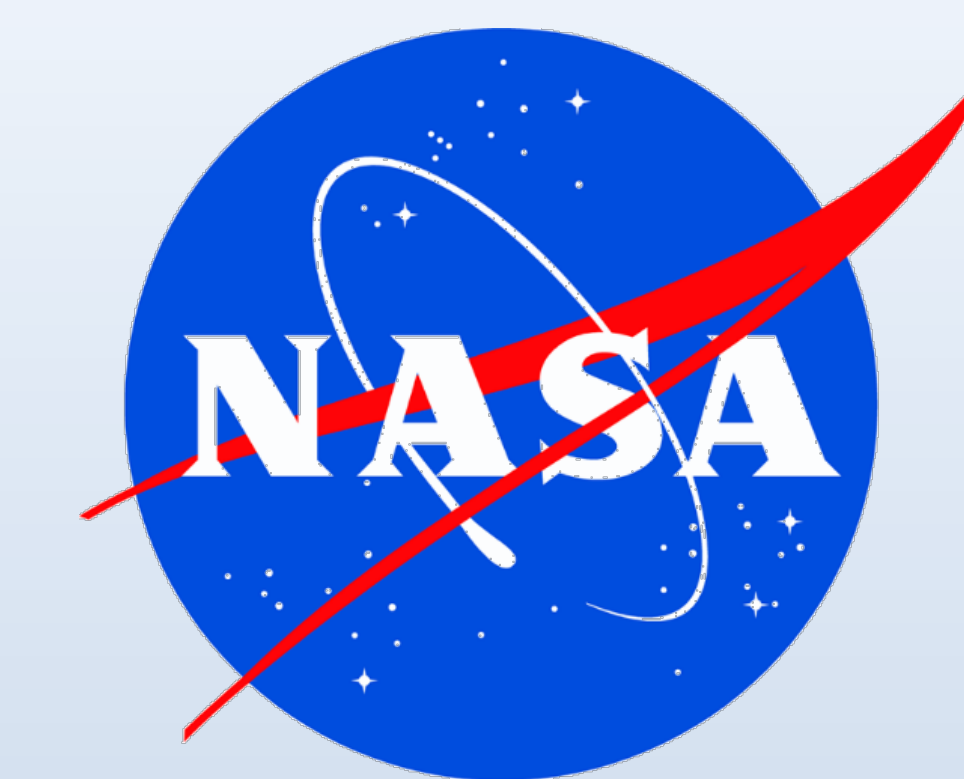


# Food Acceptability, Menu Fatigue, and Aversion on ISS Missions



Grace L. Douglas<sup>1</sup>, Peter G. Roma<sup>2</sup>, Millennia Young<sup>1</sup>

<sup>1</sup>NASA, Johnson Space Center, Houston, TX, <sup>2</sup>KBR, Houston, TX

## BACKGROUND

The acceptability of the spaceflight food system has been linked to caloric intake and associated nutritional benefits. The diets of the United States Operating Segment crewmembers during a mission are restricted to 200 processed and prepackaged standard menu items supplemented with personal preference foods. ISS crew members have noted in debriefs that they would prefer more food variety for the length of the missions and they tire of certain foods over six months. It is possible that menu fatigue leads to decreases in acceptability and increased aversion to available foods, potentially contributing to the body mass loss often experienced by ISS crew. However, the impact of repeat food consumption on acceptability within the current spaceflight food system has not yet been systematically investigated. Limited variety and crew preferences within food categories may have more severe physical and behavioral health and performance consequences as mission duration increases. Characterizing the relationship between food acceptability and mission duration will contribute to defining requirements for an acceptable food system that will support crew health and performance on long duration missions.

## OBJECTIVES

- Determine the impact of repeat consumption on food acceptability on the ISS within the current closed-variety spaceflight food system.
- Inform strategies to improve food system composition.

## CURRENT AND FUTURE FOOD SYSTEMS

### CURRENT

#### Eight Standard Category BOBs (Figure 1) Feeds a crew of three for 7-9 days

1. Breakfast
2. Rehydratable Meats
3. Meat and Fish
4. Side Dishes
5. Vegetables and Soups
6. Fruits and Nuts
7. Desserts and Snacks
8. Beverages

#### Supplemental Categories

- Personal Preference (up to 25% of intake)
- Condiments
- Fresh Foods



Figure 1: Bulk Overwrap Bag (BOB) of food. A set of eight BOBs contains up to 200 options in limited numbers.

#### Food Prep Capability

- Hot metered water
- Ambient water
- Food warmer
- Small chiller

#### Shelf Life

- 1.5 year min at room temp

### FUTURE CONSIDERATIONS

Up to three year mission

Food may be prepositioned – Will not support personal preference

No resupply

Mass, volume, and other resources may be more restricted than ISS

Food preparations capabilities may be more restricted than ISS

## METHODS

The following requests are used to capture open ended feedback:

Provide the context (e.g. Appearance; Taste; Texture/Mouth-feel) for any of your ratings.

Provide context on satisfaction or boredom with individual foods, and variety of the food system overall.

Provide any additional comments you would like to share regarding this meal.

Data are being assessed by descriptive statistics and visualizations of the ratings over time. The primary goal is to look for trends in the trajectories of ratings of the food items over time – both within and between individuals – to determine if there are substantial decreases in acceptability across all foods, or within specific food categories (e.g., vegetables). The number of times a particular item is scored provides some information on the frequency of consumption (preference), and the overall number of unique items can give a measure of overall variety. We will assess whether individuals were more likely to have more observations on food items that are rated higher, and whether those who rated foods higher had more or less overall variety. Since the data are composed of longitudinal subjective ratings, repeated measures techniques will be used to quantify acceptability trends over time and how these may relate to preference and variety. We will also provide content analysis of any additional feedback collected on the open-ended statements and debrief interviews.

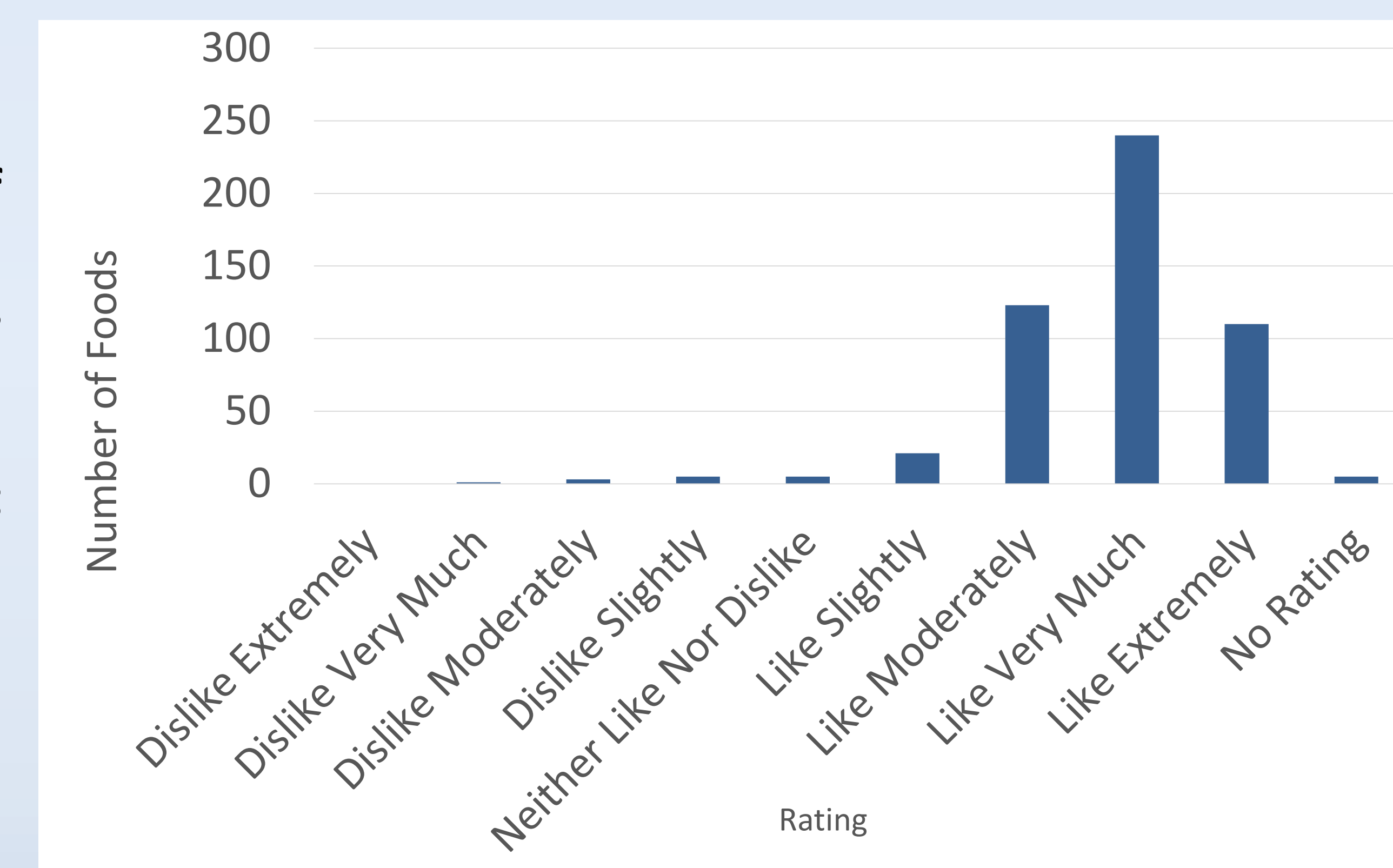
## PRELIMINARY RESULTS

Data collection is complete for five crewmembers and ongoing for three. Initial descriptive statistics are provided in Table 1. Preliminary assessments of data and open-ended comments suggest that crew limit selections to favorites early in the mission, but selected foods continue to receive acceptable scores throughout the mission duration (Figure 2). Onset of menu fatigue varies widely between individuals, and comments indicate it is due to limited variety and preference foods. Preference foods, fresh food deliveries, and International Partner foods add necessary variety, but comments indicate breakfast foods and vegetables are the most inadequate in variety and quantity. The consistent theme related to variety may indicate some menu strategies for long duration missions where preference foods will not be available.

Table 1: Initial overview of data from crew completing acceptability surveys (n=5)

Factor	Min	Max
Mission Length (Days)	198	204
First Comment Indicating Fatigue (Days)	75	106
First Comment on Inadequate Variety (Days)	8	75
Foods Rated Per Person	57	89
Foods Rated More Than Once	12	18

Figure 2: Although crew limited choices to favorites, most of the foods they rated continued to receive acceptable scores throughout the mission (above a 6 on a 9-pt hedonic scale). Post-mission debriefs support that foods that were liked initially continued to be liked and foods that were not liked initially were avoided throughout the mission.



## METHODS

In order to capture *in situ* scoring of repeat consumption experiences, a simulation study determined that a weekly questionnaire (Figure 3) must be administered to 10 crewmembers over six-month ISS missions (26 total occurrences). Crew score foods they consume at one meal a week on a 9-pt hedonic scale and provide open-ended feedback regarding food context, attributes, and the meal. The repetition is intended to target repeat consumption ratings of foods prior to menu fatigue through the point where they might stop eating those foods and begin eating other available foods or limiting their choices to their favorites.

Food Name	Dislike Extremely	Dislike Very Much	Dislike Moderately	Dislike Slightly	Neither Like Nor Dislike	Like Slightly	Like Moderately	Like Very Much	Like Extremely
<input type="text"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
<input type="text"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
<input type="text"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Figure 1: Example of questionnaire presented through the International Space Station Data Collection Tool.