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Research report

Genetic influences on dietary variety - Results from a twin study [☆]Benjamin Scheibehenne ^{a,*}, Peter M. Todd ^b, Stéphanie M. van den Berg ^c,
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ABSTRACT

The heritability of variety seeking in the food domain was estimated from a large sample ($N = 5,543$) of middle age to elderly monozygotic and dizygotic twins from the “Virginia 30,000” twin study. Different dietary variety scores were calculated based on a semi-quantitative food choice questionnaire that assessed consumption frequencies and quantities for a list of 99 common foods. Results indicate that up to 30% of the observed variance in dietary variety was explained through heritable influences. Most of the differences between twins were due to environmental influences that are not shared between twins. Additional non-genetic analyses further revealed a weak relationship between dietary variety and particular demographic variables, including socioeconomic status, age, sex, religious faith, and the number of people living in the same household.

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Introduction

Across many domains in daily life, having a variety of options to choose from is generally appealing (Bown, Read, & Summers, 2003; Catania, 1980). When choosing food, the tendency to seek variety and to avoid monotony holds for humans and other omnivores alike. Indeed, the consumption and liking of many foods decline if consumed for several days in a row (Addessi, 2008; Meiselman, deGraaf, & Leshner, 2000), and a monotonous diet of “nutrалоof” is still used as punishment in U.S. prisons (Barclay, 2014). Eating a varied diet has important health consequences as it helps to achieve an adequate intake of macro- and micronutrients, thereby reducing the risk of nutritional deficiencies (Drewnowski, Henderson, Driscoll, & Rolls, 1997; Hodgson, Hshuge, & Wahlqvist, 1994; Krebs-Smith, Smiciklas-Wright, Guthrie, & Krebs-Smith, 1987; Nicklaus, 2009). Consuming a variety of foods has also been related to a decrease in the consumption of fatty foods (Elmadfa & Freisling, 2005), increased consumption of fruits and

vegetables (Bernstein et al., 2002), and a lower risk of heart diseases among diabetics (Wahlqvist, Lo, & Myers, 1989). In line with this, according to the Food and Agriculture Organization of the United Nations, dietary guidelines around the world advise consumers to eat a variety of foods.

Increasing food variety can also lead to greater consumption in human and non-human omnivores, a phenomenon sometimes called “buffet effect” (Johnson & Vickers, 1993; Kahn & Wansink, 2004; Lyman, 1989; Rolls, Van Duijvenvoorde, & Rowe, 1983). This may help to improve nutritional status and to preserve body mass, for example, in elderly adults (Bernstein et al., 2002; Marshall, Stumbo, Warren, & Xie, 2001). However, for those individuals who do not face a risk of weight loss, a variety-driven increase in caloric intake may contribute to the growing obesity epidemic in modern societies, especially if the variety stems from high-energy foods like sweet and fatty snacks (Foote, Murphy, Wilkens, Basiotis, & Carlson, 2004). Because such unhealthy snacks increasingly outnumber healthy options like fruits and vegetables in many modern food environments (McCrorry et al., 1999), chances are that any new food item added to an individual’s diet in those environments will lower the average quality of that diet. Thus, it comes as no surprise that dietary variety often correlates positively with body weight, especially if the variety stems from energy-dense foods (Foote et al., 2004; Nicklaus, 2009).

Given these wide-ranging positive and negative consequences of a varied diet, it is important to better understand the causes of food variety seeking, and how individual differences in observed

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dietary variety can be explained. Here, we address this issue by estimating what proportion of these differences can be accounted for by heritable genetic influences. The analysis is based on data from twins who reported their eating habits. As a starting point for this empirical analysis, we distinguish different levels of dietary variety on theoretical grounds, outlined next.

Different levels of dietary variety

Variety seeking describes the tendency to choose different options from one occasion to the next, even if this requires switching to options that were less preferred initially (Ariely & Levav, 2000; Pessemer & Handelsman, 1984). The variety of a diet can be assessed on different levels of abstraction (Van Trijp & Steenkamp, 1990). On a broad level, variety can refer to the proportions of whole groups of foods like vegetables and fruits, a measure that provides the basis for many dietary guidelines and food pyramids. Besides this categorical level, variety can also be assessed on the level of individual food items or products. This approach typically takes into account the number of different food items that a person consumes within a given period of time and possibly also its share in total consumption (Van Trijp & Steenkamp, 1990). Here, a typical finding is that an increase in available variety increases consumption, as in the case of the buffet effect mentioned above (Rolls et al., 1983).

Variety on the item level can be further distinguished from the level of specific sensory attributes like the taste and the texture of single foods. Here, the key idea is that a set of foods consisting of distinct items that are similar in taste and texture yields less variety than a same-sized set consisting of items with disparate attributes. Monotony due to low variety at this level yields a decrease in consumption, presumably triggered by sensory-specific satiety (e.g. Inman, 2001; Rolls, Rolls, Rowe, & Sweeney, 1981). Furthermore, dietary variety can also be analyzed on the level of specific nutrients, for example, by distinguishing different carbohydrates, fats, or amino acids, which is a common approach in clinical nutrition studies (e.g. Foote et al., 2004).

Research on dietary variety has also distinguished different time frames, ranging from short term or acute periods (e.g. observing a single meal at home or at a buffet), to long-term studies that extend over the course of weeks or months (e.g. monitoring food consumption and preferences at different occasions; Schutz & Pilgrim, 1958). Here we focus on long-term dietary variety that is most likely to influence health, at the level of single food items consumed over an extended period of time.

Factors that influence dietary variety seeking

The degree of variety that different individuals include in their daily diets varies considerably, even among individuals who share the same cultural background (Van Trijp, Lähteenmäki, & Tuorila, 1992). While some people tend to live on a rather restricted range of foods, others consume considerable variety across many food categories (Rozin & Markwith, 1991).

These observable differences may be partly explained by external or situational factors, including fluctuations in what food options are available or constraints due to religious beliefs, budget constraints, knowledge about different food options, or medical conditions that demand a restricted diet (McAlister & Pessemer, 1982; Van Trijp, 1994; Van Trijp et al., 1992). Within a family, food choices may also depend on the needs and taste preferences of other family members, in particular nutritional gatekeepers who govern food purchase and preparation (Wansink, 2003).

However, past research further indicates that individual differences in variety seeking seem to be somewhat stable over time and situations, suggesting that variety seeking may resemble a person-

ality trait and thus be partly governed by internal factors. For example, one longitudinal study (Nicklaus, Boggio, Chabanet, & Issanchou, 2005) found that dietary variety at ages 2 to 3 was a good predictor for individual differences in food variety seeking in early adult life (see also Siegel & Pilgrim, 1958). Individual levels of food variety seeking also seem relatively consistent across different food categories, including soups, fruits, and sodas (Rozin & Markwith, 1991; Van Trijp & Steenkamp, 1992). To better understand these internal factors that drive food variety seeking, we briefly turn to related personality traits, outlined next.

Personality traits

Individual differences in dietary variety seeking may be driven by a range of internal factors, including the desire to seek (external) stimulation across different domains of daily life (Howard & Sheth, 1969; McAlister & Pessemer, 1982; Zuckerman, 1979). From that perspective, dietary choices may provide a means to regulate the experienced level of stimulation, for example, by increasing the degree of variety through choosing familiar but dissimilar food items (Van Trijp et al., 1992; Venkatesan, 1973).

To the degree that dietary variety seeking is driven by a desire for an optimal level of (external) stimulation, it may also be related to explorative traits like novelty seeking, the desire to consume novel or unfamiliar foods, and its opposite, food neophobia. Both tendencies have been shown to apply across different food categories and to be stable over time (Pliner & Hobden, 1992). In line with the idea that these traits share a common source, food neophobics have been shown to include less variety in their diet than those without neophobia (Falciglia, Couch, Gribble, Pabst, & Frank, 2000).

Another factor that may influence dietary variety seeking is individual differences in sensory-specific satiety – the degree to which the subjective value or reward of specific (food) stimuli or tastes gradually declines over time. Sensory-specific satiety provides a lower-level mechanistic explanation of the common finding that the acceptance and consumption of many food items decreases if they are repeatedly served for several days or even months in a row (Meiselman et al., 2000; Rolls & De Waal, 1985; Schutz & Pilgrim, 1958; Siegel & Pilgrim, 1958), even if it was highly attractive initially (Addessi, 2008). Thus, people who satiate more quickly to a particular taste may be more prone to seek greater diversification in their diet across a given period of time (Addessi, Mancini, Crescimbeni, Ariely, & Visalberghi, 2010; Epstein, Temple, Roemmich, & Bouton, 2009; Pessemer, 1985; Van Trijp, 1994). However, even though sensory-specific satiety has a strong biological basis and is relatively stable over time (Rolls, 2007), it usually refers to similarities of specific food attributes, including taste, appearance, smell, and texture, that are presented within a short time frame (Hetherington, Rolls, & Burley, 1989; Rolls et al., 1981). Thus, it is not clear how far it relates to variety seeking on the level of food items that are consumed over an extended period of time, which is the focus of this paper.

Evolutionary factors

From an evolutionary perspective, seeking dietary variety has both advantages and disadvantages. As an advantage, dietary variety helps omnivores to maintain a balanced food intake, and to avoid a reliance on a limited number of food sources that might deplete or disappear in variable environments (Addessi, 2008; Raynor & Epstein, 2001). On the other hand, each additional food source also increases the chances of eating contaminated or pathogen-bearing food that can impose high fitness costs on the individual. While this risk might be less prevalent in our modern food environments, it may have been an important selection force

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