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STORK
SOCIETY FOR TRANSPARENCY OPENNESS AND REPLICATION IN KINESIOLOGY

The Influence of Public Health England's Change4Life Disney Branded 10-minute Shake Ups on Children's Post Activity Affective Response

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Physical activity (PA) is considered essential to overall health, yet it is consistently reported that children worldwide are failing to meet the recommended levels. Affective responses are a potential predictor of long-term PA engagement due to their bidirectional relationship with PA. One way to influence the affective response to PA may be to influence the environment in which it takes place; a method of doing this is to immerse children using a narrative with characters. The aim of this research was to compare the effects of using a Disney branded, compared to a non-branded, PA session on children's post activity affective responses and perceived effort of PA. 32 children participated (aged between 4-11 years) and they each completed four sessions of branded activities, and four sessions of unbranded activities. The results showed that children had similar positive affective responses and perceived effort to branded and unbranded activities, and qualitative feedback from parents supported this. However, a secondary finding from qualitative thematic analysis was that parents considered branding a key contributing factor to children's enjoyment and the effort they put into the PA sessions. Future research into influencing the affective response through the environment should carefully consider how to capture this during the activity. Lastly, the research was conducted during the period of the COVID-19 lockdown and so should be interpreted in this context. Conceptual replication outside of this should be an aim of future research.

1. Introduction

Early development of healthy behaviours, including physical activity (PA), may play a prophylactic role in health outcomes (Lipowska and Lipowski 2018). PA is an essential part of a child's overall health and wellbeing (Janssen and LeBlanc 2010), and the World Health Organisation currently recommend children engage in at least 60 minutes of moderate to vigorous PA daily; however, there are consistent reports that children worldwide fail to meet these guidelines (Sallis et al., 2016; Ridgers et al., 2014). As a result, many public health organisations consider promoting PA in children a high priority (Lavizzo-Mourey et al., 2012).

Tackling this issue requires understanding of the psychosocial factors that impact these behaviours (Amin et al., 2018). There is currently a theoretical transition away from social cognitive models for determining PA, towards the affective response as a predictor of engagement (Ekkekakis 2017). Despite health behaviour theories not including consideration of affect (Barnett et al., 2019) many have argued that it should play a more prominent role. Conner and Armitage (2006) write how the Theory of Planned Behaviour could be expanded to include other variables, including affect. The theory was developed to provide explanations of both formal and informal motivational influences over behaviour and thus including affect could further this understanding (Conner and Armitage 2006). The bidirectional relationship between affective states and PA in children emphasises the importance of promoting positive emotional responses during PA to influence subsequent participation (Dunton et al., 2014).

This is supported by hedonic theory: that people are more inclined and motivated to engage in activities that bring them pleasure, and how the response to the behaviour becomes a determinant for future behaviour (Williams, 2008). Further, operant conditioning posits that desirable or undesirable outcomes from a behaviour effects its continuance due to the learnt associations (Rhodes and Kates 2015). PA itself is deeply affective and emotional, so it is critical to understand the significance of these aspects to gain a full appreciation of PA (Piggin 2020). Humans tend to maximise pleasure and minimise displeasure, suggesting that to ensure continued engagement in a behaviour then that behaviour needs to have pleasurable experiences attached to it (Williams 2008). Indeed, in children positive affective responses before, during, and after PA have been shown to be predictive of subsequent PA engagement (Dunton et al., 2014). In short if children have positive experiences of PA this is expected to positively influence future engagement.

One approach that has previously been used to influence children's PA levels is social marketing i.e. *"the use of marketing principles and techniques to influence a target audience to voluntarily accept, reject, modify or abandon a behaviour for the benefit of individuals, groups, or society as a whole"* (Kotler et al., 2002). Social marketing is well placed to create change through its use of commercial marketing strategies to *sell* healthy behaviours (Kotler et al., 2002) using the 4 P approach: product, price, promotion, and place. Of particular interest to engaging children in PA is the way that it is promoted, and thus the use of advertising, public relations, media advocacy and entertainment vehicles (Weinreich 2006). Often to promote a healthy behaviour to children, characters are used; indeed, reviews have identified this as an effective strategy to both promote PA and healthy nutrition (Budzynski-Seymour et al., 2019). Research has found that characters attract children's attention, improve product recognition, and create positive brand attitudes (Letona et al., 2014). Advertisers use pictures and simply drawn animations of funny, brightly coloured characters on the front of their products to entice children (de Droog et al., 2014). Children also develop special relationships with these characters known as a parasocial interaction. After exposure to the character children tend to see them as a friend and want to be part of that character's social world (Hoffner 1996; Lemish 2007). Although the research into using characters specifically in a PA setting is currently sparse, the potential benefits of using characters to promote PA does seem promising.

The use of characters is often paired with a related story and narrative. Storytelling and entertainment approaches have commonly been used to communicate heath information previously by researchers and practitioners (Shen and Han 2014). This type of communication is commonly dubbed *entertainment education*, and its goal is to positively influence awareness, knowledge, attitudes and/or behaviours through using characters and narratives to immersive the audience member in the story (Moyer-Gusé 2008). The concept behind this is that entertainment education works by maintaining the viewers' attention through appealing stories whereby the viewer can identify with the characters involved and engage in the story line, meanwhile the message can be delivered and processed.

One strategy that seems to combine both social marketing and entertainment education is Public Health England's Change4Life 10-minute Disney shake ups. Public Health England developed a strategy using social marketing to steer individuals towards making healthier lifestyle choices (Muldeerrig 2017). In their

resources aimed at children, Change4Life have partnered with Disney for their "10 minutes shake ups". These are games for children to play that are 10 minutes long and intended to help them towards meeting their daily target of 60 minutes moderate to vigorous PA (UK Chief Medical Officers Guidelines 2019). These resources are aimed at children between the ages of 5-11 years old and include a variety of PA based games designed alongside a range of characters that may appeal to both boys and girls[1].

Using brands such as Disney to help influence behaviour is not a new approach; research highlights Disney films often include messages expressed in a captivating way, and the films, characters, and narratives can help to shape the values, attitudes, behaviours, and encourage new ways of thinking about issues (Tranter and Sharpe 2012). Furthermore, previous Chairman and Chief Executive of the Walt Disney company, Bob Iger, pledged the company's commitment to using the unique relationship that children have with Disney characters in a positive way to help families lead healthier lives (Public Health England 2014). There is also a potential concern that use of specific characters such as Disney may merely foster continued behaviours towards their use as opposed to PA behaviour. However there has been research supporting their use in promoting prosocial behaviour in children. de Leuww and van der Laan (2018) studied children's responses after being exposed to a clip from a Disney film with or without prosocial behaviour. Those children who watched the clip containing the prosocial behaviour were more likely to help their friends with the subsequent puzzle task. It is suggested that perhaps, similarly to the influence over prosocial behaviour, using Disney characters in a PA setting may also promote the PA engagement of children. This is supported by preliminary research from Public Health England, who reported that 64% of children surveyed said they would be more physically active if they saw their favourite Disney characters being active (Public Health England 2019). Considering the role of affect in PA behaviour it may be that use of such characters and narratives to create an immersive experience enhances the positive affective experience of PA. Therefore, the aim of this research was to compare the effects of using a Disney branded, compared to a non-branded PA session, on children's post activity affective responses and perceived effort of PA.

(a) Ecological consideration

As a preface, at the time of this research (March-April 2020) the UK, along with the rest of the word, was dealing with the Coronavirus pandemic (COVID-19) which resulted in many far-reaching health, social, and economic implications (Pietrobelli et al., 2020). Globally lockdowns were enforced (by the UK government on 23rd March 2020) to help control the spread of the virus; however, there were numerous undesirable effects including a reduction in PA (Lippi et al., 2020; Sport England 2020). Many people were no longer able to participate in recreational sport or actively commute to work or school (Lippi et al., 2020). Preliminary data from Italy investigating the effect of lockdown on certain aspects of children's PA, showed that time spent in sport activities decreased by 2.3±4.6 hours per week ($p=0.003$) and screen time increased by 4.84±2.4 hours per day ($p=0.001$) (Pietrobelli et al., 2020). Similar results have been seen in the UK. Sport England's (2019) most recent Active Lives Survey data (published December 2019) showed that 46.8% of children were achieving at least 60 minutes of PA per day. However, their most recent survey data showed a substantial drop after lockdown was enforced with only small fluctuations over the initial ~3 months during lockdown (Sport England 2020).

Research from our group[2] exploring the role of characters and narrative in PA in school settings was being planned prior to the implementation of lockdown in the UK. Indeed, preliminary work regarding children's preferences for Disney characters and their characteristics had been conducted to inform resource development (Budzynski-Seymour et al., 2020). However, the closure of schools prohibited us from engaging with this as planned. Yet, during lockdown with many children and parents socially distancing in their homes, there was a perceived need nationally to promote and support PA. Sport England began their "Join the Movement" campaign promoting remote and online resources including the Change4Life activities from Public Health England. Thus, the present research was planned rapidly in response to the implementation of lockdown, and data was collected between March-April 2020. The Change4Life resources were chosen due to them being designed to be easy and simple to use, and that they

[1]Example game: Buzz's Super bowl. The introduction states "It's touchdown time in the toy box! Can your friend leap to infinity and beyond to catch the ball before it bounces?". The game involves one child throwing and catching a ball 5 times whilst their partner runs in the opposite direction, after 5 throws the runner stops and the child with the ball throws it the distance their partner has run (Change4Life, 2020).

[2]It should be noted that this work forms part of the lead authors PhD research. As such, and given the time-constraints faced by students, the decision was made to proceed with a study adapted to be delivered during the COVID-19 pandemic.

already utilised elements of characters and narratives. No face-to-face contact between researchers and participants was needed, allowing research to be conducted whilst maintaining social distancing, and all the resources needed were available publicly online. As data was being collected around PA and emotions at a time where these may be affected by the general ecological environment (experiencing a worldwide health pandemic) it seemed prudent to also collect some additional data in regard to changes in PA habits due to the lockdown; in particular the use of online resources to complete PA, as it was hypothesised that this would have increased due to the limitations that were imposed around outdoor PA.

2. Methods

(a) Study Design

An experimental within participant randomised cross over study design was used. Ethical approval was gained from the lead authors institution, Solent University, Southampton, UK (approval reference: budze2020). After reading the participant information sheet (PIS) and being afforded the opportunity to ask any questions, the parents completed an informed consent, and the children filled in an assent form. The study was pre-registered on Open Science Framework in April 2020 (https://osf.io/prd8y) and all materials, code, and data are available on the project page (https://osf.io/f7dpx/files/).

(b) Participants

Participants were recruited through social media posts targeted at parents of those children that met the inclusion criteria. Children were included in the study if they were currently of primary school age (4-11 years); however, if a child was due to start school in the current academic year they were also included.

The target sample size was 40-80 participants completing four activities for each condition (branded vs non-branded) based upon power curves from simulation. Sample size estimation was based upon data in a previous study (Budzynski-Seymour et al., 2019). Full details are available in the pre-registration. Briefly, we consider the previously reported effects for both the Children's Feeling Scale (CFS) and Children's Felt Arousal Scale (CFAS) in prior research examining "novel" trampoline PA session to traditional extracurricular sport, in addition to previously reported effects of character branding on dietary behaviour (Keller et al., 2012). We considered both "observed" PA effects (based upon effects favouring "novel" trampoline activities in Budzynski-Seymour et al., 2019), and "conservative" effect sizes (half the "observed" effects reported previously due to the observation of smaller effects in Keller et al., 2012). Accounting for multiple comparison corrections ($\alpha = 0.017$ across three dependent variables in the present study) we extended prior data from 3 to 8 observations and simulated power across both sets of effect sizes giving us ranges of participant numbers needed at the required power (≥ 80). These showed that, power would be achieved for "observed" effect sizes with 10 and 20 participants for CFS and CFAS respectively, and with 40 and 80 participants respectively for "conservative" effect sizes. Thus, to permit identification of the smallest effect sizes simulated for, and as we anticipated that not all participants would complete the study, we aimed to recruit the upper end of the conservative range.

In total 105 parents initially responded to take part in the research, 69 returned the consent forms and were given the activity packs (see below), with 32 of these being returned to the researcher. All participants who failed to return their packs were contacted two weeks later; if they did not respond then they were not contacted again. Thus, in total there were 32 participants in the study, 14 males (average age = 8.5 years $\pm$ 2.1) and 18 females (average age 8.1 years $\pm$ 1.5). Of this nine were in Key Stage 1 (KS1) (average age 6 years $\pm$ 1.1) and 23 were in Key Stage 2 (KS2) (average age = 9.3 $\pm$ 1.1). Therefore, though we were confident that our sample size was sufficient to identify effect sizes at least as large as those previously "observed" in "novel" PA in ecologically valid settings (Budzynski-Seymour et al., 2019), it was likely insufficient to observe smaller "conservative" effects based on those seen in the use of character branding in dietary behaviours (Keller et al., 2012).

Once parents contacted the researcher, they were given an information pack containing a PIS, informed consent and assent forms, plus a short questionnaire on their child's PA levels before and after the lockdown was imposed. This was intended to capture information regarding PA levels as we did not control for this in the recruitment process. Once these were returned to the researcher, they were randomly assigned into either order A (branded followed by non-branded) or order B (non-branded followed by branded). The randomisation was based on household.

(c) Procedure

The study used eight days of activities with two ten-minute activities being prescribed for each day. Children were split into one of two orders (A & B) as noted above. Four of the days were 10-minute shake ups taken directly from the Change4Life website (branded), and the other four days were the exact same exercises, but all the associated branding had been removed (non-branded). In the packs, information was provided for each session's activity. These either explained the branded version of the game with the links to the specific Change4Life online resources to be used, or provided the unbranded version of the game with a link to an unbranded generic timer.

For the branded exercises, the packs included a branded image, title and the characters associated with the activity, a link to the demonstration video, a link to a branded timer, and a set of instructions. An example of this can be seen in figure 1a below; these were called the "branded" sessions. The other four days of the program were the same exercises however with a non-branded title, no image or character, no video, a non-branded timer, and a set of instructions. An example of this can be seen in figure 1b below; these were called the "non-branded" sessions. In order A the children completed all four days of the branded exercises first, and then the four days of non-branded sessions after; in order B the children completed all four days of the non-branded sessions first, and then the four days of branded sessions after. In the activity packs, before every day's activities there was a safety page which reminded the parents and children to warm up properly and make sure that the area they were using was safe; this was the same for both groups. Children were encouraged to complete the activities with whoever they were in lockdown with, and at the same time each day for consistency. Of the participants that had packs returned, all had complete data for all the sessions.

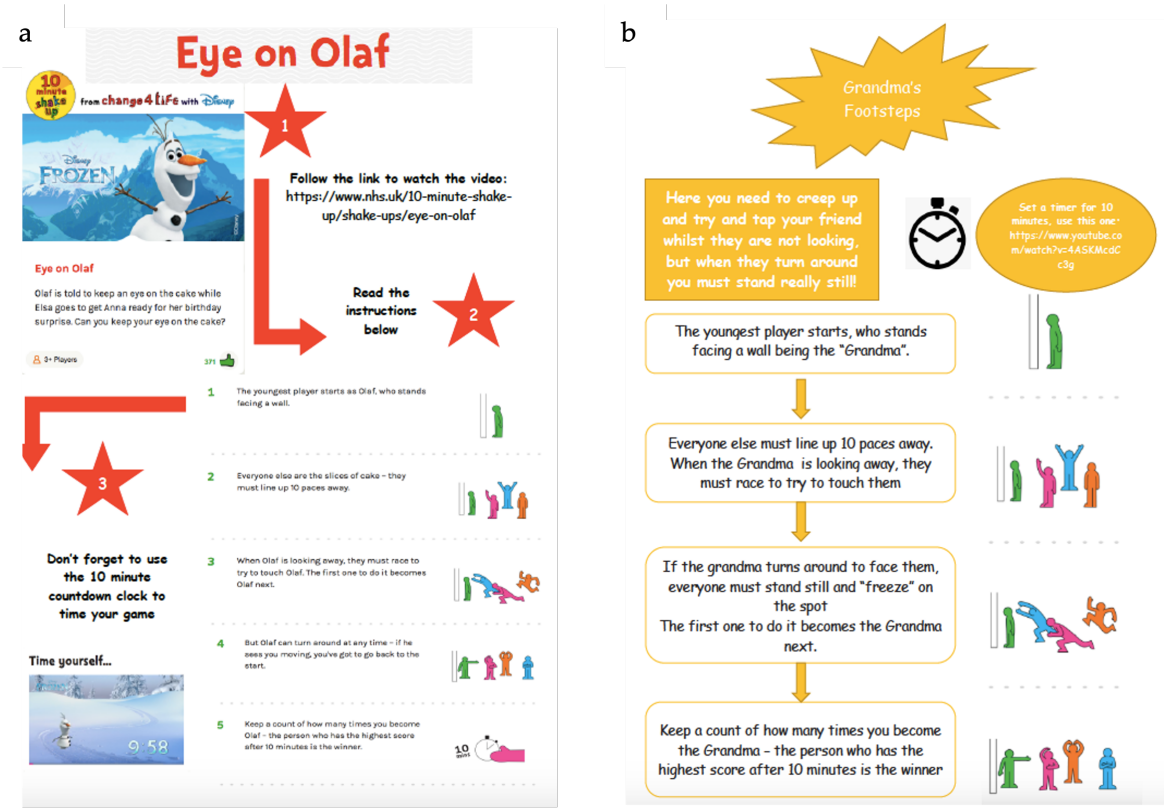

Figure 1: Example activity pack pages (a) branded, (b) non branded

(d) Measures

Due to the study being conducted in ecologically valid settings with parents and children using resources to support PA as intended, it was considered difficult to capture measures during activities without

disrupting the activities as they are intended; this would have broken the sense of immersion that was important to maintain. Thus, post activity measures were used. Post activity affective response has been investigated previously, in a recent systematic review by Rhodes and Kates (2015) into affect and exercise, nine of the included studies reported post activity affect. Furthermore, previous research does support the notion that post activity affective response moderates the intention-behaviour relationship (Kwan and Bryan 2010; Berger and Owen 1992). Immediately after each day's activity session the children were asked to answer three questions in relation to their feeling of activation, valence, and perceived effort. These were included in the activity packs where the wording can be seen (https://osf.io/ywn7e/). Valence was measured through the CFS and activation through the CFAS which were adapted for children from the adult's versions by Hulley et al., (2008). These measures are essentially the same as the validated adult versions (Hardy and Rejeski, 1989) with only changes to the descriptors and the use of faces. They were considered to have good face validity and were designed to be conceptually simple for children. Further, Hulley et al. (2008) found that during pilot testing children were able to correctly group the descriptors, faces, and numerical values. Notably, though the scales are considered reliable in adults (Van Landuyt et al., 2000), their reliability has not been examined in children to our knowledge. However, we weighed the conceptual simplicity of these scale against this given the remote nature of the data collection. Children were asked to point so their parents could circle their response (or the child could circle it themselves).

Children were also asked to report perception of effort on a simplified Borg scale. Pictorial representation was used as it was a more children friendly and developmentally appropriate method – also included in the activity packs (https://osf.io/ywn7e/) which has been found to be a valid measure in a paediatric population (Yelling et al., 2002). This was taken post session, thus encompassing a retrospective session RPE score for similar reasons regarding the need to keep the immersion throughout the activity, and the use of multiple activities in each session (Haddad et al., 2017).

Parents also answered questions about their children's PA both before and after the lockdown was imposed. These questions were adapted from Sport England's Short Active Lives Survey for Children and Young People (Sport England 2019) and can also be seen in the supplementary materials (https://osf.io/pe6yu/). At the end of eight days in the activity packs there was also a space for parental comments, to provide some qualitative feedback on their views of the activities. Parents were asked when their packs were sent out to return them with the CFS, CFAS, RPE and parental comments sections all completed.

(e) Analysis

(i) Quantitative

The primary pre-registered analysis examined the main effect of "condition" (branded or unbranded) upon the children's post activity feeling, felt arousal, and rating of perceived effort scales. A linear mixed model was employed using the "lme4" package (Bates et al., 2015) and "lmerTest" in R (v3.6.1; R Foundation for Statistical Computing, Vienna, Austria. URL http://www.R-project.org/) to examine the fixed effect of condition with random intercepts by participant ID, and Maximum Likelihood Estimation. Each participant had four observations (four for each condition). Because of the recruitment strategy and design of the study multiple participants (children) came from within the same household and completed the activities under the same conditions. Thus, to account for potential clustering a hierarchical model with participant ID nested within household was employed. The models for each dependent variable (dv) were: `lmer(dv ~ condition + (1 | household / participant ID)`. Estimated marginal means with 95% confidence intervals were produced using the "emmeans" package in addition to pairwise contrasts. Contrasts were performed with an equivalence testing approach and 90% confidence intervals. Two sets of equivalence bands were used based upon the "observed" (i.e. based upon prior research Budzynski-Seymour et al., 2019; $d_z = (0.376) to (0.517)$ for feeling scale and felt arousal scale respectively), and "conservative" fixed effect sizes (the observed effect sizes halved) used in the sample estimations. We originally noted in our pre-registration that the lower effect size out of the feeling scale and felt arousal scale would be used for the rating of perceived effort scale; however, we opted to average the effect sizes instead and used those in the same "observed" (i.e. $(0.376 + 0.517)/2 = 0.446$) and "conservative" (the "observed" halved), the lower effect used for rating of perceived effort. All tests of main effects by condition were conducted with an $\alpha = 0.017$ corrected for multiple comparisons given the three dependent variables. In addition, data visualisation included plotting individual raw data and estimated marginal means for repeated measures between condition, in addition to pairwise contrasts with

both 95% and 90% confidence intervals and equivalence bands. Standardised effect sizes were calculated as Cohen's d (Cohen 1992) and interpreted using Cohen's thresholds (>0.2 to <0.5 "small"; >0.5 to <0.8 "moderate"; >0.8 "large") using the `eff_size()` function in the emmeans package. Additional analysis included visual inspection of affect within the circumplex model (Russell 1980; Posner et al., 2005) and across time (i.e. from session 1-4) within each condition. Exploratory analysis was originally intended to be conducted based upon the categorisation of PA levels from the parents reports of their children's daily PA in minutes before lockdown (<30 minutes = Less Active; 30 to 59 minutes = Fairly Active; >60 minutes = Active). However, no children were classified as "Less Active" so we opted to instead include "PA minutes" as a fixed continuous covariate in the exploratory model and examine its interaction with condition i.e. `lmer(dv ~ condition * PA minutes + (1 | household / participant ID)`. Interaction plots were produced from the lmer model using the "interactions" package. Descriptive statistics for PA before and after lockdown were also considered. Further, anecdotal qualitative feedback from parents was examined and together considered with the results of quantitative analyses.

(ii) Qualitative

Thematic analysis was used to analyse the parental feedback, this was chosen so that patterns of meaning across the comments could be identified (Braun et al., 2016). The involved familiarisation with the data set, before coding, and theme development. This was an inductive process not based on any presumptions.

3. Results

(a) Valence

Figure 2 shows the paired comparisons for valence measured using the CFS in the raw units for both the branded and unbranded sessions (A), the paired difference between conditions in the raw units (B), and the paired difference expressed as Cohen's d in addition to observed (blue) and conservative (red) equivalence bands (C). There was no statistically significant main effect of "condition" found in the linear mixed model for valence ($F(1,224) = 1.509$, $p = 0.221$) with similar estimates for both branded (2.71 [95% CIs 2.25 to 3.18]) and non-branded activities (2.96 [95% CIs 2.49 to 3.43]). Cohen's d for the between condition contrast was trivial (-0.154 [95% CIs -0.411 to 0.103]). The equivalence test against the effect size observed from prior data [29] was statistically significant suggesting equivalence between the branded and non-branded sessions at this level ($t(35.1) = -2.871$, $p= 0.0034$). Equivalence testing against the conservative bands was not significant ($t(35.1) = –0.829$, $p= 0.2064$). Visual inspection of Figure 2A reveals considerable variability both between and within individuals in valence. Further, Figure 2C highlights that, while it is possible to infer equivalence between conditions using the previously observed effect size, the estimate is insufficiently precise to infer equivalence at the more conservative level.

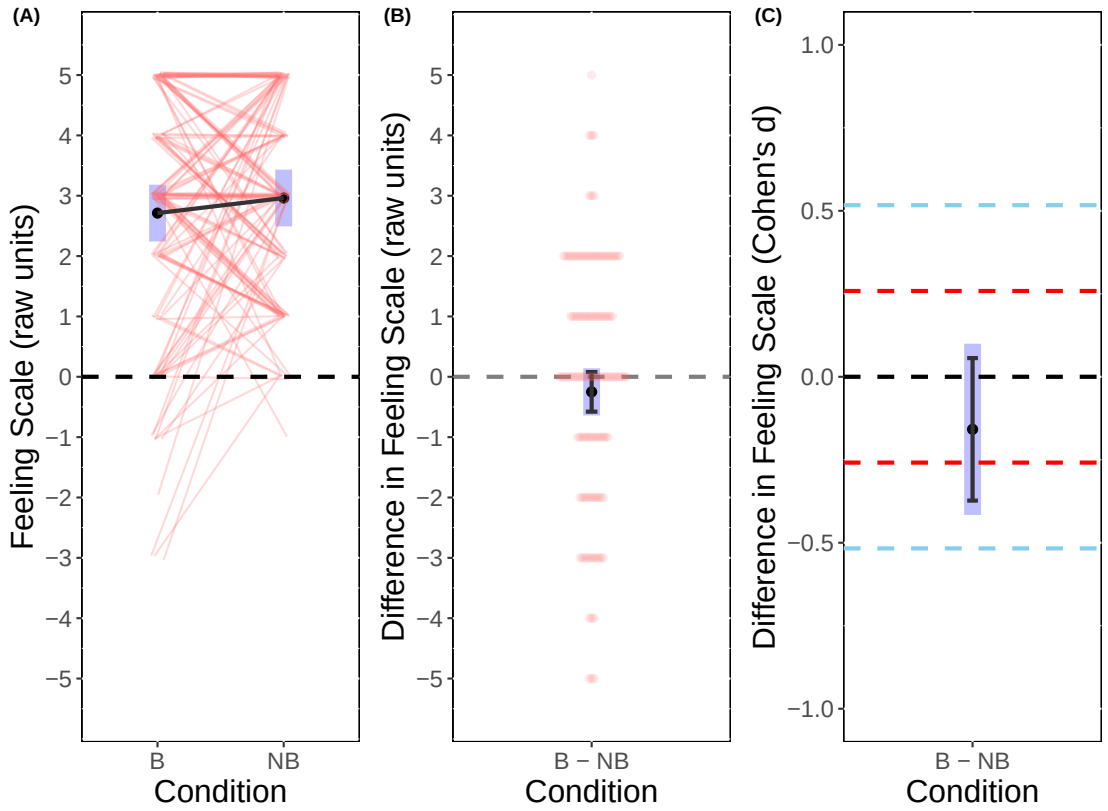

Figure 2: Feeling Scale. A: Paired individual responses and estimated marginal means [grey bands = 95% CIs] in raw units for branded (B) and non-branded (NB) conditions (note: each pair represents the same session number or time within each condition i.e. session 1 B and session 1 NB, session 2 B and session 2 NB etc.). B: Pairwise individual comparisons and estimated marginal mean [grey band = 95% CIs; black bars = 90% CIs] for comparison (i.e B minus NB) in raw units between conditions. C: Pairwise comparison estimated marginal mean [grey band = 95% CIs; black bars = 90% CIs] for comparison (i.e B minus NB) as Cohen's d between conditions with equivalence bands (dashed blue line = observed effect size; dashed red line = conservative effect size).

(b) Activation

Figure 3 shows the paired comparisons for arousal measured using the CFAS in the raw units for both the branded and unbranded sessions (A), the paired difference between conditions in the raw units (B), and the paired difference expressed as Cohen's d in addition to observed (blue) and conservative (red) equivalence bands (C). There was no statistically significant main effect of "condition" found in the linear mixed model for arousal ($F(1,233.94) = 0.816$, $p = 0.367$) with similar estimates for both branded (4.62 [95% CIs 4.29 to 4.95]) and non-branded activities (4.74 [95% CIs 4.40 to 5.07]). Cohen's d for the between condition contrast was trivial (-0.113 [95% CIs -0.369 to 0.144]). The equivalence test against the effect size observed from prior data [29] was not statistically significant ($t(32.8) = -2.088$, $p= 0.022$) nor when testing against the conservative bands ($t(32.8) = –0.596$, $p= 0.278$). Visual inspection of Figure 3A reveals considerable variability both between and within individuals in arousal. Further, Figure 3C highlights that, while tests to infer equivalence between conditions using the previously observed effect size just shy of our adjusted alpha ($p = 0.017$), the estimate appears similar to that observed for valence. However, again the precision of the estimates was insufficient to infer equivalence at the more conservative level.

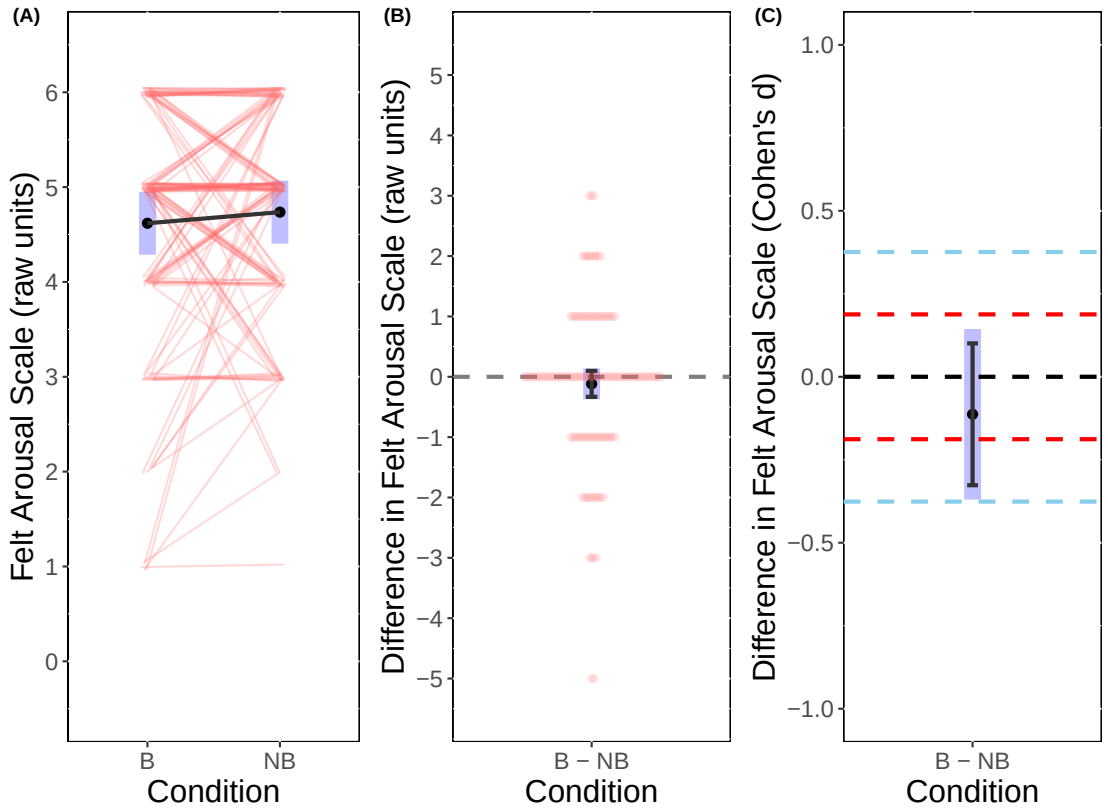

Figure 3: Felt Arousal Scale. A: Paired individual responses and estimated marginal means [grey bands = 95% CIs] in raw units for branded (B) and non-branded (NB) conditions (note: each pair represents the same session number or time within each condition i.e. session 1 B and session 1 NB, session 2 B and session 2 NB etc.). B: Pairwise individual comparisons and estimated marginal mean [grey band = 95% CIs; black bars = 90% CIs] for comparison (i.e B minus NB) in raw units between conditions. C: Pairwise comparison estimated marginal mean [grey band = 95% CIs; black bars = 90% CIs] for comparison (i.e B minus NB) as Cohen's d between conditions with equivalence bands (dashed blue line = observed effect size; dashed red line = conservative effect size).

(c) Perceived Effort

Figure 4 shows the paired comparisons for perceived effort measured using a children's version of the Borg Rating of Perceived Effort Scale in the raw units for both the branded and unbranded sessions (A), the paired difference between conditions in the raw units (B), and the paired difference expressed as Cohen's d in addition to observed (blue) and conservative (red) equivalence bands (C). There was no statistically significant main effect of "condition" found in the linear mixed model for perceived effort ($F(1,224) = 5.2019$, $p = 0.0235$) with similar estimates for both branded (4.74 [95% CIs 4.22 to 5.26]) and non-branded activities (4.28 [95% CIs 3.76 to 4.80]). Cohen's d for the between condition contrast was small (0.285 [95% CIs 0.020 to 0.550]). The equivalence test against the effect size observed from prior data [29] was not statistically significant ($t(30.7) = -1.243$, $p= 0.1116$) nor when testing against the conservative bands ($t(30.7) = 0.476$ $p= 0.6814$). Visual inspection of Figure 4A reveals considerable variability both between and within individuals in perceived effort. Further, Figure 4C highlights that, though the 95% CIs exclude zero our tests using an adjusted alpha ($p = 0.017$) did not exclude this. Also, precision of the estimates was insufficient to infer equivalence at either equivalence level.

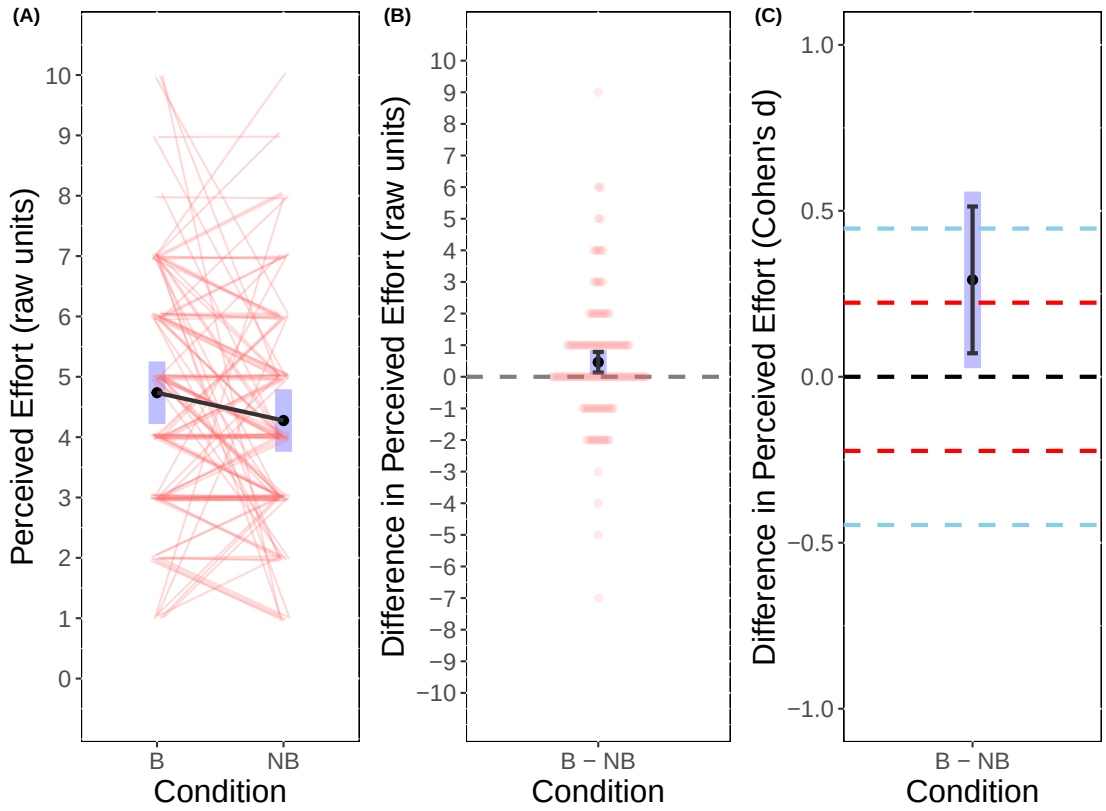

Figure 4: Rating of Perceived Effort Scale. A: Paired individual responses and estimated marginal means [grey bands = 95%CIs] in raw units for branded (B) and non-branded (NB) conditions (note: each pair represents the same session number or time within each condition i.e. session 1 B and session 1 NB, session 2 B and session 2 NB etc.). B: Pairwise individual comparisons and estimated marginal mean [grey band = 95% CIs; black bars = 90% CIs] for comparison (i.e B minus NB) in raw units between conditions. C: Pairwise comparison estimated marginal mean [grey band = 95% CIs; black bars = 90% CIs] for comparison (i.e B minus NB) as Cohen's d between conditions with equivalence bands (dashed blue line = observed effect size; dashed red line = conservative effect size).

(d) Circumplex Affect

Valence and arousal were also considered through the circumplex model of affect. A quadrant plot is shown in figure 5 with mean responses of valence and arousal for each of the four session within each condition, plus individual responses. Typical emotions associated with different coordinates of valence and arousal in circumplex space are included to aid interpretation (though it should be noted that we did not explicitly collect data regarding these emotions from our sample of participants; they are merely there for illustrative purposes). The mean responses appeared to inhabit a similar space on the plot representative of "excitement" and "elation" between conditions and across sessions with only slight increases in valence noted. Individual data however reflects the considerable variability, though the majority of responses were positive.

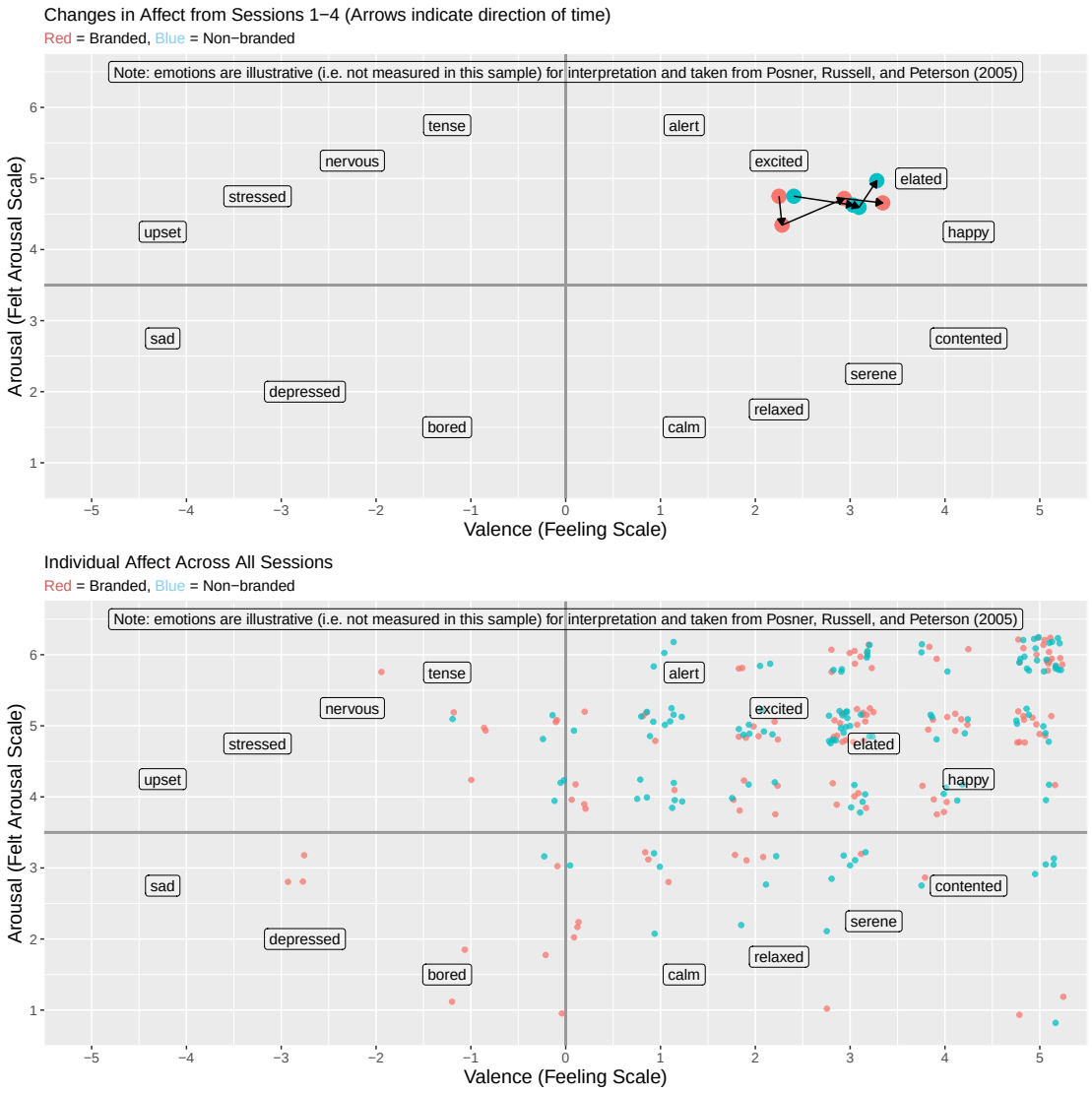

Figure 5: Quadrant plots of mean (top), and individual (bottom) by condition (red = branded; blue = non-branded) valence and arousal in circumplex space. For mean values, arrows indicate the direction of time within conditions from session 1 to 2, 2 to 3, and 3 to 4. The labels of emotions are for illustrative purposes (i.e. they were not measured explicitly in this sample and mapped to the circumplex space) and are taken from Posner, Russell, and Peterson (2005). Note: a random jitter is applied to individual data points.

(e) Effect of Daily PA Levels Before Lockdown

When daily PA levels (minutes) before lockdown was included as a continuous covariate exploratory analysis suggested little effect upon valence (β = 0.009, p = 0.1289), arousal (β = 0.005, p = 0.211), or perceived effort (β = -0.014, p = 0.0582). There were no clear interaction effects either for arousal (β = -0.0008, p = 0.837) and perceived effort (β = 0.002, p = 0.7138). Arousal was greater in both conditions for those with higher PA levels though the effects appeared small across the range of fitted values (~0.75 pts for the main effect), and perceived effort was higher for those with lower PA levels though again effects were small (~2.1 pts for the main effect). However, for valence, slopes appeared contrasting for either condition suggesting an interaction (β = -0.013, p = 0.0519); but differences in raw units were again minimal even at the extremes of fitted values (ranging ~1 pt). Figure 6 shows the interaction plots for condition and daily PA levels (minutes) before lockdown.

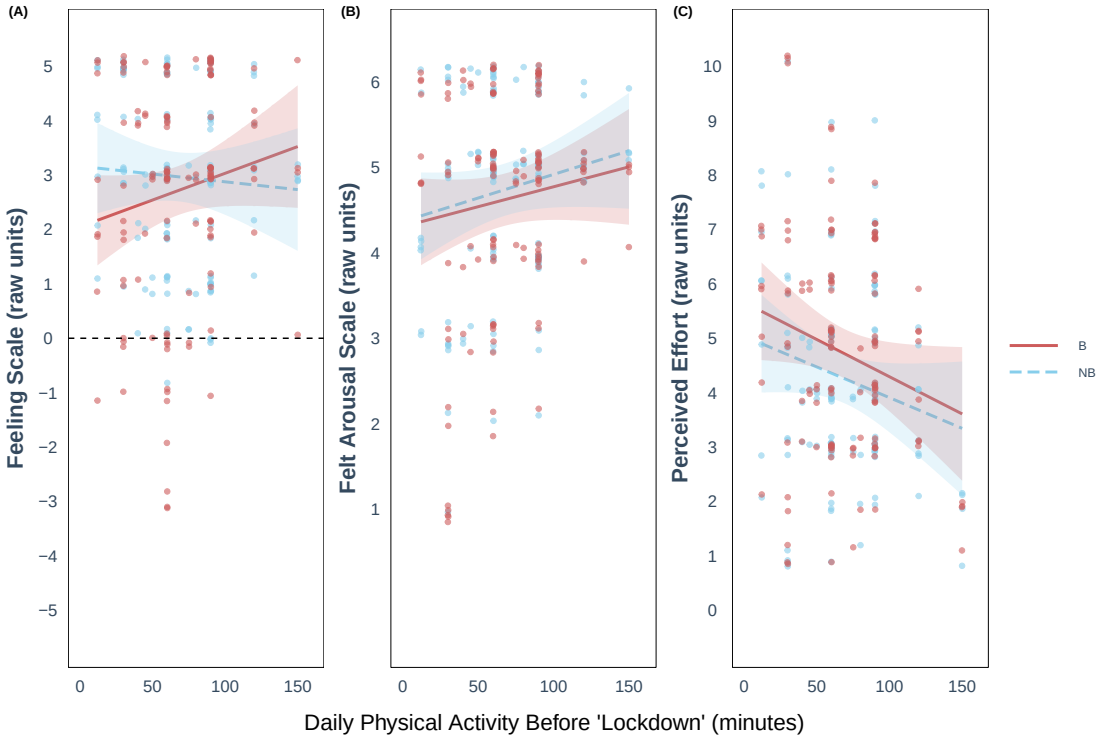

Figure 6: Interaction plots of fitted values (with 95% confidence interval ribbons from linear mixed model) for condition (red = branded; blue = non-branded) across daily PA levels (minutes) before lockdown for: (A) valence, (B) arousal, and (C) perceived effort. Note: a random jitter is applied to individual data points.

(f) Ecological consideration results - PA before and during the lockdown was imposed

Table 1 presents descriptive data regarding parents reports about their child's normal PA levels from before and after lockdown (note, responses regarding types of activity are not presented but available in the online files https://osf.io/hngdv/). There were decreases from before to after lockdown in the proportion reported as "very active" and increases in both those reported as "active" and "not very active". However, the reported time spent being active did not differ much between before and after lockdown and on average suggested that recommendations for 60 minutes of PA per day were being met. There was a considerable change in the proportion reported to be utilising online resources for PA from before to after lockdown, though the proportions of those engaging in PA inside or outside of their homes did not change.

Variable:	Before Lockdown was imposed:	During Lockdown:
How would you rate their PA levels?		
Very Active	15 (47%)	4 (12%)
Active	15 (47%)	21 (66%)
Not very active	2 (6%)	7 (22%)
In the last 7 days has your child exercised inside?		
Yes	30	30
No	2 (6%)	2 (6%)
In the last 7 days has your child exercised outside?		
Yes	32 (100%)	32 (100%)
No	0 (0%)	0 (0%)
Does your child usually exercise using online resources e.g. videos?		
Yes	0 (0%)	25 (78%)
No	32 (100%)	7 (22%)
How much time did your children usually spend doing sport, fitness activity (such as gym or fitness classes), dance, or play on each day they did the activity? (mean±SD in minutes)	68±32	63±36

Table 1: Physical Activity Questionnaire Data

(g) Thematic analysis

In total 14 parents provided written feedback on their experience of the sessions (the raw comments are available in the supplementary files https://osf.io/y8fe4/). After familiarisation with the data four themes emerged: 1) overall enjoyment of the activities, 2) added specific benefits from using Disney, 3) no specific added benefits from using Disney and 4) COVID-19 specific comments. The most common theme was overall enjoyment of the activities, this received 9 comments. An example comment from this section is "I don't think she realised she was exercising, she really enjoyed the games". The added specific benefits of using Disney was the next highest scoring theme, with 7 comments, an example comment being "he definitely found the Disney themed activities more engaging". No specific added benefits from using Disney had 4 comments, which included "they found the characters a bit young for them", and finally there were 2 COVID-19 specific comments, including that the children had been "up and down with their mental health over lockdown and some days they did not want to do the activities at all".

4. Discussion

Despite the support for the resources when examining the qualitative data, there was no clear effects of the Disney branding for the 10-minute shake ups resources specifically when considering children's post activity valence, arousal, and perceived effort responses. In fact, both sessions appeared to produce largely equivalent, and positive effects. We anticipated that the Disney branded sessions would result in a more positive affective experience based on the impact that characters can have on children (Rydell et al., 2006; Letona et al., 2014; de Droog et al., 2014; Hoffner 1996 and Lemish 2007). However, a limitation to our

study, because of it being conducted in ecologically valid environment, was the difficulty in capturing measures during activities without causing disruption to the intended immersion. Despite this, given the population examined (i.e. children/adolescents), we have some confidence that our design would have been capable of detecting between condition differences through post-activity sampling of affect.

Prior research has shown that there might be a "rebound" effect whereby, even when affective responses differ during activity, post activity responses can return to baseline levels potentially masking any differences between conditions. Thus, the children in this sample may have differed in their affect between conditions during the activities, yet the ratings provided immediately post may not have reflected this. However, prior research in adolescents typically shows that it takes some time for affective rebounding to fully occur (>5 minutes) and that even immediately post exercise there are still differences evident, at least when comparing differing intensities of effort for activities (Sheppard and Parfitt 2008). This seems to be the case even when comparing between groups with different habitual PA levels (Hallgren et al., 2010) and our analysis did not reveal any clear effects of PA levels prior to when lockdown was imposed either; though notably our sample was primarily children who were fairly active already. Thus, our results which reflect affective responses immediately post activity may still suggest that there was no difference during activities between conditions. Indeed, Kwan and Byran (2010) reported that post-task affect (taken 15 minutes post activity) moderated the intention-behaviour relationship as greater positive affect post exercise were associated with stronger intention-behaviour relationships. It is however worth noting that previous research PA shows the relationship may be moderated by the intensity of effort of the initial activity (Schneider et al., 2009).

When considering the results of the affect in circumplex space, children appeared to be "excited" during both conditions, previous research would suggest such responses refer to people being "excited" or "elated" (Posner et al., 2005; though as noted we did not capture such data in our sample explicitly), which was seen after both conditions (though notably there was considerable inter- and intra-individual variation, the majority showed typically positive responses), which shows that despite the conditions children experience positive affective responses towards PA. This is similar to prior results comparing traditional physical activities (extracurricular sport) with novel fun activities (trampoline park sessions); children showed similar post activity affective responses (and similar to those reported here) for both activities (Budzynski-Seymour et al., 2019). While it is not clear whether the lack of between condition differences in affect is a result of our study design and post activity measurement, or whether it truly reflects that children responded similarly while performing activities irrespective of branding, the qualitative feedback from parents suggests some preference for the branded activities.

The qualitative data received from a sample of parents seemed to support the quantitative data of generally positive affective responses, yet also contrasted the comparison between conditions with preferences towards branded sessions being reported. It is worth noting that the sample of parents who provided feedback represents only 43.75% of the overall sample, therefore caution needs to be taken when conclusions are made. The most common theme identified was the overall enjoyment of the activities (this included both the branded and unbranded sessions). Given the lack of differences in affective response, this may merely suggest that, given sufficiently fun and engaging activities, additional branding and narrative has little impact. However, the second most common theme was the specific benefits of using Disney; there were 7 comments made here which support the use of the Disney branding over the unbranded sessions. One specific parental comment from this theme was a comment that the "branded ones were more enjoyable, she tried harder on those days". The Disney branded sessions had the additions of a narrative and characters, and when these were present the parents perceived their children tried harder and enjoyed the sessions more. This might reflect the perceived effort where there was a small effect in favour of the branded sessions; though as noted this was small, non-significant with our adjusted alpha, and the estimate was insufficiently precise to infer equivalence.

Another parent commented "I didn't think she realised she was exercising". This comment is of particular interest as it demonstrates well the research around entertainment education. Entertainment education is a popular strategy for incorporating health and educational messages into popular media with the goal of positively influencing awareness, knowledge, attitudes, and/or behaviours (Moyer-Gusé 2008). Two main areas of interest around this are the use of a narrative and characters. Narrative involvement involves the viewer being engaged in the story line rather than in their immediate environment and as such they experience the vicarious, cognitive and emotional responses to the narrative as it develops (Moyer-Gusé 2008). Secondly with the use of characters, similarly the viewer forgets about their own reality and temporarily becomes the characters taking on their perspective (Cohen 2001). Many entertainment education approaches employ a narrative structure whereby they lead a child through a

story resulting in the child feeling swept up and developing an interest in following the events (Moyer-Gusé 2008). Children take on the role of the characters in the story as the child is engrossed in the narrative; forgetting the reality surrounding them, they take on the perspective of the character (Cohen 2001). Parents in this study reported that when they completed the Disney branded Change4Life sessions they found the addition of the characters useful and that the children "enjoyed having specific roles to play". This perhaps evidences the theory in practice; the Change4Life 10-minutes shake ups using Disney branding provide a level of immersion, gave the children participating a role to play, and both of these elements were at least perceived by parents to have helped to increase the engagement and enjoyment.

As stated earlier, an important component of the research focused around immersing the children in their environment, based upon the entertainment education literature. The influence of the environment is however an important point to raise; much of the previous research on affect and PA has been conducted in highly controlled and typically "non-immersive" environments (e.g. Sheppard and Parfitt 2008; Ekkekakis et al., 2006; Parfitt and Markland 2000); hence the ability to sample affect during the activity. This study has highlighted the issues that arise when affect needs to be measured during activity in a "real-world" setting. Indeed, the contrast between quantitative and qualitative results as they relate to the between condition comparisons might suggest that in such settings affect may be less influential than the more cognitive appraisal (though notably those of the parents in this case) of activities engaged in. However, one study which has been successful in capturing affect during ecologically valid activity is that of Dunton et al. (2014). Ecological momentary assessment was used and does support the bidirectional relationships of affect and engagement in moderate to vigorous PA. However, a limitation to their study also was the inability to know exactly what kinds of activities were engaged in and the environment in which they were performed. Specific to the present study, collecting affect was considered an issue during the activity where the environment was intended to induce a degree of immersion. This is a "catch-22" of sorts for this area of research. There is a need for more ecologically valid testing of theories relating to the relationships between PA and affect. Yet in doing such research it is difficult to avoid breaking the ecologically valid conditions under which measurement needs to take place. More research and exploratory studies need to be conducted to determine the best way to accurately assess affect in a way whereby the immersion in the activity is not greatly impacted.

The ecologically valid setting of this study, whilst presenting limitations in design, could however be considered a strength which reflects that it might be difficult to replicate findings relating to PA an affect identified in controlled laboratory settings in noisy real-world environments. Indeed, such noise is evident when considering the between and within participant variation[3]. However, another contextual consideration for this study pertaining to the ecological validity is that it was conducted during the COVID-19 pandemic and lockdown. The final theme from the qualitative data, which reflected this, is also worth discussing given the context in which the research was conducted and the inherent caveats this creates to interpretation. This research was conducted at a time where children were experiencing a worldwide health pandemic, and there was some evidence in the parental comments that this may have impacted their emotional state. One parent commented that their children's "mental health has been up and down" during lockdown and that "some days they did not want to do the activities at all". As noted, there was considerable variation in valence, arousal, and perceived effort both between and within children. Such day-to-day variation in children's mental health and wellbeing likely influenced this and potentially masked any small positive effects of the branding on these measures. Although, for valence in particular, responses were typically positive reiterating that children generally appear to have positive affective experiences doing the activities in either condition and, as noted, this was supported by qualitative comments. This is a really important point to emphasise in the situation under which this study was conducted; the lockdown imposed life changing circumstances for everyone, including children. The effects have been far reaching, and include mental health impacts. The relationship between mental health and PA is well established (Ahn and Fedewa 2011) and therefore a reduction in PA levels is expected to have had a negative effect on mental health; notwithstanding the additional worry and anxiety that comes

[3]Indeed, this variation has been reported in other ecologically valid settings. We noted similarly low intraclass correlation coefficients (ICC) from the models for valence (adjusted ICC = 0.210; conditional ICC = 0.209) and arousal (adjusted ICC = 0.219; conditional ICC = 0.219) in this study, as to those of a previous study of post activity affect during trampoline park sessions and traditional extra-curricular sports (Budzynski-Seymour et al., 2019) in children using repeated trials (for valence, adjusted ICC = 0.374; conditional ICC = 0.359; for arousal, adjusted ICC = 0.274; conditional ICC = 0.267)). Though this may also merely reflect the population. In adults ICC has for valence measured with the feeling scale is typically higher (adjusted ICC = 0.60; conditional ICC = 0.72; Unick et al., 2015). Interaction plots by individual participants are also included in the online materials (https://osf.io/smxn4/).

with experiencing a worldwide health pandemic. The usual approaches to engaging in PA that might help in coping with these life changing circumstances have been compromised as a result of lockdown.

Limitation and future research

One limitation of the study is that, due to the nature of data collection, the actual intensity of effort of activities was unknown. While not significant, it seems that the perceived effort could be slightly higher for the branded sessions, but the affective scores were lower. It is well established by previous research that as the intensity of the PA increases this results in a decline in affect[4] (e.g. Ekkekakis and Petruzzello 1999); indeed in children, though positive affect generally seems to decrease during exercise this is more extreme with higher intensities and differences are present even post activity (Sheppard and Parfitt, 2008). Though, the perception of effort may not accurately reflect the actual effort required during activity (Steele, 2020), and indeed the perception of effort and affect are phenomenologically separate constructs also (Hardy and Rejeski, 1989). Future work should examine the impact of character branding and narrative upon the spontaneous actual effort of activity that children experience, and the role that this might play in affective responses. It was also noted that, while not significant, exploratory analysis did tend to demonstrate a small negative relationship between PA levels and perception of effort.

A further limitation is that our sample was heavily weighted towards those who were already active. Were those who were less active included we may have seen greater between person variability in outcomes across conditions, as well as stronger relationships with PA levels. We also did not capture data on other socio-demographic characteristics (e.g. race/ethnicity, socio-economic status) and so it is unclear of the generalisability or applicability of these findings (for example, not everyone may have access to the online resources). Our conditions were for most participants performed in group settings (i.e. with siblings), and hence the use of a hierarchical model; but this limits generalisability to other settings. The limited responses for the qualitative feedback from parents also meant that it was difficulty to ascertain whether saturation of the themes chosen had occurred.

Findings are also limited to activities including Disney characters. Whether findings here can be inferred as generalisable to other branded narrative driven activities is not certain. However, in other work we have attempted to identify the types of characteristics children's favourite Disney characters exhibit such that other characters exhibiting these might also be considered (Budzynski-Seymour et al., 2020). Future research should of course examine the effects of characters and narrative across different experimental conditions to discern any generalisable effects. Additionally, though our sample size was more than adequate to power the study to detect previously "observed" effect sizes, we fell short of that required for the more "conservative" effects. However, given the differences in raw units observed here it seems unlikely that such conservative effects are very meaningful even if with larger samples they would be detectable.

Omitting measures during activity can result in any potential changes occurring during the activity to be missed (Bixby et al., 2001). This more restricted sampling strategy may result in a failure to capture the dynamic changes that occur during the activity which reveal a truer reflection of actual activity affect. The reasoning behind adopting a pre and/or post activity sampling strategy may be attributed to the fact that to take a measure during the activity, the activity must be interrupted and disturbed (potentially altering the phenomenological experience itself; Ariely, 1998), and thus for ease pre- and post-scores are more common. A key consideration that was made which is specific to this research is that there is a strong emphasis on the idea of immersing children in an environment, by using elements of entertainment education – characters and a narrative. For this reason, post affect scores were chosen but the limitations that arise from not sampling during the activity are noted. However, we felt justified in using this approach with children given that, though often the affective "rebound" phenomena can mask between condition differences when capturing affect post activity in adults, various studies suggest that this is less of a concern in children were post activity affect may still offer useful information regarding the activities and subsequent behaviour (Sheppard and Parfitt, 2008; Hallgren et al., 2010; Dunton et al., 2014; Budzynski-Seymour et al., 2019). This more restricted sampling strategy may result in a failure to capture the dynamic changes that occur during the activity which reveal a truer reflection of actual activity affect. This may be considered a limitation of the study, however a key consideration that was made which is specific to this research is that there is a strong emphasis on the idea of immersing children in an environment. For this reason, post affect scores were chosen but the limitations that arise from not sampling during the

[4]Indeed, in a further exploratory analysis we examined inclusion of perceived effort as a covariate upon valence (β = -0.2056, p = 0.0102) which showed this relationship, but was weaker with arousal (β = -0.0744, p = 0.1260) and there were no clear interaction effects with condition. It is noteworthy that even at higher perceived efforts valence was generally positive suggesting minimal impact; the main effect ranged ~2 pts. An interaction plot for this exploratory analysis is available in the online materials (https://osf.io/juarv/).

activity are noted. However, we felt justified in using this approach with children given that, though often the affective "rebound" phenomena can mask between condition differences when capturing affect post activity in adults, various studies suggest that this is less of a concern in children were post activity affect may still offer useful information regarding the activities and subsequent behaviour (Sheppard and Parfitt, 2008; Hallgren et al., 2010; Dunton et al., 2014; Budzynski-Seymour et al., 2019). Future PA research which aims to have an influence over any aspect of the environment targeting the affective response should consider novel ways by which to collect affective responses during the activity that have limited impact on any immersion intended, in addition to ensuring pre- and post-measures are also taken.

Finally, though it may be considered an oversight that we did not collect pre activity measures, and of course by design we did not collect measures during activity, pre-activity measures were not deemed necessary in order to identify a between condition effect in our present design (notwithstanding that post measures are predictive of subsequent PA in children anyway). Going back to the aim of the research, this was focused on the differences in affect between the conditions, rather than the change in affect reported. Though of course pre-activity measures would have allowed our estimates of effect to be presented as pre-post delta scores which for some may enhance interpretability, baseline measures in trials including randomised cross-over designs are primarily for the purpose of increasing precision of such estimates through adjustment as a covariate and removing bias that may arise from regression to the mean. However, Senn (2002) notes that such approaches must first meet certain assumptions; that it is genuinely believed that the baseline scores are predictive of the treatment effect, and that the second condition is not in any way impacted by the previous treatment. Future work could include a true baseline (i.e. prior to either treatment) in addition to suitable washout periods such that subsequent baseline measures can also be considered to be independent. Though ultimately the treatment effect estimator (i.e. the difference between the two conditions) is the same in either regard; indeed, the approach of baseline measurement adjustment in cross-over designs is analogous to that of analysis of covariance with baseline adjustment in between group pre-post designs (Senn, 2002) and in such cases whether presenting estimators as the treatment effect between conditions for the delta, or the post scores, they are mathematically equivalent (Laird, 1983).

(a) Conclusion

This research aimed to compare the effects of using a Disney branded, compared to a non-branded PA session, on children's post activity affective responses and perceived effort of PA. Though our results suggested little difference between conditions on affect and perceived effort, children generally reported positive post activity affective responses for both conditions, and this was supported also by qualitative feedback from parents. However, in contrast to quantitative between condition comparisons, the thematic analysis revealed a parental perspective of children enjoyed branded sessions more and tried harder during those activities. The use of immersive elements such as characters and a narrative in PA sessions appears potentially promising, however they did cause methodological limitations in the present study due the barriers they created in sampling affect during the activity. Sampling of affect during PA intended to create an immersive environment has the potential to break the immersion; this highlights a new concern for researchers translating findings from controlled laboratory settings into applications in real world settings. Due to these issues in the sampling strategy, and the fact that the study was conducted during the worldwide COVID-19 pandemic, any future research should attempt to replicate this work outside of the limitations inherent in pandemic conditions whilst considering how to accurately measure affect

5. Additional Information

(a) Data Accessibility

The study was pre-registered on Open Science Framework in April 2020 (https://osf.io/prd8y) and all materials, code, and data are available on the project page (https://osf.io/f7dpx/files/).

(b) Author Contributions

- Substantial contributions to conception and design: EBS, JS, MJ
- Acquisition of data: EBS
- Analysis and interpretation of data: EBS, JS
- Drafting the article or revising it critically for important intellectual content: EBS
- Final approval of the version to be published: JS, MJ

(c) Conflict of Interest

The authors declare no conflicts of interest.

(d) Funding

There are no funding statements to declare.

(e) Preprint

The pre-publication version of this manuscript can be found on SportRxiv (https://osf.io/preprints/sportrxiv/ftv8y/).

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