ELSEVIER

Physiology & Behavior 83 (2005) 813–819

PHYSIOLOGY & BEHAVIOR

Changes in the perceived pleasantness of fluids before and after fluid loss through exercise: a demonstration of the association between perceived pleasantness and physiological usefulness in everyday life

K.M. Appleton*

Department of Experimental Psychology, University of Bristol, 8 Woodland Road, Bristol, BS8 1TN, UK

Received 30 April 2004; received in revised form 23 August 2004; accepted 5 October 2004

Abstract

It has previously been suggested that the perceived pleasantness of a food item in any situation may be directly related to the physiological usefulness of that item to the consumer in that situation. This study investigated changes in the perceived pleasantness of fluids before and after fluid loss through exercise—an everyday situation in which physiological need can alter. Total of 40 exercisers achieving high fluid loss (Group H) and 41 exercisers achieving low fluid loss (Group L) rated seven fluids of varying osmolality, electrolyte content, and energy content on measures of pleasantness, before and after exercise. After fluid loss compared to before fluid loss, perceived pleasantness of all fluids increased ($F(1,79)=14.58$, $p<0.01$), and effects were greater in Group H compared to Group L ($F(1,79)=8.29$, $p<0.01$). Perceived pleasantness was also significantly higher for fluids of lowest osmolality ($F(6,474)=2.14$, $p<0.05$), and effects were again greater in Group H compared to Group L ($F(6,474)=2.10$, $p<0.05$). Both findings suggest that perceived pleasantness is related to physiological usefulness, and can be demonstrated in everyday situations.

Keywords: Pleasantness; Liking; Physiological usefulness; Physiological need; Fluids; Fluid loss; Real world; Humans

1. Introduction

It is increasingly recognised that the perceived pleasantness of any food or fluid item is determined not only by the physical and chemical properties of that item but also by the physiological characteristics of those consuming [1,2]. Perceived pleasantness has been found to differ between individuals, dependent on physiological characteristics such as age, body weight and body status [3–5], and within individuals, dependent on short-term physiological situation such as concurrent hunger and recent satiety [6–8].

Related to short-term physiological situation, it has previously been suggested that the perceived pleasantness of a food or fluid item may be directly related to the 'physiological usefulness' of that item to the consumer [9,10]. According to Cabanac [9], 'a stimulus can feel pleasant or unpleasant depending upon its usefulness as determined by internal signals' [p. 1103]. This theory of 'physiological usefulness' thus suggests that any food or fluid of physiological usefulness to the consumer in a specific physiological situation will be perceived as highly pleasant within that situation. In a physiological situation of high salt requirement, for example, salt/salty foods are expected to be perceived as highly pleasant. However, once salt requirements are satisfied and the physiological situation of salt requirement no longer exists, the perceived pleasantness of salt/salty foods would reduce. Similarly, in a physiological situation of high fluid requirement, fluids are expected to be perceived as highly pleasant; once fluid requirements, however, are satisfied, the perceived pleasantness of fluids would reduce.

Changes in the perceived pleasantness of salt in association with changes in physiological requirements for

* Tel.: +44 117 954 6618; fax: +44 117 928 8588.
E-mail address: k.appleton@bristol.ac.uk.

0031-9384/$ - see front matter © 2004 Elsevier Inc. All rights reserved.
doi:10.1016/j.physbeh.2004.10.001

salt have been reported perceived (e.g., Refs. [11–13]). In these studies, and in similar studies, however, physiological requirements have often been extreme, artificially induced, or contaminated by additional factors such as the presence of disease.

Changes in fluid requirements, in comparison, are frequently and naturally experienced in everyday life. Changes in fluid requirements occur often as a result of participation in exercise. During exercise, fluids (water and electrolytes) are lost; physiological requirements for water and electrolytes consequently increase [14,15]. Physiological requirements for water and electrolytes, thus, are higher after exercise than before exercise.

Exercise, however, does not only result in water and electrolyte loss. Energy is also lost during exercise, and physiological requirements for energy will also increase [14,15]. Due to interactions between water, electrolytes, and energy, these electrolyte and energy requirements can impact on water requirements [15,16]. A high water consumption in response to a high water requirement, for example, can dispel a physiological situation of high water requirement, but in turn can create a situation of high electrolyte requirement [15,16]. Unless otherwise addressed, however, requirements for water tend to take priority over requirements for electrolytes or energy [15,17,18]. Physiological requirements for water, thus, are higher after exercise than before exercise, and immediately after exercise, are higher than physiological requirements for electrolytes or energy.

Related to perceived pleasantness, it may be suggested that, in a physiological situation of high water requirement (i.e., after exercise), any food or fluid item satisfying this requirement will be perceived as highly pleasant in that situation (after exercise) relative to a situation without water requirements (before exercise). Furthermore, any food or fluid item satisfying that requirement to a greater extent, will be perceived as more highly pleasant in that situation (after exercise), relative to a previous situation (before exercise) and relative to other food or fluid items less able to satisfy that requirement.

This study aimed to demonstrate an association between perceived pleasantness and physiological usefulness in everyday life. The study investigated the change in perceived pleasantness of fluids of varying osmolality, electrolyte content or energy content after exercise compared to before exercise. Osmolality (a measure of the concentration of solutes in a solution) is used here as a measure of water content, where osmolality and water content are inversely related (pure deionised water has an Osmolality of 0 mosM/kg). The study was based on two hypotheses:

Hypothesis 1. The perceived pleasantness of all fluids will increase after exercise compared to before exercise.

Hypothesis 2. The perceived pleasantness of fluids lowest in osmolality will increase after exercise compared to before exercise to the greatest extent.

Both hypotheses were tested and compared in two groups of participants: those who lost high levels of fluid during the exercise undertaken (Group H) and those who lost low levels of fluid during the exercise undertaken (Group L). Group L were treated as control group. A low fluid loss control was used in preference to a no fluid loss control to allow for a variety of variables associated with undertaking exercise.

2. Method

2.1. Design

The study used a 7×2×2 repeated measures design, where the perceived pleasantness of seven fluids varying in osmolality, energy, and electrolyte content, was assessed before and immediately after exercise, by two groups of exercisers: Group H, exercisers achieving high fluid loss, and Group L, exercisers achieving low fluid loss.

2.2. Participants

Eighty-one regular exercisers took part in the study. All participants regularly exercised at least once a week, were nonsmokers to ensure against taste abnormalities [19], perceived no known taste abnormalities or defects, and perceived no known adverse reactions to sugar or artificial sweeteners. Participants were approached as they entered the Health and Fitness Suite, Guildford Spectrum Leisure Centre, Guildford, Surrey, UK, and were invited to take part in the study at that time. One hundred participants initially volunteered: 8 participants were screened out as smokers, and data was subsequently screened out for 11 participants as incomplete (4 participants) or invalid (7 participants). Data was considered invalid if the perceived sweetness or perceived strength of flavour for 'water' were statistical outliers due to abnormally high ratings [20].

Participants were split into two groups: Group H, exercisers achieving high fluid loss, and Group L, exercisers achieving low fluid loss; depending on individual fluid loss during the exercise undertaken as part of the study. Allocation to groups was conducted following completion of the study, to allow for the individual- and situation-specific nature of fluid loss through exercise.

2.3. Fluids

Seven fluids were used in the study: regular sports drink (RS), weak sports drink (WS), very weak sports drink (VS), water (W), regular fruit drink (RF), weak fruit drink (WF), and very weak fruit drink (VF). All fluids are commonly consumed both during and following exercise, but varied in osmolality, electrolyte content, and energy content per litre. Osmolality, electrolyte content, and energy content for each fluid as made up for use in the study are displayed in Table 1. Sports drinks were made using Citrus High 5 (H5, Derby,