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Research report

Potential of an analog scaling device for measuring fullness in children: Development and preliminary testing

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Abstract

Improving children's abilities to recognize when they are full is one strategy to prevent overweight, but currently, there are few validated instruments to assist this process. In the present study, we developed and tested the potential of an analog scaling device for quantifying sensations such as fullness in 4–5 year old children. The device was a picture of a doll with a rectangular stomach over which a sliding bar could be moved to communicate rated fullness levels. Eleven 4–5 year old children were shown pictures of French fries and fruit salad in five varying portion sizes that increased in diameter exponentially by a power of 1.5, ranging from 5.2 to 18.5 cm. Success in using the device was predefined as an increase in ratings as a function of increasing portion size, in at least one of two trials. Eight children were successful with the fries, and ten were successful with the fruit salad. Mean ratings across children were significantly different from each other for both foods. These data show that children can be trained to use an analog scale to quantify differences in portion sizes of foods. Future experiments will validate this scaling procedure for measuring fullness in real eating situations. If successful, this methodology might have applications to the measurement of other bodily sensations in young children.

Keywords: Analog scales; Fullness; Satiety; Child feeding; Overweight

Introduction

Visual analog scales (VAS) are commonly used to assess sensations such as hunger and fullness, and the information they provide can be particularly useful in studies of human eating behavior and obesity. While VAS methods have been researched extensively in adults (Flint, Raben, Blundell, & Astrup, 2000; Parker et al., 2004), there are few instances when they have been tested in young children (McGrath et al., 1996; Tyler, Tu, Douthit, & Chapman, 1993). There are many situations, however, in which VAS might elicit useful information from children that cannot be gained through the use of category scales. In our laboratory, we are interested in studying how children develop and express feelings of hunger and satiety. Of particular concern is the lack of validated testing procedures for children younger than 8, despite the fact that by this age, many have already developed excess body fat (Ogden, Flegal, Carroll, & Johnson, 2002). To this end, the objective of the present study was to evaluate the potential of training preschool children to rate their own fullness by determining if they could first be taught to use an analog scale to rate fullness level of a doll. Our primary goal was to determine whether children could use the scale first, without the use of actual foods, as a preliminary step to eventually testing this methodology in a real eating situation.

The idea for developing a fullness scale for children originated from our prior work (Faith, Kermanshah, & Kissileff, 2002) in which five silhouettes, each with incremental amounts of jelly beans in their stomachs to represent different levels of fullness, were employed as a category scale with a sample of local preschool children.

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Children were able to use this scale to rate increasing levels of fullness in response to imagined eating situations, corresponding to hunger, partial fullness, and fullness. However, in order to evoke a wider range of responses and potentially be able to measure children's sensitivities across a range of stimulus intensities, it was felt that an analog scale might be more appropriate. Research has also shown that VAS may be more sensitive in measuring pain responses than are category scales (Joyce, Zutshi, Hrubes, & Mason, 1975). Moreover, while VAS are typically anchored with adjectives that represent the extremes of a particular state (e.g. pain or hunger) (Hill, Magson, & Blundell, 1984), they can also be adapted for use without words. In theory, this scale might be simpler to use, especially for participants who have limited reading ability, such as children.

There are several reasons why VAS have not been widely used with young children. Of primary importance, most studies suggest that these scales are not reliable in children under the age of 5 (McGrath, de Veber, & Hearn, 1985). Berk (1994) suggests that successful and reliable use of a VAS requires a child to have the ability to seriate his or her perceptions, from smallest to largest. Developmentally, this typically occurs by the time children are in the Concrete Operational Period (Piaget, 1952), or around the age of 7 (Berk, 1994). What past studies have neglected to include, however, is an extensive training period to teach children who may not yet have reached the Concrete Operational Stage how to properly use a VAS. One study found that using a short training script increased children's abilities to rate the perception of pain on a VAS, compared to untrained children (Shields, Cohen, Harbeck-Weber, Powers, & Smith, 2003). This suggests that with some training, reliability and accuracy in using analog scales can improve. Consistent with this observation were data from certain child development researchers that challenged some of the initial tenets of Piaget's theory, suggesting that children may have greater cognitive capabilities than previously believed (Case & Okamoto, 1996). In the present study, we developed an extensive training procedure to teach children how to use a VAS. Given that the training activities were developed with the continual advice of preschool teachers, we targeted this training procedure at children who were four- to five-years-old.

What are the potential applications for developing a VAS for children? From a clinical perspective, such scales might be useful in identifying children with impaired satiety responses. For example, in adults, Wentzlaff, Guss, and Kissileff (1995) used VAS to question lean women about hunger and fullness ratings during a meal, after they had consumed specified amounts of a tomato soup test meal. They concluded that certain parameters derived from the relationship between fullness rating and intake might be used to identify characteristics of disturbed eating in clinical populations. More specifically, the authors hypothesized that subjects who showed little change in fullness ratings over the course of eating the soup might have some impairment in their satiety responses. This was supported in a follow-up study, where investigators (Kissileff et al., 1996) noted that bulimics had to eat more food to reach the same reported level of satiation as the controls. In hopes of extending these results, one of the primary goals for the present study was to develop an instrument that would allow us to determine in subsequent investigations if overweight children experienced a similar phenomenon as the bulimics in Kissileff's study, that is, would they have to eat more than lean children to experience the same level of fullness.

A second possible application is that such scales might be useful in the treatment of overweight children, or for overweight prevention. Current estimates suggest that $\frac{1}{4}$ of US children are either at risk for overweight or are overweight (Strauss & Pollack, 2001), and overweight in childhood is a risk factor for health problems later in life, including cardiovascular complications and type II diabetes (Fagot-Campagna, Saaddine, Flegal, & Beckles, 2001; Freedman, 2002). While the causes of obesity are not completely understood, energy intake in excess of energy expenditure is the ultimate determinant. Accordingly, improving a child's ability to regulate energy consumption remains a key strategy for overweight prevention and treatment. That being said, few studies have been done to actually develop and test appropriate strategies for teaching children how to regulate food consumption. Johnson and Birch (2000) found that it is possible to improve a child's ability to regulate food intake following a preload by offering an educational intervention to teach children to recognize internal satiety cues. In the same way, a validated VAS for children could be used as a teaching device to instruct them on how to better monitor their energy intake by providing them with optimal levels at which to start and stop a snack or a meal.

The objectives of the present study were: (1) to develop a procedure for training preschool children to rate fullness level on a doll, and (2) to pilot the scale and training procedure by having children make estimated fullness ratings in response to viewing pictures of different sized portions of French fries and fruit salad. We use the term "estimated" to describe these ratings because the primary aim of this paper is to develop and pilot this methodology in a simulated eating environment, and we cannot ascertain that children's ratings represent fullness as it pertains to their own bodily sensations. We hypothesized that for at least 50% of the trials, children's estimated fullness ratings would increase as a function of increasing portion size. In addition, we hypothesized that as a group, mean estimated fullness ratings would show significant increases across each of the five portion sizes for both foods tested.

Methods

Subject characteristics and recruitment: Eleven children were recruited from the Columbia University Preschool.