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The influence of parent's body mass index on peer selection: An experimental approach using virtual reality

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ABSTRACT

Relatively little is known about the influence of psychosocial factors, such as familial role modeling and social network on the development and maintenance of childhood obesity. We investigated peer selection using an immersive virtual reality environment. In a virtual schoolyard, children were confronted with normal weight and overweight avatars either eating or playing. Fifty-seven children aged 7–13 participated. Interpersonal distance to the avatars, child's BMI, self-perception, eating behavior and parental BMI were assessed. Parental BMI was the strongest predictor for the children's minimal distance to the avatars. Specifically, a higher mothers' BMI was associated with greater interpersonal distance and children approached closer to overweight eating avatars. A higher father's BMI was associated with a lower interpersonal distance to the avatars. These children approached normal weight playing and overweight eating avatar peers closest. The importance of parental BMI for the child's social approach/avoidance behavior can be explained through social modeling mechanisms. Differential effects of paternal and maternal BMI might be due to gender specific beauty ideals. Interventions to promote social interaction with peer groups could foster weight stabilization or weight loss in children.

1. Introduction

The worldwide prevalence of childhood overweight and obesity increased from 4.7% to 6.7% between 1990 and 2010, and is expected to reach 9.1% by 2020 (De Onis et al., 2010). The ongoing trend can be traced down in almost all countries and is being referred to as a global epidemic of obesity (Wang and Lobstein, 2006). Biological, psychological, and psychosocial factors are important in the development and maintenance of childhood obesity (Lehrke and Laessle, 2003; Puder and Munsch, 2010). According to the current Cochrane review summarizing treatment efforts and outcome, there is a need for research on how psychological and psychosocial factors such as familial role modeling (Munsch et al., 2008) or the social network contribute to obesity. This could allow for improvements in the long-term efficacy of childhood obesity treatment (Luttikhuis et al., 2009). The role of peers in the spread of obesity is also of considerable interest (Christakis and Fowler, 2007; Hammond, 2010), and indeed, the social contagion of overweight starts at a relatively early age. Valente and colleagues investigated friendship networks and BMI among 617 adolescents aged 12–14 and found overweight adolescents to be more likely to have overweight friends (Valente et al., 2009). According to Blanchflower et al. (2009) satisfaction with one's own body depends on the body weight of the reference group, rather than on the absolute body weight. A similar relevance of social networks has been shown for children and adolescents (Koehly and Loscalzo, 2009). Anderson (2009) suggested three psychosocial explanations that finally lead to similar weight within groups of friends. First, persons choose friends based on weight (peer selection). Second, persons adjust their behavior based on common influence (contextual effects) and third, persons change their own behavior when friends change theirs (endogenous social effect). Thus, obesity status may play an important role in social peer selection process and this in turn has an impact on further weight development of children and adolescents (Christakis and Fowler, 2007; Hammond, 2010). Interestingly, the phenomenon of peer selection and its determinants has not yet been thoroughly addressed in previous studies of childhood obesity. For example, it has been shown that adolescent girls tend to select peers in terms of similarity of body satisfaction and eating behavior type (Rayner et al., 2013).

In accordance with a bio-psycho-social approach to the development of childhood obesity (Lehrke and Laessle, 2003; Puder and Munsch, 2010), we addressed the role of biological (age, BMI and sex of the child), psychological (self-perception and eating

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behavior of the child) and bio-psycho-social factors (mothers' and fathers' BMI) on the process of constitution of social groups in 7- to 13-year-old children. At this age both family and peers are important determinants of behavior. We assessed the behavior of peer selection applying both explicit and implicit measurements in order to overcome the bias of explicit preference ratings (Hofmann et al., 2005). Accordingly, children's social behavior was assessed implicitly by measuring the interpersonal distance between the child and four avatar groups in an immersive virtual schoolyard setting. Interpersonal distance is typically indexed as the minimal distance between participant and avatar (i.e. the avatar that was approached closest) in different situations (Bailenson et al., 2003). In an explicit condition, children were asked to rank each of the four avatar groups as a function of their preference to play with during a school break. The characteristics of the virtual avatar groups (constituted of four avatar children) were manipulated. Independent variables of our design were body shape (normal weight vs. overweight) and activity (eating unhealthy food vs. playing) of the avatar groups. We used virtual reality (VR) technology, as it has been proven to be useful for social and behavior based research (McCall and Blascovich, 2009). The advantage of VR is the high degree of experimental control and simultaneously a high degree of external validity and experimental replicability (Blascovich et al., 2002). VR is appropriate for measuring interpersonal distance (approach/avoidance behavior).

Along with child-based variables such as their BMI, sex and age, an important focus of this study is the influence of parental BMI on the child's peer selection assessed via the minimal distance to the avatar groups. This is based on findings showing a dominant influence of parents on children's eating behavior (Munsch et al., 2011). Additionally, a child's social network depends on the social network of their parents, which is again influenced by bio-psycho- and sociological factors (Parke et al., 2002; Ragan et al., 2013). Previous research revealed contradicting results regarding the role of parent's sex on the development of children's overweight and obesity. Some studies report a strong influence of either mother's (Brion et al., 2010; Kral and Rauh, 2010; Zimmermann et al., 2004) or father's BMI (Freeman et al., 2012), comparable effects of father's and mother's BMI (Patel et al., 2011) or a sex specific influence with the mother's BMI being more important for girls and the father's BMI being more important for boys (Perez-Pastor et al., 2009). There is evidence that this same sex link is not genetic, but rather due to complex modeling mechanisms in the social environment (Perez-Pastor et al., 2009). We expect the minimal distance to an avatar to depend on a child's sex, BMI, self-perception, eating behavior, and especially on the BMI of the child's parents. Indeed, parents are social mediators because they model social behavior and influence the timing and frequency of peer contact as well as the quality of peer activities of their children (Profiler and Hart, 1992).

Previous research showed that overweight children have negative attitudes toward overweight people (Lerner and Korn, 1972). For example, they placed a figure representing themselves farther away from an overweight child than from normal weight figures (Iwawaki et al., 1977; Lerner, 1973), and when asked explicitly, they preferred to play with normal weight children and children with disabilities compared to overweight children (Brylinsky and Moore, 1994). What is more, the consumption of unhealthy food is perceived as negative by normal weight and overweight persons alike (Czyzewska and Graham, 2008). Thus, we expected that children, regardless of their own body weight would express a preference to spend the break with normal weight avatars that play, when asked explicitly. The more implicit behavioral measure (minimal distance to the avatar peers) should give more precise, online, and differentiated information about children's social approach or avoidance behavior, not biased by social variables. Given the importance of familiar role modeling, a predominant role of parental BMI in the approach/avoidance behavior is expected. We presume parental BMI to be a significant predictor for the minimal distance to the avatars, and we explore the role of other biological and psychological variables such as BMI, sex, age, self-perception and eating behavior of the child. We expected the child's behavior in VR to shed light on detail aspects of peer selection in real world situations.

2. Methods

2.1. Participants

Fifty-seven children took part in the study. They were recruited through public primary schools and sport programs for overweight children. They visited our lab group wise, and participated in the VR experiment individually. The mean age of the children was 10.19 years ($SD=1.58$, range: 7–13 years), they were Caucasian and from middle class families living in the German-speaking part of Switzerland. The study was approved by the ethics committee of the University of Bern. Informed written parental approval was obtained prior to the study and children gave oral consent to participate.

All children were weighed on a Seca electronic balance (Seca, Vogel+Halke, Germany) and height was measured without shoes to the nearest 0.1 cm by means of a stadiometer. BMI was calculated as weight in kilograms divided by the square of height in meters. The mean BMI of the children was 19.06 ($SD=3.97$, range: 14.23–30.08). Based on age- and sex-specific norms (Cole et al., 2000), children can be assigned to one of two categories: normal range (corresponding to BMI ≤ 25 at age 18) and overweight (corresponding to BMI > 25 at age 18). For the cut off points, centile curves corresponding to the BMI 25 at age 18 were calculated (Cole et al., 2000). Forty-one children (20 boys) had normal body weight and 16 children (8 boys) were overweight. Social acceptance, physical appearance and global self-worth were assessed via Harter's self-perception scale for children (Asendorpf and Aken, 1993). Furthermore, we assessed eating behavior in terms of restrictive, external and emotional eating behavior using the Dutch eating behavior questionnaire (DEBQ, Van Strien et al., 1986; German translation of Grunert, 1989).

Parental BMI was assessed through self-report of height and weight (questionnaire). The mean reported BMI was 24.97 ($SD=4.95$, range: 18.21–47.63) for the mothers, and 26.48 ($SD=3.11$, range: 20.02–36.13) for the fathers. For further analyses, parents were classified in two categories: normal weight (BMI ≤ 25) and overweight (BMI > 25). Twelve children had both parents in the normal weight category, 14 children had both parents in the overweight category, 10 children had the father in the normal weight category and the mother in the overweight category and 16 children had the mother in the normal weight category and the father in the overweight category. Three mothers and five fathers did not report their height and weight.

2.2. Stimulus material

We created a virtual schoolyard (St. Claire High School, sketchup.google.com), which was accessed by children via head-mounted display (HMD, nVisor SX60). They were presented four scenarios including four types of children avatar groups: normal weight and eating avatars, normal weight and playing avatars, overweight and eating avatars, overweight and playing avatars. See Fig. 1 for an example (normal weight and eating avatars).

All participants were exposed to the four conditions, the order of which was counterbalanced. Apart from body shape and