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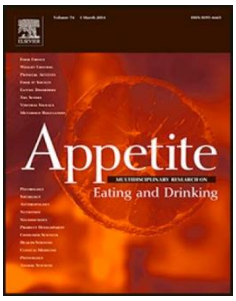
DOI:
10.1016/j.appet.2015.01.015

Accepted Manuscript



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PII: S0195-6663(15)00024-0
DOI: http://dx.doi.org/doi: 10.1016/j.appet.2015.01.015
Reference: APPET 2419

To appear in: *Appetite*

Received date: 17-6-2014
Revised date: 16-1-2015
Accepted date: 19-1-2015

Please cite this article as: Maxine Sharps, Suzanne Higgs, Jackie Blissett, Arie Nouwen, Magdalena Chechlacz, Harriet A Allen, Eric Robinson, Examining evidence for behavioural mimicry of parental eating by adolescent females: an observational study, *Appetite* (2015), http://dx.doi.org/doi: 10.1016/j.appet.2015.01.015.

Examining evidence for behavioural mimicry of parental eating by adolescent females: an observational study

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Funding statement: The current study was funded in part, by the European Foundation for the Study of Diabetes (EFSD)/ Novo Nordisk European Clinical Research Programme in Adolescents with Type 2 Diabetes.

The authors report no conflicts of interest

Word count: 4419

Key words: mimicry; social modelling; social eating

Highlights

- Evidence of mimicry of parental eating behaviour by adolescent females is examined
- Parental consumption was associated with adolescent children eating the same food
- Mimicry of food intake may occur in a shorter timeframe than previously assumed
- Mimicry of food intake may be food item specific

ABSTRACT

Behavioural mimicry is a potential mechanism explaining why adolescents appear to be influenced by their parents' eating behaviour. In the current study we examined whether there is evidence that adolescent females mimic their parents when eating. Videos of thirty-eight parent and female adolescent dyads eating a lunchtime meal together were examined. We tested whether a parent placing a food item into their mouth was associated with an increased likelihood that their adolescent child would place any food item (non-specific mimicry) or the same item (specific mimicry) in their mouth at three different time frames, namely during the same second or within the next fifteen seconds (+15), five seconds (+5) or two second (+2) period. Parents and adolescents' overall food intake was positively correlated, whereby a parent eating a larger amount of food was associated with the adolescent eating a larger meal. Across all of the three time frames adolescents were more likely to place a food item in their mouth if their parent had recently placed that same food item in their mouth (specific food item mimicry), however there was no evidence of non-specific mimicry. This observational study suggests that when eating in a social context there is evidence that adolescent females may mimic their parental eating behaviour, selecting and eating more of a food item if their parent has just started to eat that food.

Social context has been shown to have a strong influence on eating behaviour (Herman, Roth & Polivy., 2003; Goldman et al., 1991). Social modelling research has shown that the eating behaviour of adults and children can be influenced by the amount of food other diners are eating; eating more when others are eating more, and less when they are eating less (Bevelander et al., 2012; Hermans et al., 2009). A variety of potential explanations of these effects have been suggested. For example, modelling may occur because the behaviour of one's peers sets a norm of what constitutes a socially appropriate amount to eat (Herman et al., 2003; Vartanian et al., 2013), or because it acts as an informational cue to guide behaviour (Robinson et al., 2013).

Parents are thought to be one of the most important social influences on child and adolescent eating behaviour (Salvy et al., 2011), influencing health beliefs, behaviours and dietary intake (Oliveria et al., 1992; Lau et al., 1990). Moreover, parental and child food consumption tend to be correlated in terms of the type and amounts of food that both eat (McGowan et al., 2012; Wroten et al., 2012; Sweetman et al., 2011). Likewise, research has shown that children are more likely to try a food if they observe their parent eating that same food (Harper et al., 1975). More recent research has also shown, in an experimental setting, that the presence of a parent shapes the amount and types of food adolescents eat (Salvy et al., 2011). However, the mechanisms underlying the processes by which adolescents adapt their eating to match parental behaviour when eating has received less attention.

One possibility is that adolescents mimic or synchronise to their parents' eating behaviour when dining together. Behavioural mimicry refers to the process whereby a person imitates the behaviour of another person without conscious awareness. This is thought to occur due to a tight neural link between perception and action (Chartrand & Bargh., 1999; Chartrand et al.,

2009), such that observing another person's movements may trigger one's own motor system to perform that same movement (Lakin & Chartrand., 2003; Iacoboni., 2009), e.g. taking a bite of food. Mimicry has been suggested to occur for a number of behaviours (Larsen et al, 2009; Neumann & Strack., 2000; Bernieri., 1988) and more recently the role of behavioural mimicry in social eating contexts has been examined. Hermans et al. (2012) found that when two female adults ate the same meal together, participants were more likely to pick up and eat the food if their eating partner had done so in the proceeding five seconds. Similarly, Bevelander et al. (2013) found that when a young child (aged 6-11) picked up and ate a chocolate-covered peanut, this was associated with an increased likelihood that their eating partner would subsequently pick up and eat that food. Thus, previous studies have only investigated behavioural mimicry in child-only or adult-only groupings (Hermans et al., 2012, Bevelander et al., 2013). Since research supports that adolescents' eating behaviour may be affected by the eating behaviour of a present parent (Salvy et al., 2011), it will be important to understand whether mimicry of eating behaviour may occur between a parent and an adolescent. It may be the case that mimicry of parental eating is a mechanism explaining parental influence on adolescent eating behaviour.

In studies to date examining behavioural mimicry during social eating, participants have only been provided with a single food item to eat (Hermans et al., 2012; Bevelander et al., 2013). From these studies it is, therefore, not possible to infer whether participants were mimicking eating of a specific food type (if you take food x, I then take food x) or whether participants were simply synchronising the rate of their food intake in a more general/non-specific manner. For example, it may be that watching another person pick up a food item triggers an automatic reaction to reach for any food item (non-specific food item mimicry) or only the same food item (specific food item mimicry). Differentiating between these two possibilities

is of importance because it may signal mechanisms that underlie mimicry. If automatic synchrony of gestures is of importance (Hermans et al., 2012; Iacoboni et al., 1999) then we may expect to see evidence for non-specific mimicry, because mimicry of the action of eating is key. Conversely, if mimicry occurs because an eating partner sets a norm about which foods are and are not appropriate to eat (Vartanian et al., 2013; Herman et al., 2003), then only mimicry of congruent food items may be observed. These questions are also of importance because in naturalistic social eating contexts such as family meal times, a variety of food items are likely to be available.

In the present study, we aimed to examine whether there is evidence that female adolescents mimic the eating behaviour of their parents when eating together. In order to assess mimicry, videos of parent-adolescent dyads eating a multi-item lunchtime meal were examined. We examined whether there was evidence of both 'non-specific food item mimicry' and 'specific food item mimicry'. Based on previous studies of eating mimicry (Bevelander et al., 2013; Hermans et al., 2012), it was hypothesised that a parent placing a food item in their mouth would be associated with an increased likelihood that their female adolescent child would also place a food item in their mouth. However, we reasoned that if evidence of mimicry was observed, it may only be food item specific, as parental behaviour during a meal may primarily signal which foods are appropriate to eat and when.

METHOD

Background

The videos analyzed were of adolescents and parents eating a multi-item lunchtime meal together, which were recorded as part of a test day for a larger study examining brain

activations and responsiveness to food cues. In the larger study, participants arrived at the laboratory on the morning of their test day where they underwent an MRI scanning session, which was followed by a multi-item lunch. Participants were aware that their lunch time meal would be video-recorded. However, participants were not explicitly told that their food intake would be measured or that mimicry would be later examined. Three groups of participants were recruited as part of the larger study: adolescents with type 2 diabetes, overweight and obese adolescents (without type 2 diabetes), and healthy weight adolescents (without type 2 diabetes). See supplemental material for more detailed information about the selection criteria for the larger study.

Participants

From the original data collected, we were unable to use ten videos due to equipment failure or error. A further video was excluded because the participant did not eat anything. In addition, we opted to focus on female adolescents only, due to the consistency of which social influence effects have been replicated amongst females (Hermans et al., 2012; Pliner and Mann., 2004; Roth et al., 2001), and there being only a small number of videos of adolescent males available. Therefore, nine videos of adolescent males were not coded or analyzed. Thus, the total sample for the present research consisted of 38 dyads containing female adolescents eating with a parent. See Table 1 for sample ethnicity and socio-economic status. There were 33 female parents and 5 male parents. The adolescents were aged 12.0 – 18.8 years, with a mean age of 15.4 years, SD = 1.9. Adolescent weight categories were classified according to the defined International Obesity Task Force age specific cut offs (Cole et al, 2000, Cole et al, 2007). Eleven of the adolescents were classed as being in the healthy weight range (BMI 18.5-24.9), fourteen were classed as overweight and obese (BMI $\geq$ 25) and thirteen had type 2 diabetes (BMI = 17.3-57.1). For the total sample mean

adolescent BMI = 30.6, SD = 9.7, and mean parental BMI = 30.1, SD = 5.8. See Table 2 for adolescent and parental BMI information for the healthy weight, overweight and obese, and diabetic groups separately.

For our planned analyses we did not have any hypotheses relating to whether the weight or diabetes status of adolescent participants would moderate or influence any tendency to mimic parental eating. This is because social influence on food intake has been shown to be a relatively consistent effect and has been observed to a similar degree in both healthy weight and overweight individuals (Conger et al., 1980, Herman et al., 2003, Robinson et al., 2014). We did, however, check if this was the case by conducting our planned analyses (see later section) and by including adolescent group (healthy weight, overweight and obese, diabetic) as an additional factor. There was no evidence that adolescent group significantly moderated any mimicry effects ($p > 0.05$). Thus, as the number of adolescents in each group was relatively small and we did not have strong a-priori hypotheses, the results we report throughout are for all adolescent participants combined.

Lunch time meal

All sessions took place in an eating laboratory at the University of Birmingham. The room was furnished with a table and two chairs. Adolescents and parents were served a standardized multi-item meal each on separate trays. Each lunch item was on a separate plate and the meal consisted of a cheese sandwich (369 kcals), an individual Chicago Town cheese pizza (453 kcal), a small bowl of cherry tomatoes (18kcal), an Activia strawberry yoghurt (123 kcal), an apple (45kcal), a Satsuma (18kcal), 25g Walkers ready salted crisps (131 kcal), and two Maryland double chocolate cookies (112kcal). A jug of water and two glasses

were also provided. They were asked not to share food from each other's trays and told that they were not expected to eat all the food, but to eat until they were full.

ANALYSIS

Strategy of analysis for overall food consumption

Our first aim was to test whether there was evidence that parent and adolescent overall food intake was related. We did this by correlating the total amount of food adolescents ate (in kcals) with the amount of food their parent ate (kcals) using a Spearman's correlation.

Coding of video data

To test if adolescents mimicked the eating behaviours of their parents, we coded the video data by recording every time an adult or adolescent placed a food item into their mouth, the name of that food item (e.g. pizza), and the time that the food entered the mouth. All occurrences of eating were recorded by the first author. A random sample constituting 10% of these codings were checked independently by one of the other authors and there were no disagreements. The first author then coded each time an adolescent placed food into their mouth during the sensitive and non-sensitive time periods of the meal (see next section '*Defining sensitive and non-sensitive periods*'). All of this coding was then cross-checked by an independent research assistant blind to the study hypotheses. Only a small number of discrepancies were noted (7 instances of mimicry were coded incorrectly, which constituted less than 1% of total coding), and these were resolved after discussion between the research assistant and lead author.

Defining sensitive and non-sensitive periods

Previous studies have examined if participants are more likely to eat a food item in the 5 or 15 seconds after a dining partner has placed food in their mouth (known as a 'sensitive period'), compared to the other periods of the meal when a partner has not recently placed food into their mouth (known as a 'non-sensitive period') (Hermans et al., 2012; Bevelander et al., 2013; Larsen et al., 2010). In the present study we examined three sensitive timeframe cut off points (+2, +5, +15 seconds), because we reasoned that mimicry may also occur in a shorter time frame (i.e. within + 2 seconds of a person eating) than previous studies have tested, as mimicry has been suggested to be automatic (Iacoboni et al., 1999). The three timeframe cut off points (+2, +5, +15) were treated as *separate* timeframes. Each meal was split into sensitive (the times during the meal in which a parent had recently placed food into their mouth) and non-sensitive time periods (all other times during the meal; i.e., the times during the meal in which a parent had not recently placed food in their mouth) for each of the three *separate* time frames (+2, +5, +15). This approach allowed us to test whether the rate at which adolescents placed food into their mouth differed between *sensitive* vs. *non-sensitive* periods for the three time frames individually. (See [1] for a detailed example). We presumed that if adolescents ate at a quicker rate during sensitive vs. non-sensitive periods, this would constitute evidence of mimicry. We calculated the rate of placing food into the mouth (defined as a consumption ratio, see next section) as opposed to the number of times food was placed in the mouth. We did this to account for differences in total sensitive vs. non-sensitive time during each meal.

Strategy of analysis for mimicry

As noted, we coded how frequently adolescents placed food items into their mouth during the sensitive periods (times when the parent **had** recently placed food in their mouth) and during the non-sensitive periods (times when the parent **had not** recently placed food in their mouth)

of the lunchtime meal, for the three time frames separately. We then quantified this formally by computing 'consumption ratios'; the number of times a food item was placed into an adolescents' mouth per second[2]. Following this, we compared the consumption ratio observed for the sensitive periods vs. non-sensitive periods of the meal using a Wilcoxon signed ranks test[3] for the three different time frames individually (+2, +5, +15). We adjusted the analyses using a Bonferroni correction to account for multiple comparisons. This allowed us to compare the consumption ratios (the number of times a food item was placed into an adolescents' mouth per second) for the periods of the meal in which a parent had recently placed into their mouth vs. periods of the meal in which the parent had not recently placed food into their mouth. Importantly, we computed these consumption ratios for both *non-specific* food item mimicry and *specific food* item mimicry.

Non-specific food item mimicry

In order to compute consumption ratios for **non-specific** food item mimicry, we used the aforementioned analysis strategy and examined the rate at which adolescents placed **any** food item into their mouth during the sensitive periods vs. the rate at which adolescents placed **any** food into their mouth during the non-sensitive periods. This analysis allowed us to examine whether adolescents more frequently placed **any** food item in their mouth in periods when their parent had recently placed **any** food item in their mouth, as opposed to periods of the meal when a parent had not recently placed **any** food in their mouth.

Specific food item mimicry

In order to compute consumption ratios for **specific** food item mimicry here we examined the rate at which adolescents placed the **same** food item into their mouth which their parent had placed in their mouth in the proceeding 2, 5, or 15 seconds (sensitive period) vs. times when

the parent **had not** placed a food item into their mouth in the proceeding 2, 5, or 15 seconds (non-sensitive periods). This analysis allowed us to examine whether adolescents more frequently placed a food item in their mouth in the periods of the meal in which their parent had recently placed the **same** food item in their mouth, as opposed to all other time periods of the meal.

Thus, we were able to examine whether there was evidence of *specific* food item and *non-specific* food item mimicry using *+2, +5 and +15* time frames individually.

RESULTS

Total food intake

Parents ate a mean of 816.1 (±204.8) calories during the lunchtime meal, and adolescents ate a mean of 697.6 (±238.3) calories during the meal. A Spearman's correlation showed that the amount eaten by the parents and children was significantly correlated [r (38) = .49, $p < .001$], whereby a parent eating a larger number of calories was associated with their adolescent child also eating a larger number of calories.

Meal length and frequency of food being placed into the mouth

Mean meal length was 18 minutes and 13 seconds (SD = 6.37). The mean number of times that parents placed any food item into their mouth was 59.50 (SD = 19.07). The mean number of times that adolescents placed any food item into their mouth was 77.84 (SD = 24.19). On average, parents placed food into their mouth every 19.88 seconds (SD = 8.98), which constitutes a mean consumption ratio = 0.06 bites per second during the meal. Adolescents placed food into their mouth every 14.53 seconds (SD = 4.93) on average, which constitutes a mean consumption ratio = 0.08 bites per second during the meal.

Non-specific mimicry

There was little evidence of non-specific food item mimicry during the meal. The consumption ratios for each of the three sensitive time periods were not significantly higher than the consumption ratios observed during the equivalent non-sensitive periods; +2 (z =-.17, p =.26, r=-.03) +5 (z=-1.47, p=.42, r=-.24), and +15 (z= -2.27, p =.06, r=-.37). (See Table 3 for consumption ratio values). This indicates that the rate at which adolescents placed any food into their mouth (the consumption ratios) was similar during the periods of the meal in which their parent had recently placed any food into their mouth (sensitive periods) and all other periods of the meal in which their parent had not recently placed any food into their mouth (non-sensitive periods). This effect was regardless of whether 'sensitive' was defined as being within +2, +5 or +15 seconds after a parent had placed food into their mouth. Thus, it was not the case that adolescents were significantly more likely to place any food item into their mouth if their parent had recently placed a food item into their mouth.

Specific mimicry

For specific food items, there was evidence of mimicry for the +2 (z = -3.42, p <. 001, r=-.55), +5 (z= -3.90, p <.001, r=-.63), and +15 (z= -3.73, p <. 001, r=-.60) second timeframes; consumption ratios during these sensitive time periods were higher than the consumption ratios observed during the equivalent non-sensitive periods. (See Table 3 for consumption ratio values). This indicates that the rate at which adolescents placed a food into their mouth was greater in the periods of the meal in which their parent had recently eaten that same food item (sensitive periods) compared to the other remaining periods of the meal in which their parent had not recently eaten that same food item (non-sensitive periods). This effect was regardless of whether 'sensitive' was defined as being within +2, +5 or +15 seconds after a

parent had placed food into their mouth. Thus, there was evidence that adolescents were significantly more likely to place a food item in their mouth if their parent had recently placed that same food item into their mouth.

DISCUSSION

The present study examined whether there is evidence that female adolescents may mimic their parents when eating together during a lunchtime meal. In line with previous work (Story et al., 2002), there was evidence of a positive correlation between parent and adolescent food consumption; adolescents consumed more calories during their lunch when their parent consumed more calories. We also examined if behavioural mimicry may underlie the influence that parents can have on their adolescents' eating behaviour. Results indicated that a parent placing a food item into their mouth was associated with an increased likelihood that their adolescent child would subsequently pick up and eat the *same* food item during the following two, five and fifteen second periods. However, we did not find evidence that a parent placing a food item into their mouth was associated with an increased likelihood of their child placing *any* food item into their mouth in these time periods. Thus, adolescents appeared to mimic eating of specific food items only.

As in previous eating behaviour studies in adults and children (Hermans et al., 2012; Bevelander et al., 2013), this observational data appears to support behavioural mimicry of eating. However, the current study expands on these studies because we found evidence of behavioural mimicry in a different dyad than has previously been examined (adolescents and parents). We were also able to test whether adolescents mimicked the *specific* type of foods their parents were eating, or whether this process of mimicry was not food item specific, i.e.

whether the parent placing a food into their mouth would simply increase the likelihood that the adolescent would place any food in their mouth. The findings of the present study suggest that adolescents were not simply synchronising their gestures or eating speed to match their parents (due to a lack of evidence for non-specific mimicry), which has been suggested as a potential explanation for social influence on eating (Hermans et al., 2012). Instead, adolescents may have been using their parents as a reference point about which food items to eat and when, which could be interpreted through either a normative or informational account of social influence on eating (Robinson et al., 2013; Herman et al., 2003). Further studies will, however, need to address this proposition more directly. The main novel finding of the present work was that we found evidence of specific food item mimicry during a shorter time frame (during the same or subsequent two seconds after a parent had placed food into their mouth), and within a different relationship than has been previously tested (Hermans et al., 2012; Bevelander, 2013). This finding suggests that there may be evidence for mimicry of eating behaviour in a shorter time frame than has been previously assumed.

One possible reason why we did not find evidence for non-specific mimicry (i.e. a parent placing food into their mouth was not associated with an increased likelihood that the adolescent subsequently placed *any* food into their mouth) is that the rate of adolescent eating was relatively high during the meal. It could be argued that a high eating rate across all periods of the meal would make it difficult to observe differences between periods of the meal in which a parent had vs. had not recently eaten. This might be the result of a form of ceiling effect. Thus, further research examining food-item specific vs. non-food item specific mimicry in other meal settings which promote a slower pace of eating would be valuable. It is also possible that the influence parents appeared to have on adolescent eating may be, in part, explained by a form of visual attentional bias (Laibson, 2001; Wardle, 2007; Hardman et al.,

2014), such that adolescents visually followed parental gaze or hand movement to food choices, and parents visually attending to a specific food increased the likelihood that the adolescent then followed that cue and ate the same food.

A strength of the present study was that we examined parent-adolescent child dyads eating in a semi-naturalistic environment, rather than examining behavioural mimicry when a member of the dyad (i.e., the confederate) has been instructed on how much to eat (Hermans et al., 2012; Bevelander et al., 2013). Moreover, we examined mimicry during a multi-item lunch time meal which allowed us to examine the extent to which adolescents mimicked specific food choices. It is not clear whether this finding of specific mimicry is unique to this dyad or whether it may occur in other relationships, therefore, further research is needed. Due to the cross-sectional nature of the present study one possibility that we cannot rule out is that some of the specific mimicry we observed may have been explained by the adolescents and parents already sharing similar meal/food item order preferences. Thus, further work could build on the findings reported here by examining the effect of experimentally manipulating a parent's behaviour during a meal on the extent to which their adolescent child mimics this behaviour. One limitation that could also be addressed in further work is to investigate evidence of mimicry between adolescent males and their parents. Here our sample was female. However, recently Bevelander et al., (2013) found that both male and female children (6-11 years old) were more likely to eat after witnessing a peer reaching for snack food than without such a cue. Therefore, it is possible that adolescent males may model the eating behaviour of their parents, and that mimicry may underlie this modelling. In addition, the current study focussed on adolescents' mimicry of parental eating. However, a previous study found mimicry among both eating companions (Hermans et al, 2012). Therefore, it may be of interest to investigate whether mimicry of eating is a bi-directional process within this dyad. Finally, we did not

examine whether state (e.g., hunger) or trait (e.g., the quality of the relationship between the parent and adolescent) factors may have moderated the likelihood of mimicry. Further work designed to specifically explore the factors which may make mimicry more or less likely would, therefore, be valuable.

Conclusions

This observational study suggests that when eating in a social context, there is evidence that adolescent females may mimic their parental eating behaviour, selecting and eating more of a food item if their parent has just started to eat that food.

Notes

[1] Taking the +2 time frame as an example, the 'sensitive periods' of the meal were all seconds of the meal which occurred within the same or next 2 seconds after a parent had placed food into their mouth. The 'non-sensitive' periods of the meal were all other seconds during the meal. Likewise, for the +5 time frame, the 'sensitive periods' of the meal were all seconds of the meal which occurred within the same or next 5 seconds after a parent had placed food into their mouth. The 'non-sensitive' periods of the meal were all other seconds during the meal. Thus, for each participant the meal was split into 'sensitive' and 'non sensitive' time using three different sensitive period cut-off points (+2, +5, +15 seconds).

[2] Consumption ratios were calculated by counting the number of times that the adolescent placed food into their mouth within a period and dividing this by the total amount of seconds in that period.

[3] In the Wilcoxon signed ranks test the sensitive periods were deducted from the non-sensitive periods. The negative ranks indicate the sensitive periods while the positive ranks indicate the non-sensitive periods. No ties were observed in the analysis.

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Table 1. Demographic information of sample

Demographics		Parent n = 38	Adolescent n = 38
Ethnicity	White	50%	55.3%
	Asian	39.5%	36.8%
	Black	5.3%	2.6%
	Chinese	2.6%	2.6%
	Other/ Mixed	2.6%	2.6%
Income*	<£15,000	41.7%	n/a
	£15,000-60,000	44.4%	n/a
	>£60,000	13.9%	n/a
Education level	Secondary school	21.10%	n/a
	GCSE	28.90%	n/a
	A-level/ College	26.30%	n/a
	University Graduate	7.90%	n/a
	Post-graduate	15.80%	n/a

***n=36 for income, information not available for 2 parents.

502 **Table 2.** Mean BMI (SD) for healthy weight, overweight and obese, and diabetic adolescent
503 groups
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	Healthy weight adolescents (n=11)	Overweight and obese Adolescents (n=14)	Type 2 diabetic adolescents (n=13)
Adolescent BMI	21.8 (1.7)	33.3 (6.9)	34.7 (11.6)
Parental BMI	26.1 (4.7)	32.1 (5.0)	31.3 (6.0)

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Table 3. Consumption ratios for food item specific and non-food item specific mimicry during sensitive and non-sensitive periods (n=38)

	Food item specific mimicry		Non-food item specific mimicry	
	Sensitive	Non-sensitive	Sensitive	Non-sensitive
		+2 seconds		
Mean (SD)	0.022 (0.018)	0.016 (0.027)	0.078 (0.031)	0.080 (0.038)
Median	0.018*	0.011	0.070	0.070
		+5 seconds		
Mean (SD)	0.021 (0.017)	0.012 (0.006)	0.076 (0.029)	0.085 (0.048)
Median	0.018*	0.010	0.068	0.074
		+15 seconds		
Mean (SD)	0.021 (0.018)	0.011 (0.006)	0.075 (0.027)	0.109 (0.107)
Median	0.015*	0.009	0.069	0.071

Consumption ratios indicate the number of times per second adolescents placed a food item into their mouth within sensitive and non-sensitive periods. A higher ratio indicates a greater rate of placing food items into the mouth.
*indicates a significant difference between the sensitive and non-sensitive consumption ratios at $p < 0.01$.