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## Development of a new questionnaire to assess the links between children's self-regulation of eating and related parental feeding practices

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1 Development of a new questionnaire to assess the links between children's self-regulation of  
2 eating and related parental feeding practices

3

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5 on a schedule, body mass index, responsive feeding

6

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23

24

25 **ABSTRACT**

26 Young children have an innate ability to self-regulate food intake, driven primarily by hunger  
27 and satiety cues, but this ability tends to decrease during early childhood. The study aimed to  
28 first examine the development and initial validation of a self-report questionnaire suitable for  
29 French samples that assess two dimensions of **children's self-regulation of eating** (eating in  
30 the absence of hunger, poor eating compensation abilities) and potential related parental  
31 feeding practices. The second aim was to assess the links between **children's self-regulation**  
32 **of eating** and parental feeding practices **as well as** the links between children's self-regulation  
33 and children's body mass index. **An initial** 28-item questionnaire was developed. It included  
34 items related to the child's eating in the absence of hunger and eating compensation, which  
35 were selected mainly from interviews conducted with 45 mothers, and items related to  
36 parental feeding practices selected from existing tools. This questionnaire was then completed  
37 by 793 parents. A 21-item questionnaire was validated using a confirmatory factor analysis  
38 **that** showed satisfying fit indices. The structural equation modeling indicated that the use of  
39 food as reward was positively associated with eating in the absence of hunger, whereas  
40 parental awareness of children's cues was negatively associated with both children's eating in  
41 the absence of hunger and poor eating compensation ability. Interestingly, positive  
42 associations between eating in the absence of hunger and child's BMI, and between poor  
43 eating compensation ability and child's BMI were reported. The current study offered an  
44 initial validation of a new questionnaire that combines parental feeding practices and  
45 constructs involved in children's **self-regulation of eating**. Further studies are needed to  
46 disentangle these links and their directionality as well as the associations with children's body  
47 mass index.

48

49

## 50 **1. Introduction**

51

52 Infants have an innate ability to self-regulate their **food** intake, as intake is primarily driven by  
53 responses to hunger and satiation cues (Birch & Deysher, 1986; Birch, Johnson, Andersen,  
54 Peters & Schulte, 1991; Johnson, McPhee & Birch, 1991). However, it has been shown that  
55 this innate ability decreases with age (Fomon, 1974; Fox, Devaney, Reidy, Razafindrakoto &  
56 Ziegler, 2006; Taveras et al., 2004). As foods become more easily available, children, even  
57 from an early age, are often faced with challenging situations where overeating may occur  
58 (Fox, Devaney, Reidy, Razafindrakoto, & Ziegler, 2006; Rolls, Engell & Birch, 2000;  
59 Savage, Fisher & Birch, 2007; Taveras et al., 2004). As children age, their ability to self-  
60 regulate their food intake becomes influenced by the external environment (Birch, Fischer &  
61 Davidson, 2003), for instance, by portion sizes (Fisher, Arreola, Birch, & Rolls, 2007; Fisher  
62 & Kral, 2008) or by parental control in feeding (Faith, Scanlon, Birch, Francis, & Sherry,  
63 2004; Fisher & Birch, 1999; Frankel et al., 2016). These environmental influences could lead  
64 children to focus their attention on external cues rather than on internal cues to self-regulate  
65 their eating (Fisher & Birch, 1999). Children with poor **self-regulation of eating** are at an  
66 increased risk for developing obesity (Francis & Susman, 2009). The present study focused on  
67 the following two behaviors that are potentially related to overeating in that they have been  
68 shown to be linked with childhood adiposity: eating in the absence of hunger and eating  
69 compensation ability (Kral et al., 2012). Eating in the absence of hunger refers to a child's  
70 susceptibility to eating palatable foods even when satiated (Shunk & Birch, 2004; Tanofsky-  
71 Kraff et al., 2008; Hughes and Frazier-Wood, 2016). Eating compensation refers to the ability  
72 to adjust **food intake** between successive eating occasions (Birch & Deysher, 1986).

73

74 To date, there are limited data regarding eating in the absence of hunger and poor caloric  
75 compensation in young children, and most of the existing data are based on laboratory  
76 paradigms. In these laboratory settings, eating in the absence of hunger is measured directly  
77 by determining a child's actual *ad libitum* food intake after the child has consumed a meal and  
78 reports that he/she is full (Fisher & Birch, 2002; Hughes & Frazier-Wood, 2014). The caloric  
79 compensation ability is reflected by a decrease in food intake after having eaten a high energy  
80 preload compared to a low energy preload (Birch & Deysher, 1986; Hughes and Frazier-  
81 Wood, 2014; Remy, Issanchou, Chabanet, Boggio, & Nicklaus, 2015). These experimental  
82 paradigms cannot be used on very large samples, and their implementation in longitudinal  
83 studies is difficult. Thus, a validated questionnaire would be useful for assessing a child's  
84 susceptibility to self-regulation of eating (eating in the absence of hunger, eating  
85 compensation ability) in large-scale and/or longitudinal studies. Only a few readily available  
86 self-report questionnaires on eating in the absence of hunger in 8- to 12-year-old Anglophone  
87 children have been validated (Madowitz et al., 2014) and 14-year-old children (Tanofsky-  
88 Kraff et al., 2008). To the best of our knowledge, no questionnaire has been developed that  
89 assesses both eating in the absence of hunger and eating compensation ability in young  
90 children. However, the existing evidence indicates that eating behaviors are quite consistent  
91 from childhood to adolescence (Madruza, Araujo, Bertoldi, & Neutzling, 2012; Nicklaus &  
92 Remy, 2013), highlighting the need for validated tools that evaluate eating behaviors of  
93 children that may potentially be related to being overweight.

94

95 Previous cross-sectional studies using eating in the absence of hunger or caloric compensation  
96 paradigms have suggested that the ability to regulate food intake decreases with age;  
97 compared to younger children, older children ate more in the absence of hunger (see  
98 Lansigan, Emond, & Gilbert-Diamond, 2015 for a review) and showed poorer caloric

99 compensation (Birch & Deysher, 1986; Cecil et al., 2005; Hetherington, Wood & Lyburn,  
100 2000; Zandstra, Mathey, Graaf, & van Staveren, 2000). Rolls et al. (2000) observed that a  
101 larger portion size induced a higher **food** intake in 5-year-old children but not in 3-year-old  
102 children, confirming the decrease in the ability of self-regulation that occurs with **age**.  
103 However, only a few studies have offered insight regarding the specific early age that the  
104 ability to regulate energy intake begins to decrease. Fox et al. (2006) reported the existence of  
105 a negative association between energy density and average portion size in 6- to 11-month-old  
106 **children** but not in toddlers; this suggests that the mechanisms that **drive the self-regulation of**  
107 **eating** are diminished in toddlers. Thus, it seems particularly important to explore both eating  
108 in the absence of hunger and eating compensation behaviors from **this** early age.

109

110 The ability to self-regulate tends to decrease as eating becomes affected more by external  
111 cues, such as palatability and portion size, and by parental influence (Faith, Scanlon, Birch,  
112 Francis, & Sherry, 2004; Fisher et al., 2007; Fisher & Birch, 1999; Fisher & Kral, 2008;  
113 Fomon, 1974; Fox et al., 2006; Frankel et al., 2016; Taveras, Scanlon, Birch et al., 2004;  
114 Wardle, Guthrie, Sanderson, Birch, & Plomin, 2001; Wardle, Guthrie, Sanderson & Rapoport,  
115 2001). The influence of parental feeding practices and styles on a child's eating behavior,  
116 intake and subsequent weight status has been demonstrated in many studies (see Ventura &  
117 Birch, 2008, for a review). Some parental feeding practices, such as feeding when an infant is  
118 not hungry, seem to promote overeating in children by impairing an infant's response to his or  
119 her internal states of hunger and satiation (DiSantis, Hodges, Johnson, & Fisher, 2011; Shunk  
120 & Birch, 2004; Tanofsky-Kraff et al., 2008).

121

122 **Thus**, the ability to measure children's **self-regulation of eating** and related parental feeding  
123 practices outside of a laboratory setting is an important contribution. Using validated

124 questionnaires, Frankel et al. (2016) examined the relationships between parental feeding  
125 styles as assessed by the Caregiver's Feeding Styles Questionnaire (CFSQ, Hugues, Power,  
126 Fisher, Mueller & Nicklas, 2005) and preschool children's self-regulatory abilities as assessed  
127 by the Child Eating Behavior Questionnaire (CEBQ, Wardle, Guthrie, Sanderson & Rapoport,  
128 2001). This study involved low-income Hispanic and black parents and their children.  
129 Interestingly, Frankel et al. found that indulgent feeding styles (feeding characterized by low  
130 levels of demandingness or expectations for children's food intake behaviors and high levels  
131 of responsiveness or the warmth and sensitivity of parents' reactions to children's cues of  
132 hunger/satiety) were associated with children's lower satiety responsiveness and higher food  
133 enjoyment. Satiety responsiveness refers to a child's sensitivity to and consumption in  
134 response to feelings of fullness and hunger, whereas enjoyment of food describes how a child  
135 is responsive to external food cues (Carnell & Wardle, 2007; 2008). These behaviors are  
136 components of the self-regulation of eating and have been shown to mediate the links between  
137 parental feeding styles and children's body mass index (Carnell & Wardle, 2007; 2008).  
138  
139 Until now, the assessment of the relationships between parental feeding practices/styles and  
140 children's self-regulation of eating has been examined mainly with Anglo-Saxon samples  
141 and/or with low-income parents (Carnell & Wardle, 2007, 2008; Hodges et al., 2013; Hughes  
142 & Frazier-Wood, 2014; Johnson, 2000; Johnson, McPhee & Birch, 1991; Musher-Eizenman  
143 & Holub, 2007). No questionnaire has been validated in France, despite the country's cultural  
144 specificities (Rozin, Fischler, Imada, Sarubin, & Wrzesniewshi, 1999; Rozin, Kurzer, &  
145 Cohen, 2002). According to these authors, French culture is more attached to food-pleasure-  
146 oriented eating values than to food-health-oriented ones, in comparison to American cultures,  
147 for instance; this could, in turn, lead French parents to favor very different feeding practices  
148 than Anglo-Saxon parents, as shown by Schwartz et al. (2013). These authors have shown that

149 for French mothers, pleasure and taste development are considered of primary importance  
150 from infancy. They observed that for French mothers, complementary feeding lays the  
151 foundations of taste early in life. In this study, thematic analysis of transcribed focus groups  
152 and interviews revealed the perceived importance of flavor exposure and taste discovery in  
153 educating the palate of infants with a variety of different foods beyond mere nutrition.  
154

155 The objective of the first part of the present study was to develop a self-report questionnaire  
156 suitable for French samples that assesses different dimensions of children's self-regulation of  
157 eating and related parental feeding practices. Given the importance of establishing healthy  
158 eating habits in early childhood (Birch & Ventura, 2009; Kelder, Perry, Klepp, & Lytle,  
159 1994), we focused on the period from 1 to 5 years of age. Our aim was to combine into the  
160 same instrument both behaviors involved in children's self-regulation of eating: eating in the  
161 absence of hunger, which may reflect responses to external cues, and eating compensation  
162 ability, which may reflect responses to internal cues (Almiron-Roig et al., 2013; Remy et al.,  
163 2015). The originality of our approach is that we based the development of our questionnaire  
164 on input from French parents' perceptions collected during interviews since French parents  
165 may have a very different approach to feeding than families in Anglo-Saxon households do.  
166 The objective of the second part of our study was to validate the questionnaire and then to  
167 assess the relationships between children's self-regulation of eating and a broad range of  
168 behaviors that French parents may engage in when managing their child's eating regulation  
169 and the relationships between children's self-regulation and children's body mass index. We  
170 sought to identify which parental feeding practices could be considered effective or  
171 ineffective for French parents regarding children's self-regulation of eating. Moreover, we  
172 hypothesized a relationship between children's self-regulation of eating and children's body  
173 mass index.

174

## 175 **2. General study design**

176

177 The current study relies on two parts. In the first part, semi-structured interviews were  
178 conducted to create a self-report questionnaire suitable for French samples by assessing  
179 dimensions of children's self-regulation of eating and dimensions of related parental feeding  
180 practices. Then, input from parents and the literature on parental feeding practices were used  
181 to develop a new instrument that more adequately assessed parental perception of children's  
182 self-regulation of eating and parental feeding practices that parents may engage in when  
183 managing children's eating behaviors. An initial version of the parental self-report  
184 questionnaire was then constructed.

185 In the second part, this questionnaire was distributed to another sample of participants. The  
186 questionnaire was then validated, and the selected items were used to examine the links  
187 between parental feeding practices, children's self-regulation abilities and children's body  
188 mass index.

189 Written informed consent was obtained from both parents of all the children. The protocol  
190 was reviewed and approved by the local ethical committee, CPP Est I Burgundy (ID RCB:  
191 2012-A00187-36). We certify that all the applicable institutional and governmental  
192 regulations concerning the ethical use of human volunteers were followed during this research  
193 study.

194

## 195 **3. Part 1: Development and validation of the questionnaire**

196

### 197 *3.1. Methods*

#### 198 *3.1.1. Participants*

199 **Forty-five French mothers of children aged from 12 to 60 months were recruited for the**  
200 **interviews** (mean age<sub>mother</sub> = 33.50). Some mothers were unemployed (10.0%); low,  
201 intermediate and high occupational status represented 28.0%, 36.9% and 25.1%, respectively.  
202 The mothers were all native French speakers.

203

### 204 **3.1.2. Interviews**

205 During the interviews conducted at home **by** a psychologist, the mothers were first asked to  
206 describe their child's eating behavior in terms of hunger and satiety cues and in terms of self-  
207 regulation. The very first question was '*How do you know whether your child is hungry or not*  
208 *hungry?*' The second question was '*When is your child hungry/not hungry?*' The third  
209 question was '*How do you react when your child says that s/he is hungry/not hungry?*'  
210 Finally, the mothers were asked '*Do you think that your child is able to regulate/to*  
211 *compensate food intake? In which situations can the behavior of "caloric/energy*  
212 *compensation" be (or not be) observed? In other words, in which situations your child is able*  
213 *(or not able) to compensate food intake?*'

214 To explore parental practices that could impede a child's self-regulation, the mothers were  
215 then asked, '*How do you manage your child when s/he says that s/he is still hungry—for*  
216 *instance, just after a meal?*', '*How do you manage your child when s/he is hungry and has*  
217 *difficulty in waiting for eating?*', and '*Do you use foods as a reward to regulate your child's*  
218 *mood?*'

219

### 220 **3.1.3. Analysis of the interviews**

221 The analysis of the interviews relied on the analysis of the thematic content, which was  
222 conducted by three **psychologists among the study investigators**. Many descriptions

223 spontaneously emerged from these interviews. These descriptions were first simply listed and  
224 then categorized into different thematic contents as follows.

225 Maternal perception of **children's self-regulation of eating**. Some mothers described their  
226 children as having poor self-regulation abilities in terms of eating compensation (*'If my child*  
227 *has a snack just before mealtime, he eats as usual during mealtime, even if he had received a*  
228 *snack just before'*). They also reported different situations in which their children would eat in  
229 the absence of hunger (*'After a mealtime, if candies are available, he will eat some, even if I*  
230 *am sure that he is not hungry anymore'*).

231 Parental awareness of **children's** internal cues. It appeared that difficulties in coping with a  
232 child's hunger (or lack of hunger at a mealtime) were very common in the mothers (*'My child*  
233 *has a big appetite!'*). For some mothers, it was relatively difficult to know whether their  
234 children were hungry or not (*'Well, it is not easy to know when my child is hungry. What is*  
235 *sure is that he always prefers to play than to eat!'*). Other mothers seemed very aware of their  
236 children's cues, especially of hunger cues (*'As soon as he becomes agitated, as soon as he*  
237 *wiggles, I know what that means!'*).

238 Parental feeding practices used to manage **children's self-regulation of eating**. It is noteworthy  
239 that most of the mothers who reported that their children ate in the absence of hunger also  
240 described their use of food as a reward (*'X is congratulated when she eats all the food in her*  
241 *plate'; 'I am so proud when the plate is clean!'*) and, to a lesser extent, their use of food for  
242 emotional regulation (*'I sometimes give him a piece of bread or a candy for waiting'*).

243 The other types of situations spontaneously described by the mothers were linked to  
244 structuring feeding habits related to their organization of meal times (*'The hours for meal*  
245 *times are very regular, even on the weekend'*) or to their feeding practices (*'My child is*  
246 *allowed to snack between meal times'*). For the mothers, these eating aspects (regularity of

247 meal times and ‘snacking’) were evoked in association with a child’s ability to compensate  
248 for his or her food intake (*‘It is easier to regulate behavior when the meal times are regular’*).

249

#### 250 *3.1.4. Item selection*

251 The items of the dimensions that were included in the questionnaire were selected mainly  
252 from the following two sources: i) mother’s accounts during the interviews; ii) evaluation of  
253 the existing validated questionnaires, since it appears that some spontaneous responses that  
254 were related to parental feeding practices were very similar to items of existing validated  
255 scales: the Comprehensive Feeding Practices Questionnaire (CFPQ, Musher & Holub, 2007)  
256 and the Infant Feeding Questionnaire (IFQ, Baughcum et al., 2001).

257

#### 258 *3.2. Results*

259 **An initial version of the questionnaire with 28 items was constructed.** The selected items are  
260 summarized in Table 1, which describes the source of the selected items (from the mothers’  
261 interviews or from the existing validated scales) and the corresponding scale for each answer.  
262 For the sake of clarity, only the 21 items from the dimensions **retained for** the structural  
263 equation modeling (see below) are presented **in this Table**.

264

265 *Insert Table 1 about here*

266 **Table 1. Twenty-one items of the self-report questionnaire were categorized by dimension**  
 267 **with their corresponding answer modalities and the source (interviews or existing scales).**  
 268 **Only items retained for the SEM analysis are reported.**

<b>Selected items and related dimensions</b>	<b>Answer modality</b>	<b>Sources</b>
<b>Child's self-regulation abilities dimensions</b>		
<b>Eating in the absence of hunger</b>		
If my child is no longer hungry and I offer him something s/he particularly likes... ( <i>Tick your answer</i> )	S/he does not want it <sup>(1)</sup> S/he asks if he can have it later S/he eats a few bites, just to taste it S/he eats it up	Interviews
After s/he has finished his meal, if candies are available and I let him/her... ( <i>Tick your answer</i> )	S/he does not take any <sup>(2)</sup> S/he takes them in order to have them later S/he takes one or two just to taste them S/he takes a lot	Interviews
<b>Poor eating compensation ability</b>		
My child eats less at meal times when s/he has eaten something before the meals.	5-point scale ranging from "Never" to "Always"	Interviews
My child gets full before his/her meal is finished.	5-point scale	Interviews
My child eats less at meal times when s/he has been at a birthday party or snacked at a friend's house.	5-point scale	Interviews
If my child eats, let us say, a bun or a muffin, one hour before the meal... ( <i>Tick your answer</i> )	S/he is not hungry when it is time for the meal <sup>(3)</sup> S/he is hungry when it is time for the meal but eats less than usual S/he eats as s/he usually eats	Interviews
<b>Parental feeding practices dimensions</b>		
<b>Food as reward</b>		
I offer sweets (candy, ice cream, cake, pastries) to my child as a reward for good behavior.		CFPQ (Musher & Holub, 2007)
I offer my child her/his favorite food in exchange for good behavior.	5-point scale ranging from "Never" to "Always"	CFPQ (Musher & Holub, 2007)
I withhold sweets/dessert from my child in response to bad behavior.		CFPQ (Musher & Holub, 2007)
<b>Parental awareness of child's cues</b>		
I know when my child is hungry.		IFQ (Baughcum et al., 2001)
I know when my child is full.	5-point scale ranging from "Never" to "Always"	IFQ (Baughcum et al., 2001)
I know when my child is not hungry during meal times.		IFQ (Baughcum et al., 2001)
<b>Snacking/flexibility in eating</b>		
At home, I allow my child to help him/herself to biscuits and sweets/chocolates.		Interviews
When we are out shopping, my child is allowed to have something to eat.		Interviews
After being physically active (walking, swimming...), my child has something to eat.	5-point scale ranging from "Never" to "Always"	Interviews
If my child is hungry, I allow him/her to eat.		Interviews
My child has a snack between meals.		Interviews
My child eats between meals.		Interviews
<b>Feeding on a schedule</b>		
During the week, do you make him/her eat at set times?		IFQ (Baughcum et al., 2001)
During the weekend, do you make him/her eat at set times?	5-point scale ranging from "Never" to "Always"	IFQ (Baughcum et al., 2001)
When my child is hungry before a meal time, I make him/her wait.		Interview

269 <sup>1</sup> The corresponding scores ranged from 1 (S/he does not want it) to 4 (S/he eats it up).

270 <sup>2</sup> The corresponding scores ranged from 1 (S/he does not take any) to 4 (S/he takes a lot).

271 <sup>3</sup> The corresponding scores ranged from 1 (S/he is not hungry when it is time for the meal) to 3 (S/he eats as s/he usually  
272 does).  
273

274 It should be **noted** that the items related to the dimension of eating in the absence of hunger  
275 (*'After s/he has finished his meal, if candies are available and I let him/her...'*) could be  
276 closely related to the dimensions of the Child Eating Behavior Questionnaire (CEBQ, Wardle  
277 et al., 2001), especially the dimension of the enjoyment of food, which refers to how  
278 responsive a child is to external food cues (Carnell & Wardle, 2007; Wardle et al., 2001), and  
279 the dimension of food responsiveness, which describes how responsive a child is to food and  
280 eating (Wardle et al., 2001). In the same vein, it should be **noted** that the items related to the  
281 dimension of children's eating compensation ability (*'My child eats less at meal times when  
282 s/he has eaten something before the meals'*) are very close to those of the satiety  
283 responsiveness dimension of the CEBQ, since this dimension refers to a child's sensitivity to  
284 and consumption in response to hunger and fullness internal cues. These existing relevant  
285 scales were not used *a priori* in the current study because (i) **we favored the mothers'**  
286 **verbatim responses to fully adapt the questionnaire to French participants** and (ii) they  
287 concerned other age ranges that did not strictly correspond to the age group of children of the  
288 present study. The items that were spontaneously reported clearly evoked concrete and  
289 idiosyncratic situations that may be culturally determined, which may, in turn, allow  
290 participants to more fully engage while they complete the questionnaire.  
291 Concerning the parental feeding practices, most of the items were selected from existing  
292 questionnaires, as reported in Table 1. The items that belong to the dimension 'parental  
293 awareness of child's cues' and those belonging to the dimension 'feeding on a schedule' were  
294 selected from the Infant Feeding Questionnaire (Baughcum et al., 2001) because they mostly  
295 matched the mothers' verbatim responses. Three items from the dimension 'use of food as  
296 reward' were selected from the Comprehensive Feeding Practices Questionnaire (Musher-

297 Eizenman & Holub, 2007), as they spontaneously emerged during the interviews with the  
298 mothers.

299 A new dimension entitled ‘Snacking/eating flexibility’ was **constructed** and included items  
300 from the interviews with the mothers. This dimension described situations in which the child  
301 was allowed to eat between the main meals (*‘At home, I allow my child to help him/herself to*  
302 *biscuits and sweets/chocolates’*; *‘When we are out for shopping, my child is allowed to have*  
303 *something to eat’*) and relied on concrete situations spontaneously described by the mothers.  
304 Finally, two of the three items of the dimension ‘emotional regulation’ of the CFPQ  
305 questionnaire of Musher-Eizenman and Holub (2007) were selected (*‘Do you give this child*  
306 *something to eat or drink if s/he is bored even if you think s/he is not hungry?’* *‘Do you give*  
307 *this child something to eat or drink if s/he is upset even if you think s/he is not hungry?’*), as  
308 they emerged, though to a lesser extent, during the interviews.

309

## 310 **4. Part 2: Parental feeding practices, children’s self-regulation abilities and children’s** 311 **body mass index**

### 312 **4.1. Methods**

#### 313 *4.1.1. Participants*

314 **Parents of pupils in 6 daycare centers and in 7 kindergarten schools in Dijon and Paris were**  
315 **invited to participate in the study via leaflets. All parents who agreed to** participate in the  
316 study were recruited. Parents of premature children (born before 37 weeks of gestation) were  
317 excluded from the analysis. A total of 932 questionnaires were distributed. Ultimately, 793  
318 parents of pupils in the daycare centers (mean age<sub>mother</sub>=34.00 [min-max=22-46]; mean age  
319<sub>father</sub>=35.92 [min-max=22-39]) and kindergarten schools (mean age<sub>mother</sub>=35.09 [min-  
320 max=23-46]; mean age<sub>father</sub>=37.50 [min-max=24-46]) participated in the study (response rate  
321 of 85%). The parents of the children aged approximately 1 to 3 years old were recruited from

322 daycare centers (n=247), while the parents of children aged 3 to 6 years old were recruited  
323 from kindergartens (n=546) (see Table 2).

324 *Insert Table 2 about here*

325 Table 2. Characteristics of the participants who completed the questionnaire.

	Daycare centers	Kindergartens
Number of children in the analyses	247	546
Age, mean (sd)	2.52 (1.10)	4.47 (1.09)
Girls/boys	109/138	259/287
Girl/boy ratio *	.44/.56	.47/.53
Mean z-BMI (sd)**	-0.37 <sup>a</sup> (1.39)	-0.04 <sup>a***</sup> (1.41)
Education of the mothers [ratios for levels 1-6] (see note)		
Level 1	.04	.13
Level 2	.24	.34
Level 3	.27	.17
Level 4	.25	.15
Level 5	.14	.15
Level 6	.06	.06
Education of the fathers [ratios for levels 1-6] (see note)		
Level 1	.09	.12
Level 2	.43	.40
Level 3	.20	.17
Level 4	.07	.09
Level 5	.13	.14
Level 6	.08	.08

326 *Legend*

327 \* *Chi*-squared test revealed that the distributions of the girls and boys in the daycare centers and in the  
328 kindergartens were not different ( $Chi^2(1) = 0.54, p = 0.45$ )

329 \*\* Z-score of BMI based on French norms (Rolland-Cachera et al., 1991).

330 \*\*\* Within a line, means with the same letter were not significantly different ( $p > 0.05$ ).

331

332 *Note.* Level 1 corresponds to youth training, a BTEC First Diploma, a GNVQ Foundation, or no diploma.

333 Level 2 corresponds to A level or a high-school diploma/degree. Level 3 corresponds to a diploma of higher  
334 education or 12<sup>th</sup> grade. Level 4 corresponds to a three-year university degree. Level 5 corresponds to a

335 Master's degree or a Master 2, and level 6 corresponds to higher than a Master 2 (PhD).

336 It should be noted that mothers with a low level of education were more represented in the kindergarten

337 group than in the daycare centers ( $Chi^2(5) = 0.35, p < 0.001$ ). This may be because the mothers with jobs used

338 the daycare system for their children. In contrast, the number of years of education of the fathers was not

339 significantly different between the daycare centers and the kindergartens ( $p = 0.49$ ).

340

341

#### 342 *4.1.2. Questionnaire completion*

343 The questionnaires were anonymous and took less than 10 minutes to complete. They were  
344 filled out at the participants' homes and were returned in sealed envelopes. Questions  
345 concerning the child's age and gender, the parent's age, and some demographic characteristics  
346 were asked. The parents were also asked for **their children's heights and weights** from  
347 weighing records measured by a pediatrician and reported in the 'health notebook'. The **'health**  
348 **notebook'** is a very common tool in France that records health information for each child  
349 (height, weight, vaccination, diseases, growth, etc.). This tool has to be brought by the parents  
350 to each compulsory medical examination of their children so that the pediatrician can record  
351 the children's health information. From these data, the child's body mass index (BMI) was  
352 calculated ( $\text{kg}/\text{m}^2$ ) and converted into a standardized z-score based on the French norms  
353 (Rolland-Cachera et al., 2002; Rolland-Cachera, Cole, Sempe, Tichet, Rossignol, & Charraud,  
354 1991).

355

#### 356 *4.1.3. Statistical Analysis*

357

358 Confirmatory factor analysis (CFA): Validation of each dimension of the questionnaire  
359 The questionnaire was validated using a structural equation modeling (SEM) approach  
360 (Bollen, 1989; Kaur et al., 2006). To validate the internal consistency of the questionnaire, a  
361 confirmatory factor analysis (CFA) was conducted in three steps. First, a measurement model  
362 was fitted for the dimensions linked to children's **self-regulation of eating** (eating in the  
363 absence of hunger and poor eating compensation); second, another measurement model was  
364 fitted for the dimensions related to parental feeding practices (use of food as reward,  
365 awareness of child's cues, feeding on a schedule, and snacking). Third, a measurement model

366 was fitted for all dimensions together. In each measurement model, all constructs were  
367 allowed to correlate with each other. Finally, modification indices were considered to suggest  
368 fit improvement.

369

370 Structural equation modeling: Assessments of the links between parental feeding practices,  
371 children's self-regulation abilities and children's BMI

372 To assess the structure between the dimensions related to parental feeding practices (use of  
373 food as reward, awareness of child's cues, feeding on a schedule, and snacking), the  
374 dimensions related to children's self-regulation of food intake (eating in the absence of  
375 hunger, and eating compensation ability) and child's BMI, a structural equation modeling  
376 analysis was conducted. First, the model defined by regression effects of the four dimensions  
377 related to parental feeding practices on the two dimensions related to child's self-regulation of  
378 eating (eating in the absence of hunger and eating compensation ability) was estimated. Then,  
379 non-significant regression links were removed. Finally, the child's BMI was added with  
380 regression links between the two dimensions related to the child's self-regulation of eating  
381 and the child's BMI.

382

383 All CFA and SEM analyses were conducted using the R package lavaan 0.5-23.1097  
384 (Rosseel, 2012). Missing data (< 7% for the items of the questionnaires; < 10% regarding  
385 child's BMI) were removed using a listwise deletion procedure. As a result, 557 observations  
386 of the original 793 remained for the estimation. All items except child's z-BMI were declared  
387 as ordered, and a diagonally weighted least squares estimator (DWLS) was used to estimate  
388 model parameters. Each model fit was assessed using the root mean square error of  
389 approximation (RMSEA), the comparative fit index (CFI) and the Tucker-Lewis Index (TLI).  
390 The objective was to obtain a small RMSEA and high CFI and TLI indices. The usual cut-offs

391 equal to 0.05 for RMSEA and 0.90 for CFI and TLI were considered guidelines, although it  
392 has been shown that such values are easily reached in the case of ordered items (Xia & Yang,  
393 2018). To the best of our knowledge, no cut-off has ever been proposed regarding fit indices  
394 when analyzing ordered categorical variables.

395

## 396 **4.2. Results**

397

### 398 *4.2.1 Descriptive analysis.*

399 A descriptive analysis was conducted to check the relevance and understanding of the items  
400 by the participants. Two points were raised. First, some items were almost never used by our  
401 participants. On average, 94% of the participants declared that they never use food to calm  
402 their child or used this practice rarely. For this reason, the two items related to emotional  
403 regulation practices were not included in the SEM analysis. Second, the analysis of the  
404 answers revealed that five items were not fully understood by the participants. It appeared that  
405 the wording was ambiguous or that the response modality was not suitable, leading to missing  
406 answers in a large proportion and/or to annotations, which led us to exclude these items. In  
407 particular, the excluded items were formulated as follows: “My child eats less when...”, and  
408 the participants were invited to assess the probability of occurrence (from “never” to  
409 “always”) of each proposal: “s/he is ill”, “does not like the offered food”, “eats something  
410 before a mealtime”, “has eaten a lot during the previous meal”, “is tired”, “is angry”. The  
411 instructions were not clearly understood, as some participants selected only one proposal from  
412 the list by circling it without specifying its frequency as expected, whereas other participants  
413 rated the frequency of each proposal. It appeared that the list of proposals intrinsically mixed  
414 activities that were too disparate to be fully understood by the participants. Therefore, these

415 items were excluded, leading to a questionnaire composed of 21 items, as presented in Table  
416 1.

417

418 *4.2.2. Confirmatory factor analysis (CFA): Validation of each dimension of the questionnaire*

419 The items belonging to the child's self-regulation of food intake (eating in the absence of

420 hunger and eating compensation ability) and to the dimensions related to parental feeding

421 practices (use of food as reward, awareness of child's cues, feeding on a schedule, and

422 snacking) were submitted to CFA analyses. The analysis performed on 21 items (Table 3)

423 indicated good fit indices (DWLS = 487,  $df = 173$ ,  $p < 0.001$ ,  $RMSEA = 0.054$  [0.049-0.060];

424  $CFI = 0.95$ ;  $TLI = 0.94$ ).

425

426 *Insert Table 3 about here*

427

428

429 Table 3: CFA models with factor loadings

Selected items and related dimensions	mean (SD)	Preliminary loading <sup>3</sup>	Std. error	Final loading <sup>3</sup>	Std. error
<b>Child's self-regulation abilities dimensions</b>					
<b>Eating in the absence of hunger<sup>1</sup></b>	<b>2.43 (0.79)</b>	<b>α= 0.47</b>			
If my child is no longer hungry and I offer him/her something s/he particularly likes. ( <i>Tick your answer</i> )	2.47 (1)	0.36	0.30	0.47	0.07
After s/he has finished his meal, if candies are available and I let him/her... ( <i>Tick your answer</i> )	2.39 (0.96)	1.08	0.91	0.83	0.11
My child eats less at meal times when s/he has eaten something before the meals. <sup>2</sup>				0.15	0.06
<b>Poor eating compensation ability<sup>1</sup></b>	<b>3.15 (0.70)</b>	<b>α= 0.74</b>			
My child eats less at mealtimes when s/he has eaten something before the meals. <sup>2</sup>	2.23 (0.62)	0.51	0.04	0.49	0.04
R My child gets full before his/her meal is finished.	3.32 (1.02)	0.83	0.02	0.82	0.02
R My child eats less at meal times when s/he has been at a birthday party or snacked at a friend's house.	3.70 (0.95)	0.71	0.03	0.70	0.03
If my child eats, let us say, a bun or a muffin, one hour before the meal... ( <i>Tick your answer</i> )	3.36 (1.10)	0.74	0.02	0.76	0.02
<b>Parental feeding practices dimensions</b>					
<b>Food as reward</b>	<b>1.83 (0.79)</b>	<b>α= 0.69</b>			
I offer sweets (candy, ice cream, cake, pastries) to my child as a reward for good behavior.	1.81 (0.94)	0.89	0.03	0.88	0.03
I offer my child her/his favorite food in exchange for good behavior.	1.74 (0.91)	0.71	0.03	0.71	0.03
I withhold sweets/dessert from my child in response to bad behavior.	1.94 (1.16)	0.61	0.04	0.62	0.04
<b>Parental awareness of child's cues</b>	<b>3.97 (0.58)</b>	<b>α= 0.54</b>			
I know when my child is hungry.	4.11 (0.79)	0.56	0.04	0.50	0.04
I know when my child is full.	4.09 (0.76)	0.65	0.04	0.62	0.04
I know when my child is not hungry during meal times.	3.70 (0.87)	0.64	0.04	0.70	0.05
<b>Snacking/flexibility in eating</b>	<b>2.24 (0.62)</b>	<b>α= 0.68</b>			
At home, I allow my child to help him/herself to biscuits and sweets/chocolates.	2.37 (0.91)	0.75	0.02	0.74	0.03
When we are out for shopping, my child is allowed to have something to eat.	1.39 (0.75)	0.58	0.04	0.52	0.05
After being physically active (walking, swimming...), my child has something to eat.	2.27 (1.20)	0.54	0.03	0.53	0.04
If my child is hungry, I allow him/her to eat.	2.26 (0.91)	0.74	0.03	0.73	0.03
My child has a snack between meals.	2.65 (1.17)	0.50	0.03	0.47	0.04
My child eats between meals.	2.49 (0.99)	0.48	0.04	0.48	0.04
<b>Feeding on a schedule</b>	<b>4.20 (0.55)</b>	<b>α= 0.48</b>			
During the week, do you make him/her eat at set times?	4.64 (0.58)	0.90	0.05	0.96	0.05
During the weekend, do you make him/her eat at set times?	4.19 (0.78)	0.69	0.04	0.66	0.04
When my child is hungry before a meal time, I make him/her wait.	3.77 (0.95)	0.41	0.04	0.39	0.05

430 In the preliminary step, two models were considered, one for the child's self-regulation abilities and another for the parental  
431 feeding practices. In contrast, all dimensions were included in the same final model.

432 <sup>1</sup> For the child's eating in the absence of hunger dimension and for the poor eating compensation ability, the higher the score  
433 is, the less the child is able to self-regulate food intake.  
434 <sup>2</sup> This item loaded mainly on the construct 'Poor eating compensation ability' but also on the construct 'Eating in the absence  
435 of hunger'. This modification, which makes sense, was suggested by the modification indices and improved the model fit.  
436 <sup>3</sup> Loading and standardized loadings are equal. All the items have a  $p$ -value  $< 0.001$  except the item 'My child eats less at  
437 meal times when s/he has eaten something before the meals', the  $p$ -value of which is 0.007.

438  
439 Interestingly, the correlation between the two constructs related to the child's **self-regulation**  
440 **of eating** (eating in the absence of hunger and poor eating compensation) was not significant  
441 (standardized estimate = -0.11,  $p = 0.06$ ), suggesting that these two behaviors are **distinct**.

442

443 *4.2.3. Structural equation modeling: Links between parental feeding practices, child's self-*  
444 *regulation of food intake and child's BMI*

445 The model with all the parental constructs and the child's self-regulation constructs were  
446 evaluated in the same measurement model. The model showed a good fit (DWLS = 537,  $df =$   
447  $193$ ,  $p < 0.001$ ,  $RMSEA = 0.057$  [0.051,0.062];  $CFI = 0.94$ ;  $TLI = 0.93$ ). For the sake of  
448 clarity, Figure 1 represents only significant regressions between latent variables. All  
449 regression and covariance parameters are reported in Table 4.

450

451 *Insert Table 4 and Figure 1 about here*

452

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Table 4: SEM model: parameter estimates, standard errors, p values and standardized estimates (i.e., completely standardized solutions) for regression parameters, and correlations between dimensions

<b>Structural regression coefficients</b>	<b>Estimate</b>	<b>Std. err</b>	<b>P value</b>	<b>Std. estimate</b>
<b>Poor eating compensation ability</b>				
Snacking/flexibility in eating	-0.12	0.07	0.077	-0.12
Feeding on a schedule	-0.09	0.06	0.156	-0.09
Food as reward	-0.11	0.06	0.054	-0.10
Parental awareness of child's cues	-0.18	0.06	0.005	-0.17
<b>Eating in the absence of hunger</b>				
Snacking/flexibility in eating	-0.02	0.09	0.866	-0.01
Feeding on a schedule	0.03	0.09	0.739	0.03
Food as reward	0.34	0.08	0.000	0.31
Parental awareness of child's cues	-0.22	0.09	0.016	-0.20
<b>z-BMI</b>				
Poor eating compensation ability	0.22	0.06	0.000	0.17
Eating in the absence of hunger	0.21	0.07	0.003	0.17
<b>Latent variable correlations</b>				
	<b>Food as reward</b>	<b>Parental awareness of child's cues</b>	<b>Snacking/ flexibility in eating</b>	<b>Feeding on a schedule</b>
<b>Food as reward</b>				
<b>Parental awareness of child's cues</b>	-0.09			
<b>Snacking/flexibility in eating</b>	0.26	0.17		
<b>Feeding on a schedule</b>	-0.16	0.18	-0.41	

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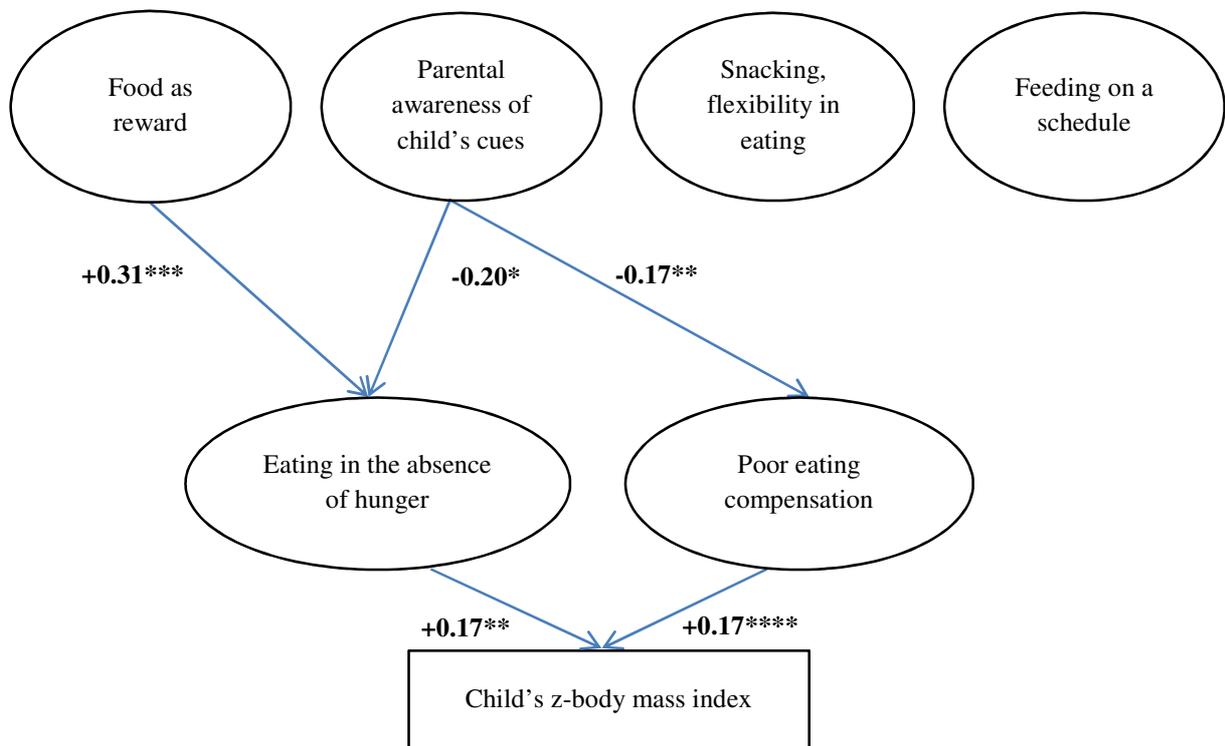
As shown in Figure 1, the model showed a negative association between the parental awareness of the child's internal cues and the child's eating in the absence of hunger (standardized estimate = -.20;  $p = 0.02$ ), meaning that the lower the awareness that parents declared about their children's internal cues, the more the children were perceived as being at risk of eating in the absence of hunger. This practice was also negatively associated with children's poor eating compensation ability (standardized estimate = -.17;  $p = 0.005$ ), suggesting that the lower the awareness that they declared about their children's internal cues, the more the children were described as having poor compensation abilities. Moreover, a positive association between the use of food as reward dimension and children's eating in the absence of hunger was reported (standardized estimate = 0.31;  $p < 0.001$ ); the more the

469 parents used food in a non-eating context, the more the child was described as eating in the  
470 absence of hunger. Interestingly, significant positive relationships were observed between  
471 eating in the absence of hunger and children's z-BMI (standardized estimate = 0.17,  $p =$   
472 0.003) and between poor eating compensation and children's z-BMI (standardized estimate =  
473 0.17,  $p < 0.001$ ).

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476



**Figure 1.** Structural model for the association between the parental constructs, the child's self-regulation constructs (eating in the absence of hunger, poor eating compensation) and child's body mass index. Only significant regressions are represented ( $*p < 0.05$ ,  $**p < 0.01$ ,  $***p < 0.001$ ), for which standardized regression coefficients are reported.

## 479 **5. General discussion**

480

481 The first aim of the present study was to examine the development and the initial validation of  
482 a new self-reported questionnaire for use in large-scale French studies to assess two children's  
483 behaviors involved in challenging eating situations (eating in the absence of hunger and poor  
484 eating compensation ability) and related feeding practices that are supposed to be used by  
485 parents while coping children's eating behaviors.

486

487 The results of the confirmatory factor analysis allow us to confirm the relevance of the child's  
488 constructs (eating in the absence of hunger and poor eating compensation ability) and the  
489 parental feeding practices' constructs (food as reward, parental awareness of child's cues,  
490 snacking, and feeding on a schedule) of the new self-report questionnaire. Concerning the  
491 child's constructs, the results validated the internal consistency of the two dimensions and  
492 confirmed that eating in the absence of hunger and poor eating compensation ability are two  
493 relatively independent behaviors, as shown in a study using experimental paradigms (Remy et  
494 al., 2015). Thus, it could be argued that the eating in the absence scale offers insights  
495 regarding whether a child may initiate eating when not hungry, whereas the poor eating  
496 compensation scale offers insights regarding whether a child may adjust his/her intake during  
497 a meal depending on what s/he has eaten before the meal (Hughes & Frazier-Wood, 2016).

498 The present results suggested that eating in the absence of hunger and poor eating  
499 compensation ability reflect different alterations **in self-regulation of eating** that are already  
500 present in 1–5-year-old French children. The hypothesis that eating in the absence of hunger  
501 may reflect responses to external cues and eating compensation to internal cues could explain  
502 this non-significant link (Almiron-Roig et al., 2013; Remy et al., 2015).

503

504 Concerning the parental constructs, the current study corroborated the use of different feeding  
505 practices by French parents, especially the use of food as reward (CFPQ, Musher & Holub,  
506 2007), the parental awareness of children's cues and the dimension of feeding on a schedule  
507 (IFQ, Baughcum et al., 2001). Our study also offered an initial validation of a new subscale  
508 dedicated to snaking/flexibility in eating **constructed** from the mothers' verbatim responses  
509 obtained during the interviews.

510

511 The second aim of the current study was to assess i) the relationships between **children's self-**  
512 **regulation of eating** and parental feeding practices that parents may engage when managing  
513 their **children's self-regulation of eating and ii)** the relationships between children's self-  
514 regulation and children's body mass index. Using a structural equation modeling approach,  
515 our results revealed that the lower the awareness that parents declared about their children's  
516 internal cues, the more a child was perceived to be at risk of eating in the absence of hunger.  
517 In the same vein, the lower the awareness that parents declared about their children's internal  
518 cues, the more a child is described as having poor eating compensation abilities. These  
519 relationships reinforced the hypothesis that caregiver feeding patterns that are unresponsive to  
520 child hunger and/or fullness cues may contribute to over intake by promoting eating in the  
521 absence of hunger or eating beyond fullness (Costanzo & Woody, 1985; DiSantis et al., 2011;  
522 Frankel et al., 2014; Hodges et al., 2013). The present results may suggest that a child-  
523 centered feeding approach that is responsive to the child's hunger and satiety cues is likely to  
524 respect the child's behaviors that are driven by internal biological cues or sensations when  
525 eating.

526

527 Moreover, a relationship between the use of food as reward and children's eating in the  
528 absence of hunger has been reported, suggesting that the more a parent uses food in a non-

529 eating context, the more a child is described as eating in the absence of hunger. This  
530 association is consistent with previous data that has shown that the use of food as reward is  
531 associated with higher consumption of unhealthy foods in children (Kröller & Warschburger,  
532 2009; Remy et al., 2015). A narrative review of the literature highlights the point that the  
533 effects of the use of food as reward could lead to mixed results, depending on the type of  
534 measured outcome (liking vs food refusal) and the initial level of liking of the food (Cooke,  
535 Chambers, Añez & Wardle, 2011). The authors pointed out that in some conditions, non-food  
536 rewards (e.g., stickers, praise) can be highly effective in encouraging children to taste new or  
537 less-liked foods to benefit from the ‘mere exposure’ effect. The beneficial effect of receiving  
538 a reward upon acceptance of a disliked vegetable, over and above the effect of mere exposure  
539 alone, has also been described with no evidence of any decrease in acceptance, either in the  
540 short term or up to three months after rewards were withdrawn (Cooke et al., 2011b).  
541 However, there seems to be a consensus on the fact that offering food as a reward appeared to  
542 be universally ineffective (Cooke et al., 2011a). In the current study, the items of the  
543 dimension of use of food as reward clearly referred to situations in which parents offered food  
544 as a reward in exchange for good behavior. Thus, the relationships between this instrumental  
545 practice and children’s eating in the absence of hunger clearly supported previous literature on  
546 the negative impact of instrumental feeding, such as using food as reward (Birch et al., 1982,  
547 1984; Newman & Taylor, 1992; Rigal et al., 2012) or using food to soothe infants or toddlers  
548 (Stifter, Anzman-Frasca, Birch & Voegtline, 2011; Stifter & Moding, 2015).

549

550 Finally, no relationship was reported between feeding on a schedule and children’s **self-**  
551 **regulation of eating**. One could argue that this structuring habit may be effective, since the  
552 regularity of meal times could help children attend to internal, biologically driven cues or  
553 sensations of hunger between meal times. Previous studies have shown that an increased

554 frequency of family meals was associated with healthier consumption (Davis et al., 2007).  
555 The present results failed to demonstrate that the regularity of meal times could favor a child's  
556 developmental regulation of food intake. Similarly, no relationship was reported between  
557 snacking and children's self-regulation of eating. Further studies are needed to fully  
558 understand the potential role of this factor on children's eating self-regulation.

559

560 Interestingly, both significant positive relationships were observed between eating in the  
561 absence of hunger and the child's body mass index and between poor eating compensation  
562 ability and the child's body mass index. These results suggest that these two constructs reflect  
563 children's difficulties in self-regulation of eating, which could lead to over-consumption with  
564 adverse impacts on children's body mass index. These results are very close to those of the  
565 literature on children's emotional and external eating. It has been shown that higher emotional  
566 and external eating behaviors lead to over-eating in response to emotions or food-related  
567 stimuli, regardless of the internal states of hunger and satiety, in overweight rather than in  
568 normal-weight children or adolescents (Braet et al., 2008; Braet & van Strien, 1997; Kral et  
569 al., 2012; Webber, Hill, Cooke, Carnell, & Wardle, 2010). Thus, the observed relationships  
570 between children's eating in the absence of hunger/poor eating compensation ability and  
571 children's body mass index confirmed previous findings and reinforced the relevance of the  
572 model. It can be concluded that an impaired ability to regulate short-term food intake may  
573 represent a behavior for being at risk of being overweight in young children. The fact that  
574 relationships have been found between parental feeding practices and children's self-  
575 regulation abilities and between children's self-regulation abilities and children's body mass  
576 index could offer initial evidence of the validity of the questionnaire.

577

578 Strengths and limits

579 Even if it is not possible, strictly speaking, to validate a questionnaire in a single study, the  
580 current research was undertaken to provide initial evidence of the validity of a new instrument  
581 dedicated to children's self-regulation of eating and related parental feeding practices in  
582 French parents of 1–5-year-old children. The advantage of the self-report questionnaire, in  
583 comparison with the other experimental protocols that are commonly conducted to assess self-  
584 regulation in young children, is that it can be used easily in large-scale studies. Moreover, for  
585 the assessment of the a child's eating compensation ability and eating in the absence of  
586 hunger, one could argue that an approach based on a questionnaire may be more relevant than  
587 a laboratory setting, since it allows the parent to take into account not only the adjustment of  
588 intake during one meal (i.e., short-term compensation), as in the experimental settings, but  
589 also the pattern over a time period that is longer than just one meal. The present study  
590 suggested that the parents were aware of their children's regulation abilities. One limit of this  
591 declarative approach, however, could be the effect of social desirability. In previous studies, it  
592 has been shown that the parents' perception of feeding practices can be influenced by their  
593 own dietary restraints, their perceptions of their children's risk of being overweight (Birch &  
594 Fisher, 2000), their own weight history (Saelens et al., 2000), and their concern for their  
595 children's weight (Gray, Janicke, Wistedt, & Dumont-Driscoll, 2010). A limitation of our  
596 study is that no information on breast-feeding and formula-fed practices has been collected,  
597 despite the documented differences in self-regulation among breast and formula-fed infants.  
598 Further investigations that include this information are needed. Another limitation may be  
599 linked to the use of cross-sectional data, which impede speculation on the directionality and  
600 dynamic of the reported effects. It seems that similar caution is warranted here since parental  
601 assessments of eating in the absence of hunger and eating compensation may also be  
602 responsive to/stem from child weight. Even if the current study did not validate the instrument  
603 against the gold-standard laboratory studies already in use, it offered an initial validation of a

604 questionnaire based on both a qualitative analysis of the mothers' verbatim responses that  
605 emerged from the interviews and a structural equation modeling approach used to confirm the  
606 different parental and child's constructs. Contrary to previous studies that targeted low-  
607 income parents (for instance, see Frankel et al., 2014), the present research involved a quite  
608 large sample of French parents from different socio-economic statuses, as observed in  
609 previous French studies (see, for instance, Rigal et al., 2012). This allowed us to identify  
610 deleterious feeding practices regarding children's self-regulation of food intake and a  
611 significant relationship between children's **self-regulation of eating** and children's body mass  
612 index, even if the study did not exclusively target families with disadvantaged socioeconomic  
613 statuses.

614

#### 615 Conclusions and perspectives

616 It appears that eating in the absence of hunger and poor eating compensation ability are two  
617 relatively independent behaviors that are linked to children's body mass index and that are  
618 impacted by different parental factors. What can be concluded from this study? The more  
619 parents use food as reward, the more their children are perceived as being at risk of eating in  
620 the absence of hunger (which makes it an ineffective practice). The more parents pay attention  
621 to their children's hunger and satiety cues, the less their children are perceived as being at risk  
622 of eating in the absence of hunger, and the less they are perceived as being unable to self-  
623 regulate food intake (effective practices). More research is needed to understand the complex  
624 motivations underlying these parental behaviors so that appropriate interventions can be  
625 developed and to take into account this particular developmental period (ages 1–5), given the  
626 stark differences in fine and gross motor skill capacities (grasping, gripping, pincer-grip, etc.),  
627 nutritional needs/norms, and daily routines. Addressing these questions is especially  
628 challenging because attention to these cues can help children focus on internal signals, which

629 can, in turn, improve their abilities to self-regulate **food intake** (Gross et al., 2010; Johnson,  
630 2000). Future studies should assess whether teaching both parent and child to focus on satiety  
631 cues may prevent at-risk children from overeating.

632

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634

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