycle Green-coded entrees Hot vegetables Fresh fruit	45 weeks; Apr 2017-Feb 2018
Healthier soda fountain additions	Addition of two beverage machines that offered low- or nocalorie carbonated drinks	Procurement - weekly delivered inventory Juice Iced tea Sodas (diet and regular) Sparkling water	Not evaluated in this study
Chip display redesign	Increased the ratio of healthier savory snacks, such as baked chips and popcorn, and placed at eye-level. Fried snacks placed at the bottom	Procurement - weekly delivered inventory Potato chips (fried and baked) Pretzels Popcorn	Not evaluated in this study

Table 3.

Mean Weekly Unit Sales of Selected Menu Items During Baseline, Intervention, and Post-intervention Study Periods, Adjusted for Total Sales Volume.

Category	Food item	Color label	Baseline	Intervention	*P*-value	Post-intervention	*P*-value
Entrees	Green entrees		684	764	$P = 0.22$	659	$P = 0.18$
	Red entrees		552	548	$P = 0.95$	901	$P = 0.17$
	Yellow entrees		474	430	$P = 0.66$	416	$P = 0.91$
Fruits, salad, sides	Hummus	Green	18	15	$P = 0.01$	13	$P = 0.56$
	Whole fruit	Green	853	921	$P = 0.18$	740	$P < 0.01$
	Fruit cup	Green	32	62	$P < 0.01$	67	$P = 0.50$
	Yogurt	Green	156	115	$P < 0.01$	123	$P = 0.23$
	Packaged salad	Green	45	127	$P < 0.01$	161	$P < 0.01$
Desserts	Desserts	Red	488	367	$P < 0.01$	371	$P = 0.88$
	Pudding	Yellow	29	30	$P = 0.73$	23	$P = 0.04$
French fries, starches, and cooked vegetables	Cooked starches	Green yellow red	2669	2498	$P = 0.01$	2426	$P = 0.46$
	Cooked vegetables	Green yellow red	1586	1703	$P = 0.01$	1672	$P = 0.57$
	French fries	Yellow	239	345	$P < 0.01$	407	$P = 0.04$
Grill items	Hamburgers, hot dogs	Yellow/Red	302	369	$P < 0.01$	348	$P = 0.40$
	Grilled chicken	Green	267	311	$P = 0.02$	308	$P = 0.91$
	Vegetable and Turkey burgers	Green/ Yellow	25	37	$P < 0.01$	30	$P = 0.07$

Table 4.

Adjusted Changes in Sales From Baseline to Intervention and From Intervention to Post-intervention[a].

	Incidence rate ratio (95% CI)			
	Baseline to intervention (model l)[b]		Intervention to post-intervention (model 2)[b]	
Food item	**Immediate change**	**Slope change**	**Immediate change**	**Slope change**
Green-coded entree	1.08 (0.85, 1.37)	1.00 (0.99, 1.01)	0.65 (0.31, 1.37)	1.01 (0.98, 1.04)
Yellow-coded entree	1.29 (0.74, 2.24)	0.99 (0.97, 1.01)	0.58 (0.07, 5.12)	1.03 (0.95, 1.13)
Red-coded entree	1.45 (0.98, 2.13)	0.98 (0.97, 1.00)	0.88 (0.21, 3.75)	1.01 (0.95, 1.08)
Hummus	1.33 (0.88, 2.02)	1.00 (0.98, 1.02)	12.66 (0.93, 172.93)	0.90 (0.81, 1.01)
Whole fruit	**1.23 (1.04, 1.45)**	0.97 (0.90, 1.04)	2.41 (0.42, 13.72)	0.97 (0.93, 1.02)
Fruit cups	**2.65 (1.32, 5.32)**	**0.97 (0.94, 0.99)**	**0.10 (0.04, 0.25)**	**1.11 (1.06, 1.16)**
Yogurt	0.84 (0.62, 1.12)	1.01 (1.00, 1.03)	**0.37 (0.17, 0.78)**	**1.06 (1.02, 1.10)**
Packaged salads	**41.96 (18.76, 93.87)**	**0.81 (0.76, 0.85)**	0.64 (0.37, 1.11)	**1.03 (1.01, 1.06)**
Desserts	1.26 (0.95, 1.67)	**0.98 (0.97, 0.99)**	**0.19 (0.05, 0.72)**	**1.09 (1.02, 1.15)**
Pudding	**3.82 (1.82, 8.01)**	**0.94 (0.91, 0.97)**	**0.09 (0.02, 0.33)**	**1.13 (1.06, 1.20)**
Cooked starches	0.92 (0.82, 1.03)	1.00 (1.00, 1.01)	**0.29 (0.12, 0.70)**	**1.05 (1.01, 1.10)**
Cooked vegetables	0.94 (0.84, 1.05)	**1.01 (1.00, 1.01)**	1.38 (0.99, 1.92)	**0.98 (0.97, 1.00)**
French fries	1.64 (0.99, 2.72)	0.99 (0.96, 1.01)	1.62 (0.61, 4.31)	0.99 (0.95, 1.02)
Hamburgers/hot dogs	0.90 (0.66, 1.21)	1.01 (1.00, 1.02)	**2.24 (1.45, 3.47)**	**0.96 (0.94, 0.97)**
Grilled chicken	0.98 (0.60, 1.60)	1.00 (0.98, 1.02)	**2.26 (1.09, 4.68)**	0.96 (0.92, 1.00)
Vegetable/Turkey burgers	**2.57 (1.73, 3.82)**	**0.96 (0.94, 0.98)**	**0.21 (0.06, 0.73)**	**1.07 (1.01, 1.13)**

[a]Estimates with $P < 0.05$ are in bold.

[b]Two negative binomial models were estimated for each food item. Model 1 was estimated over the baseline and intervention periods only (weeks 1–36) and included a two-way interaction between time trend and intervention period indicator (including main effects), total sales, the menu cycle, and the special meals indicator. Incidence rate ratio of the immediate change represents the exponent of beta-coefficient of intervention period indicator. Incidence rate ratio of the slope change represents the exponent of beta-coefficient of the interaction effect between time trend and intervention period indicator.Model 2 was estimated over the intervention and post-intervention periods only (weeks 4–45 for whole fruit, weeks 19–45 for all other items) and included a two-way interaction between time trend and post-intervention period indicator (including main effects), total sales, the menu cycle, and the special meals indicator. Incidence rate ratio of the immediate change represents the exponent of beta-coefficient of post-intervention period indicator. Incidence rate ratio of the slope change represents the exponent of beta-coefficient of the interaction effect between time trend and post-intervention period indicator.

Table 5.

Percentage of the Intervention Strategy Implemented as Intended During Baseline, Intervention, and Post-intervention.

	Availability			Prominent placement			Color-coded labels		
Strategy	**Baseline**	**Intervention**	**Post**	**Baseline**	**Intervention**	**Post**	**Baseline**	**Intervention**	**Post**
Featured performance plate	0%	100%	50%	0%	92%	50%	0%	100%	50%
Salad bar	100%	100%	100%	42%	79%	88%	0%	100%	100%
Green vegetable	100%	100%	100%	67%	100%	100%	100%	100%	100%
Green entree	67%	100%	100%	33%	83%	50%	67%	100%	100%
Green starch	67%	83%	100%	0%	83%	0%	67%	67%	100%
Grilled vegetable	0%	100%	0%	0%	100%	0%	0%	100%	0%
Grilled chicken	100%	100%	100%	33%	67%	0%	100%	100%	100%
Vegetable burger	100%	100%	100%	67%	100%	100%	100%	100%	100%
Menu board- hot food line	0%	100%	100%	0%	88%	100%	n/a	n/a	n/a
Menu board- short order bar	0%	100%	100%	0%	92%	100%	n/a	n/a	n/a
Water	67%	100%	100%	67%	100%	100%	0%	100%	100%
Fountain drinks [+]	n/a	n/a	n/a	n/a	n/a	n/a	0%	67%	100%
Chip display [+]	100%	100%	100%	75%	88%	100%	0%	50%	100%
Poster (salad)	0%	67%	50%	0%	67%	50%	n/a	n/a	n/a
Table tents	0%	67%	0%	0%	67%	0%	n/a	n/a	n/a
Total	19%	88%	57%	31%	90%	65%	26%	87%	83%

[+] Chip display and fountain drinks did not have placement strategy, rather, increasing the proportion of healthier versions;

[*] Percentage (%) of the time each strategy was implemented. Baseline n = 3, Intervention n = 6, post intervention n = 2. N/A indicates that the strategy is non-applicable and was not assessed