



Just-about-right and ideal scaling provide similar insights into the influence of sensory attributes on liking



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ABSTRACT

Just-about-right (JAR) scaling is criticized for measuring attribute intensity and acceptability simultaneously. Using JAR scaling, an attribute is evaluated for its appropriateness relative to one's hypothetical ideal level that is pre-defined at the middle of a continuum. Alternatively, ideal scaling measures these two constructs separately. Ideal scaling allows participants to rate their ideal freely on the scale (i.e., without assuming the "Too Little" and "Too Much" regions are equal in size). We hypothesized that constraining participants' ideal to the center point, as is done in the JAR scale, may cause a scaling bias and, thereby, influence the magnitude of "Too Little" and "Too Much". Furthermore, we hypothesized that the magnitude of "Too Little" and "Too Much" would influence liking to different extents.

Coffee-flavored dairy beverages ($n = 20$) were formulated using a fractional, constrained-mixture design that varied the ratio of water, milk, coffee extract, and sucrose. Participants tasted 4 of 20 prototypes that were served in a monadic sequential order using a balanced incomplete block design. Data reported here are for participants randomly assigned to one of two research conditions: ideal scaling ($n = 129$) or JAR scaling ($n = 132$). For both conditions, participants rated overall liking using a 9-point hedonic scale. Four attributes (*sweetness*, *milk flavor*, *coffee flavor* and *thickness*) were evaluated. The reliability of an individual participant's ideal rating for an attribute was evaluated using the standard deviation of their ideal ratings ($n = 4$). All data from a participant were eliminated from further analyses when his/her standard deviation of the ideal ratings for any of the four rated attributes was identified as a statistical outlier. This resulted in the elimination of 15 of 129 (12%) of participants in the ideal scaling group. Multiple linear regression was employed to model liking as a function of "Too Little" or "Too Much" attribute intensities.

Mean ideal ratings (averaged across participants) for all four attributes were significantly different from the central point of the scale (i.e., 50). However, *coffee flavor* was the only attribute for which the mean ideal rating (57.2) fell outside the central 10% (45.0–55.0). Even so, the magnitude of "Too Little" and "Too Much" was not affected by the scaling method. The influence of the magnitude of "Too Little" and "Too Much" on liking was asymmetrical. Both scaling methods agreed that *sweetness* and *coffee flavor* were the main sensory attributes affecting liking. Overall, JAR scaling and ideal scaling were comparable for measuring "Too Little" and "Too Much", and identifying the main factors affecting liking.

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Introduction

Just-about-right (JAR) scaling is widely applied in the food industry for product development (Popper & Gibes, 2004; Rothman & Parker, 2009; Xiong & Meullenet, 2006). JAR scales are popular in marketing and R&D departments in the industry due to their ease of use and directional guidance (Ares, Barreiro,

& Giménez, 2009; Gacula, Rutenbeck, Pollack, Resurreccion, & Moskowitz, 2007; Popper & Kroll, 2005). JAR scales are reported to be an easy way to determine if an attribute's intensity is at an optimal level (Lawless & Heymann, 2010; Moskowitz, 2001; Popper & Kroll, 2005). This technique is commonly used at an early stage of product development (Pangborn, Guinard, & Meiselman, 1989), when a systematic solution (e.g., full formulation design) is not available, or cost or time is a concern.

The JAR scale is a bipolar measurement. In JAR scaling, two semantically opposite anchors, e.g., "Not Sweet At All" and "Much Too Sweet", are placed at each end of the scale, and the midpoint is labeled "Just About Right" or "Just Right" (Booth, Thompson, &

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Shahedian, 1983; Rothman & Parker, 2009; Shepherd, Smith, & Farleigh, 1989). “Just About Right” or “Just Right” is assumed to be a participant’s ideal level (van Trijp, Punter, Mickartz, & Kruithof, 2007). Using JAR scaling, an attribute is evaluated for its performance (appropriateness) relative to this ideal level (Rothman & Parker, 2009; Worch, Dooley, Meullenet, & Punter, 2010). Attribute performance could be “Too Little”, “Too Much” or “Just About Right”. Generally, “Too Little” or “Too Much” attribute intensity is estimated by the deviation of the participant’s scale rating from the center point of the scale. The intensity of an attribute can be increased if it is perceived as “Too Little,” or decreased if it is perceived as “Too Much”. For this reason, the JAR scale is recognized as a directional tool (Moskowitz, 2001).

JAR scaling combines the measurements of attribute intensity and consumer acceptability (Moskowitz et al., 2008). Some researchers have criticized this practice, and suggested JAR scaling should not replace traditional experimental design for product optimization (Stone & Sidel, 2004). Others claim JAR scaling is a challenging task for naïve consumers because these ratings involve at least three decisions: (a) perception of the attribute intensity; (b) location of the participants’ ideal point; and (c) comparison of the difference between perceived intensity and ideal point (Moskowitz, 2001; van Trijp et al., 2007). Furthermore, studies find optimal formulations achieved by JAR scaling differ from those predicted by hedonic scores (Epler, Chambers, & Kemp, 1988; Shepherd et al., 1989).

JAR scales may incorporate some unique biases. JAR ratings may be influenced by cognitive factors in addition to perception (Rothman & Parker, 2009). For example, a participant who is on a diet may treat “sweetness” of ice cream as a negative attribute, and tend to always rate ice cream as “too sweet”. Conversely, for a product attribute that positively influences *liking*, a participant might always rate it “not enough”. For instance, a participant who likes to eat meat may always rate the meat topping on a pizza “not enough”.

Alternatively, ideal scaling separates the measurements of attribute intensity and acceptability using two identical scales (Gilbert, Young, Ball, & Murray, 1996; Rothman & Parker, 2009; van Trijp et al., 2007; Worch, Le, Punter, & Pages, 2012a). In ideal scaling, acceptability is presumably maximized at the ideal intensity level. Both JAR scaling and ideal scaling implicitly assume a participant has an “ideal” (level) for a specific attribute, which may not be valid if the individual is truly indifferent to changes in that attribute. Moreover, these two methods differ in where the ideal level is assumed to lie. Unlike JAR scaling, where the ideal level is fixed at the central point of the scale, ideal scaling allows a participant to designate his/her hypothetical ideal level anywhere on the scale, and “Too Little” and “Too Much” are estimated by the difference between perceived intensity and ideal intensity. Ideal scaling has been applied in the industry and academia for decades (Gilbert et al., 1996; Goldman, 2005; Hoggan, 1975; van Trijp et al., 2007; Worch et al., 2012a). However, comparisons of JAR scaling and ideal scaling for measurement of “Too Little” or “Too Much” are lacking. Here we hypothesized participants’ ideal intensities differ from the central point of the scale, which consequently may influence the measurement of “Too Little” and “Too Much,” and their effect on *liking*.

Materials and methods

This study was a part of a larger experiment designed to optimize a coffee-flavored dairy beverage for a facility on the Penn State campus. Participants ($n=388$ in total) were randomly assigned to one of three research conditions that differed only in ballot design. For the purpose of this study, only the data from

research conditions that applied ideal scaling and JAR scaling are discussed. In both conditions, participants were asked to rate *liking* as well as attribute intensities for *sweetness*, *milk flavor*, *coffee flavor*, and *thickness*. Procedures were exempted from IRB review by the Penn State Office of Research Protections staff under the wholesome foods exemption in 45 CFR 46.101(b)(6). Participants provided informed consent and were compensated for their time.

Participants

A total of 261 participants (70 male, 191 female) were invited and finished the product evaluation using either ideal scaling ($n=129$) or JAR scaling ($n=132$). Participants were recruited ahead of time using an existing participant database managed by the Sensory Evaluation Center at Penn State, or via staff intercepts in public spaces in or around the Food Science Department at Penn State.

To qualify for participation, individuals had to be regular drinkers of coffee or coffee-flavored beverages (Table 1), and free of food allergies. The majority of participants (105) were between 18 and 27 years old, 49 were 28 and 37, 38 were 38 and 47, 48 were 48 and 57, 18 were 58 and 67, and only 3 were over 67 years old. The majority were White ($n=205$, ~78.5%); 36 identified themselves as Asian or Pacific Islander, 7 as African or African American, 8 as Hispanic/Latino, and 5 did not report their ethnicity.

Sample formulation and preparation

Using eChip® software (Wilmington, DE), twenty coffee-flavored dairy beverages were formulated using a fractional, mixture design with four constrained variables: coffee extract (3.0–5.0 wt%); Autocrat Sumatra 1397, Autocrat Natural Ingredients, Lincoln, RI), sucrose (5.0–8.0 wt%), milk (35–55 wt%, 2% fat, Berkey Creamery, University Park, PA), and water (35–55 wt%). These components accounted for 99.8% of the individual formulations. A constant amount of pectin (0.2 wt%; Grinsted® SY, Dupont Danisco) was added to all the samples. The composition of each formula is shown in Table 2. Pectin solutions were first prepared by blending pectin into the water. Coffee extract, milk, and sucrose were added to pectin solutions. Batches were heated to 72 °C to assure that the sucrose was completely dissolved, the pectin dispersed, and the product was safe for human testing. The finished prototypes were stored at refrigeration temperature (~4 °C) for at least 24 h before serving. Two ounces of coffee milk were served in 4-oz Solo transparent plastic cups (Solo Cup Company, Urbana, IL).

Sensory evaluation

Participants were randomly assigned to one of two research conditions upon entering the test booths. To minimize fatigue, a balanced incomplete block design (Gacula, 2008) was applied to alleviate carryover effects; accordingly, each participant tasted only 4 of 20 samples. For each sample, participants were asked to rate their overall *liking* and attribute intensity. The attributes assessed included *sweetness*, *milk flavor*, *coffee flavor*, and *thickness*.

Liking was assessed using a standard 9-point hedonic scale (1 = “Dislike Extremely”, 5 = “Neither Like Nor Dislike”, and 9 = “Like Extremely”) (Peryam & Pilgrim, 1957). Attribute intensities, both perceived and ideal, were measured using continuous line scales (0–100); two descriptive anchors were placed at 10% and 90% of these scales, representing low intensity (e.g., “Not At All Sweet”) and high intensity (e.g., “Extremely Sweet”). Just-about-right (JAR) scales were designed as continuous line scales with three descriptive anchors, low intensity (i.e., “Much Too Weak”) on the left end, “Just About Right” at the center, and high intensity (i.e., “Much Too Strong”) on the right end. Demographics

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