Macronutrient Valuation: A Novel Tool to Study Food Preference and Choice

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In a study published in this issue of the Journal of Nutrition, Buckley et al. (1) develop a computerized task to measure macronutrient valuation that they define as the "value that humans place on a calorie derived from fat, carbohydrate, and protein". In the same paper, they then use the new method to explore how protein valuation correlates with body composition in a separate sample of community-dwelling elderly. The authors suggest that macronutrient valuation is a driver for food preference that might contribute to explaining food choices. According to this framework, preference for highly palatable and sweet foods might for instance result from a higher valuation of carbohydrates and fats, while higher protein valuation might explain preference for foods that are rich in protein. Studying protein valuation from this point of view is of particular interest: while our capacity to choose high-protein containing foods is essential for health, we cannot rely on a consciously perceptible sensory stimulus, as it is the case with texture for fat (2) or sweet taste for sugars. Indeed, despite evidence about the red color (3) or umami taste (4) being markers of dietary protein, there is no specific sensory characteristic that is shared among all high-protein containing foods. Therefore, it is more likely that our ability to choose dietary protein sources is based on conditioning that occurs throughout our life when we experience association between consumption of specific foods (here, sources of dietary protein) and beneficial nutritional outcome (here, suppression of amino acid depletion). While precise mechanisms that lead to such conditioning remain yet to be discovered as of today, studies in rodents and humans demonstrate that animals compose their diet in a way to ensure sufficient protein intakes, and a diet that is depleted in protein or essential amino acids provokes aversion and lower intakes as a result of experienced metabolic distress (5). In a natural setting, measure of protein valuation could thus be a useful method to explore how humans choose dietary sources of protein for their diet.

The procedure presented in the paper by Buckley and colleagues (1) consists in a computerized two-alternative forced-choice task using foods varying in macronutrient content. The task uses pictures of 25 foods that are often consumed by the British population, selected in a way to minimize inter-correlations between fat, protein and carbohydrate content. The task included 25

foods to generate 300 two-alternative choice trials. The volunteers made their choice while imagining that the food they chose would be the only food they could consume during the day. Valuation of a single macronutrient was then measured as the odds ratio of choosing a food if it contains 1 kcal/g more of that macronutrient than the second food alternative.

The authors studied test-retest reliability of the method on a sample of 90 healthy adults who completed the task twice on two separate days. They succeeded in demonstrating strong positive correlation in odds ratios for protein, carbohydrate, fat and energy density across sessions. It should however be noted that correlation for protein valuation was less strong compared to other odds ratios (protein: r=0.71; carbohydrate: r=0.97, fat: r=0.90 and energy density: r=0.86, respectively). Another noticeable result was that protein and carbohydrate appeared to be valued more than fat.

Higher protein valuation might help dietary protein detection and ensure adequate protein and essential amino acid intake. It remains to be studied whether higher protein valuation might facilitate choice of high-protein containing foods leading to enhanced appetite control, or explain overeating linked to lower protein-calorie dietary ratio known as the protein leverage effect (7). The issue is even more important for populations with specific needs as the elderly, in whom inadequate protein intake is associated with reduced muscle mass (8). The second study presented in the paper by Buckley et al. (1) tested the relationship between strength of protein valuation and fat-free mass index in a group of 84 community-dwelling older adults. They observed that individuals with higher protein valuation also displayed higher fat-free mass index. This observation shows potential importance of macronutrient valuation as a driver of healthy eating habits.

In summary, Buckley and colleagues develop a task that is reliable in the way that it is robust to test-retest and is not subject to self-reporting bias inherent to food preference questionnaires. It will be of use to the scientific community in a range of studies on food choice related to protein content, expected satiety or energy density. The principal limit appears to be the selection of foods

for the task, as one needs to avoid inter-correlation in macronutrient levels while also keeping foods familiar and well accepted by the volunteers. Thus, the task will need to be adapted when used in novel populations, especially in those with specific diets or food intolerance; however, such adaptation also confers flexibility to the method.

The perspectives of the study of macronutrient valuation are broad, however further studies should consider not only the influence of separate macronutrients but also interactions between them. A recent functional MRI study used a willingness-to-pay task to demonstrate that combination of fat and carbohydrate might increase food valuation in a supra-additive way (9). Studying interactions could shed additional light at the findings by Buckley and colleagues, which so far indicate that fat is the least valued macronutrient.

The origin of macronutrient valuation also needs clarification. Is it purely a result of a physiological drive to meet nutritional needs, or is it influenced by cognitive factors? Finally, the major step to make is to establish the link between macronutrient valuation and actual dietary choices. Although the study on elderly revealed a positive relationship between protein valuation and fat-free mass index, the authors did not observe interaction between protein valuation and protein consumption and suggest that this might be due to differences in individual habits or dietary environment. Therefore, while macronutrient valuation can be a marker of predisposition to consume certain foods, it is still unclear how much weight it has on shaping our dietary choices. Ultimately, study of macronutrient valuation has to consider food environment in which individuals are able to make a finite number of choices. This last point sends us back to the fundamental issue of fostering healthy eating in an environment that offers unhealthy food choices.

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