Contemporary Clinical Trials 40 (2015) 95–104

Contents lists available at ScienceDirect

Contemporary Clinical Trials

journal homepage: www.elsevier.com/locate/conclintrial

Design and implementation of a study evaluating extinction processes to food cues in obese children: The Intervention for Regulations of Cues Trial (iROC)

Kerri N. Boutelle [a,b,*], June Liang [a], Stephanie Knatz [a], Brittany Matheson [a], Victoria Risbrough [b], David Strong [c], Kyung E. Rhee [a], Michelle G. Craske [d], Nancy Zucker [e], Mark E. Bouton [f]

[a] University of California San Diego, Department of Pediatrics, United States
[b] University of California San Diego, Department of Psychiatry, United States
[c] University of California San Diego, Department of Family and Preventative Medicine, United States
[d] University of California, Los Angeles, Department of Psychology, United States
[e] Duke University, Department of Psychiatry, United States
[f] University of Vermont, Department of Psychology, United States

ARTICLE INFO

Article history:
Received 18 June 2014
Received in revised form 12 November 2014
Accepted 14 November 2014
Available online 22 November 2014

Keywords:
Obesity
Eating in the absence of hunger
Cue exposure
Overeating
Child

ABSTRACT

Obesity and its health sequelae affect a significant portion of children in the United States. Yet, the current gold-standard family-based behavioral weight-loss treatments are only effective for one-third of children long-term. Therefore, we developed iROC (Intervention for Regulation of Cues) to specifically target a method to decrease overeating in overweight children, based on learning theory, to inform and enhance interventions targeting diet and obesity in youth. This study will rigorously test extinction processes as a method of decreasing physiological and psychological responses to food cues in overweight and obese children. Through exposing children to their highly craved foods, and 'training the brain and body' to decrease overeating, we are hoping to produce longer-lasting weight loss or weight-gain prevention over time.

1. Introduction

Childhood obesity is prevalent [1] and eating past nutritional needs is the proximal cause of rising obesity rates over the past three decades [2]. Food intake in humans is a complex process that originates and is maintained by basic learning and conditioning processes [3–5]. Obese individuals, compared to lean, have been shown to differentially respond to external food cues, with increases in both subjective ratings (increased desire to eat) and physiological responses (increased cephalic phase responses-biological preparations to eat) [6,7]. Evidence from neuroimaging shows that obese adults and adolescents, compared to lean, exhibit a greater increase in fronto-striatal circuitry activation during anticipation of high-caloric foods [8,9]. Additionally, obese children compared to lean children have higher activation in neural circuitry involved in reward, motivation, and cognitive control when shown pictures of food [10,11] and activation in areas associated with learning, memory, and reward when given a taste of food [12]. This project focuses on Pavlovian conditioning because it is the most basic principle of learning and there are extinction processes that can be used to weaken the relationships that lead to overeating. To date, it is unknown whether physiological reflexes to food cues and subjective experiences of food craving can be altered via extinction learning.

* Corresponding author at: Pediatrics and Psychiatry, University of California, San Diego, 8950 Villa La Jolla Dr. Suite A203, La Jolla, CA 92037, United States. Tel.: +1 858 534 8037; fax: +1 858 534 8069.
E-mail address: kboutelle@ucsd.edu (K.N. Boutelle).
URL: http://www.chear.ucsd.edu (K.N. Boutelle).

http://dx.doi.org/10.1016/j.cct.2014.11.011
1551-7144/

Basic science research in extinction has highlighted challenges in the long-term retention of extinction learning. It is now understood that extinction involves new learning and the original learning remains available under the right circumstances [13,14]. The context (cues in the environment) in which extinction takes place also influences subsequent long-term retention of extinction learning [13,15]. There are two general strategies that can be employed to optimize extinction [16]. The first is to *strengthen* the extinction learning. The second is to *bridge* two or more contexts to promote extinction in the new context. Research suggests that extinction can be optimized/strengthened by manipulating trial spacing and frequency of extinction trials [16–19] by the inclusion of a partial reinforcement schedule, which slows the rate of reacquisition of old learning [13,20,21]. Furthermore, extinction may be bridged across two or more contexts by increasing the number of contexts in which extinction occurs [16] and the use of extinction cues [22,23].

Cue Exposure Treatments (CET-Food) utilize extinction processes by providing repeated non-reinforced exposures to food associated with overeating to extinguish the individual's conditioned response (i.e. cravings or physiological responses) in addition to training the individual to habituate to (tolerate) the cravings associated with the cue. We have tested CET-Food in two published projects to date [24,25]. In our studies, CET-Food was delivered once a week utilizing exposures to a different single food each week based on the individual's hierarchy of highly craved foods. However, the evaluation of the above variables from basic extinction learning may enhance the effects of CET-Food. At this point, the optimal frequency, format, partial reinforcement schedule, and context of the CET-Food intervention has not been identified.

Understanding the processes of extinction as it relates to food cues has the potential to significantly enhance and target interventions for overeating. This study, entitled Intervention for Regulation of Cues (iROC), will advance scientific knowledge by employing principles of extinction in CET-Food to impact cephalic phase responses (CPRs) and self-reported cravings, to ultimately decrease overeating.

2. Objectives for iROC study

The iROC study is funded by a grant from NIDDK (R01). This study builds upon our pilot studies that were funded by a University of Minnesota Faculty Development Grant and which demonstrated the feasibility and acceptability of CET-Food for overweight and obese children and their families [24,25]. The primary aim of the current project is to evaluate the most salient factors from basic learning literature that could potentially improve CET-Food for children. There are numerous studies within this project, and each will build on the previous study. We will present our plan of research here, however, we recognize that it may change during the course of the study. During the first two studies in iROC, we will test four concepts related to extinction focusing on strengthening extinction learning and bridging extinction to multiple contexts. Finally, we will combine the most effective factors in a proof of concept study. At the conclusion of this project, we will have a well-defined protocol and a procedures manual for CET-Food, estimates of variability and levels of response in overweight children, and preliminary information about the efficacy of this intervention in overweight children in preparation for future studies. The secondary aim of the current project is to explore changes in aspects of food cue reactivity (subjective and physiological responses to the food cues) that could be associated with the effectiveness of CET-Food in the reduction of overeating.

3. Study design

3.1. Overview

The extinction concepts that will be tested in the iROC study will be evaluated in two 2×2 studies, and then we will test the most effective methods in a proof of concept study. During Study 1 and Study 2, we will test 4 concepts related to Pavlovian extinction literature that are salient to human food intake: 1) number of extinction trials, 2) single vs. multiple foods in exposures, 3) extinction training in multiple contexts and 4) the use of an enhanced partial reinforcement schedule (see Fig. 1). All of the trials will incorporate extinction cues [22,23] (bracelets) to remind the children of their new learning and thus help to bridge extinction between contexts. Following an exposure learning session, the children will verbalize what they have learned as a result of the session to enhance inhibitory processes [26]. Study 3 will be a proof of concept study, which develops the intervention based on the results of Studies 1 and 2 and evaluates initial efficacy and acceptability.

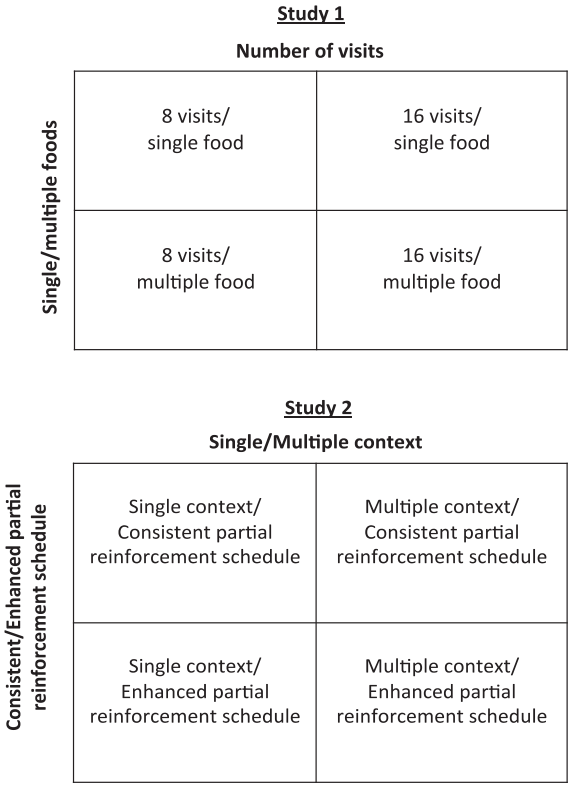

Fig. 1. Study design for Study 1 and Study 2.