ARTICLE

Association between parents' and children' implicit and explicit attitudes towards physical activity and sedentary behaviors

Géraldine Escriva-Boulley[1] and Julie Boiché[2,*]

[1] Haute Alsace University, Mulhouse, France
[2] Montpellier University, Montpellier, France

Abstract – Purpose. The present study aimed to explore the associations between parents' physical activity (PA) and sedentary behaviors (SED) and their explicit and implicit attitudes towards these behaviors and their children's PA and SED, and attitudes. Children's and parents' age and gender were taken into account.
Method. One hundred and seven dyads composed of one parent ($M_{age} = 42.9$ years) and her/his child ($M_{age} = 11.6$ years) completed questionnaires assessing behaviors and explicit attitudes towards PA and SED. Implicit attitudes were evaluated with an Implicit Association Test.
Results. Parents' PA was positively correlated with their children's PA. No significant correlation was noted for SED, implicit and explicit attitudes. Results from hierarchical regression analyses showed that children's explicit attitudes towards PA were negatively associated with parents' SED. Except for an unexpected result (*i.e.*, children's implicit attitudes were positively associated with parents' explicit attitudes towards PA), no other association was found.
Conclusion(s). This study is the first to investigate the association between parents' and their children's implicit and explicit attitudes towards PA and SED. The results indicate that focusing on the increase of PA, on the decrease of SED and the development of positive attitudes towards PA in both children and parents could be an interesting mean to promote PA in interventions aiming to improve families' health.

Keywords: automatic processes, family, health-related behavior, Implicit Association Test (IAT), PA

Résumé – Association entre les attitudes implicites et explicites des parents et des enfants à l'égard de l'activité physique et des comportements sédentaires. Objectif. La présente étude investigue les relations entre l'activité physique (AP) et les comportements sédentaires (SED) des parents et leurs attitudes explicites et implicites à l'égard de ces comportements, d'une part, et l'AP et les SED ainsi que les attitudes de leurs enfants, d'autre part, en tenant compte de leur âge et de leur genre.
Méthode. Cent sept dyades composées d'un parent ($M_{age} = 42,9$ ans) et de son enfant ($M_{age} = 11,6$ ans) ont rempli des questionnaires évaluant les comportements et les attitudes explicites envers l'AP et les SED. Les attitudes implicites ont été évaluées avec un test d'association implicite.
Résultats. L'AP des parents était positivement corrélée avec l'AP de leurs enfants. Aucune association significative n'a été notée pour les SED, les attitudes implicites et explicites. Les résultats des régressions hiérarchiques ont montré que l'attitude explicite des enfants envers l'AP était négativement associée aux SED des parents. À part un résultat inattendu (*i.e.*, les attitudes implicites des enfants étaient positivement associées aux attitudes explicites des parents à l'égard de l'AP), aucune autre association n'a été trouvée.
Conclusion(s). Cette étude est la première à examiner l'association entre les attitudes implicites et explicites des parents et de leurs enfants à l'égard de l'AP et des SED. Les résultats indiquent qu'insister sur l'augmentation de l'AP, la diminution des SED et le développement d'attitudes positives envers l'AP chez les enfants et les parents pourrait être un moyen intéressant de promouvoir ce comportement.

Mots clés : processus automatiques, famille, comportement lié à la santé, test d'association implicite (IAT), AP

* Corresponding author: geraldine.escriva-boulley@uha.fr

Lack of physical activity (PA) is a major risk factor for several chronic diseases (Lee *et al.*, 2012). Research has emphasized the importance of promoting PA and limiting sedentary behaviors (SED, *i.e.*, the time spent sitting or lying down during waking hours, which results in little or no movement) because these two behaviors have independent effects on health (Van Sluijs, Page, Ommundsen, & Griffin, 2010). The current recommendation for health benefits in young people is to practice at least 60 minutes of moderate to vigorous PA (MVPA) every day. Additionally, another recent report suggests that continuous sedentary sequences should be limited to 60 minutes in children and 120 minutes in adolescents (ANSES, 2016). While current evidence indicates the young people in general are aware of the association between an active lifestyle and health (Harris, Cale, Duncombe, & Musson, 2018), several studies have shown that less than 20% of this population meets the PA recommendations (Cooper *et al.*, 2015). In particular, PA decreases by about 4% every year from the age of 5 years, due in large part to the increasing amount of time spent in SED (Cooper *et al.*, 2015).

This decrease in PA and rise in SED among youth is a key public health issue because behavioral patterns established in childhood tend to persist into adulthood (Craigie, Lake, Kelly, Adamson, & Mathers, 2011). There is consequently a need to better understand determinants of children and adolescents' PA and SED in order to develop informed, evidence-based interventions. Previous studies have shown that PA (see Sterdt, Liersch, & Walter, 2013, for a review) and SED (Kim, Ma, & Maehashi, 2017; Pereira, Zhang, Sousa-Sá, Santos, & Cliff, 2020) in children and adolescents are determined by several factors. The present article particularly focuses on the role played by one of the main actors in children's social environment, namely parents.

1 The role of parents in children's PA and SED

Because of shared environment, parents are one of the first to provide health information and education (Niermann, Spengler, & Gubbels, 2018). Thus, parents can play a critical role in shaping PA and SED in youth (Bois & Sarrazin, 2006). This influence can occur through a variety of mechanisms. First, past research has highlighted the contribution of the role modeling effect, *i.e.*, the observation that parental behaviors tend to be imitated by their children. This effect was particularly emphasized in the Theory of Planned Behavior (TPB; Ajzen, 1991), which holds that behavior is mainly determined by an individual's behavioral intention. Intention, in turn, is in part determined by subjective norms, including an injunctive dimension (*i.e.*, the perception of social approval by significant others, which motivates behavior through social reward/punishment) and a descriptive dimension (*i.e.*, the perception of behaviors adopted by significant others; Cialdini, Kallgren, & Reno, 1991). The latter could illustrate a direct influence

of the social environment on individuals' behavior, reflecting a role modeling process (McEachan *et al.*, 2016). Recent literature reviews indicate that this phenomenon is consistently observed, regarding both PA (Xu, Wen, & Rissel, 2015) and SED (Neshteruk, Nezami, Nino-Tapias, Davison, & Ward, 2017). In particular, the effect was observed regarding screen time − which is the most commonly reported SED (Mansoubi, Pearson, Biddle, & Clemes, 2014). In the case of these behaviors, correlations from small to moderate were observed.

Beyond a direct effect through their own behaviors, previous research has shown that parents are also likely to influence their children through their beliefs or attitudes (Sterdt *et al.*, 2013). In particular, research showed that parents' attitudes about PA can influence their children's adoption of this behavior (Sterdt *et al.*, 2013). According to McEachan *et al.*'s (2016) meta-analysis on health behaviors – including PA –, personal attitudes have direct associations with individuals' corresponding health behaviors and/or indirect effects through their intentions. In this vein, one study showed that the more parents are convinced of the importance of PA, the more children tend to display such beliefs, and conversely (Anderson, Hughes, & Fuemmeler, 2009). Nevertheless, there is currently no scientific evidence that this is the case regarding SED. Also, by referring to the TPB that highlights the association between attitudes and behaviors, and based on the results of studies that highlighted shared behavioral patterns between parents and children, it is possible to assume that parents and children also share attitudinal patterns. In other words, parents' attitudes could influence children's attitudes and *vice versa*. However, no study has investigated this relationship for SED. Moreover, the literature is rather scarce regarding the extent to which parents and children share similar perceptions of SED.

2 A dual process approach of PA and SED

Dual-process models (Perugini, 2005; Strack & Deutsch, 2004) have been increasingly applied to the prediction of health-related behaviors (*e.g.*, Phipps, Hagger, & Hamilton, 2020), including PA. Such models distinguish consciously accessible, reasoned processes, and automatically activated constructs, which are processes that are unlikely to be fully governed by reasoned processes (*e.g.*, frequent behaviors, routine). Some of these models which examine attitudes – *i.e.* evaluative responses based on the association between a given object and an evaluation in memory, which can guide behavior (Ajzen & Dasgupta, 2015; Strack & Deutsch, 2015) – posit that they can be dual, and distinguish deliberate or explicit attitudes and automatic or implicit attitudes (Gawronski & Brannon, 2019). More precisely, in the explicit way, attitudes guide behaviors *via* deliberate processes, which involve reflection to choose between several alternative behaviors by evaluating their value, costs and benefits (Fazio, 2007). In implicit attitudes,

evaluative responses are activated quickly and automatically when individual are exposed to relevant environmental stimuli. Once activated, implicit[1] attitudes could affect an individual's behavior quickly and with little need for awareness or cognitive input through the activation of information, cognitive, and physical responses related to the automatically activated evaluative information (Chen & Bargh, 1999; Conroy & Berry, 2017; Phipps, Hagger, & Hamilton, 2019).

As such, those dual-process models posit that PA adoption is not guided only by controlled processes but also by automatic processes (Brand & Ekkekakis, 2018; Cheval & Boisgontier, 2021; Conroy & Berry, 2017). This hypothesis rose in response to two issues: past studies in PA setting mainly investigated controlled processes to predict and better understand the mechanisms underlying the behaviors (Gourlan *et al.*, 2016), but those determinants explain a relatively modest amount of PA variance (Rhodes & de Bruijn, 2013) and hardly explain why intentions towards PA not always turn into effective behaviors. Because researchers ambitioned to enhance understanding of the PA adoption, automatic processes related to PA become more and more popular (Rebar *et al.*, 2016; Sheeran *et al.*, 2016). Studies confirmed that these explicit and implicit attitudes are independent systems (*e.g.*, Cheval, Sarrazin, & Pelletier, 2014; Hyde, Doerksen, Ribeiro, & Conroy, 2010) but also that implicit attitudes and explicit cognitions can be associated to predict intention and behaviors (Muschalik, Elfeddali, Candel, & De Vries, 2018).

3 Measure of explicit and automatic attitudes

Explicit attitudes are traditionally measured by direct measures *i.e.,* which represent the assessment of an object or a construct in response to an instruction to report it (Greenwald & Lai, 2020). This kind of measure generally implies an introspective awareness, because the participant is to share his/her opinions and feelings about the object or the construct (Greenwald & Lai, 2020). For example, in the TPB, attitudes encompass both instrumental (*e.g.*, healthy–unhealthy, valuable–worthless) and affective (*e.g.*, pleasant–unpleasant, interesting–boring) content. For these direct measurements, self-report questionnaires are generally used. In parallel to the development of dual-process models, there was a need to develop measures that could

capture automatic attitudes and that can be used in addition or instead of self-report questionnaires in order to overcome its limitations (*e.g.* forgetting, social desirability) (Bar-Anan & Nosek, 2014). These methods are referred to as "indirect", in contrast to direct, measures since they are not based on self-assessment and use behaviors such as speed and/or accuracy of responses in a categorization task to "indirectly" infer implicit attitudes (De Houwer, 2006). Indirect measures are supposed to measure attitudes activated automatically (Olson & Fazio, 2009).

The most well-known indirect measure is the Implicit Association Test (IAT; Greenwald, McGhee, & Schwartz, 1998). The IAT measures the speed and accuracy with which individual sort words on a computer screen by pressing buttons on a keyboard. By doing so, IAT allows accessing the relative strength of a person's mentally-held automatic associations of two evaluative categories (*e.g.*, positive and negative) with two opposing conceptual targets (*e.g.*, PA *versus* SED) (Brownstein, Madva, & Gawronski, 2019). More precisely, participants are asked to sort stimuli (*i.e.*, words or pictures) from four categories by pressing two response keys. For example, in an IAT that measures individuals' automatic attitudes towards PA, participants are exposed to two categories that represent the conceptual targets (*e.g.*, PA *versus* SED) and two evaluative attributes (*e.g.*, beneficial *versus* harmful). When the target category and its corresponding evaluative category share the same response key, one talks about a compatible phase. For example, participants must press the left key when a stimulus belonging the "PA" concept (*e.g.*, running) or when a positive evaluative attribute (*e.g.*, beneficial) appears on the screen. Conversely, participants must press the right key when a stimulus belonging to the "SED" concept (*e.g.*, couch) or when a negative evaluative attribute (*e.g.*, detrimental) appears on the screen. When the contingencies are reversed (*e.g.*, left key for "SED" and positive attributes *versus* right key for "PA" and negative attributes), one talks about an incompatible phase. The faster and more accurately the participant classifies stimuli in the compatible phase compared to the incompatible phase, the more favorable his or her automatic attitudes towards PA behaviors (Greenwald, Nosek, & Banaji, 2003).

Using IAT allows assessing the attitudes of adults and children, even the younger ones, (*e.g.*, Cvencek, Greenwald, & Meltzoff, 2011). In studies which investigated children's implicit attitudes, IAT has been sometimes modified. Some modifications included reducing length (Williams & Steele, 2016), using pictures instead of words (Cvencek *et al.*, 2011; Thomas, Burton Smith, & Ball, 2007), using words and pictures (Baron & Banaji, 2006), presenting stimuli auditorily (Charlesworth, Kurdi, & Banaji, 2020) or including color coded response buttons (Cvencek *et al.*, 2011). Researchers used pictures instead of words when the study involved children who are not able to read. Words are included in IAT when children are 6 years (Baron & Banaji, 2006) or older (*e.g.*, Charlesworth *et al.*, 2020).

---

[1] The understanding of the word "implicit" in the studies about attitudes varies considerably and leads to a debate on its meaning (*e.g.*, Corneille & Hütter, 2020; Greenwald & Lai, 2020). Recently, Corneille and Hütter (2020) proposed to reduce this conceptual ambiguity by substituting the term implicit for the notion of automaticity. However, in the present article, instead of substituting the term implicit for automatic, these concepts will be used interchangeably because "implicit" is the common term used in the studies about attitudes.

4 Implicit and explicit attitudes to predict PA and SED

A recent meta-analysis concluded that, although small, the association between implicit attitudes towards PA and actual PA behavior is significant (Chevance, Bernard, Chamberland, & Rebar, 2019). In addition, previous studies showed that implicit attitudes predicted PA beyond the effect of controlled constructs (*e.g.*, explicit attitudes and intention; Calitri, Lowe, Eves, & Bennett, 2009; Chevance, Caudroit *et al.*, 2017; Rebar *et al.*, 2016). This meta-analysis also indicated that, to date, young adults have been the most studied age group, and that there is only one previous study conducted in children and adolescents (*e.g.*, Craeynest, Crombez, Deforche, Tanghe, & De Bourdeaudhuij, 2008). Results from these studies showed that implicit attitudes towards PA were positively and significantly associated with PA. Results regarding implicit attitudes towards SED remain scare, and their results are less consensual, showing both implicit attitudes towards SED were not associated with PA (Chevance, Stephan, Héraud, & Boiché, 2018) and that implicit processes/attitudes towards SED were negatively associated with PA (Cheval, Sarrazin, Isoard-Gautheur, Radel, & Friese, 2015; Chevance *et al.*, 2018). Moreover, the relationship between implicit attitudes and SED remains largely unexplored. Last, it is worth noting that, to our knowledge, no studies investigated the link between parents' implicit attitudes towards PA and those of their children.

5 Implicit attitudes in parents and children

In light of the literature presented, the question of how the social environment can transmit more or less positive attitudes towards PA and SED is worthy of consideration, both at explicit and implicit levels. Yet, to our knowledge, only two studies have examined the extent to which explicit and implicit attitudes towards health-related behaviors are shared by parents and their children. Guidetti, Conner, Prestwich, and Cavazza (2012) targeted young adults' (18–22 years) and their parents' attitudes towards food. Regarding explicit attitudes, no correlations emerged between the scores of the young adults and their parents for fruits or snacks. Conversely, the young adults' implicit attitudes towards fruit were significantly predicted by those of their parents in a multivariate model. As noted by the authors, young adults and their parents have considerable shared experience in relation to food. Given that implicit attitudes reflect early socialization experiences, this shared experience might have been translated into greater similarity in implicit attitudes. In contrast, for explicit food attitudes, more recent and more salient shared experiences (*e.g.*, with friends) might explain the absence of association. In this study, no effect of parents' gender was found.

The second study by Sherman, Chassin, Presson, Seo, and Macy (2009) targeted adolescents (from 10 to 18 years) and their parents regarding tobacco-related attitudes and behaviors. The results indicated that mothers with more positive implicit and explicit attitudes had children with more positive implicit and explicit attitudes. In turn, children's implicit – but not explicit – attitudes predicted smoking initiation 18 months later. This result was explained by the observation that implicit attitudes may be communicated by parents in very subtle ways, such as nonverbal behaviors, which may directly impact young individuals' behavior. In this study, results also showed a positive but not significant association between fathers and children' attitudes.

6 The present study

The purpose of this study was to investigate whether parents' PA and SED, as well as their implicit and explicit attitudes towards these behaviors, are correlated with those of their children. Based on past research, a positive and significant correlation between parents' PA and SED and their children's behaviors was expected. We also expected positive and significant correlations between parents' scores of explicit and implicit attitudes towards PA and SED and their children's attitudes towards these behaviors. The second aim of this study was to explore whether parents' attitudes and behaviors predict their children PA and SED, and reciprocally, whether children's attitudes and behaviors predict their parents PA and SED. In accordance with previous results regarding the impact of age (Sterdt *et al.*, 2013) and gender (*e.g.*, Neshteruk *et al.*, 2017; Schoeppe *et al.*, 2017; Yao & Rhodes, 2015) in the relation between parents' and children's PA, these variables were taken into account in the analyses.

7 Method

7.1 Participants

One hundred and fifty dyads were proposed to participate to the study. Among them, 107 dyads composed of one parent ($M_{\text{age}} = 42.9$ years; SD = 5.84; range = 29–54; 75% female) and her/his child ($M_{\text{age}} = 11.6$ years; SD = 3.13; range = 8–18; with 51% $\leq$ 10 years; 53% female) agreed to participate and were included. *Post-hoc* power analysis for correlation and for regression analyses using G*power indicate no power issue given the present sample size ($q = 0.4$, $\alpha = 0.05$; 1-$\beta = 0.82$ and $f^2 = 0.2$, $\alpha = 0.05$; predictors = 14; 1-$\beta = 0.82$, respectively).

7.2 Procedure

Participants were recruited in public libraries, recreation centers, and elementary, middle and high schools during the first semester of 2017. These locations were chosen because it is possible to meet both parents and children at the same time, and because they are dedicated to both PA and not PA practice, enabling the recruitment of various profiles of families. When parents accompanied or came to pick up their children to these locations, both

were asked to participate in a study. They were informed that the study was about their leisure time and that study participation would last about 15 minutes, consisting of a computer task and a questionnaire to complete. Participants did not receive an incentive for their participation. Only children and adolescents between 8 and 18 years old were included. In this particular age range, children are able to read and understand, and adolescent are still living with their parents (which renders the issue of social influence relevant). Individuals presenting reading or vision disabilities were not included. When the inclusion criteria were met, parent and child were brought to a room loaned to the research team, where they signed written informed consent forms that included more detailed information about the study (consent form in Supplementary material), and completed the study in a quiet environment. Parents and children completed the same tasks (*i.e.*, a computerized IAT; Greenwald *et al.*, 1998, followed by a leisure time questionnaire including sociodemographic information) simultaneously using separate material, and they were instructed not to communicate with each other. To ensure anonymity and to pair the data from parents with those of their child, participants were attributed matching numbers (*i.e.*, the code included a number for the dyad, and a letter for their status − parent *versus* child).

7.3 Measures

7.3.1 Implicit attitudes

Implicit attitudes towards PA/SED were assessed using an IAT both in children and parents. Following the recommendation from Greenwald *et al.* (2003), the IAT was presented on a computer in seven blocks including practice and critical blocks (see Tab. S1 in Supplementary material). The blocks where PA exemplars were paired with positive words, and SED exemplars with negative words, were labeled "compatible", whereas the blocks in which these pairings were reversed were labeled "incompatible". The order of presentation of compatible and incompatible blocks was randomly counterbalanced across participants.

Stimuli associated with positive and negative evaluative attributes were selected based on the material used in previous research (Chevance, Héraud, Guerrieri, Rebar, & Boiché, 2017). Stimuli representing common activities or verbs associated with PA and SED were selected from Chevance *et al.* (2017). A pool of stimuli was pilot-tested in 60 individuals (including children and adults) to ensure that the words were understood and unambiguously attributed to one of the four conceptual categories at all ages. This preliminary study led to the selection of four words for each category: positive (fun, happy, good, enjoyable), negative (boring, sad, bad, lame), PA (bike, dance, run, swim), and SED (TV, couch, read, sit).

The IAT data were scored using R software. We used the "IAT scores" package to calculate a *DW*-score (Richetin, Costantini, Perugini, & Schönbrodt, 2015):

– for each participant, the 10% fastest and slowest latencies were replaced by the last untrimmed latencies for both error and correct responses;
– the difference between the average latencies of the two critical blocks (*i.e.*, practice and test blocks together) was divided by the pooled standard deviation of all the latencies;
– the score was computed based on practice and critical trials together.

Scores ranged between 2 and −2, with positive scores indicating favorable implicit attitudes towards PA compared with SED. Internal consistency, which was expressed by split-half reliability, was calculated using the function SplitHalf in R software and were high for both parents and children ($r = 0.94$; $r = 0.83$, respectively).

7.3.2 Explicit attitudes

Explicit attitudes towards PA and SED were assessed using the same adjectives as in the IAT for positive and negative categories (principle of correspondence, Ajzen & Fishbein, 1977). The same questionnaire was proposed to children and parents. Questions were based on a questionnaire from previous work carried out with children (Bélanger-Gravel & Godin, 2010; Plotnikoff, Lubans, Costigan, & McCargar, 2013), developed following Ajzen's guideline, with the following stem: "*Do you think that practicing PA/SED almost every day is something…?*". The participants rated each item on a Likert-type scale ranging from 1 ("Not at all") to 4 ("Yes, absolutely"). The scores for explicit attitudes towards PA and SED were obtained by subtracting the mean score for negative attributes from the mean score for positive attributes. Scores ranged between −3 and +3 (positive results indicating favorable explicit attitudes towards the targeted behavior). Internal consistency was good ($\alpha = 0.84$ for explicit attitudes towards PA; $\alpha = 0.89$ for explicit attitudes towards SED).

7.3.3 Behaviors

PA was assessed using an adapted version of the self-administered Physical Activity Questionnaire for Children (PAQ-C; Janz, Lutuchy, Wenthe, & Levy, 2008). The same questionnaire was proposed to parents and children. Only the part which focuses on free time was used and it was clearly specified to participants that it was PA outside school or work that were assessed. PA was defined as voluntary movements that cause a person to sweat, breathe hard, and increase heart rate, and examples were provided: leisure time PA (*e.g.*, biking with friends), sports (*e.g.*, playing football in a club), or occupational and daily activities (*e.g.*, walking one's dog, cleaning). We evaluated SED based on the PA questionnaire (*i.e.*, same details offered, same procedure, and same stem structure). SED was defined as no or very little movement, and examples were again provided: SED as leisure time activities (*e.g.*, reading, watching TV) or daily activities

Table 1. Descriptive statistics for attitudes and behaviors in parents and children.

	Parents, M (SD)	Children, M (SD)
Physical activity	138.32 (159.48)	125.12 (113.28)
Sedentary behavior	111.89 (117.11)	133.64 (120.31)
Explicit attitudes	3.94 (1.66)	2.51 (1.89)
Implicit attitudes	0.08 (0.66)	0.16 (0.44)

(*e.g.*, doing homework, writing a report). Participants were asked to report the specific names of PA and SED in which they were engaged during last week with the frequency and duration (*i.e.*, number of sessions and average time per session) of each activity behavior over the last seven days (*i.e.*, "*In the past 7 days, how many times did you engage in PA/SED?*"). The average times per session were summed to estimate the total amount of time spent in PA and SED in hours per week. The validity and reliability of the PAQ-C have been demonstrated.

8 Statistical analysis

Pearson correlations and hierarchical regression analyses were performed to examine the relationships between the parents' and children's PA and SED, and their attitudes towards these behaviors. In the latter analysis, children and parents age and gender were controlled. Treatment of missing data are detailed in the supplementary material.

9 Results

9.1 Correlations

Means and standard deviations for PA and SED behaviors, as well as implicit and explicit attitudes scores, appear in Table S2 in Supplementary material regarding the version of IAT (*i.e.*, compatible *versus* incompatible) and in Table 1 regarding parents' and children's data. Pearson correlations between all variables were computed (Tab. 2). Regarding the hypothesized positive link between parents' and children's behaviors, we found a positive correlation between parents' and children's PA ($r(107) = 0.19$; $P = 0.05$; 95% CI [0.00, 0.36]), but no association was found for SED ($r(107) = 0.01$; $P = 0.92$; 95% CI [−0.18, 0.20]). For the hypothesized positive link between parents' and children's attitudes, the correlation was not significant between parents' and children's attitudes at either the explicit level – for PA ($r(107) = 0.10$; $P = 0.33$; 95% CI [−0.10, 0.20]) or SED ($r(107) = 0.09$; $P = 0.37$; 95% CI [−0.10, 0.27]) or the implicit level ($r(107) = -0.03$; $P = 0.79$; 95% CI [−0.21, 0.17]).

Table 2. Correlations between attitudes and behaviors in parents and children.

	Parents ($n = 107$)
Children and adolescents ($n = 107$)	
1. Physical activity	0.19*
2. Sedentary behavior	0.01
3. Explicit attitudes (PA)	0.10
4. Explicit attitudes (SED)	0.09
5. Implicit attitudes (standardized)	−0.03

Note: * $P < 0.05$; ** $P < 0.01$.

9.2 Hierarchical regressions

After controlling for parents and children age and gender, and for parents' and children's PA and SED (depending on the dependent variable examined), results from hierarchical regression analyses showed one marginal association (Tab. 3): children's explicit attitudes for PA were negatively associated with parents SED ($\beta = -0.19$; $P = 0.07$). No significant association was found either for children's PA ($F = 1.603$, $P = 0.10$, $R^2 = 0.20$; $\beta = 0.15$; $P = 0.16$ with parents' PA, $\beta = 0.04$; $P = 0.73$ with parents' SED, $\beta = 0.15$; $P = 0.17$ with parents' explicit attitudes for PA; $\beta = 0.02$; $P = 0.89$ with parents' explicit attitudes for SED; $\beta = 0.01$; $P = 0.94$ with parents' implicit attitudes), nor for children's SED ($F = 2.19$, $P = 0.02$, $R^2 = 0.25$; $\beta = 0.01$; $P = 0.93$ with parents' PA, $\beta = 0.08$; $P = 0.47$ with parents' SED, $\beta = -0.12$; $P = 0.27$ with parents' explicit attitudes for PA; $\beta = -0.09$; $P = 0.41$ with parents' explicit attitudes for SED; $\beta = 0.14$; $P = 0.16$ with parents' implicit attitudes). No significant association was found either for parents' PA ($F = 1.40$, $P = 0.18$, $R^2 = 0.18$; $\beta = 0.10$; $P = 0.36$ with children's explicit attitudes for PA; $\beta = -0.01$; $P = 0.93$ with children's explicit attitudes for SED; $\beta = 0.06$; $P = 0.56$ with children's implicit attitudes), nor for parents' SED ($F = 1.53$, $P = 0.13$, $R^2 = 0.19$; $\beta = -0.11$; $P = 0.30$ with children's explicit attitudes for SED; $\beta = -0.13$; $P = 0.23$ with children's implicit attitudes). One surprising result was that parents' explicit attitudes for PA was positively associated with children's implicit attitudes ($\beta = 0.23$; $P = 0.04$).

Table 3. Hierarchical regressions between attitudes and behaviors in parents and children when controlled for gender and age.

Children and adolescents	Physical activity	Sedentary behavior	Explicit attitudes (PA)	Explicit attitudes (SED)	Implicit attitudes (standardized)
Parents					
Physical activity	0.15	0.01	0.10	−0.01	0.06
Sedentary behavior	0.04	0.08	−0.20^t	−0.11	−0.13
Explicit attitudes (PA)	0.15	−0.12	0.14	0.02	0.23*
Explicit attitudes (SED)	0.02	−0.09	0.10	0.11	0.10
Implicit attitudes (standardized)	0.01	0.14	0.01	0.17	−0.09
R^2	0.20	0.25	0.17	0.16	0.16

Note: $t < 0.80$; * $P < 0.05$; ** $P < 0.01$.

10 Discussion

This study investigated the relationship between parents' and children's PA and SED, as well as between their respective explicit and implicit attitudes towards these behaviors. By performing correlation, we hypothesis that a positive association between parents' PA and SED and their children's behaviors. We also expected positive association between parents' scores of explicit and implicit attitudes towards PA and SED and their children's attitudes towards these behaviors. Our ambition was also to explore whether parents' attitudes and behaviors are associated with their children PA and SED, and reciprocally, whether children's attitudes and behaviors are associated with their parents PA and SED, controlling for gender and age, by performing hierarchical regression analysis. In line with our first hypothesis, the results highlighted a potential effect of parental role modeling through a significant and positive association between the parents' and their children's PA. This result strengthens the conclusions of previous research in the PA context (Xu *et al.*, 2015). However, this relation is no longer significant in regression analysis. The weight of other variables such as children gender and SED could have been more important in predicting children PA (Tab. S3 in Supplementary material). It is well known that boys are more active than girls starting from childhood and that the Active Couch Potato phenomenon (*i.e.*, profiles of individuals who spend large amounts of time both in PA and SED) exists (Owen, Healy, Matthews, & Dunstan, 2010).

Contrary to previous research on screen time (Xu *et al.*, 2015), no association was found between parents' and children's SED. One major difference between our study and previous research is that our measure encompassed multiple SED. This method may have characterized very particular patterns of activities in leisure time for adults *versus* children (*e.g.*, listening to music, reading, talking on the phone, doing homework). Future studies should further investigate this issue with a more consensual definition of SED, with a complementary measurement using accelerometer and with a more fine-grained analysis of SED. This result could also be explained regarding previous results showing that the role-modelinghypothesis is different regarding children age

(Tab. S3 in Supplementary material). Specifically, it is more systematically observed in children than in adolescents (Sterdt *et al.*, 2013). Parents are the primary caregivers and thus the primary model for their young children, whereas adolescents spend increasing amounts of time away from their parents. Their development is thus substantially impacted not only by their family life, but also by others such as peers (Arnon, Shamai, & Ilatov, 2008).

Next, our results showed no evidence that parents' explicit and implicit attitudes were correlated with their children explicit and implicit attitudes, respectively. At the explicit level, the previous results on the association between parents' and children's attitudes have been inconsistent: although a significant correlation has sometimes emerged for PA (Anderson *et al.*, 2009), this has not always been the case for other health-related behaviors (Guidetti *et al.*, 2012; Sherman *et al.*, 2009). At the implicit level, the lack of correlation might have been be due to the singularity of PA and SED compared with the previously investigated health-related behaviors, which showed significant parent-child implicit attitudes associations (Guidetti *et al.*, 2012; Sherman *et al.*, 2009). Another explanation could be related to the IAT content. The use of words for both evaluative categories and conceptual targets could have been too demanding for the younger children. Although we took children specificity into account by pretesting the words used in children, recruiting children with at least two years of reading experience or slightly reducing the length of the IAT, we could have chosen to present pictures of the conceptual targets instead of words. However, previous studies which used IAT in PA setting (*e.g.*, Chevance, Heraud *et al.*, 2017; Craeynest *et al.*, 2008) or investigate parents and their children's implicit attitudes (Guidetti *et al.*, 2012; Sherman *et al.*, 2009) only used words. Additionally, the use of the same IAT in parents and children facilitate the comparison between their scores. Nevertheless, future studies could ambition to build and validate IAT for children in PA setting using pictures and/or words.

Otherwise, two interesting results emerged. Children explicit attitudes for PA was negatively associated with parent SED and children's implicit attitudes was associated with parents' explicit attitudes for PA. It is worth

noticing that a sort of hierarchical process seems to emerge: parents' behaviors (SED) which are visible, are associated with explicit attitudes which requires introspection and which is controlled and reportable; while parents' explicit attitudes is associated with children's implicit attitudes which is more automatic. These results went further previous studies, which showed that parents PA and beliefs about PA are associated to those of their children, by showing that parents SED is also important in the way their children evaluate PA. Finally, the last result is in line with previous research which highlighted the role of verbal statements in young children's implicit attitudes acquisition (Charlesworth et al., 2020). Other research is need to further investigate these results.

Some limitations should be considered when interpreting the results of this study. First, the cross-sectional design does not enable a directional interpretation of the significant links observed. Recent studies provided evidence that parents' behaviors such as PA parenting practices (i.e., "concrete behavioral strategies employed by parents to influence their children's PA", Laukkanen et al., 2018; p. 2691) could occur in response to children-related factors (e.g., PA enjoyment, temperament, age) and children's behaviors (Laukkanen et al., 2018; Sleddens, Gubbels, Kremers, van der Plas, & Thijs, 2017). Notwithstanding this evidence showing the existence of a shared behavioral patterns (i.e., bidirectional relationship), this line of research is still dominated by studies that consider parents as agents influencing children' PA and SED, without taking into account reciprocal processes. Further longitudinal and experimental research is thus needed to investigate the relationships of parents' and children's PA and SED and their attitudes about them. In the same vein, one line of research recently developed investigating whether parents and their children's characteristics such as explicit attitude are associated with each other's health intentions/behaviors in addition to their own (e.g., Joyal-Desmarais et al., 2019). Future studies can investigate this interdependence relationship in focusing on PA and SED. Second, although parents are an important source of influence on children's behaviors, they are not the only one. In children's social environment, friends are also likely to play a critical role in the adoption of health behaviors (e.g., Guidetti et al., 2012), particularly PA and SED (Salway, Sebire, Solomon-Moore, Thompson, & Jago, 2018). Further research is needed to investigate whether meaningful individuals in children's and adolescents' social networks affect their PA and SED. Third, no distinction was made about attitudes, even though this construct encompasses both affective content (i.e., pleasant versus unpleasant feelings associated with a category of behaviors) and instrumental beliefs (i.e., perceived outcomes of behavior adoption on the long run), which do not affect

behaviors in the same way (McEachan et al., 2016). Fourth, it is worth noting that most of the studies which investigate attitudes towards PA used SC-IAT[2] (e.g., Conroy et al., 2010; Hyde et al., 2010) and only a few used IAT (e.g., Chevance, Caudroit, Romain, & Boiché, 2017; Chevance et al., 2018) or investigated attitudes towards SED using the SC-IAT (e.g., Chevance et al., 2018). Although a recent study suggested using IAT in PA setting by showing that when compared test-retest reliability between these two kinds of measure, IAT showed better reliability (Chevance, Héraud et al., 2017), criticisms of this indirect measure exist. For instance, studies suggest that, although recourse to controlled processes are limited, compared to self-report measures, indirect methods not only involved to automatic ones (e.g., Hahn, Judd, Hirsh, & Blair, 2014). Despite, these criticisms research showed the value of using implicit measure and stated that IAT (or measures adapted from it) is one of the most employed and efficient measures (Zenko & Ekkekakis, 2019). Fifth, this study was based on self-reported PA and SED that induce social desirability bias. The use of accelerometer could be informative in future studies.

11 What does this article add?

The current study is the first to investigate the association between parents' and children' implicit and explicit attitudes towards PA and SED, in addition to the same association regarding these behaviors. It reports the correlations between parents' and children's behaviors, highlighting, and it seems what parents do and say could have an influence on children explicit and implicit attitudes, respectively. The results lead to the conclusion that actively including parents in interventions aiming to increase children's and adolescents' PA is worth to be considered. Actual practice of PA, and raising awareness of the benefits of PA and the harmful effects of SED could be a potential way to promote PA within families.

Supplementary Material

Table S1. Structure of the IAT (PA versus SED) – IC version.
Table S2. Descriptive statistics for attitudes and behaviors in parents and children regarding the version of IAT.
Table S3. Hierarchical regressions between attitudes and behaviors in parents and children.

The Supplementary Material is available at https://www.mov-sport-sciences.org/10.1051/sm/2022013/olm.

---

[2] IAT provides an indication of a relative evaluation between two targets (e.g., PA versus SED) and does not enable the measurement of attitudes about independent targets, as Single Category IAT (SC-IAT; Karpinski & Steinman, 2006) does, i.e. assess only PA or only SED.

References

Ajzen, I. (1991). The theory of planned behavior. *Organizational Behavior and Human Decision Processes*, *50*(2), 179–211.

Ajzen, I., & Dasgupta, N. (2015). Explicit and implicit beliefs, attitudes, and intentions: the role of conscious and unconscious processes in human behavior. In P. Haggard & B. Eitam (Eds.), *The sense of agency* (pp. 115–144). New York: Oxford University Press.

Ajzen, I., & Fishbein, M. (1977). Attitude-behavior relations: a theoretical analysis and review of empirical research. *Psychological Bulletin*, *84*, 888–918.

Anderson, C.B., Hughes, S.O., & Fuemmeler, B.F. (2009). Parent-child attitude congruence on type and intensity of physical activity: testing multiple mediators of sedentary behavior in older children. *Health Psychology*, *28*(4), 428–438. https://doi.org/10.1037/a0014522.

ANSES [Agence nationale de sécurité sanitaire de l'alimentation de l'environnement et du travail]. (2016). *Actualisation des repères du PNNS − Révisions des repères relatifs à l'activité physique et à la sédentarité [Update of PNNS benchmarks − Revisions to physical activity and physical inactivity benchmarks]*.

Arnon, S., Shamai, S., & Ilatov, Z. (2008). Socialization agents and activities of young adolescents. *Adolescence*, *43*(170), 373–397.

Bar-Anan, Y., & Nosek, B.A. (2014). A comparative investigation of seven implicit measures of social cognition. *Behavior Research Methods*, *46*, 668–688. https://doi.org/0.3758/s13428-0130410-6.

Baron, A.S., & Banaji, M.R. (2006). The development of implicit attitudes: evidence of race evaluations from ages 6 and 10 and adulthood. *Psychological science*, *17*(1), 53–58.

Bélanger-Gravel, A., & Godin, G. (2010). Key beliefs for targeted interventions to increase physical activity in children: analyzing data from an extended version of the theory of planned behaviour. *International Journal of Pediatrics*, *2010*, 1–7. https://doi.org/10.1155/2010/893854.

Bois, J., & Sarrazin, P. (2006). Les chiens font-ils des chats ? Une revue de littérature sur le rôle des parents dans la socialisation de leur enfant pour le sport. *Movement Sport Sciences*, (1), 9–54.

Brand, R., & Ekkekakis, P. (2018). Affective-reflective theory of physical inactivity and exercise. *German Journal of Exercise and Sport Research*, *48*(1), 48–58.

Brownstein, M., Madva, A., & Gawronski, B. (2019). What do implicit measures measure? *Wiley Interdisciplinary Reviews: Cognitive Science*, *10*(5), e1501.

Calitri, R., Lowe, R., Eves, F.F., & Bennett, P. (2009). Associations between visual attention, implicit and explicit attitude and behaviour for physical activity. *Psychology and Health*, *24*(9), 1105–1123. https://doi.org/10.1080/08870440802245306.

Charlesworth, T.E., Kurdi, B., & Banaji, M.R. (2020). Children's implicit attitude acquisition: evaluative statements succeed, repeated pairings fail. *Developmental Science*, *23*(3), e12911.

Chen, M., & Bargh, J.A. (1999). Consequences of automatic evaluation: immediate behavioral predispositions to approach or avoid the stimulus. *Personality and Social Psychology Bulletin*, *25*(2), 215–224. https://doi.org/10.1177/0146167299025002007.

Cheval, B., & Boisgontier, M.P. (2021). The theory of effort minimization in physical activity. *Exercise and Sport Sciences Reviews*, *49*(3), 168–178.

Cheval, B., Sarrazin, P., Isoard-Gautheur, S., Radel, R., & Friese, M. (2015). Reflective and impulsive processes explain (in)effectiveness of messages promoting physical activity: a randomized controlled trial. *Health Psychology*, *34*(1), 10–19. https://doi.org/10.1037/hea0000102.

Cheval, B., Sarrazin, P., & Pelletier, L. (2014). Impulsive approach tendencies towards physical activity and sedentary behaviors, but not reflective intentions, prospectively predict non-exercise activity thermogenesis. *PLoS One*, *9*(12), e115238.

Chevance, G., Bernard, P., Chamberland, P.E., & Rebar, A. (2019). The association between implicit attitudes towards physical activity and physical activity behavior: a systematic review and correlational meta-analysis. *Health Psychology Review*, *13*(3), 248–276.

Chevance, G., Caudroit, J., Romain, A.J., & Boiché, J. (2017). The adoption of physical activity and eating behaviors among persons with obesity and in the general population: the role of implicit attitudes within the Theory of Planned Behavior. *Psychology Health & Medicine*, *22*(3), 319–324. https://doi.org/10.1080/13548506.2016.1159705.

Chevance, G., Héraud, N., Guerrieri, A., Rebar, A., & Boiché, J. (2017). Measuring implicit attitudes towards physical activity and sedentary behaviors: test-retest reliability of three scoring algorithms of the Implicit Association Test and Single Category-Implicit Association Test. *Psychology of Sport and Exercise*, *31*, 70–78. https://doi.org/10.1016/j.psychsport.2017.04.007.

Chevance, G., Stephan, Y., Héraud, N., & Boiché, J. (2018). Interaction between self-regulation, intentions and implicit attitudes in the prediction of physical activity among persons with obesity. *Health Psychology*, *37*(3), 257.

Cialdini, R.B., Kallgren, C.A., & Reno, R.R. (1991). A focus theory of normative conduct: a theoretical refinement and reevaluation of the role of norms in human behavior. *Advances in Experimental Social Psychology*, *24*(C), 201–234. https://doi.org/10.1016/S0065-2601(08)60330-5.

Conroy, D.E., & Berry, T.R. (2017). Automatic affective evaluations of physical activity. *Exercise and Sport Sciences Reviews*, *45*(4), 230–237. https://doi.org/10.1249/JES0000000000000120.

Cooper, A.R., Goodman, A., Page, A.S., Sherar, L.B., Esliger, D. W., van Sluijs, E.M., Andersen, L.B., Anderssen, S., Cardon, G., Davey, R., Froberg, K., Hallal, P., Janz, K.F., Kordas, K., Kreimler, S., Pate, R.R., Puder, J.J., Reilly, J.J., Salmon, J., Sardinha, L.B., Timperio, A., & Ekelund, U. (2015). Objectively measured physical activity and sedentary time in youth: the International Children's Accelerometry Database (ICAD). *International Journal of Behavioral Nutrition and Physical Activity*, *12*(1), 113. https://doi.org/10.1186/s12966-015-0274-5.

Corneille, O., & Hütter, M. (2020). Implicit? What do you mean? A comprehensive review of the delusive implicitness construct in attitude research. *Personality and Social Psychology Review*, *24*(3), 212–232.

Craeynest, M., Crombez, G., Deforche, B., Tanghe, A., & De Bourdeaudhuij, I. (2008). The role of implicit attitudes towards food and physical activity in the treatment of youth obesity. *Eating Behaviors*, *9*(1), 41–51.

Craigie, A.M., Lake, A.A., Kelly, S.A., Adamson, A.J., & Mathers, J.C. (2011). Tracking of obesity-related behaviours from childhood to adulthood: a systematic review. *Maturitas*, *70*(3), 266–284. https://doi.org/10.1016/j.maturitas.2011.08.005.

Cvencek, D., Greenwald, A.G., & Meltzoff, A.N. (2011). Measuring implicit attitudes of 4-year-olds: the preschool Implicit Association Test. *Journal of Experimental Child Psychology*, *109*(2), 187–200.

De Houwer, J. (2006). What are implicit measures and why are we using them? In R.W. Wiers & A.W. Stacy (Eds.), *The handbook of implicit cognition and addiction* (pp. 11–28). Thousand Oaks, CA: Sage.

De Houwer, J., & De Bruycker, E. (2007). The Implicit Association Test outperforms the extrinsic affective Simon task as an implicit measure of inter-individual differences in attitudes. *British Journal of Social Psychology*, *46*(2), 401–421.

Fazio, R.H. (2007). Attitudes as object-evaluation associations of varying strength. *Social Cognition*, *25*(5), 603–637.

Gawronski, B., & Brannon, S.M. (2019). Attitudes and the implicit-explicit dualism. In D. Albarracín & B.T. Johnson (Eds.), *The handbook of attitudes* (pp. 158–196). New York, NY: Psychology Press.

Gourlan, M., Bernard, P., Bortolon, C., Romain, A.J., Lareyre, O., Carayol, M., Ninot, G., & Boiché, J. (2016). Efficacy of theory-based interventions to promote physical activity. A meta-analysis of randomised controlled trials. *Health Psychology Review*, *10*(1), 50–66. https://doi.org/10.1080/17437199.2014.981777.

Greenwald, A.G., McGhee, D.E., & Schwartz, J.L. (1998). Measuring individual differences in implicit cognition: the Implicit Association Test. *Journal of Personality and Social Psychology*, *74*(6), 1464–1480. https://doi.org/10.1037/0022-3514.74.6.1464.

Greenwald, A.G., Nosek, B.A., & Banaji, M.R. (2003). Understanding and using the Implicit Association Test: I. An improved scoring algorithm. *Journal of Personality and Social Psychology*, *85*(2), 197–216.

Greenwald, A.G., & Lai, C.K. (2020). Implicit social cognition. *Annual Review of Psychology*, *71*, 419–445. https://doi.org/10.1146/annurev-psych-010419-050837.

Guidetti, M., Conner, M., Prestwich, A., & Cavazza, N. (2012). The transmission of attitudes towards food: twofold specificity of similarities with parents and friends. *British Journal of Health Psychology*, *17*(2), 346–361. https://doi.org/10.1111/j.2044-8287.2011.02041.x.

Hahn, A., Judd, C.M., Hirsh, H.K., & Blair, I.V. (2014). Awareness of implicit attitudes. *Journal of Experimental Psychology: General*, *143*, 1369.

Harris, J., Cale, L., Duncombe, R., & Musson, H. (2018). Young people's knowledge and understanding of health, fitness and physical activity: issues, divides and dilemmas. *Sport, Education & Society*, *23*(5), 407–420.

Hyde, A.L., Doerksen, S.E., Ribeiro, N.F., & Conroy, D.E. (2010). The independence of implicit and explicit attitudes towards physical activity: introspective access and attitudinal concordance. *Psychology of Sport and Exercise*, *11*(5), 387–393.

Janz, K.F., Lutuchy, E.M., Wenthe, P., & Levy, S.M. (2008). Measuring activity in children and adolescents using self-report: PAQ-C and PAQ-A. *Medicine and Science in Sports and Exercise*, *40*(4), 767–772.

Joyal-Desmarais, K., Lenne, R.L., Panos, M.E., Huelsnitz, C.O., Jones, R.E., Auster-Gussman, L.A., Johnson, W.F., Simpson, J.A., & Rothman, A.J. (2019). Interpersonal effects of parents and adolescents on each other's health behaviours: a dyadic extension of the theory of planned behaviour. *Psychology & Health*, *34*(5), 569–589.

Karpinski, A., & Steinman, R.B. (2006). The single category Implicit Association Test as a measure of implicit social cognition. *Journal of Personality and Social Psychology*, *91*, 16–32. https://doi.org/10.1037/0022-3514.91.1.16.

Kim, H., Ma, J., & Maehashi, A.C. (2017). Factors impacting levels of physical activity and sedentary behavior among young children: A literature review. *International Journal of Applied Sports Sciences*, *29*, 1–12.

Laukkanen, A., Niemistö, D., Finni, T., Cantell, M., Korhonen, E., & Sääkslahti, A. (2018). Correlates of physical activity parenting: the Skilled Kids study. *Scandinavian Journal of Medicine & Science in Sports*, *28*(12), 2691–2701.

Lee, I.M., Shiroma, E.J., Lobelo, F., Puska, P., Blair, S.N., Katzmarzyk, P.T., & Lancet Physical Activity Series Working Group. (2012). Effect of physical inactivity on major non-communicable diseases worldwide: an analysis of burden of disease and life expectancy. *The Lancet*, *380*(9838), 219–229. https://doi.org/10.1016/S0140-6736(12)61031-9.

Mansoubi, M., Pearson, N., Biddle, S.J.H., & Clemes, S. (2014). The relationship between sedentary behaviour and physical activity in adults: a systematic review. *Preventive Medicine*, *69*(1), 28–35. https://doi.org/10.1016/j.ypmed.2014.08.028.

McEachan, R., Taylor, N., Harrison, R., Lawton, R., Gardner, P., & Conner, M. (2016). Meta-analysis of the Reasoned Action Approach (RAA) to understanding health behaviors. *Annals of Behavioral Medicine*, *50*(4), 592–612. https://doi.org/10.1007/s12160-016-9798-4.

Muschalik, C., Elfeddali, I., Candel, M.J., & De Vries, H. (2018). A longitudinal study on how implicit attitudes and explicit cognitions synergistically influence physical activity intention and behavior. *BMC Psychology*, *6*(1), 1–13.

Neshteruk, C.D., Nezami, B.T., Nino-Tapias, G., Davison, K.K., & Ward, D.S. (2017). The influence of fathers on children's physical activity: a review of the literature from 2009 to 2015. *Preventive Medicine*, *102*, 12–19. https://doi.org/10.1016/j.ypmed.2017.06.027.

Niermann, C.Y., Spengler, S., & Gubbels, J.S. (2018). Physical activity, screen time, and dietary intake in families: a cluster-analysis with mother-father-child triads. *Frontiers in Public Health*, *6*, 276. https://doi.org/10.3389/fpubh.2018.00276.

Olson, M.A., & Fazio, R.H. (2009). Implicit and explicit measures of attitudes: the perspective of the MODE model. In R.E. Petty, R.H. Fazio, & P. Briñol (Eds.), *Attitudes: Insights from the new implicit measures* (pp. 19–63). New York, NY: Psychology Press.

Owen, N., Healy, G.N., Matthews, C.E., & Dunstan, D.W. (2010). Too much sitting: the population health science of sedentary behavior. *Exercise and Sport Sciences Reviews*, *38*(3), 105–113. https://doi.org/10.1097/JES.0b013e3181e373a2.

Pereira, J.R., Zhang, Z., Sousa-Sá, E., Santos, R., & Cliff, D.P. (2020). Correlates of sedentary time in young children: a systematic review. *European Journal of Sport Science*, *21*(1), 118–133. https://doi.org/10.1080/17461391.2020.1741689.

Perugini, M. (2005). Predictive models of implicit and explicit attitudes. *British Journal of Social Psychology*, *44*(1), 29–45. https://doi.org/10.1348/014466604x23491.

Phipps, D.J., Hagger, M.S., & Hamilton, K. (2019). A meta-analysis of implicit and explicit attitudes in children and adolescents. *PsyArXiv*. https://doi.org/10.31234/osf.io/52jrs.

Phipps, D.J., Hagger, M.S., & Hamilton, K. (2020). Predicting limiting 'free sugar' consumption using an integrated model of health behavior. *Appetite*, *150*, 104668. https://doi.org/10.1016/j.appet.2020.104668.

Plotnikoff, R.C., Lubans, D.R., Costigan, S.A., & McCargar, L. (2013). A test of the theory of planned behavior to predict physical activity in an overweight/obese population sample of adolescents from Alberta, Canada. *Health Education & Behavior*, *40*(4), 415–425.

Rebar, A.L., Dimmock, J.A., Jackson, B., Rhodes, R.E., Kates, A., Starling, J., & Vandelanotte, C. (2016). A systematic review of the effects of non-conscious regulatory processes in physical activity. *Health Psychology Review*, *10*(4), 395–407. https://doi.org/10.1080/17437199.2016.1183505.

Richetin, J., Costantini, G., Perugini, M., & Schönbrodt, F. (2015). Should we stop looking for a better scoring algorithm for handling Implicit Association Test data? Test of the role of errors, extreme latencies treatment, scoring formula, and practice trials on reliability and validity. *PLoS ONE*, *10*(6), e0129601. https://doi.org/10.1371/journal.pone.0129601.

Rhodes, R.E., & de Bruijn, G.-J. (2013). How big is the physical activity intentionbehaviour gap? A meta-analysis using the action control framework. *British Journal of Health Psychology*, *18*(2), 296e309. https://doi.org/10.1111/bjhp.12032.

Salway, R.E., Sebire, S.J., Solomon-Moore, E., Thompson, J.L., & Jago, R. (2018). Associations within school-based same-sex friendship networks of children's physical activity and sedentary behaviours: a cross-sectional social network analysis. *International Journal of Behavioral Nutrition and Physical Activity*, *15*(1), 18. https://doi.org/10.1186/s12966-018-0653-9.

Schoeppe, S., Vandelanotte, C., Bere, E., Lien, N., Verloigne, M., Kovács, E., Manios, Y., Bjelland M., Nordgård Vik, F F., & Van Lippevelde, W. (2017). The influence of parental modelling on children's physical activity and screen time: does it differ by gender? *European Journal of Public Health*, *27*(1), 152–157. https://doi.org/10.1093/eurpub/ckw182.

Sheeran, P., Bosch, J.A., Crombez, G., Hall, P.A., Harris, J.L., Papies, E.K., & Wiers, R.W. (2016). Implicit processes in health psychology: diversity and promise. *Health Psychology*, *35*(8), 761e766. https://doi.org/10.1037/hea0000409.

Sherman, S.J., Chassin, L., Presson, C., Seo, D.-C., & Macy, J.T. (2009). The intergenerational transmission of implicit and explicit attitudes towards smoking: predicting adolescent smoking initiation. *Journal of Experimental Social Psychology*,, *45*,(2,) 313–319. https://doi.org/10.1016/j.jesp.2008.09.012.

Sleddens, E.F., Gubbels, J.S., Kremers, S.P., van der Plas, E., & Thijs, C. (2017). Bidirectional associations between activity-related parenting practices, and child physical activity, sedentary screen-based behavior and body mass index: a longitudinal analysis. *International Journal of Behavioral Nutrition and Physical Activity*, *14*(1), 89.

Sterdt, E., Liersch, S., & Walter, U. (2013). Correlates of physical activity of children and adolescents: a systematic review of reviews. *Health Education Journal*, *73*(1), 1–18. https://doi.org/10.1177/0017896912469578.

Strack, F., & Deutsch, R. (2004). Reflective and impulsive determinants of social behavior. *Personality and Social Psychology Review*, *8*(3), 220–247. https://doi.org/10.1207/s15327957pspr0803_1.

Strack, F., & Deutsch, R. (2015). The duality of everyday life: dual-process and dual system models in social psychology. *APA Handbook of Personality and Social Psychology*, *1*, 891–927.

Thomas, S.R., Burton Smith, R., & Ball, P.J. (2007). Implicit attitudes in very young children: an adaptation of the IAT. *Current Research in Social Psychology*, *13*(7), 75–85.

Van Sluijs, E.M.F., Page, A., Ommundsen, Y., & Griffin, S.J. (2010). Behavioural and social correlates of sedentary time in young people. *British Journal of Sports Medicine*, *44*(10), 747–755. https://doi.org/10.1136/bjsm.2008.049783.

Williams, A., & Steele, J.R. (2016). The reliability of child-friendly race-attitude implicit association tests. *Frontiers in Psychology*, *7*, 1576.

Xu, H., Wen, L.M., & Rissel, C. (2015). Associations of parental influences with physical activity and screen time among young children: a systematic review. *Journal of Obesity*, *2015*, 546925. https://doi.org/10.1155/2015/546925.

Yao, C.A., & Rhodes, R.E. (2015). Parental correlates in child and adolescent physical activity: a meta-analysis. *International Journal of Behavioral Nutrition and Physical Activity*, *12*(1), 10. https://doi.org/10.1186/s12966-015-0163-y.

Zenko, Z., & Ekkekakis, P. (2019). Internal consistency and validity of measures of automatic exercise associations. *Psychology of Sport and Exercise*, *43*, 4–15.