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Applying the Behavior Change Technique Taxonomy to four multi-component childhood obesity interventions

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Abstract

Applying the Behavior Change Technique Taxonomy has the potential to facilitate identification of effective childhood obesity intervention components. This article evaluates the feasibility of coding Childhood Obesity Prevention and Treatment Consortium interventions and compares reliability between external Taxonomy-familiar coders and internal intervention-familiar coders. After training, coder pairs independently coded pre-specified portions of intervention materials. An adjudication process was used to explore coding discrepancies. Reliability between internal and external coders was moderate (prevalence and bias-adjusted kappa .38 to .55). Reliability for specific target behaviors varied with substantial agreement for physical activity (.63 to .76) and moderate for dietary intake (.44 to .63). Applying the Taxonomy to these interventions was feasible, but agreement was modest. Coding discrepancies highlight the importance of refining coding to capture the complexities of childhood obesity interventions, which often engage multiple recipients (e.g., parents and/or children) and address multiple behaviors (e.g., diet, physical activity, screen time).

Keywords: childhood obesity; behavior change interventions, intervention design; intervention measurement; fidelity

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3 Childhood obesity is a global public health problem (Ng et al., 2014). Unfortunately,
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5 childhood obesity prevention and treatment trials often yield null or modest results (Psaltopoulou
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7 et al., 2019). Obtaining a better understanding of the inner-workings and nuanced design of
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9 childhood obesity interventions could lead to the development of more effective interventions
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11 (Tate et al., 2016). The etiology of obesity is multifaceted and thus interventions necessarily
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13 target several weight-related behaviors, employ multiple behavior change techniques and target
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15 multiple participants (e.g., parents and children) concurrently. This complexity contributes to the
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17 challenge of identifying the components of effective interventions and understanding why
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19 interventions are ineffective. Combining results from multiple intervention studies is also more
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21 difficult when their intervention components are poorly specified (Bangdiwala et al., 2016).
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26 **Tools to Specify Behavioral Interventions**

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28 To help researchers better specify intervention components, behavior change experts
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30 have created a number of common language hierarchies. These tools help identify commonalities
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32 in seemingly disparate interventions and ultimately uncover cross-study findings. For example,
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34 one intervention may be described as using ‘goal setting’ and another as using ‘intention
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36 planning’ when in fact both are deploying the same approach. Using different terminology to
37
38 describe similar intervention techniques prevents readers from easily comparing across studies to
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40 understand the true impact of such intervention strategies. Via these common language tools,
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42 researchers can conduct cross-study reviews to identify which techniques are associated with
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44 outcomes and then design studies to explicitly test the inclusion or exclusion of various strategies
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46 to optimize interventions (Black et al., 2020; Martin et al., 2013).
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51 One commonly used tool is the Behavior Change Technique Taxonomy, a hierarchically
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53 organized, cross-behavior taxonomy created to describe behavior change techniques, the active
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COPTR Taxonomy

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1 ingredients designed to bring about change in an intervention (Michie et al., 2013). The
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3 Taxonomy was developed using a rigorous Delphi method with numerous behavior change
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5 experts compiling techniques across many prior classification systems. The validity of this
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7 approach has been established and the reliability and utility have been demonstrated across
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9 multiple fields since its inception (Abraham et al., 2015; Michie et al., 2015; Wood et al., 2016).
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11 Coding techniques involve a deductive process of categorizing intervention content and making
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13 interpretative judgments about the presence or absence of each specific technique.
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19 Recent research has shown that coders can gain competence in coding techniques by
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21 completing coder training (Abraham et al., 2015; Wood et al., 2015). There is a growing interest
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23 in applying the Taxonomy to childhood obesity interventions, but the majority of studies to date
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25 have not captured nuanced details about which techniques have been used with which target
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27 behavior (e.g., diet, physical activity) and to whom techniques have been delivered (i.e., parents
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29 alone, children alone, both parents and children) (Martin et al., 2013). Being able to specify the
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31 presence or absence of techniques delivered within target behaviors and delivered to target
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33 participants will help experts in the field examine the relative effectiveness of these techniques.
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35 Further, training study staff to identify techniques in their own intervention materials can help to
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37 reduce the cost of coding, increase specificity and consistency of intervention reporting across
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39 the field, and support the uptake of this rigorous methodology more broadly. However, it is
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41 unknown whether the coder's degree of familiarity with a particular intervention and their degree
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43 of experience with the Taxonomy influences coding. Given this, the effectiveness of the online
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45 Taxonomy training program for teaching study-specific coders to code intervention materials
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47 should be evaluated.
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The Childhood Obesity Prevention and Treatment Research Consortium

COPTR Taxonomy

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The Childhood Obesity Prevention and Treatment Research (COPTR) consortium provided a unique opportunity to address important questions regarding the application of the Taxonomy to childhood obesity interventions (Pratt et al., 2013). The consortium included four study centers testing four unique interventions designed with varying intervention content and some common design elements such as targeting multiple weight-related behaviors, inclusion of multiple components and settings, and inclusion of parents and children as target participants (Moore et al., 2013; Po'e et al., 2013; Robinson et al., 2013; Sherwood et al., 2013). Results reported to date indicate variability in the impact of the COPTR interventions on obesity and related health behaviors (Barkin et al., 2018; French et al., 2018; Moore et al., 2019). Thus, using the Taxonomy to characterize the interventions has the potential to shed light on behavior change techniques that are differentially effective.

Purpose

In the present study we evaluated inter-coder reliability between COPTR intervention team coders (internal coders) and coders from the Centre for Behaviour Change at University College London (external coders) for coding a year of intervention materials for each of the four unique COPTR interventions. The aims of this study were to: describe the degree of inter-coder agreement between internal coders and external coders; describe the degree of inter-coder agreement between internal and external coders across target behaviors (diet, physical activity, screen time, sleep, stress) and target participants (parent, child, both, or unspecified); and describe the degree of inter-coder agreement within internal coder pairs and within external coder pairs at specified intervals. An adjudication process was then utilized to understand the discrepancies between internal and external coders in order to inform recommendations for coding childhood obesity intervention materials.

Methods

To examine the inter-coder reliability between internal coder pairs and between external coder pairs, intervention materials for each of the COPTR interventions (e.g., manuals for intervention delivery, participant handouts, phone scripts) were coded using the Behavior Change Technique Taxonomy (Michie et al., 2013). Below are descriptions of the interventions and associated materials. The existing online Taxonomy training program and process are also described.

Minnesota's NET-Works Intervention

The NET-Works intervention promoted healthy eating and physical activity among preschool-aged children (Sherwood et al., 2013). The intervention was delivered in three components that included home visits, parenting classes, and pediatric primary care. Home visits were conducted monthly over three years and assisted parents in developing parenting skills and encouraged healthy eating, physical activity and reduced television viewing among children. Home visits included goal setting, activities to promote healthy skills and norms, and the promotion of linkages to related community resources. Home visitors also provided between-visit support by telephone or e-mail. Parenting classes, conducted by parent educators, complemented home visits with a matched curriculum of topics such as parenting skills, healthy eating, active play and limitations on television viewing. Finally, home visitors worked in partnership with parents to promote conversations with primary care practitioners on key weight-related topics at annual well-child visits. The NET-Works intervention was associated with lower levels of total energy intake and television viewing time at 2 and 3-year follow-ups. In secondary analyses, NET-Works significantly reduced BMI (body mass index) over three years among Hispanic children and children with baseline overweight or obesity (French et al., 2018).

Case Western Reserve University's IMPACT Intervention

IMPACT was a three-arm trial including two intervention conditions and a control (Moore et al., 2013). The HealthyCHANGE intervention included in this analysis draws on motivational interviewing and cognitive-behavioral techniques to facilitate behavior change. Participants received information about diet, physical activity, sleep and stress management; small group intervention sessions; and phone contacts. The other intervention arm, not reviewed here, was the SystemsCHANGE intervention which focused on restructuring family environment and a series of family-designed small experiments. Neither of the family-based interventions improved BMI slope (primary outcome) over 3 years or health-related secondary outcomes (Moore et al., 2019).

Vanderbilt's GROW Healthier Intervention

GROW Healthier was a multi-level behavioral intervention directed at parent-preschooler pairs and their built environment (Po'e et al., 2013). It was a 3-year family-centered intervention focused on skills-building around healthy lifestyles with three phases: intensive, maintenance, and sustainability. The 3-month intensive phase was conducted at the community recreation center with 12 weekly skills-building sessions in nutrition, physical activity, and parenting. The 9-month maintenance phase included monthly coaching phone calls that reinforced skills taught in the intensive phase. The 2-year sustainability phase included cues to action to use the built environment to support healthy behaviors for parents and children. Participants received a BMI feedback graph annually and an adaptive intervention phone call if they had moved into an overweight or obese classification. Participation in the GROW Healthier intervention was associated with reductions in total energy intake but not BMI trajectory over the 3-year follow-up period (Barkin et al., 2018).

Stanford's GOALS Intervention

GOALS was a multi-level (individual children, families, groups, primary care providers, and community youth-serving organizations), multi-component (eating behaviors, including environmental changes in the home, physical activity/inactivity, and screen time), and multi-setting (homes, community centers, and primary care clinics) intervention. Intervention components included home visits, an afterschool team sports program, and primary care provider progress reports, and were delivered over three full years. Families chose the order they wished to address eating behaviors, physical activity or screen time and each family progressed at their own rate through content as skills were mastered. The intervention was grounded in social cognitive theory (Bandura, 1997) with emphasis on Latino cultural values (Resnicow et al., 1999). Research in cognitive and social psychology was used to frame intervention components promoting greater and more sustained effects (Dweck, 2017; Robinson, 2010).

Behavior Change Technique Taxonomy Online Training

The online Taxonomy training (www.bct-taxonomy.com) is based on tutorial training and includes practice coding tasks, feedback, structured discussion led by expert tutors, access to support networks and additional resources. The training progressively introduces the 44 most common techniques using hands-on tasks with intervention descriptions from journal articles across various health behaviors. The training does not cover all 93 techniques, assuming coder ability to apply learnings to the remainder of less-common techniques. Six training sessions provide technique descriptions, a new coding guideline and an interactive task. Coders are given a score and automated feedback after each session. The final two sessions are only available after scoring 70% on the first assessment. Recommend training time is 1 hour per session and 1 session per week.

Coder Training, Certification, Background and Experience

Internal Coders

Internal coding pairs, two from each COPTR study, had at least an undergraduate degree in health-related fields. None had prior experience coding the Taxonomy. The internal coders had variable levels of familiarity with their study's intervention materials, including developing materials or providing intervention supervision, but none directly delivered interventions. All internal coders completed the online Taxonomy training and achieved at least 70% in the first assessment. As part of the training, internal coders completed the online training and participated in three 1-hour discussions led by expert Taxonomy tutors from University College London. Prior to the webinar, internal coders practiced coding using one of the COPTR intervention design manuscripts (Sherwood et al., 2013) as well as sample intervention materials from a past childhood obesity trial (Robinson et al., 2007).

External Coders

External coders were four Health Psychology post-graduate students at University College London (two pairs). All external coders had previously completed the online training and had experience using the Taxonomy to specify techniques in descriptions of health-related interventions. External coders did not participate in the three additional training discussions with Taxonomy tutors. For consistency, the pairs also coded the single COPTR manuscript (Sherwood et al., 2013) prior to coding COPTR intervention materials. Agreement between coding pairs was similar with pair 1 and pair 2 achieving a prevalence- and bias-adjusted kappa (PABAK) of .71 and .72, respectively. External coders had no previous knowledge of COPTR interventions.

COPTR Taxonomy

Coding Process***External Coders***

External coding pairs coded each study's documents prior to internal coders. Each site's materials were coded by a single external coder pair (two individual coders). One pair completed a portion of Minnesota's materials and all Case Western's materials. A second pair completed the second portion of Minnesota's materials and all Vanderbilt's and Stanford's materials. Materials were coded in the following order: Minnesota, Case Western, Vanderbilt, and Stanford. Following instructions for coding intervention content, coders independently coded by highlighting and adding comments electronically to intervention documents (Michie et al., 2014). Individual coders from a coding pair met three times throughout coding to compare independent coding and create an adjudicated version. External coders met to adjudicate after completing approximately 10%, 50% and 100% of pages in each study's materials. The specific documents included in each portion of the studies' intervention materials are shown in Table 1. External coders developed study-specific coding templates specifying target behaviors (e.g., physical activity, diet, sleep, stress, screen time) and target participants (e.g., parent, child, both).

<Table1>

Internal Coders

A single pair of trained internal coders at each COPTR site coded their own study's materials following the process outlined above for external coders. Each coding pair met after independently coding approximately 10%, 50% and 100% of materials to create an adjudicated version. Internal coders at each study used the template of target behaviors and target participants created by external coders.

Statistical Analysis

Statistical descriptions of data, including agreement charts, describe the number of techniques identified by each set of coders (Bangdiwala, 2016). Inter-coder reliabilities were calculated using PABAK to adjust for chance agreement, prevalence of occurrence, and bias in technique identification rates (Byrt et al., 1993). Inter-coder reliabilities were calculated between internal coders at each site, at specified intervals (i.e. at 10%, 50% and 100% completion milestones during coding) and between internal and external coders. The inter-coder reliabilities between internal and external coders were further examined by target behavior and target participants. To determine whether or not coding was adequately successful, the following standard ranges for interpreting agreement were used: *almost perfect* agreement (.75 to .99); *substantial* agreement (.45 to .74); *moderate* agreement (.20 to .44); *fair* agreement (0.00 to .19); and *poor* agreement (<0.00) (Muñoz & Bangdiwala, 1997). For this study, anything below .45 was considered inadequate.

Results

Aim 1- Agreement Between Internal and External Coders

Coding time ranged from 4 to 22 minutes per page for internal coders. Minnesota took an average of 65 hours per coder to complete 1051 pages of materials (~4 minutes per coder per page) while Case Western took 57 hours per coder for 682 pages (~5 minutes per coder per page). Vanderbilt took 106 hours per coder for 294 pages (~22 minutes per coder per page) and Stanford took 45 hours per coder for 453 pages (~6 minutes per coder per page). On average, internal coders spent 25 hours on each study's intervention materials (~2 minutes per page). Inter-coder reliabilities between internal and external coders indicated *moderate* and *substantial* agreement with PABAK values ranging from .38 to .55 across studies as indicated in Table 2.

<Table2>

Figure 1 shows the patterns of agreement between coders. As shown in Figure 1, bar graph A, the number of techniques congruently identified by both internal and external coders ranged from 31 to 43. Figure 1, bar graph D depicts the number of techniques congruently not identified by either internal or external coders, ranging from 33 to 36. In Figure 1, bar graph B, the number of techniques identified by external coders only ranged from four to 28 and in Figure 1, bar graph C, the number of techniques identified by internal coders only ranged from one to 23. Minnesota internal coders identified only one technique not also identified by external coders. External coders, however, identified 28 techniques in the Minnesota materials that internal coders did not identify. A similar pattern was observed for Stanford with internal coders identifying only two techniques not identified by external coders and external coders identifying 12 techniques not identified by internal coders. The reverse pattern was observed for Vanderbilt with internal coders identifying 23 techniques not identified by external coders and external coders identifying only four techniques not identified by internal coders. For the Case Western materials, a similar number of techniques were identified by internal coders only (12 techniques) and external coders only (13 techniques).

<Figure1>

Sixteen techniques were identified as present by both internal and external coders in all four sites, all of which were included in the online training and are commonly used (e.g., *goal setting*, *problem solving*, and *action planning*). There were 15 techniques not found in any of the materials by internal or external coders, of which only two were covered in the online training. Most were less-common techniques (e.g., *imaginary punishment*, *overcorrection*). There were no commonalities across sites in terms of specific techniques discrepantly coded.

Aim 2 - Reliability Between Internal and External Coders Across Target Behavior and Target Participant

Table 3 presents inter-coder reliabilities between internal and external coders for specific target behaviors (e.g., diet, physical activity, TV or sleep), general health behaviors or other specific non-health-related behaviors. Inter-coder reliability, measured by PABAK ranged from .44 to .63 for diet (*moderate to substantial* agreement); .63 to .76 for physical activity (*substantial to almost perfect* agreement); .59 to .66 for television (*substantial* agreement; Minnesota and Stanford only); .72 to 1.00 for sleep (*almost perfect* agreement); and .68 to .98 for stress (*substantial to almost perfect* agreement; Case Western and Vanderbilt only).

<Table3>

Results by target participant are also shown in Table 3. Reliability between internal and external coder PABAK ranged from .44 to .68 (*moderate to substantial* agreement) in study materials that directed the interventionist to work primarily with the parent to influence child behaviors and outcomes. Reliability ranged from .29 to .66 (*moderate to substantial* agreement) for study materials that directed the interventionist to work primarily with the child to influence their own behaviors and outcomes. Reliability ranged from .32 to .68 (*moderate to substantial* agreement) in study materials that directed the interventionist to work concurrently with the parent and child to influence child behaviors or outcomes. Reliability ranged from .76 to .96 (*almost perfect* agreement) between internal and external coders when the target participant was unclear. Though this was an infrequent occurrence, in the Minnesota materials, external coders only identified four of 93 techniques in study materials that did not have a clear target participant and internal coders did not identify any techniques in study materials without a clear target participant.

Aim 3- Reliability Within Internal and External Coder Pairs at Specified Intervals

Table 4 also presents within-pair reliability at specified intervals. Among internal coders, the mean reliability difference between the first 10% and the last 50% of the intervention materials was .03 (SD = .09). For Minnesota and Case Western internal coder pairs, reliability was in the *substantial agreement* range for the first 10% of the materials and in the *almost perfect* range for 51% -100% intervention category. Reliability estimates for the Vanderbilt internal coder pair was in the *substantial* range for both the first 10% and 51% -100% of the intervention materials. Reliability estimates for the first 10% and the last 51% -100% of intervention materials for the Stanford internal coder pair were in the *almost perfect* agreement range.

<Table4>

Aim 4- Final Adjudication Process Between Internal and External Coders

After calculating reliabilities and evaluating discrepancies between internal and external coders, a final adjudication process was developed. The full set of results for each coding pair and the adjudicated decision by technique can be found in Online Supplementary Table 1. The first step was to identify the discrepant techniques. Excerpts of coded materials corresponding to each discrepant techniques were compiled and compared. Two conferences between COPTR and University College London investigators were conducted by phone to discuss the rationale for coding discrepant techniques. Final decisions were made by consensus regarding the presence or absence of specific techniques for the coded materials. The majority of discrepancies were changed to reflect the original coding of the external coders and were due to different interpretations of the definition of a particular technique. Less often, discrepancies were due to inferences about intervention materials made by the internal coders given their familiarity with

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3 the intervention. Additionally, some discrepancies were changed to reflect the original coding of
4 the internal coders, and these discrepancies were usually due to misinterpretation of intervention
5 materials by the external coders.
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10 Discussion

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12 Identifying the behavior change techniques used in effective and ineffective obesity
13 interventions can provide insight into which techniques lead to change and which techniques are
14 unnecessary. To do this work systematically throughout the field, researchers need to be able to
15 reliably identify techniques within their own interventions. Our results largely demonstrate the
16 feasibility of training researchers to code techniques in intervention materials via the online
17 Taxonomy training. The vast majority of calculated inter-coder reliabilities were above the pre-
18 determined adequately successful threshold of .45 (*substantial* agreement or better). However,
19 most of the inter-coder reliability estimates did not achieve a more stringent reliability threshold
20 of 0.75 (*almost perfect* agreement). Further, these measures of reliability in coding of
21 intervention materials between internal and external coders were notably lower than reliability
22 previously reported in external coders coding intervention descriptions (Abraham et al., 2015).
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24 Given this, [and the final adjudication process](#), a number of concrete suggestions for future
25 research to improve reliability in coding are provided below.
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42 [There were five major takeaways from the adjudication process and resulting](#)
43 [recommendations for the field. First, researchers should develop guidance on how to specify](#)
44 [techniques in terms of the target participant. There were a number of techniques that were co-](#)
45 [delivered to the parent as *Instruction* on how to deliver techniques to their child in order to](#)
46 [support the child's behavior change. We recommend that future versions of the Taxonomy](#)
47 [include information on how to specify these co-delivered Techniques. This would also aide in](#)
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distinguishing between techniques such as *Self-Monitoring* and *Monitoring of Behaviors by Others*, which was a common discrepancy. Second, the researchers should develop a set of specific *a priori* decisions about coding prior to initiation to improve reliability and reduce the time needed for coding. These decisions should be published alongside results. Prior to initiating coding, we recommend that all coders identify the intervention's target participant(s), behavior(s), and outcome(s); this may make it easier to distinguish between BCTs such as *Goal Setting (Behavior)* and *Goal Setting (Outcome)*, which was a common discrepancy. Third, researchers should intentionally select which types of materials to code *a priori* so less adjudication may be needed throughout. We recommend intentionally selecting the materials to be coded in the 10%, 50%, 100% adjudication steps to include selections from each type of intervention materials coded (e.g., participant workbooks, training manuals, handouts). Fourth, researchers should develop training materials for coders to support coding intervention materials in addition to manuscript decisions. We recommend training and certification on materials similar to those coded (i.e., intervention materials with similar target participants, behaviors, and outcomes). Lastly, there is a need for intervention developers to better specify their interventions using the Taxonomy. When designing and developing intervention materials, researchers should consider using standardized definitions, such as the Behavior Change Technique Taxonomy, to clearly label proposed active ingredients.

Although many of the techniques identified as present by both internal and external coders were among the 44 considered commonly-used techniques and included in the online training (Michie et al., 2015), there were discrepancies in some techniques that were not included in the training. Further training on the remaining techniques could be warranted if identified as a priority by researchers. Some techniques were discrepantly coded across three or four sites

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3 suggesting that further training is needed for the following: *monitoring of behavior by others*
4 *without feedback, information about antecedents, review outcome goals, feedback on behavior,*
5 *associative learning, graded tasks, social incentives, and framing/reframing.* There did not
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8 appear to be a relationship between the amount of time to code or length of materials and
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12 reliability. Future research using advanced techniques such as content analysis could be useful in
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15 identifying which specific techniques are problematic and why.

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17 During adjudication, the primary noted reasons for discrepancies was due to
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19 misinterpretation of the techniques rather than the materials, which supports the inclusion of
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21 specific training around reducing bias when coding ones' own intervention materials.
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23 Additionally, there was variability in reliability within coding pairs across different intervals of
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25 intervention materials (e.g., 1% -10%, 11% -50%, 51% -100%). This is likely due in part to
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27 different types of intervention materials included in various intervals. Because not all types of
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29 materials are covered equally in the online training with some not covered at all, additional
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31 training modules should be created for various types of intervention materials. Similar findings
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33 have been supported elsewhere (Wood et al., 2016). The way individual techniques are described
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35 in different types of intervention materials may have restricted coders' abilities to identify
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37 techniques. As the importance of using this methodology to improve the description of
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39 intervention content becomes more well-known in research and practice communities, more
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41 specific language can be used within different types of intervention materials, which may have
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43 the additional benefit of improving the specificity with which they are delivered. Decisions made
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45 between coder pairs during the adjudication process may lead to more similar results within a
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47 coding pair, but less similar results with experienced Taxonomy coders (Abraham et al., 2015).
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50 However, improvements in coding within pairs were not seen consistently across sites. It is
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possible that different patterns may have been related to the variability in coders' familiarity with the techniques, their role in the interventions, or their background and related education.

Given the potential benefits of using a common language to identify techniques designed within interventions, steps were taken to understand the discrepancies between internal and external coders in terms of target behaviors and target participants. Similar to target behaviors, coders are also required to identify the target "outcome" to correctly code certain techniques. This source of discrepancy became clear during the final adjudication process. To correctly adjudicate, the decision was made to identify only one target outcome for each of these trials, either a reduction in weight status or body mass index trajectory. But certain target behaviors (e.g., child diet) could have been identified as intermediate outcomes of other target behaviors (e.g., diet-related parenting practices). Taxonomies and ontologies of target behaviors are currently being developed to help researchers use consistent terminology and may improve the reliability of coding efforts such as these (Larsen et al., 2017). Although the range of inter-coder reliability estimates was similar regardless of the target participant, the final adjudication process identified this a key area for future research. In behavior change interventions targeting child outcomes (e.g., childhood obesity), parents were often targeted as intermediaries. Similarly, although there were no obviously different patterns of techniques in the studies for older children compared to younger children, some techniques may not be relevant when only targeting younger children. For example, goal setting around weight loss outcomes is not an appropriate technique to use with preschoolers. Making *a priori* decisions about which techniques could apply by target participant or age could help improve reliability by reducing the total number of techniques from which to choose. Further work needs to be done to determine which techniques can be delivered to which participants and how co-delivered techniques should be classified.

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The strengths of this study most notably include: the novelty of specifying intervention content across different interventions with the same outcome, using robust measures of reliability (i.e., PABAK and agreement charts), and the development of a formal adjudication process to identified areas for improvement. Limitations of this study included the inability to capture “frequency” or “dose” of techniques in a meaningful way as well as the inability to adjust analyses for potential clustering or non-independence of techniques. In addition, this study focused only on techniques designed rather than those delivered, received or enacted by participants (i.e., treatment fidelity). In order to report fidelity to an intervention, the intended intervention must first be specified. This project serves as the groundwork for future research testing whether or not interventions are delivered as specified in the design. Although developing methods for identifying intervention dose, clustering and treatment fidelity are warranted (Lorenatto et al., 2014), standardized and feasible approaches to conducting such analyses do not yet exist. Because this project aimed to serve as a feasible example of how researchers can code techniques in their own studies, these advanced approaches were not taken here.

Though this project focused on coding of techniques in childhood obesity interventions, these results and approaches from this study have applicability more broadly across health promotion interventions. This Taxonomy and online coder training can be used by health promotion practitioners to better understand the discrete components of behavior change and how these align with behavior change theory and theoretical frameworks. This would allow practitioners to design or redesign interventions in more targeted, efficient way. The current project is an exciting step in the application of the Taxonomy framework to behavior change interventions for pediatric obesity in that it provides a necessary next step to help researchers identify which components of an intervention were or were not effective and why.

COPTR Taxonomy

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For Peer Review

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COPTR Taxonomy

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3 Wood, C. E., Hardeman, W., Johnston, M., Francis, J., Abraham, C., & Michie, S. (2016).

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5 Reporting behaviour change interventions: Do the behaviour change technique taxonomy

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Table 1*Specific Documents Included in the Intervention Materials Coded by **Internal** and **External****Coders*

Study Site	Documents		
	1% - 10% Materials	11% - 50% Materials	51% - 100% Materials
Minnesota ¹	Parent Educator manual (Sessions 1-3)	Parent Educator manual (Sessions 4-14)	Family Connector manual, activity cards, tip sheets, sample packet, primary care provider training presentation
Case Western ¹	Intervention manual, handouts (Sessions 1-3)	Intervention manual, handouts (Sessions 4-11)	Intervention manual, handouts (Sessions 12-25)
Vanderbilt ²	Intervention booklets (Sessions 1-4)	Intervention booklets (Sessions 4-12), intervention facilitators guide	Intensive phone call scripts, maintenance phase phone call scripts, adaptive intervention phone call scripts, body mass index feedback reports
Stanford ²	Home visiting manual, handouts (Diet Lessons 1-4)	Home visiting manual, handouts (Diet Lessons 5-7, Environmental Changes Lessons 1-4 and Physical Activity Lessons 1-5)	Home visiting manual, handouts (Physical Activity Lessons 6-7, Screen Time Lessons), handouts, and afterschool sports curriculum

¹Coded by study specific **internal** coding pair and **external** coding pair 1²Coded by study specific **internal** coding pair and **external** coding pair 2

Table 2*Inter-coder Reliability Between **Internal** Coders and **External** Coders Within Each Study Site's**Intervention Materials*

Variable	Study Site			
	Minnesota	Case Western	Vanderbilt	Stanford
PABAK	.38	.46	.41	.55
Number of techniques identified by external coders	59	46	37	48
Number of techniques identified by internal coders	32	45	56	45

Note: PABAK = Prevalence- and Bias-adjusted Kappa

Table 3

Inter-coder Reliability Between External Coders and Internal Coders by Target Behavior and Target Participant

Study Site	Inter-coder Reliability (PABAK)						
	Target Behavior						
	Diet	Physical Activity	TV	Sleep	Stress	General ¹	Other ²
Minnesota	.63	.68	.66	.94	n/a	0.00	.40
Case Western	.58	.76	n/a	.70	.68	.42	.85
Vanderbilt	.44	.74	n/a	.72	.98	.61	.46
Stanford	.51	.63	.59	1.00	n/a	.81	.68
	Target Participant						
	Parent	Child	Both	Unclear ³			
Minnesota	.68	.46	.68	.91			
Case Western	.53	.29	.51	.76			
Vanderbilt	.44	.66	.32	.96			
Stanford	.63	.33	.43	.94			

Note: PABAK = Prevalence and Bias-adjusted Kappa

¹The behavior was unspecified, typically with regards to healthy behaviors in general

²The behavior was specified but not an *a priori* identified health behavior (e.g., mindfulness)

³It was unclear whether the coded technique was specific to the parent, child or both

Table 4

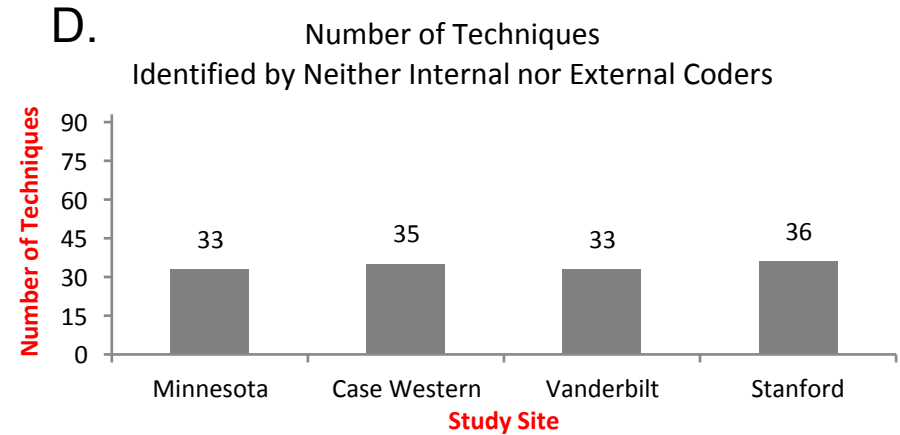
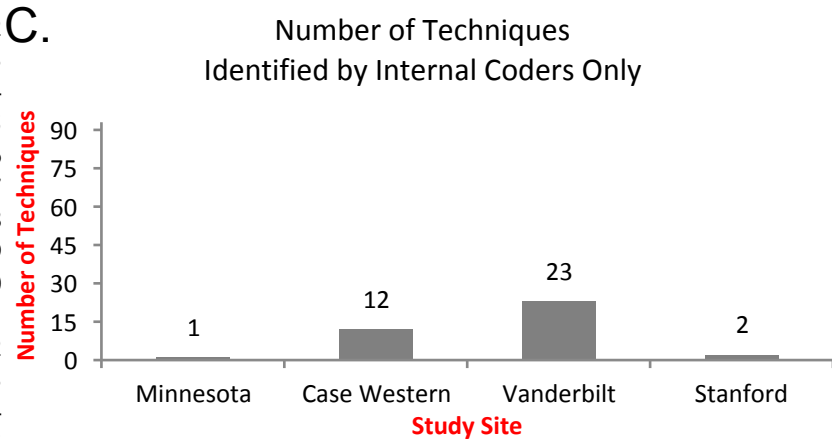
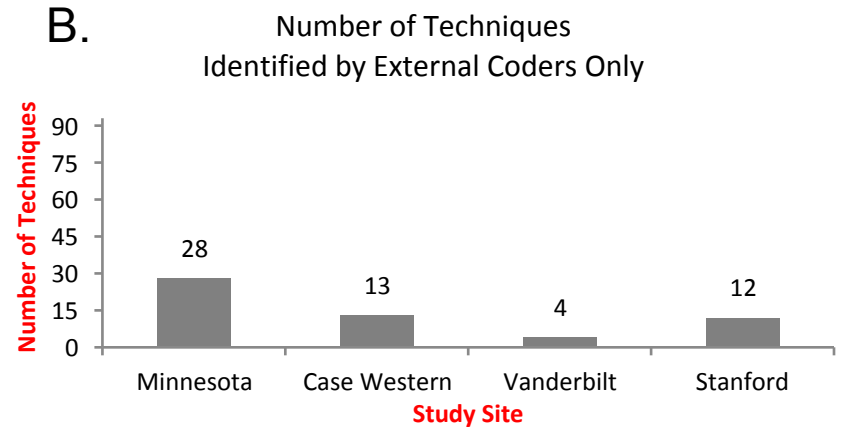
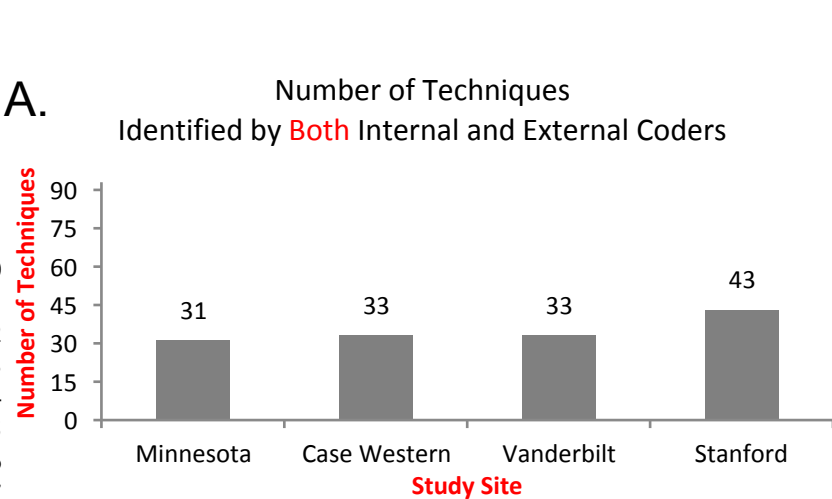
Inter-coder Within-pair Reliability (PABAK) for Internal and External Coders at Specified Intervals

Coder Pairs	Study Site			
	Minnesota	Case Western	Vanderbilt	Stanford
Internal Coders				
1% -10%	.74	.68	.63	.83
11% -50%	.74	.54	.44	.81
51% -100%	.83	.80	.59	.76
External Coders (Pair 1)				
1% -10%	.69	.67	-	-
11% -50%	.76	.85	-	-
51% -100%	.81	.83	-	-
External Coders (Pair 2)				
1%-10%	-	-	.85	.85
11%-50%	-	-	.81	.85
51%-100%	-	-	.85	.94

Note. PABAK = Prevalence and Bias-adjusted Kappa

Figure 1

1 *Number of Techniques Identified by Coding Pairs Across Sites*



37 *Note: Bar graphs A-D depict the patterns of agreement between coders.*

Online Supplementary Table 1

Data from Coding of Behavior Change Techniques Using the Behavior Change Technique Taxonomy by *Internal* and *External* Coders

Behavior Change Technique	Internal Coders				External Coders				Adjudicated Decision			
	Minnesota	Case Western	Vanderbilt	Stanford	Minnesota	Case Western	Vanderbilt	Stanford	Minnesota	Case Western	Vanderbilt	Stanford
01.01. Goal setting (behavior)	x	x	X	x	x	x	x	x	x	x	x	x
01.02. Problem solving	x	x	X	x	x	x	x	x	x	x	x	x
01.03. Goal setting (outcome)		x	X				x	x			x	x
01.04. Action planning	x	x	X	x	x	x	x	x	x	x	x	x
01.05. Review behavior goal(s)	x	x	X	x	x	x	x	x	x	x	x	x
01.06. Discrepancy between current behavior and goal		x		x	x	x	x	x		x		x
01.07. Review outcome goal(s)		x	X		x		x	x			x	
01.08. Behavioral contract			X	x	x	x	x	x		x	x	x
01.09. Commitment	x		X	x	x	x		x	x	x	x	x
02.01. Monitoring of behavior by others without feedback		x	X		x			x				x
02.02. Feedback on behavior		x	X	x	x			x	x			x
02.03. Self-monitoring of behavior	x	x	X	x	x	x	x	x	x	x	x	x
02.04. Self-monitoring of outcome(s) of behavior		x	X	x	x		x	x		x	x	x
02.05. Monitoring of outcome(s) of behavior without feedback			X		x		x	x			x	
02.06. Biofeedback		x	X	x				x				x
02.07. Feedback on outcome(s) of behavior	x	x	X	x		x	x	x	x	x	x	x
03.01. Social support (unspecified)	x	x	X	x	x	x	x	x	x	x	x	x
03.02. Social support (practical)	x	x	X	x	x	x	x	x	x	x	x	x
03.03. Social support (emotional)		x	X		x	x			x	x		
04.01. Instruction on how to perform the behavior	x	x	X	x	x	x	x	x	x	x	x	x
04.02. Information about antecedents			X		x	x		x	x	x		x
04.03. Re-attribution												
04.04. Behavioral experiments												

Behavior Change Technique	Internal Coders				External Coders				Adjudicated Decision			
	Minnesota	Case Western	Vanderbilt	Stanford	Minnesota	Case Western	Vanderbilt	Stanford	Minnesota	Case Western	Vanderbilt	Stanford
05.01. Information about health consequences	x	x	X	x	x	x	x	x	x	x	x	x
05.02. Salience of consequences		x	X			x				x		
05.03. Information about social and environmental consequences	x	x	X	x	x	x	x	x	x	x	x	x
05.04. Monitoring of emotional consequences	x	x	X		x	x			x	x		
05.05. Anticipated regret												
05.06. Information about emotional consequences	x	x	X		x	x	x	x	x	x	x	x
06.01. Demonstration of the behavior	x	x	X	x	x	x	x	x	x	x	x	x
06.02. Social comparison	x	x	X	x	x	x	x	x	x	x	x	x
06.03. Information about others' approval	x		X	x	x			x	x			x
07.01. Prompts/cues	x	x	X	x	x		x	x	x		x	x
07.02. Cue signaling reward												
07.03. Reduce prompts/cues												
07.04. Remove access to the reward				x								
07.05. Remove aversive stimulus			X	x				x				x
07.06. Satiation			X									
07.07. Exposure												
07.08. Associative learning					x	x	x		x	x	x	
08.01. Behavioral practice/rehearsal	x	x	X	x	x	x	x	x	x	x	x	x
08.02. Behavior substitution		x	X	x	x	x	x	x	x		x	x
08.03. Habit formation	x	x	X	x	x	x	x	x	x	x	x	x
08.04. Habit reversal			X	x	x	x	x	x	x	x	x	x
08.05. Overcorrection												
08.06. Generalization of target behavior					x			x				x
08.07. Graded tasks				X	x	x	x	x				x
09.01. Credible source	x	x	X		x		x	x	x	x	x	x
09.02. Pros and cons		x		x	x	x		x		x		x
09.03. Comparative imagining of future outcomes	x				x				x			

Behavior Change Technique	Internal Coders				External Coders				Adjudicated Decision			
	Minnesota	Case Western	Vanderbilt	Stanford	Minnesota	Case Western	Vanderbilt	Stanford	Minnesota	Case Western	Vanderbilt	Stanford
10.01. Material incentive (behavior)	x		X	x	x		x	x	x		x	x
10.02. Material reward (behavior)	x	x		x	x		x	x	x			x
10.03. Non-specific reward		x	X	x	x	x	x	x	x	x	x	x
10.04. Social reward	x	x	X	x	x		x	x	x		x	x
10.05. Social incentive			X	x	x				x			x
10.06. Non-specific incentive		x	X	x	x	x	x	x		x	x	x
10.07. Self-incentive	x	x	X		x	x			x	x		
10.08. Incentive (outcome)		x										
10.09. Self-reward	x	x	X		x	x	x		x	x	x	
10.10. Reward (outcome)		x	X		x	x				x		
10.11. Future punishment												
11.01. Pharmacological support												
11.02. Reduce negative emotions		x	X		x	x			x			
11.03. Conserving mental resources			X									
11.04. Paradoxical instructions												
12.01. Restructuring the physical environment		x	X	x	x	x		x	x	x		x
12.02. Restructuring the social environment			X	x		x		x		x		x
12.03. Avoidance / reducing exposure to cues for the behavior		x		x		x		x		x		x
12.04. Distraction		x	X	x	x	x		x	x	x		x
12.05. Adding objects to the environment	x	x	X	x	x	x	x	x	x	x	x	x
12.06. Body changes			X			x				x		
13.01. Identification of self as role model	x	x	X	x	x	x	x	x	x	x	x	x
13.02. Framing / reframing	x		X		x	x		x	x	x		x
13.03. Incompatible beliefs						x						
13.04. Valued self-identity				x	x			x	x			x
13.05. Identity associated with changed behavior												
14.01. Behavior cost					x				x			

Behavior Change Technique	Internal Coders				External Coders				Adjudicated Decision			
	Minnesota	Case Western	Vanderbilt	Stanford	Minnesota	Case Western	Vanderbilt	Stanford	Minnesota	Case Western	Vanderbilt	Stanford
14.02. Punishment					x				x			
14.03. Remove reward			X		x				x		x	
14.04. Reward approximation				x				x				x
14.05. Rewarding completion												
14.06. Situation-specific reward						x		x				
14.07. Reward incompatible behavior												
14.08. Reward alternative behavior												
14.09. Reduce reward frequency				x				x				x
14.10. Remove punishment												
15.01. Verbal persuasion about capability			X	x			x	x			x	x
15.02. Mental rehearsal of successful performance					x							
15.03. Focus on past success	x		X		x	x	x	x	x	x	x	x
15.04. Self-talk						x				x		
16.01. Imaginary punishment												
16.02. Imaginary reward	x				x				x			
16.03. Vicarious consequences					x				x			

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<ul style="list-style-type: none"> WJNR does not publish color figures. 	The color figure has been converted to grayscale.
<ul style="list-style-type: none"> Label supplemental information as Online Supplementary Table 1. Refer to the table by this name in the text. 	The supplemental information is renamed Online Supplementary Table 1 and referred to by that name in the text.
<ul style="list-style-type: none"> Double check citations against reference list following manuscript revision and remove or add references as necessary. 	All included citations have been checked for consistency in the reference list.
<ul style="list-style-type: none"> De-anonymize the manuscript including adding full references for any previously anonymized citations. 	The manuscript is now de-anonymized.
<ul style="list-style-type: none"> Revised manuscript MUST have changes indicated by red font. 	All changes to the manuscript are indicated in red font, not in tracked changes.
<ul style="list-style-type: none"> Authors MUST upload an itemized list of reviewer and editor comments with revisions/responses in a two column table as a Supplementary File along with the revised manuscript files in Step 6 "File Upload." The reviewer/editor comments should be in the left column and the author 	This itemized list of response to reviewer and editor comments is included as a Supplementary File.

<p>responses and revisions in the right column. Use a separate row for each reviewer comment so the author responses and revisions are clearly aligned with the reviewer comments.</p>	
<ul style="list-style-type: none"> • SAGE Publications has begun implementing the most recent version of the APA Style Manual. Please use these new 7th edition style rules when preparing your revised manuscript: https://us.sagepub.com/sites/default/files/apa_style_november_2019.pdf 	<p>The APA Style Manual was followed closely in the revision of this manuscript.</p>
<p>Reviewers' Comments to Author:</p>	
<p>Reviewer 1</p>	
<p><i>Comments to the Author</i></p>	
<p>The manuscript "Applying the Behavior Change Technique Taxonomy to four multi-component childhood obesity interventions" presents reliability data for an online coding scheme of behavior change techniques. Having consistent and reliable coding of intervention content is an important step toward identifying the most promising treatment components. Though I appreciate the goals of BCTTv1 and the paper, several issues temper my enthusiasm.</p>	<p>We appreciate this reviewer's enthusiasm for our manuscript and this topic and have addressed each of the issues as outlined below.</p>
<p><i>Major Comments</i></p>	
<p>1. First, the introduction needs to do a better job of setting the stage for how BCTTv1 is an important tool for moving the field forward. It seems to be written as if the reader is familiar with BCTTv1 and its application. Prior to reviewing this manuscript, I was unfamiliar with the taxonomy and its use. I expect that many other readers of WJNR would be similarly naive.</p>	<p>We have now provided a broader context for the importance of tools to specify interventions and an example of how this creates uncertainty in behavior change research. The manuscript now better introduces the Taxonomy for unfamiliar readership.</p>
<p>2. Justification for the coding of only presence/absence is needed. To the degree that the goal of the BCTTv1 is to aid in aggregation of studies in a field of inquiry, some designation of the degree of emphasis seems warranted. To give a technique that is applied once at the end of an intervention the same weight as a technique that is used in all sessions seems to misrepresent the nature of the intervention being coded. Though mentioned in the limitations, this is a central issue to the application of BCTTv1.</p>	<p>As the reviewer states here, determining the 'dose' or quantitative amount of various techniques is an important next step for this work. We feel the current work specifying whether or not an intervention uses a given strategy at all (e.g., presence/absence) for a given target behavior and with a target participant makes an important contribution and is a practical step in the right direction for this early application of new methodology to the field of behavioral childhood obesity interventions. Though we agree dose is very important, we determined that with our resources and data we could not</p>

	successfully estimate dose in this project. We hope that future research will make that next step, and have now made this case explicitly in the manuscript.
<p>3. Although it seems that the true aim of the study is to establish that the online training yields acceptable reliability, the authors do not set a threshold for acceptability. Thus, the results are purely descriptive and open to personal interpretation. While I appreciate that a p-value may not be possible, I suggest that the authors make a case for what would be deemed evidence of success.</p>	<p>For this work, we agree with the reviewer that estimation of the magnitude of reliability is more appropriate than application of a statistical probability. In the manuscript we now highlight that we used the field-standard “substantial” inter-coder reliability of ≥ 0.45 as the benchmark for adequate success. The benchmark was not met for some techniques within different target behaviors and target participants. Further, a more stringent reliability cutoff of 0.75 (“almost perfect”) was seen in even fewer instances. These findings stress the need for future work to improve researchers’ ability to feasibly code interventions, and we provided a number of concrete suggestions to achieve this going forward.</p>
<p>4. The online training description suggests that only about half (44) of the 93 BCTs are introduced. Please clarify.</p>	<p>This is correct, the Taxonomy developers chose only to focus on the most commonly used techniques, with the assumption that coders would be able to apply learnings to the remainder of less-common techniques. Our results suggest this assumption may not have been valid, and further training on the remaining techniques may be warranted. We have further specified this in the manuscript.</p>
<p>5. The rationale for including three measures of agreement needs to be further explained. In particular, percentage agreement is generally considered to display an upward bias. Reviewing the results also suggests minimal difference in the two forms of Kappa.</p>	<p>We agree the sensitivity analysis via 3 measures of reliability did not yield largely different results and thus does not add substantial value to the manuscript. We changed this to now only include PABAK, the most conservative measure.</p>
<p>6. It’s unclear why reliability over time is important. Given the adjudication sessions three times through the process, drift should be minimized.</p>	<p>The importance of reliability ‘over time’ is related more to the type and order of intervention materials included in each coding section over time than to drift. In fact, our results show there was poorer reliability in certain sections, suggesting further work needs to be done to</p>

	train coders in identifying techniques across certain material types as material change over time. We have better described this issue in the manuscript and have changed the language of 'over time' to 'at specified intervals' for further clarity.
7. I don't see how the present results support the need for coding via intervention materials versus manuscript descriptions. There was nothing in the results regarding discrepancies between these two approaches.	We agree this comment distracts the reader from the key messages. We have removed this content from the manuscript to avoid confusion.
<i>Minor Comments</i>	
8. There were multiple typos and errors in APA citation style. Please review carefully and consider using a copy-editor.	The manuscript has been carefully reviewed, edited and formatted with the help of a professional editor.
9. Be more specific/detailed throughout. For example, "black box" is a vague term and the word "complex" is used three times in the first paragraph without any details about what drives the complexity or why it is important to intervention design and evaluation.	Additional specificity and detail has been added throughout including the examples provided here. We thank the reviewer for this suggestion and feel it has greatly strengthen the impact of this manuscript.
10. It's unclear what the "first year" of COPTR interventions means. It would seem that the coding is done on materials that should be static.	We have edited for clarity by removing the unnecessary information on implementation year from the manuscript.
Reviewer: 2	
<i>Comments to the Author</i>	
Thank you for submitting your manuscript to the Western Journal of Nursing Research. The manuscript is unique and presents an interesting methodology to code intervention materials aimed at promoting behavior change.	We are happy to hear the excitement for this topic across all the reviewers and feel this highlights the fit with the Western Journal of Nursing Research's readership.
<i>Major Comments</i>	
1. The first sentence on page 2 (lines 25 & 26) needs updated references. The statement that childhood obesity prevention and treatment trials often yield null or modest results uses a reference from 2008. Is this still the case in 2020, which is 12 years later? I would recommend updating the first sentence with more current references.	This is unfortunately still the case today. We have updated this citation with a recent systematic review confirming this point (Psaltopoulou 2019).
2. It isn't clear to me how coding intervention materials is useful in discovering the 'black box' of behavior change interventions. Although intervention materials can be uniform, there is variation between interventionists in how intervention components are delivered. In this	Thank you for raising this very important point. Intervention fidelity is a critical issue in understanding why interventions are or are not successful. In order to describe the fidelity of an intervention, the intended

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<p>case, I would think that intervention fidelity would need to be monitored. It would also be important to note differences in intervention delivery based on the preparation and education level of the interventionists. Overall, the paper would be much stronger if you could clearly argue/explain how using the BCTTv1 would assist in developing more effective interventions (page 2 line 28).</p>	<p>intervention must first be specified. We see the manuscript as setting the groundwork for future research testing whether or not intended delivery of specific techniques leads to outcomes. We have now further argued this point in the discussion.</p>
<p>3. On page 4, line 74, there is a statement that written informed consent was obtained by the participants. Who are the participants? The coders? This isn't clear.</p>	<p>We agree this is not relevant to this manuscript and the statement has now been removed.</p>
<p>4. Two of the four interventions presented in the paper were directed toward pre-schoolers. Do the authors have any comments on challenges this may present when coding? Would the entire tool be appropriate for use in young children?</p>	<p>This is a very interesting point. Although there were no obvious differences in patterns of techniques used in the studies for older children compared to younger children, this could be one way to narrow the scope of techniques down from 93. We have now included this as a point in the discussion.</p>
<p>5. Please present data to support the efficacy of the four interventions reviewed. The assumption of the paper is that these interventions have all been successful in preventing childhood obesity. Consequently, coding intervention materials & components may be useful if there is evidence to support the interventions.</p>	<p>We feel specifying interventions that are not effective is equally as important as specifying effective interventions. If an intervention is ineffective, specifying the intervention techniques can not only help you subsequently measure fidelity to these techniques but also do post-hoc analyses to determine if certain components were effective when others were not. This work allows researchers to learn a great deal from interventions that were not effective overall and can support the revision of more effective interventions going forward. We have now called out this critical point in the manuscript. That point notwithstanding, we now make reference to the study results that have been published to-date.</p>
<p>6. Please include description of how the BCTTv1 was developed and previously reported reliability and validity data.</p>	<p>We have now included a more robust description of the development, reliability, validity and utility in the manuscript. In short, the BCTTv1 was developed using a Delphi method with behavior change experts compiling</p>

	techniques across a number of previous classification systems.
7. The Discussion and implications for practice and research section seems to re-state the findings of the study. Given all of the outcomes and information presented in the paper, how do the investigators synthesize and summarize these results? How did the study provide insight into solving the problems you were addressing?	Given the great feedback from reviewers, we have revised the manuscript to more fully describe the implications of these results for childhood obesity researchers and for behavior change researchers across fields.
8. I think the comments on Table 4 should also be presented paper.	We have now included a summary of this information in the text of the results.
<i>Minor Comments</i>	
9. The paper contains multiple acronyms that makes reading very difficult. I recommend only using a few of them and use words for the rest.	This has been edited to use less than three acronyms to improve readability.
10. On page 2, lines 32-34 It seems true that combining results from multiple interventions is difficult when intervention focus, content, etc differ. In addition, uniform outcome measures are also needed to determine intervention outcomes.	We agree with the reviewer, but do not think this point is of central relevance to this methodologic manuscript and chose to leave the specific discussion about standardizing outcomes out of the manuscript due to limited space.
11. On page 9 (line 202) and following, anthropomorphic characteristics are assigned to coding sites. For example, "Minnesota took an average of....." Minnesota didn't do this the coders did.	This language has been edited throughout.
Reviewer: 3	
<i>Comments to the Author</i>	
Dear authors, I have read your manuscript with great interest. Overall, it appears to me that this manuscript is a relevant topic for Western Journal of Nursing Research. The authors should be commended for their attempt to extend the application of the Behavior Change Technique Taxonomy (BCTTv1). In my view the paper has good potential. I require the authors to reflect on the whole of the paper and revise/rewrite parts where needed. I suggest that the authors address the points I highlighted below.	Thank you for your enthusiasm for this work. We agree that it is of great value for the field and are appreciative of the detailed and thoughtful feedback provided.
<i>Major Comments</i>	
1. The abstract describes the study in a very concise manner. However, I would recommend that the authors edited the methods part to mention explicitly the content analysis method.	This is now mentioned in the abstract, although it was kept very brief to stay within word count guidelines.
2. In the introduction and positioning of the paper, the authors should not assume that all the readers are familiar with BCTTv1 presented in this	Given this feedback and that of Reviewers 1 and 2 above, we have updated the manuscript to include a more

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<p>paper. That said, I would recommend that the authors present the main components of BCTTv. The authors mention that Line 35 -39 a brief explanation that does not capture the nuanced of BCCTTv1. It is important that the authors clarify this point since they argue that the majority of studies were use and codify BCTs Lines 42-43.</p>	<p>detailed description of the taxonomy as critically relevant to the understanding of this manuscript.</p>
<p>3. The authors seem to have missed the opportunity to briefly inform the audience of the uniqueness of BCTTv compared to others theoretical frameworks/taxonomies. This will help the readers to better understand the significance of the study and its implications. For example, the authors may need to briefly compare different approaches to show why did they choose BCTTv1 for childhood obesity interventions.</p>	<p>We now better described the uniqueness of the BCTTv1 as a more comprehensive taxonomy that was developed using rigorous, valid and reliable methods with demonstrated utility that builds upon older and less rigorous classification systems.</p>
<p>4. Generally speaking, the authors need to BCT components. I found that they did mention BCT labels to show behavior change techniques using the Behavior Change Technique Taxonomy (BCTTv1) in Table 1 in page 8. I would recommend that the authors mention some examples earlier in the manuscript to help the reader to follow their points.</p>	<p>Examples and a more thorough description are now included in the introduction of the manuscript.</p>
<p>5. Relatedly, It is important that the authors discuss prior studies that use BCTTv1 in previous content analysis and how their findings are relevant to their studies.</p>	<p>We have now included a more robust discussion of prior ways in which researchers have used these taxonomies to identify effective intervention strategies. Though the purpose of our manuscript is to demonstrate the reliability of coding techniques, not to take the next step of actually identifying which techniques are effective, we agree this broader context is helpful in making clear the importance of this first step.</p>
<p>6. It should be noted that the writing and editing needs to be carefully checked and copy-edited as there are several oddities throughout. There are errors and typos that could have been avoided. For example:</p> <ul style="list-style-type: none"> • In the introduction: paragraph 2: Line 42 “the “instead of ‘The’ • p. 3 – Line 50 unneeded period that should be deleted p. 6 Line 135 sessions instead of session P. 7 Line 137 • p.14 line 305 ‘was’ instead of ‘were’ • p. 12 line 250 interventionists instead of the interventionist and so forth... 	<p>This manuscript was now carefully reviewed by a professional editor and the edits noted here and throughout have been made.</p>

<p>7. Please review your punctuation. There are many instances where punctuation marks are misplaced P. 14 Line 305 elsewhere (Wood).</p>	<p>This has also been carefully reviewed and updated throughout.</p>
<p>8. Table 3 includes a 'general' and 'Other, The authors need to spell out what these two categories include. Why did they separate them in two categories.</p>	<p>This is now clarified in a footnote- 'general' refers to a behavior that was unspecified, typically in regard to healthy behaviors in general and 'other' refers to a behavior that was specified but was not one of the <i>a priori</i> identified behaviors (e.g., mindfulness)</p>
<p>9. Figure 1: the numbers presented do not add up. for example : the total number of BCTs by COPTR and UCL is 31 (figure 1 a) however in figure 1 B. UCL coders identify 28 and COPTR identified 1 (figure 1 C)? should the total of UCL coders and COPTR sum up to 31? the authors need to explain these discrepancies. I understand that the authors discussed the discrepancies between COPTR and UCL coders, however, it is not clear if they refer to figure 1 or whether their points are relevant to my comment. Please clarify.</p>	<p>Within each site and across the for chart sections (A, B, C, and D) these should add up to the 93 possible techniques. As an example, adding up the Minnesota columns across A (n=31 techniques), B (n=28 techniques), C (n=1 technique) and D (n=33 techniques) there are 93 total techniques. We double checked these numbers for accuracy and adjusted the figure titles for clarity.</p>
<p>10. One important point is that the authors may want to expand their research by citing similar research & findings to show how their study contributes to/extend existing scholarship</p>	<p>We have added more detail on this point to the discussion – specifically describing how these results compare to previously-conducted coding reliability work and providing detailed examples of how this work extends current scholarship.</p>
<p>11. I would like to see the authors linking their findings to health promotion interventions. I think the discussion is very generic. It would interesting to discuss how the findings can help practitioners and interventionists. and whether existing behavior change theories can benefit from BCCT's components</p>	<p>Given this feedback, we have now included a much more robust discussion of how these results can be practically used by practitioners and interventionists in addition to researchers in health promotion.</p>
<p>12. Finally, I wish you great success as you move forward on your research.</p>	<p>Thank you again for the rigorous feedback, we feel your comments have greatly strengthened the manuscript and its impact for this readership.</p>

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July 3, 2020

Re: Professional Editing Services

To whom it may concern:

This letter confirm that the manuscript detailed below was edited by me, Dr. Amelia Davis, a freelance professional editor on Upwork, a global freelancing platform.

Manuscript Title: COPTR Taxonomy_Manuscript_2020625

Manuscript Author(s): Dr. Nancy Sherwood

Date Completed: July 3, 2020

The manuscript was edited for grammar, word choice/usage, sentence structure, flow and overall readability. American Psychological Association (APA) 7th Edition reference formatting was strictly followed for all text, references, tables and figures included unless directed otherwise by the authors.

It is my pleasure to certify that this document has been edited, to the best of my ability, in good faith and in communication with the author(s) regarding editing needs. Should you have questions regarding the editing of this manuscript, please feel free to contact me at the email address listed above.

Sincerely,



C. Amelia Davis, Ph.D.