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Influence of Peers and Friends on Children's and Adolescents' Eating and Activity Behaviors

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Abstract

Obesity during childhood and adolescence is a growing problem in the United States, Canada, and around the world that leads to significant physical, psychological, and social consequences. Peer experiences have been theoretically and empirically related to the "Big Two" contributors to the obesity epidemic, unhealthy eating and physical inactivity [1]. In this article, we synthesize the empirical literature on the influence of peers and friends on youth's eating and physical activity. Limitations and issues in the theoretical and empirical literatures are also discussed, along with future research directions. In conclusion, we argue that the involvement of children's and adolescents' peer networks in prevention and intervention efforts may be critical for promoting and maintaining positive behavioral health trajectories. However, further theoretical and empirical work is needed to better understand the specific mechanisms underlying the effects of peers on youth's eating and physical activity.

Keywords

peer influences; obesity; children; adolescents; food intake; food selection; physical activity

The rates of pediatric obesity in the United States, Canada, and European countries have sharply increased in recent decades. Today, approximately 31% of children and adolescents in the United States are considered overweight or obese, with similar rates reported in Canada and several European countries [2, 3]. This recent trend is alarming for several reasons, one being that overweight children and adolescents are now experiencing medical conditions that were once exclusively diagnosed in adults, such as Type II diabetes [4] and cardiovascular disease [5].

It is also the case that being overweight has become a normative state for some children, adolescents, and adults. Social psychology research has consistently shown that social norms (or what is considered typical) are likely to influence the initiation and maintenance of a variety of behaviors [6, 7]. Recent evidence suggests that the same is true for obesogenic

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behaviors and overweight status [8, 9]. For example, it has been found that children and adolescents whose social networks (parents and schoolmates) comprise overweight individuals are more likely to underestimate their own weight and develop inaccurate perceptions of what constitutes appropriate weight status [10]. Given that children's and adolescents' perceptions of the eating and activity behaviors of their parents and friends can influence their own behaviors [8], and that overweight youth tend to affiliate with overweight peers [11, 12] and have greater energy intake in the presence of overweight peers (compared to their leaner counterparts) [13], it seems likely that such norms about eating and activity reinforce obesogenic behaviors and overweight status in many individuals.

To alter the recent obesity trends, there has been considerable interest in understanding the early causes and origins of weight gain. Research has consistently shown that a multitude of factors contribute to an increased risk for obesity during childhood and adolescence, including variability in genetic influences on eating and metabolic rate [14]. However, the rapid increase in the prevalence of obesity seems to coincide primarily with behavioral and environmental changes that have led to increased energy intake and a lack of physical activity [15]. Specifically, children's and adolescents' increased energy intake has been attributed to the persistent over-consumption of energy-dense foods and drinks [16], such as fast food [17] and sweetened drinks [18], whereas a reduction in energy output is attributed to declining levels of physical activity and the adaptation of more sedentary lifestyles [1]. For instance, it has been found that children who watch more television are less likely to do vigorous physical activity and are likely to have higher body mass indices (BMIs) [19]. For these reasons, unhealthy eating and physical inactivity have been referred to as the "Big Two" contributors to the obesity epidemic [1].

Most recently, there has been growing interest in understanding aspects of the physical environment that encourage over-consumption of energy-dense food and sedentary behavior. At the same time, there is a growing consensus that the norms, values, and assumptions entrenched in children's and adolescents' social environment play a significant role in the development and maintenance of obesity. Family and peer environments are the primary social contexts contributing to young peoples' norms regarding weight and weight-related behaviors [20]. Although parents provide the strongest influence on children's health beliefs and behaviors and dietary intake [21, 22], there is growing evidence that children and adolescents are also influenced by what their peers eat and whether their peers are physically active [21, 23]. The effects of families on children's and adolescents' eating and physical activity have been well researched and reviewed [24–28]. However, there has not been a systematic review of the research investigating peer effects on eating and physical activity during childhood and adolescence. The lack of a comprehensive review impedes our ability to clearly ascertain from the extant literature: (a) why and how friends and peers are strong contributors to childhood and adolescent obesity, and (b) how to most effectively translate knowledge to inform efficacious prevention and treatment approaches. Thus, the overarching aim of the present review was to review the literature on how peer relationships and peer networks influence childhood and adolescent obesity, focusing on the "Big Two" contributors to the obesity epidemic [1]. We review the literatures on peers in relation to eating *and* physical activity because we believe that these two strong contributors to the obesity epidemic can both be explained by the peer social context during childhood and adolescence.

Our review of the literatures on peer influences of eating and physical (in)activity during childhood and adolescence was theoretically driven by earlier reviews of the general social influences on eating in adult populations [29] and by our earlier research on the effects of peers and friends on eating and physical activity [30–33]. To find relevant English-language

empirical research for the influence of peers and social networks on children's and adolescents' eating and physical (in)activity, a literature search of PsychInfo, PubMed, and Google Scholar was conducted using the following key words: "modeling"; "impression management"; "social facilitation"; "peers"; "peer influence" ; "social network"; "normative influence"; "food intake"; "eating"; "physical activity"; "sports"; "exercise"; "children" and "adolescents". These key words were used in combinations of four to include one theoretical keyword (i.e., modeling, impression management, social facilitation, normative), one behavioral keyword (i.e., eating, physical activity, sports, exercise), one word referring to peers (i.e., peers, peer influence, social network), and one age group identifier (i.e., children and adolescents). The reference lists of relevant publications were also reviewed to identify additional pertinent literature. In general, our search was strongly focused on experimental research, however we also expanded our review to survey research, including studies employing social network methods that explore socialization processes among peers. In particular, we reviewed non-experimental research when the experimental work within a particular research domain was sparse (e.g., peer effects on physical activity). We also reviewed non-experimental research to broaden our understanding of the extent to which processes observed in the laboratory translate to more naturalistic peer settings. When possible, we considered research that tested for differences in peer effects on eating and physical activity between overweight and nonoverweight youth to gain a general understanding of whether certain peer processes place some (but not all) youth at increased risk of becoming or remaining overweight.

To our knowledge, there exist no developmental studies on the ways in which peers impact physical activity and eating at various ages and in different developmental periods. Therefore, in our review, we summarize findings from studies of children and adolescents together, even though there are almost certainly considerable developmental differences in the source(s) and nature of the peer influence. We acknowledge that peers and friends are likely more influential on eating and physical activity as children get older. Indeed, it is during late childhood and early adolescence (10–14 years) that youth spend the majority of their waking hours in the company of peers and when positive peer relations experiences become critical for healthy psychosocial development and adjustment [34]. We further acknowledge that the larger social context also includes parents and family members, and direct the interested reader to the following excellent recent reviews on the family and obesity: [35] and [36].

Peer Influences on Eating and Physical Activity during Childhood and Adolescence

Research on the effects of peer influence on youths' eating and physical activity has been proliferating over the last decade. Although this work has generated evidence demonstrating that peers, friends, and broader social networks influence eating and physical activity during childhood and adolescence, the research conducted has been largely atheoretical. This is especially true for the research on peers and physical activity. Thus, we first review three theoretical mechanisms, and supporting evidence, that have been used to describe the effects of general social influences on eating in *adult* populations: social facilitation, modeling, and impression management. We also review the emerging empirical evidence suggesting that these mechanisms may also be relevant for understanding the influences of peers on food intake and physical activity in children and adolescents. At the end of this section, we also describe the normative framework, put forth by Herman and colleagues [29], which attempts to integrate research on these three explanatory mechanisms. As described below, the normative framework is particularly useful when interpreting recent evidence that obesity and obesogenic behaviors tend to cluster in youths' broader peer networks.

Social Facilitation of Eating and Activities

In its earliest conceptualization, social facilitation theory described an increase in performance as a result of the presence of others [37]. Most recently, it has been argued that it is the evaluation [38–40] or the degree of cognitive overload [41] that occurs when in the company of others that serves as a source of arousal, subsequently leading to impaired performance on complex or difficult tasks [42, 43]. In its application to eating and physical activity research, social facilitation has taken on a broader meaning, encompassing the general idea that the presence of others can promote behaviors/performance through a variety of mechanisms (see below).

Eating

With regard to eating, it is consistently found that in the presence of others, people eat more than when they eat alone [44–46]. The dominant explanation for the social facilitation of eating is the time-extension hypothesis [46, 47], which states that the presence of others indirectly promotes increased eating by extending the duration of the meal. However, it is also possible that presence of others directly increases the amount consumed and thus indirectly extends the duration of the meal [29]. Although the underlying mechanism is not yet clear, social facilitation of eating has been shown across a range of meal occasions (breakfast, lunch, dinners, snacks); when adults are eating at home or in a restaurant; and whether or not they are consuming alcohol at the meal. Showing the ubiquity of the effect, social facilitation of eating has also been found in a number of different societies [48–50] and across a variety of research methodologies, including the food diary approach, direct observation, and experimental methods [51, 52].

Importantly, there is also evidence that social facilitation operates on *youths*' energy intake. For instance, Lemung and Hillman [53] examined the effect of group size on preschool-ages children's food consumption. They observed children's eating behavior during their regular snack time in small groups (three classmates) or large group (nine classmates). It was found that children started eating more rapidly, ate faster, and consumed more food in the larger group than in the smaller group. Moreover, it was found that when the duration of the snack time lasted longer, children ate more in the larger group but not in the smaller group. Interestingly, children in the larger group showed less social interaction compared to those in the smaller group, which was attributed to heighted arousal in the larger group, which in turn led to greater food consumption.

It should be noted, however, that there are some instances in which the effects of social facilitation do not appear to be as straightforward as initially formulated. For instance, although the number of others present in the eating context has an influence on food intake [44], there is indication that social facilitation is attenuated or even absent when adults eat with *unfamiliar* others in contrast to eating with *familiar* individuals, such as friends and family members [45, 54]. de Castro [45] has argued that individuals may feel more comfortable with familiar than unfamiliar others, allowing for the release of inhibitions that control eating.

Similar to the adult literature, it is also clear that the presence of peers does not always increase youths' food intake. For example, Péneau and colleagues compared the effects of peers and the availability of alternative activities on 15–16 year-old adolescents' food intake [55]. Participants were scheduled to eat lunches in four contexts: (1) when alone, (2) in the company of three unfamiliar peers, (3) while watching TV, and (4) while listening to their own music. Results indicated that adolescents ate *less* food when paired with three unfamiliar peers than in any other condition. Similar effects have also been found among

children, such that children who were eating with strangers were found to consume less food than children who were eating with their siblings [56].

Another important finding in the literature on peers and food intake among youth is that the effects of peers on eating appear to depend on weight status, at least during childhood and early adolescence (10–14 years). For instance, in one study, it was found that overweight children (ages 6–9 years) ate more when alone than when in the presence of three unfamiliar peers [57]. However, normal-weight children did not eat differently when in the presence of these peers. These results were later replicated with older youth (10–12 years) [58]. Thus, it appears that for certain children and adolescents, such as those who are overweight, different processes may supersede social facilitation. For example, given the strong association between overweight status and social stigma, it is possible that overweight youth are especially motivated to make a good a positive impression on unfamiliar others. On the other hand, research has also indicated that overweight youth consume more food when paired with overweight than non-overweight unfamiliar peers and friends [59], suggesting that these same impression management processes may be eased when in the company of similarly-overweight peers. Further understanding the conditions under which social facilitation occurs for lean and overweight youth is critical given that overweight youth tend to be friends with one another [11, 12].

Physical activity

The application of social facilitation to physical activity is fairly straightforward given that its original conceptualization was developed based on physical activity performance (i.e., cyclists; [37]). Social facilitation processes are infrequently referenced in studies of child and adolescent physical activity, although there is a small body of work indicating that youth are more physically active when in the company of peers and friends [60–64]. Youth who report a greater presence of peers in their lives also report engaging in greater physical activity [61, 63, 64], while lonely children, who are often friendless and isolated from their peers, report the least amount of physical activity [65]. Additionally, the presence of peers has been found to increase the *variety* of physically active alternatives, subsequently increasing the amount of physical activity in which youth participate [66]. These findings are not surprising given that many physical activities during childhood and adolescence are social, typically involving some form of organized or spontaneous active play with one or more partners (e.g., kickball, tag, softball; [67, 68]).

Recent work exploring peer effects on youth physical activity provide some insight as to why overweight children and adolescents tend to be less physically active than their normal-weight peers. Utilizing experience-sampling procedures, two studies found that although overweight and non-overweight youth were equally physically active when in the presence of friends, overweight children and adolescents are alone more frequently than non-overweight youth [69, 70]. Survey research has also clearly demonstrated that overweight youth experience weight-based stigma and marginalization by their peers, and as a result tend to have fewer friendships than their leaner counterparts [11, 12, 71]. Thus, overweight youth may lack basic opportunities to engage in physical activities with their peers.

Overall, this work strongly suggests that relationships with peers are an important precursor to physical activity during childhood and adolescence. At a basic level, peers and friends appear to provide opportunities to engage in active leisure activities, and because overweight youth tend to be marginalized by their peers their opportunities to be physically active may be reduced. However, whether or not peers also increase energy expenditure or ‘performance’ during these activities, as suggested by traditional conceptualization of this socialization mechanism [37], has been under-researched. One experimental study by Rittenhouse, Salvy, and Barkley [72] sought to explicitly examine this social facilitation

process. They found that overweight boys were less physically active than normal-weight boys when alone, however when these boys paired with a non-overweight *or* overweight peer, overweight/obese boys increased their physical activity to a level that was similar to the non-overweight boys, a finding that is consistent with proposed role of social facilitation on physical performance. Additional research is needed to determine if this effect holds for girls and across developmental stages.

Although simply the presence of peers and friends seems to have a positive effect on youths' physical activity, it should be noted that the qualitative nature of children and adolescents' peer experiences (the degree to which they are negative or positive relationships) also appears to be important. Indeed, investigators have demonstrated that it is not simply the presence of peers that matters, but that perceptions of *support* from and positive relations with peers and friends are associated positively with children's and adolescents' participation in physical activity both concurrently and longitudinally [73–77]. In particular, this effect seems to be stronger for team sports that than other activities, likely because team sports require greater involvement of peers [78, 79].

Negative peer experiences have also been related to lower levels of physical activity. For instance, researchers have shown that *peer victimization*, or repeated physical, verbal (e.g., teasing), and/or relational (e.g., rumors) peer abuse, is associated negatively with physical activity levels [80, 81]. Youth who experience *criticism* by peers specifically regarding their weight have also been found to be less physically active relative to their classmates [82–84]. The research suggests that the negative internalizing consequences of peer victimization leads to decreased levels of physical activity [85], while teasing among early adolescents has been associated with higher preferences for sedentary/isolative activities and lower preferences for active/social activities [86]. Thus, children and adolescents may avoid physical activities in an attempt to avoid further weight criticism, teasing, and victimization from peers in general, intentionally removing themselves from opportunities to do activities with peers, and from the possibility of positive social facilitation effects.

In a more recent study, Barkley and colleagues [87] tested whether being ostracized or excluded by peers (via Cyberball game [88]) would decrease youths' activity. Children in this study were assigned to an excluded (ostracized) condition (vs. included/control condition), and subsequently given free-choice access to a variety of physical and sedentary activities in a gymnasium for 30 minutes. Ostracized children were found to have accumulated 22% fewer accelerometer counts and allocated 27% more time to the sedentary activities compared to the included condition. Although this study did not examine possible differences between overweight and non-overweight children, the results offer the first experimental support for the relation between negative peer difficulties and decreased physical activity in children. Additional studies that both include normal weight and overweight/obese youth are needed to determine whether children's weight status would moderate the effects of ostracism on physical activity. Also, given that the presence of peers and also the qualitative nature of the peer relationships seem to matter, it would be fruitful for intervention and prevention programs designed to promote physical activity and weight loss to include large group activities, as well as small group activities in which friends can participate together.

Modeling of Eating and Physical Activity

Whereas most social facilitation studies focus on the ways in which the presence of others impacts behavior, researchers have also argued that people directly adjust their behavior to that of others. This process is often referred to as social modeling by Bandura and other social learning theorists (e.g., [89]), who view this as a cognitive process whereby

individuals form beliefs and attitudes about the behaviors they observe in others, which in turn shapes their own behavior. Conceptualizations of social modeling have also included more automatic behavioral mimicry whereby individuals unwittingly mimic the behavior of their interaction partners [90, 91], although this may be driven, to some extent, by social goals [92].

Eating

Studies on social modeling of eating in adults have consistently shown that individuals eat more when their eating companions eat more and less when their eating companions eat less [31, 32, 93–95]. In a classical modeling experiment of eating, naïve participants are paired with experimental confederates whose food intake is predetermined by the experimenter, and therefore there is no opportunity for the sort of mutual potentiation of eating that may occur among the freely eating individuals in a social facilitation scenario. In such studies, the modeling of food intake effect has been found to be quite robust and to over-ride strong physiological influences [96]. Moreover, evidence of modeling has been found when the eating model is not physically present but when participants are led to believe that previous participants have eaten a certain amount, suggesting that it is not simply the behavior of others from which individuals can learn and be reinforced, but that individuals' perceptions of behaviors matter as well [97–99]. To date, numerous scholars have demonstrated that modeling effects have a strong and pervasive influence on the eating behaviors of both normal and overweight adults, suggesting that these effects do not depend on weight status [93–95].

Importantly, modeling of food intake has been found not only among adults, but also consistently among children and adolescents [58, 100, 101]. For instance, Romero, Epstein and Salvy [102] found that girls between 8 and 12 years old ate more cookies when they were exposed to a peer eating a large number of cookies than girls who were exposed to a peer only eating a small number of cookies. Furthermore, it was found that children's snack consumption was predicted by their peer's consumption of the same snack. That is, children were found to eat more or less when their peers ate more or less [58, 101]. In contrast to the adult literature, however, it appears that the extent to which children are influenced may depend upon their weight status. For instance, in a recent study, Bevelander and colleagues [100] found that overweight children were more sensitive to observing a peer consume a large amount of snack food (and as result, more likely to overeat) than were normal-weight children. They also found that the modeling effects for overweight children persisted over time (i.e., 2-days), suggesting that the peers (and the degree to which they eat) may have a particularly strong impact on the eating behavior and patterns of overweight youth.

Because modeling effects capture the emulation of others' behaviors (as opposed to more generalized effects of the presence of others on food intake) there are also some interesting findings with respect to peer effects on the selection of particular food types. For example, in line with peer modeling effects on food intake, the consumption of healthy snacks by unfamiliar peers was found to influence youth (9–11 years) to consume more healthy foods, even in the presence of both healthy and unhealthy food options [58]. These effects were found in both overweight and non-overweight children.

Physical activity

Theory on modeling has often guided physical activity interventions with the basic premise that children and adolescents who are provided opportunities to watch models engage in physical activity should become more physical active. However, despite the use of modeling as an intervention tool, basic research testing the circumstances under which conformity or modeling of physical activity is optimized is sparse. Only a handful of experimental studies

have explored the utility of exposing children and adolescents to peer models who are physically active. Some of this work has found evidence that exposing youth to fictional cartoons ("Fit n' Fun Dudes` [103]) or videos of physically active youth [104], is related to increased physical activity. For instance, Horne and colleagues [103] found that exposing children to physically active cartoon characters increased both boys' and girls' physical activity to more than 30 minutes of moderate-to-vigorous physical activity per day, with effects being particularly strong for girls. Observational studies provide some additional evidence that peers and friends are important models of physical activity during childhood and adolescence. For instance, studies have shown that adolescent physical activity is correlated with the physical activity of their friends [105–107]. However, many of these studies have relied on adolescents' perceptions of their friends' behavior, rather than friends' self-report activity levels, which may result in the overestimation of behavioral similarity among friends [108]. The few studies capturing self-reported activity of friends have also consistently shown that friends are similar in the degree to which they participate in physical activity [109]. One longitudinal study of Australian adolescents, by de la Haye and colleagues [30] suggests that friends engage in similar amounts of physical activity due to socialization and modeling processes, as well as social selection processes (whereby two adolescents similar to each other in physical activity level select each other as friends). Additional longitudinal work is needed to assess the generalizability of these findings.

Furthermore, it is important to note that investigators have yet to test whether peer modeling of physical activity in intervention studies has lasting effects. There is some indication that some of the peer modeling effects may diminish with time [103], and if these effects do persist, it is not clear which positive contingencies outside of the laboratory (e.g., encouragement from friends) are needed for maintenance. Further investigation is also needed into the specific processes responsible for the modeling effects. There is some indication that peer modeling of physical activity may have an impact vis-à-vis children's and adolescents' *physical self-efficacy*, or their beliefs about being able to overcome perceived barriers and perform required skills necessary to engage in physical activity (in terms of frequency, duration, and intensity) [110]. Indeed, a number of studies have shown that physical activity self-efficacy is both an important determinant as well as a consequence of physical activity and that exposure to physically active models can increase physical activity [111–113], suggesting more careful attention should be paid to physical efficacy in the evaluation of intervention studies.

Impression Management on Eating and Physical Activity

While studies on social facilitation and modeling generally describe changes in individuals' behaviors when in the presence of others, impression management studies seek to explain individuals' motivations to behave when in the company of others [29]. The general idea is that individuals consciously or unconsciously attempt to control the impressions that other people form by regulating information and their self-presentation [114].

Eating

Impression management studies on *eating* assume that under conditions in which making a good impression is important, people tend to try to accomplish their impression management goals by eating minimally [29, 97, 115]. This has been found to be true in studies of adults; similar evidence has been found in studies of older children and young adolescents, who are also concerned with being perceived positively by age-mates and friends [58, 101]. In general, conveying a good impression through eating at any age appears to involve eating *less*, likely because obesity is highly stigmatized and individuals tend to associate negative characteristics (e.g., overeaters, physically inactive) with people who consume large amounts of food [116]. However, there may be some important exceptions: foods also have

cultural and social meanings, and the consumption of certain types of foods (such as unhealthy snack food) associated with social capital or status may be done to convey a good impression among peers, especially during adolescence when peer approval becomes increasingly important. For example, seeking peer acceptance has been put forward as an explanation for the association between acculturation to American norms with higher frequency of fast-food consumption among Hispanic and Asian-American youth [117]. Another study found that in some school contexts, adolescent males who consumed the most energy-dense snack foods tended to be the most popular [118]. Indeed, teens report that "healthy eating" often conflicts with the desired image they wish to portray to their peers, and that certain foods, and even brands, are used to build one's social image and social standing among peers [119]. These complexities suggest that researchers and clinicians need to carefully consider impression management concerns, and what is considered "cool" within particular peer groups and contexts, when designing intervention and prevention efforts for adolescents.

Physical activity

Impression management is also thought to be an important mechanism underpinning the peer effects on youth physical activity, given the social nature of many leisure-time activities, and association between physical activity and peer status [120]. A number of studies have examined the types of impressions that are associated with those who exercise regularly [121]. For example, it has been found that exercisers are more often rated as being sociable, confident, and having more self-control than non-exercisers [122]. Previous results also indicate that non-exerciser stereotypes exist [123]. That is, non-exercisers are more often negatively biased compared to exercisers or control targets. This may be due to the wide-spread "healthism" idea that regular exercise is a moral obligation and that those who do not exercise are weak or deviant [124, 125].

Given that negative stigma is also associated with overweight individuals who are sedentary and physically inactive, one would expect that the impression management motives to increase physical activity would be especially strong for overweight individuals. In support of this idea, a recent study shows that the presence of unfamiliar peers has a greater impact on the physical activity levels of overweight youth than their leaner counterparts [72]. However, it is also consistently found that overweight youth are less likely to engage in physical activities than normal-weight youth [126–128], likely because they have learned that removing themselves from physical activity settings altogether is a "safer" option than participating in these activities and potentially being scrutinized and teased by peers. Thus, the "power" of peers to impact the physical activity of overweight youth may be somewhat limited given their avoidance of physical activity settings.

A Normative Account of Social Influences on Eating and Physical Activity

Eating

The literatures reviewed above clearly show that peers impact eating and physical activity during childhood and adolescence, but also demonstrate that they are complex and that the direction of the influence (i.e. increase vs. decrease) depends on a variety of factors (e.g., nature of the relationship with the companion, what that companion is doing). In an attempt to achieve some integration between the three explanatory mechanisms of social influences of eating, Herman and his colleagues [29] proposed a normative framework accounting for the effects of others on eating. This normative model posits that, in the presence of palatable food, and in the absence of other constraints, people are motivated to eat as much as they can but that the presence of others determines when eating *stops*. Thus, social norms serve an inhibitory function, indicating at what point individuals must stop eating if they are to

avoid excess and become socially inappropriate. What appears to be a systematic matching or modeling of food intake in some cases would actually be a systematic effort to avoid incurring the stigma of excess, or to conform to the norms in place. In this model, individuals conform to others' behaviors because they see the amount eaten by others as an indicator of how much one can/should eat or because they believe that by conforming they will ingratiate themselves to others, and thus positively manage their impression [97, 129]. These eating norms, however, may not only impact food intake, but also food selection. For instance, Cullen and colleagues [130] found that children's normative beliefs about the extent to which their peers and friends consumed fruits, juice and vegetables was strongly associated with what their peer consumed. Also, in a rare longitudinal study of food selection from middle adolescence into young adulthood, it was found that perceived peer support for healthy eating was a negative longitudinal predictor of later fast food intake [131].

Physical activity

Herman and colleagues' framework was designed to better understand social influences on eating, but we believe that similar ideas can be used to integrate findings of social influences on physical activity. The influence of injunctive norms, as originally formulated in the theory of planned behavior [132], has often emerged as a weak predictor of physical activity [133]. However, descriptive norms (as opposed to injunctive ones) or perceptions about the prevalence and frequency of others' behavior [134, 135] have been found to be strong predictors of behavior [136]. One factor that seems to influence the relation between descriptive norms and behavior is the relevance of the normative group. For example, Polonec and colleagues [137] found a stronger association between the drinking behavior of college students and the drinking norms of their friends than between the drinking behavior of college students and the drinking norms of general others in the students' college. Similarly, Campo and colleagues [138] found that norms about a "typical student" were not related to drinking behavior in students while norms about "friends" were positively related to alcohol consumption. Furthermore, and most relevant to this review, it has been found that friends' physical activity was related more strongly with individual physical activity than was the physical activity behaviors of other groups [139], and that the descriptive norms associated with friends' physical activity are the strongest predictors of individual physical activity [136].

Social networks and obesity

It should be noted that the notions of descriptive norms and the normative framework put forth by Herman and his colleagues are consistent with recent social network theory and research on obesity. As mentioned previously, behaviors that are normative are the behaviors that are shared by the local social milieu. The well-publicized study by Christakis and Fowler suggested that adults were more likely to become overweight over three decades if their friends were overweight or obese [140], and similar findings have been reported in children [141–143] (although these findings have also received some critique, e.g., [144]). Christakis and Fowler suggested that the psychosocial mechanisms accounting for the spread of obesity may rely less on behavioral imitation or modeling and more on changes in individuals' general perceptions of the social norms regarding the acceptability of obesity [140], an argument that is similar to Herman's normative model [29]. The general idea is that when individuals become aware that their friends are gaining weight (or losing weight), the social norms about what is socially acceptable change. Thus, after becoming aware that a friend has gained weight, an individual might relax his or her exercise program or diet, in part because the standards and social norms for weight have been altered. It should be noted, however, that there is no direct evidence to date that supports this hypothesis. Nevertheless, this may imply that although friends' norms about weight change in parallel, their resultant

weight gain might be determined by different behaviors (e.g., increased intake of unhealthy foods, decreased physical activity). The observation that geographic distance does not attenuate the effect of friends' weight on individuals' own weight provides additional support that norms rather than modeling (which often requires direct observation) may best account for the findings of Christakis and Fowler [140].

There is some question as to whether these same conclusions can be drawn among young people. Children and adolescents whose social networks (parents and schoolmates) comprise overweight individuals are more likely to underestimate their own weight and develop inaccurate perceptions of what constitutes appropriate weight status [10]. Peers may also act as important "weight referents", influencing young people's weight norms and *indirectly* affecting their weight management and obesogenic behaviors. However, recent longitudinal studies examining weight status in the context of adolescent friendship networks have found that weight-based similarities among friends are at least partially, if not predominantly, explained by youth selecting friends with similar weight attributes, or by other confounding social selection or environmental factors [11, 145]. Indeed, there is a large literature showing that weight-based stigma among youth results in overweight youth being excluded from friendships and marginalized in broader peer networks, and therefore likely to befriend other marginalized, overweight peers [11, 12, 71]. Whether normative influences among adolescent peers predict changes in adiposity, controlling for these friendship selection processes, is a question that requires additional research over longer periods of time.

Additionally, it is not clear if the proposed "social contagion" of overweight among youth is explained by normative influences, or if the underpinning mechanisms are more likely to be modeling and/or impression management. Perceived peer group norms about physical activity (e.g., beliefs about the extent to which friends at school are physically active) have been found to predict adolescents' *intentions* to be physical active and self-reports of physical activity, findings that suggest that adolescents rely on normative information from friends when making decisions about whether to be physical active [78] and support Herman's normative framework described previously [29]. Beliefs about *best friends'* physical activity in particular have been associated with self-reports of physical activity, suggesting that only specific, emotionally close friends may have the "power" to influence youths' physical activity [146].

However, a small number of observational studies suggest that normative beliefs may not explain friends' influence on eating and physical activity over longer periods of time. In a series of studies looking at the friendship networks of Australian adolescents (where adolescents and their friends are recruited into the study, each reporting on their friendships and behaviors), de la Haye and colleagues found that both BMI and obesity-related behaviors, such as energy-dense food intake, physical activity, and physical inactivity (i.e., screen-time) tended to be similar among friends, thus clustering in friendship groups and larger peer networks [118]. Over the course of one school year, similarities among friends in physical activity [30] and consumption of energy-dense foods [147] were found to be explained by social influence: evidenced by the fact that adolescents' behaviors were predicted by their friends' behaviors, controlling for similarities when the friendships were formed. However, for both eating and physical activity, the influence of friends' behaviors on adolescent behaviors was not found to be mediated via a range of cognitive mechanisms, such as those outlined in traditional social learning theory. Specifically, the effect of friends' behaviors on adolescents' behavior over time was *not* explained by a process whereby friends' behaviors influenced adolescents descriptive peer norms, attitudes, or intentions. These findings suggest that it may be modeling processes, as opposed to normative influences, that underpin the influence of friends on these weight-related behaviors in naturalistic settings. Alternately, adolescents' adoption of their friends' behaviors may be

driven by impression management and goals to fit into their peer group, rather than their own beliefs about weight, eating, or physical activity. Finally, it is also probable that friends experience shared environments and opportunities to engage in particular eating or physical activity behaviors that may also account for increasing similarities in their behavior over time. Future observational research needs to consider the potential role of these various mechanisms driving peer influences on weight-related behaviors, and studies should examining the role of the mediating processes on behavior change over time.

Conclusions, Implications, and Future Research

This review provides a brief overview of the research on peer influences on children and adolescents' eating and physical activity. There is no question that peers and friends impact eating and physical activity. However, understanding *how* peers and friends influence youths' eating and activity behavior is essential to most effectively translate knowledge into efficacious prevention and intervention efforts. This review reveals some clear patterns delineating when and how impact eating peers and activity choices during childhood and adolescence.

In general, this research indicates that the presence of peers and friends increases children and adolescents' energy intake, except (1) in situations in which impression management concerns are high and (2) when peers exhibit healthy eating. As noted previously, the available research makes it difficult to ascertain which mechanism account for the effects of peer influences on healthful eating. The majority of the studies seem to assume that this effect is the result of modeling [56, 148–154]. However, it is conceivable that what appears to be systematic matching/modeling of eating is in fact an attempt (in overweight youth at least) to convey a good impression or to follow either the experimental demands or the social norms in place, with the goal of avoiding the stigma incurred by overweight individuals who eat "unhealthy" foods. Future research will need to determine the developmental trajectory of concerns with eating appropriately and whether youth associate their eating behaviors with impression management strategies.

Review of the physical activity research indicates that having peers/friends to play with, and having positive relationships with these youth, fosters involvement in and possibly facilitates physical activity in children and adolescents. Being alone and/or experiencing negative peer interactions appears to deter youth from being physically active. Physical activity in youth most often involves some kind of social play or team sports, and so it is not surprising that children who are alone are also less physically active. Youth who encounter criticism during physical activity may also withdraw from these activities due to their apprehension of being evaluated and also because this aversive context is likely to decrease the reinforcing value of these settings [82]. Moreover, there is also evidence of modeling effects and normative influence on physical activity in children and adolescents, evidenced by youth emulating the physical activity levels of their peers and friends.

In reviewing the empirical evidence, we extend three explanatory mechanisms (social facilitation, impression management, modeling) and the normative framework [29] that integrates these mechanisms from the literature on social influences on eating in adults to the research on peer influences on eating and physical activity during childhood and adolescence. Although these theoretical mechanisms/frameworks reviewed here appear to be useful heuristics for interpreting and organizing the research on peer influence on eating and physical activity during childhood and adolescence, there is a clear need for research specifically testing these frameworks in samples of children and adolescents, and studies that "pit" one framework against the other. As evident in this review, it is not always clear which mechanism prevails and under what circumstances, and particularly in naturalistic

settings. Future work also needs to go beyond descriptive and correlational approaches in order to advance our understanding of the ways in which peers and friends contribute to the development and maintenance of unhealthy eating and activity behavior, and how they might promote healthier trajectories. Longitudinal research will be important to test the direction of the effects reported in many of the studies reviewed herein, and the likely bidirectional associations between friendships and behaviors.

The challenge of future work in this field is to develop a thorough understanding of how, why, and in which contexts peers influence youths' eating and physical activity, so that the impact of social environmental factors on public health policy can approximate the impact of similar work on the physical environment. To achieve this we will need to address mechanisms accounting for the effects of peers and friends on eating activity, yet be sufficiently broad in scope to inform public policies, prevention efforts, and interventions. Most of the current research, including ours, has been mostly parametric in nature and conducted in fairly artificial environments. On the other hand, intervention-like studies that have targeted broader systems (i.e., schools) have often failed to have a significant impact. It is not clear at this point whether the limited success of these interventions resides in a lack of control in implementing effective interventions, or whether these clinical initiatives would have been ineffective (i.e., with very small effect sizes) even if implemented in ideal settings and conditions. One difficulty inherent to this area of research is that the social environment is much harder to modify by third parties than the physical environment. It is conceivable to tax high-energy density foods, to modify portions sizes offered in restaurants, or to provide access to parks and recreational areas. It is another matter when the task involves manipulating close interpersonal relationships among youth in order to modify broader social networks and peer effects.

Maybe the solution to the conundrum is to look outside of obesity effort and follow public health initiatives in other areas. For instance, one approach that has shown promising results in modifying the social environment for the treatment of substance abuse is the community reinforcement approach. The community reinforcement approach (CR) is based on the conceptualization of the powerful role that socio-environmental contingencies play in encouraging or discouraging healthy behaviors [7, 9, 155–157]. According to this approach, social, recreational, and familial reinforcers are used to assist individuals in the adoption and maintenance of a healthier lifestyle, within the context of a supportive social network. Conceivably, modifying social network norms can help redefine appropriate eating behavior and choices of activity and create a community of individuals that shares common lifestyle goals. Family-based approaches are an obvious source of social support and can engage families in a supportive health-oriented social network. The goal is not to change the behavior of all individuals within the family social network (e.g., grandparents who might be reluctant to change) but to increase the ratio of individuals adhering to a healthier lifestyle. Modifying the social network decreases support for unhealthy eating and enhances support for healthy eating and engaging in healthier activities. Previous attempts to substitute healthy behaviors for obesogenic habits may have been limited, in part because sedentary activities are highly reinforcing and easily accessible, and in part because individuals are surrounded by family members, friends, and peers who are supporting the behaviors they are trying to replace. Modifying the social context may facilitate generalization of healthy behaviors across environments, as well as contribute to the maintenance of healthy behaviors in the community. Future research will be determinant in assessing whether this approach, while proven successful for substance abuse [7, 9, 155–157], is also efficacious and effective in the prevention and treatment of childhood obesity.

Highlights

1. The prevalence of pediatric obesity sharply increased in recent decades.
2. There has been a recent increased interest in the impact of the social environment on youth's eating behavior and choices of activities.
3. The presence of peers and friends increases children and adolescents' energy intake, except (1) in situations in which social-evaluative concerns are high and (2) when peers exhibit healthy eating.
4. Friendships and positive peer relationships foster involvement in physical activity during childhood and adolescence, whereas being alone and/or experiencing negative peer difficulties (which occurs often for overweight children and adolescents) appears to deter youth from being physically active.
5. Further theoretical work is needed to delineate the mechanisms underpinning the effects of social influences on youth's eating and activity behaviors.

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