Side effects of television food commercials on concurrent nonadvertised sweet snack food intakes in young children[1–3]

Doeschka J Anschutz, Rutger CME Engels, and Tatjana Van Strien

ABSTRACT

Background: Exposure to food commercials is assumed to be related to children's food preferences and snack food intake patterns. However, surprisingly few studies tested whether watching food commercials actually leads to elevated snack food intake.

Objective: We experimentally tested the side effects of television food commercials on concurrent nonadvertised sweet snack food intake in young children aged 8–12 y.

Design: The children ($n = 120$) watched a movie interrupted by 2 commercial breaks that contained either food commercials or neutral commercials. While watching, the children could freely eat palatable food. Afterward, they filled out questionnaires and were weighed and measured.

Results: The main finding of our study was the interaction between commercial type and sex of the child. Food intake in boys was higher when they watched the food commercials than when they watched the neutral commercials, whereas food intake in girls was slightly lower when they watched the food commercials than when they watched the neutral commercials.

Conclusion: The results suggest that boys are susceptible to food cues in commercials. *Am J Clin Nutr* 2009;89:1328–33.

INTRODUCTION

Increasing effort is needed to investigate the causes of childhood obesity (1). Television is often considered to be an important factor in the development of palatable food consumption patterns in young children (2–5). The aim of this study was to experimentally test the direct effects of exposure to food commercials on nonadvertised sweet snack food intake in children while watching television. Content analyses have shown that the most frequently advertised product category children are exposed to when watching television is highly energy-dense food (3). Young children are especially vulnerable to being influenced by the media. They learn through observing others and by imitating the behavior of an appealing model when they expect a positive outcome from the behavior (6). Thus, children might learn to associate the food portrayed in the commercials with positive, likeable features and adopt the behavior they see in commercials. Although the aim of advertising is to make children want the particular product promoted, several unintended effects can occur (7, 8). In the current study, we were particularly interested in whether children directly eat more snack food offered at that moment, regardless of the brand promoted. This could indicate that when children are exposed to food commercials anywhere, they are encouraged to eat any snack food available. Children in Western countries spend a considerable amount of time watching television and are therefore automatically exposed to a large number of food commercials. If exposure to food commercials indeed influences their direct food intake, this (unintended) influence may account for a substantial proportion of the snack food intake in children. In the present study we focused on the intake of sweet and high-fat snack foods, which are known to be highly rewarding (9, 10), especially in young children (11). In addition, when not compensated for, a high intake of sweet and high-fat snack foods might be related to weight gain (12).

A few studies found that exposure to food commercials was related to greater recognition and more favorable evaluations of the advertised product (13, 14) and an increased preference for palatable food in children (15–17). Data from a diary study showed that higher levels of exposure to food advertising were related to higher levels of consumption of the branded food (18). Gorn and Goldberg (19) found that children who were exposed daily to candy commercials more often chose candy over fruit as an afternoon snack. Furthermore, Halford et al (20–22) found that children ate more test food after exposure to food commercials than after exposure to nonfood commercials.

The results of previous studies suggest that food commercials might affect children's attitudes as well as their food intakes. However, Buijzen et al (18) assessed the parents' report on the child's television watching behavior (time and network), but it remains possible that the children did not actually watch the commercials. In addition, investigating food intake while watching television might serve as a better indicator of the direct effect commercials have than offering food choices (19) or assessing food intake after exposure to commercials (20–22). People often eat in front of the television (23). When they associate a specific activity with a specific behavior, it may become habitual and automatic (24). Surprisingly, previous studies have not tested

[1] From the Behavioural Science Institute (DJA, RCMEE, and TVS) and the Institute for Gender Studies (TVS), Radboud University, Nijmegen, Netherlands.

[2] Supported by a grant from the Behavioural Science Institute, Radboud University, Nijmegen, Netherlands.

[3] Reprints not available. Address correspondence to DJ Anschutz, Behavioural Science Institute, Radboud University, PO Box 9104, 6500 HE Nijmegen, Netherlands. E-mail: d.anschutz@bsi.ru.nl.

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whether children actually eat more in front of the television as a result of being exposed to food commercials. In the present study, we were also interested in sex and age differences, because the effects of exposure to environmental food cues might vary between personal factors, such as the child's sex and age (25).

SUBJECTS AND METHODS

The sample consisted of 120 children (grades 3–6) from 3 primary schools in the eastern part of the Netherlands, 46.7% of whom were boys. The mean (±SD) age of the children in grade 3 ($n = 28$) was 8.43 ± 0.57 y, in grade 4 ($n = 28$) was 9.32 ± 0.61 y, in grade 5 ($n = 31$) was 10.39 ± 0.56 y, and in grade 6 ($n = 24$) was 11.29 ± 0.69 y. Grade information for a few children ($n = 9$) was missing, because these children did not provide this information on the questionnaire. In our sample, 5.9% of the children were underweight, 79% had a normal weight, 10.9% were overweight, and 4.2% were obese (*see* BMI classifications below). The percentage of overweight and obese children in our study (15.1%) was highly comparable with the current percentage of overweight and obese children in the Netherlands (13.7%; 26). No differences were found in BMI category distribution between the age and sex groups. The children were randomly assigned over conditions to create groups that can be assumed equal on factors that we did not measure in the current experiment but that can be related to food intake, ie, physical activity (27).

Procedures

The ethical committee of the Faculty of Social Sciences, Radboud University, approved of the present study. Data collection took place between November 2007 and February 2008. After we obtained consent from the school to participate, the parents of the children received a letter with detailed information about the study and were asked to indicate whether they would allow their children to participate or not (active informed consent). It was emphasized that all data collected would remain confidential. After we obtained written parental consent, the children were individually tested at their school during regular school hours. About 80% of the children whose parents were approached were allowed to participate. Children who were allergic to the test food did not participate. It is unknown exactly how many children were allergic to the test food, because the parents were informed about the test food in the study information letter and it was pointed out that children who were allergic to any contents of the test food could not participate. Therefore, it is likely that parents of allergic children did not give permission for their children to participate. Two children that were given permission to participate brought a permission letter that explicitly stated that they were allergic to peanuts.

A seminaturalistic setting was created at each school, which was designed to look like a living room. A comfortable chair was present in which the child could sit while watching television. In front of the chair was a small side table with a plant, a glass of water, and a preweighed bowl containing chocolate-coated peanuts (peanut M&Ms; Mars, Inc, McLean, VA). The experimenter told the child that he or she was about to view a movie about penguins, which would last ≈20 min, and could eat whatever he or she liked from the available snack food. Then, the child was left alone for 20 min. After each session, the bowl with chocolate-coated peanuts was weighed to assess how much the child had eaten. Each session was recorded with a video camera, and the experimenter observed each session on a wireless screen out of sight of the child to guarantee the safety of the child during the experiment.

All participants watched a movie clip from *The March of the Penguins*. This movie was chosen because it was considered to be neutral in emotional content. All possible "emotionally arousing" fragments were removed (eg, scenes of penguins dying on their journey or of them losing an egg) while keeping the story line intact. In general, the clip showed the journey the penguins made from the ocean to an assembly point (0–08.38 min, including a commercial break). At the assembly point, an egg was being laid and transported from the mother to the father penguin (8.38–10.59 min). The mother returned to the ocean while the fathers brooded the eggs in a group under harsh weather conditions (10.59–14.15 min, including a commercial break). When the penguins were born, the mothers returned and the fathers left (14.15–16.36 min). The early behavior of the small penguins was shown in the final clip, eg, when they first walked away from their mother or had contact with other small penguins (16.36–20 min).

After 5 and 12 min, the movie was interrupted by a short commercial break. During the food commercial condition, the commercial breaks each contained 3 food commercials mixed with 2 neutral commercials (eg, promotion of toys or video games). During the neutral commercial condition, the commercial breaks each consisted solely of 5 neutral commercials. The 6 food commercials used advertised Verkade cookies, McDonalds, Haribo candy, Dr. Oetker muffins, Kentucky Fried Chicken, and a Dr. Oetker dessert. We want to stress that we did not use branded snack food to measure food intake during the movie, because we were not interested in specific brand effects, but rather in the general effect of commercials for palatable foods on (available) snack food intake. This effect would represent the unintended side effects of food commercials on immediate snack food intake in children while watching television. All commercials were contemporary television commercials aimed at children. (*See* Appendix 1 under "Supplemental data" in the online issue for detailed information about all of the commercials used.)

After watching the movie, the children filled out several questionnaires. All children filled out the questionnaire themselves while an experimenter was present to answer queries. When they were finished, the experimenters measured the heights and weights of the children. The children were then accompanied back to their class, where the experimenter invited the next child to participate. All children were asked not to talk about the experiment with their classmates. The schools were informed about the results of the study after the data collection and analyses were finished.

Measures

Because food intake can also be affected by the state of hunger, we controlled for individual differences in hunger by presenting the children a visual analog scale (VAS; 14 cm) to measure the extent to which they felt satisfied or hungry before the experiment began. We did not ask the children to refrain from eating for a certain amount of time before the experiment to avoid characteristics that would influence their food intake (28–30) and to

mimic the daily routine as much as possible. VASs are widely used and have proven to be very reliable and valid as rating scales for measuring subjective experiences related to appetite, mood, and pain (31–33). Previously, VASs were used in samples with young children (34, 35) and were found to be as reliable as Likert scales in children aged ≥6 y (36).

Liking of test food

Because individual differences in test food preference might influence food intake, we controlled for the liking of chocolate-coated peanuts by presenting the children with a 14-cm VAS to measure the extent to which they liked the test food.

Liking of the movie

Children were presented with a 14-cm VAS to measure the extent to which they liked the movie, ranging from "I disliked the movie very much" to "I liked the movie very much."

Liking of the commercials

To measure the extent to which the children liked the commercials, they were presented with a 14-cm VAS, ranging from "I disliked the commercials very much" to "I liked the commercials very much."

Commercial recall

We asked the children to write down as many ads as they could remember. The number of correctly remembered ads was summed to get a commercial recall score for each child (≈28). Recall of a commercial was defined as being accurate when the right brand as well as the right product promoted in the commercial was mentioned by the child.

Body mass index

BMI, measured as weight (kg)/height^2 (m), was calculated based on measured height and weight. Weight was measured to the nearest of 0.1 kg while the children were wearing light clothing and no shoes. Height was also measured according to standard procedures (no shoes), to the nearest of 0.5 cm. We determined whether the children were underweight, normal weight, overweight, or obese using international cutoff scores (37).

Food intake

While watching the movie, the children could eat freely from a preweighed bowl containing chocolate-coated peanuts. We chose to provide only one snack food—peanut M&Ms—because we assumed that children generally eat one kind of snack food at a time at home and are not presented with several snack foods while they are watching television. In addition, we did not want the children to focus too much on the food in the setting. We learned from previous studies that peanut M&Ms are a preferred snack food during television viewing (28). Furthermore, as mentioned before, sweet and high-fat snacks are known to be highly rewarding (9, 10), especially in young children (11). The amount of snack food eaten during the experiment was measured to the nearest 0.1 g by using a professional balance (Kern 440; Kern & Sohn, Balingen, Germany), and the total amount of snack food eaten (in g) was our dependent measure.

Analytic strategy

First, using one-factor analyses of variance, we checked whether there were any differences in hunger, liking of test foods, BMI, age, and sex distribution between the food commercial and neutral commercial conditions. Furthermore, differences between both conditions on liking of the movie, liking of the commercials, and commercial recall were tested. Additionally, the effects of the commercials could only be attributed to the commercials if the differences in food intake started during or after the first commercial break. Because we randomly assigned the children to the different conditions, we assumed that the food intake before the first commercial break was equal in both groups. However, to get an idea of what the children ate before the first commercial break, we coded every bite of peanut M&Ms they took before the first commercial break. This measure was not completely reliable, because several children ate more than one peanut M&M in a bite, which was very hard to establish with our video system. As a result, this measure was only a rough indication of how much the children ate. Therefore, we decided not to use this measure in our primary analyses, but rather to use it as a rough check of differences in precommercial intake. Second, to test the effects of commercial type on food intake, we performed analyses of variance. If significantly correlated with food intake, hunger, liking of test food, and BMI were entered into the model as covariates. Although adding covariates can decrease power because more parameters have to be estimated, adding powerful predictors of the dependent variable (when uncorrelated with the independent variables one is interested in) can cause a relatively larger reduction in the error of the model, which increases statistical power (27). Therefore, we decided to add possible control variables that correlated significantly with food intake. Furthermore, the main and interaction effects of commercial condition and the moderators we were interested in (sex and age) on food intake during television viewing were tested by using analyses of covariance.

RESULTS

Manipulation checks

First, we checked whether there were differences between the conditions regarding sex, age, BMI, hunger, liking of test food, liking of the movie, liking of the commercials, and commercial recall of the children. The means and SDs for all variables, separately for condition and sex, are shown in **Table 1**. No differences between the food commercial and neutral commercial condition on sex, age, BMI, hunger, and liking of test food were found, which indicated that randomization was successful. Children exposed to the food commercial and neutral commercial conditions equally liked the movie and the commercials. However, when the children watched the food commercials, they recalled significantly more commercials than when they watched the neutral commercials [$F(1, 119) = 6.768$, $P < 0.01$, Cohen's $d = 0.47$]. No differences were found between conditions on the number of peanut M&Ms the children ate before the first commercial break, which indicated that the observed effects were likely attributable to the commercials.

TABLE 1
Variables measured, by condition and sex[1]

	Food commercial condition ($n = 63$)			Neutral commercial condition ($n = 57$)			
	Boys ($n = 28$)	Girls ($n = 35$)	Total ($n = 63$)	Boys ($n = 28$)	Girls ($n = 29$)	Total ($n = 57$)	P value[2]
Age (y)	9.9 ± 1.3	9.8 ± 1.2	9.8 ± 1.2	10.1 ± 1.3	9.6 ± 1.2	9.8 ± 1.2	0.879
BMI, corrected (kg/m^2)	2.1 ± 0.7	2.3 ± 0.7	2.2 ± 0.7	2.1 ± 0.5	2.0 ± 0.3	2.1 ± 0.4	0.131
Hunger (cm on VAS)	4.9 ± 3.3	3.9 ± 3.1	4.3 ± 3.2	5.1 ± 3.6	4.4 ± 3.4	4.8 ± 3.5	0.483
Liking of test food (cm on VAS)	8.6 ± 4.3	7.4 ± 4.6	7.9 ± 4.5	9.2 ± 4.6	7.6 ± 5.1	8.4 ± 4.9	0.601
Liking of movie (cm on VAS)	11.6 ± 2.9	9.8 ± 3.7	10.6 ± 3.4	11.1 ± 3.9	10.8 ± 2.8	10.9 ± 3.3	0.623
Liking of commercials (cm on VAS)	3.8 ± 2.7	4.0 ± 3.6	3.9 ± 3.2	3.1 ± 3.1	4.7 ± 3.0	3.9 ± 3.1	0.984
Commercial recall (n)	2.1 ± 1.1	2.2 ± 1.1	2.2 ± 1.1	1.7 ± 1.1	1.6 ± 1.2	1.7 ± 1.1	0.010
Food intake (g)	53.8 ± 57.0	14.6 ± 19.3	32.6 ± 45.2	38.1 ± 49.1	23.9 ± 30.0	31.0 ± 40.9	0.841
Food intake, adjusted (g)[3]	51.8 ± 6.7	19.1 ± 6.3	—	32.9 ± 6.8	26.4 ± 6.7	—	0.050[4]

[1] All values are means ± SDs. VAS, visual analog scale.
[2] Reflects the differences between total means between the food commercial and neutral commercial conditions by one-factor ANOVA.
[3] Adjusted for hunger and liking of the test food.
[4] Reflects the interaction between condition and sex, by ANCOVA, after adjustment for hunger and liking of the test food.

Food intake

Pearson's correlations between the model variables are shown in **Table 2**. Hunger and liking of test food were related to food intake, so these variables were included as control variables (covariates) in all analyses. Because BMI and age were not significantly related to food intake, we did not include them as covariates.

In the first analysis of covariance, we tested the moderating effect of sex on the relation between commercial condition and food intake. The results showed that both hunger [$F(1, 115) = 5.765$, $P < 0.020$] and liking of test food [$F(1, 115) = 26.488$, $P < 0.001$] had a main effect on the food intake of the children. The more the children reported to be deprived and the higher their test food preference, the more of the test food they ate. There was no main effect of commercial condition on food intake [$F(1, 115) = 0.640$, $P = 0.385$]. However, a significant main effect was found for sex [$F(1, 115) = 8.871$, $P < 0.004$]. Furthermore, the interaction between condition and sex was significant [$F(1, 115) = 3.925$, $P = 0.050$]. In this analysis, 35.2% of the variance in food intake was explained by the model. Closer inspection of the interaction effect showed that whereas the snack food intake of the boys was higher during the food commercial condition than during the neutral commercial condition, the snack food intake of the girls was slightly lower during the food commercial condition than during the neutral commercial condition. To check whether school had an influence on food intake and whether there was an interaction between commercial condition and sex on food intake, we included school as a random factor in our model. However, school had no effect on food intake [$F(2, 108) = 0.040$, $P = 0.961$] or on the interaction between condition and sex on food intake [$F(1, 108) = 3.863$, $P = 0.052$]. Therefore, we decided to remove school from our final analysis to avoid including too many control variables in our model and reducing statistical power.

The results of the analysis that tested age as a moderator (with control for hunger and liking of test food) showed that commercial condition [$F(1, 115) = 0.363$, $P = 0.548$] and age [$F(1, 115) = 0.002$, $P = 0.967$] had no significant main effects on food intake, and no interaction was found between commercial condition and age on food intake [$F(1, 115) = 1.303$, $P = 0.256$]. In this analysis, 28.5% of the variance in food intake was explained by the model. Finally, whether children liked the commercials or not did not mediate the relation between condition and food intake.

TABLE 2
Pearson's correlations between the model variables ($n = 120$)

	Sex	Age	BMI	Hunger	Liking of the test food
Sex					
Age	−0.11				
BMI	0.05	−0.10			
Hunger	−0.13	0.02	−0.05		
Liking of the test food	−0.15	0.13	−0.14	0.19[1]	
Food intake (g)	−0.32[2]	0.01	0.02	0.48[2]	0.30[2]

[1] $P < 0.05$.
[2] $P < 0.001$.

DISCUSSION

The aim of the present study was to test the side effects of television food commercials on concurrent nonadvertised sweet snack food intake in children while watching television. The main finding was that sex moderated the relation between commercial exposure and food intake. Snack food intake by boys was higher when they watched the food commercials than when they watched the neutral commercials, whereas snack food intake by girls was slightly lower when they watched the food commercials than when they watched the neutral commercials.

A possible explanation for this finding was that boys may have a higher tendency to eat in response to food stimuli than do girls (38, 39). This may also extend to exposure to food stimuli on the television screen, because boys were more vulnerable to exposure to external cues in food commercials (eg, the sight of food) and therefore ate more when they are exposed to these kinds of commercials than when exposed to neutral commercials. Apart from external eating, boys are often found to have less self-control than do girls (40), and low self-control has been found to be related to a higher intake of saturated fat (41). It is essential that future research includes measures of external eating and self-control to examine whether these constructs underlie the sex difference we found in the relation between exposure to food commercials and food intake in preadolescent children.

Another explanation for the sex differences we found was that girls were more likely to inhibit the tendency to eat in response to food cues. Previous research showed that even very young girls experience more sociocultural pressure, eating disturbances, and/or body dissatisfaction than do their male peers (42, 43). Thus, boys may actually have shown a normal response to food commercials, whereas girls may have suppressed their natural response to the food commercials and therefore did not eat more when they viewed these commercials than when they viewed the neutral commercials. It would be interesting to include measures of restrained eating or perceived pressure to be thin in future studies to test this assumption. Furthermore, a ''healthy'' food option (eg, carrots, healthy cookies, and raisins) might be included in addition to the high-sugar, high-fat snack food that we offered to the children. This would enable a test of whether exposure to palatable food commercials leads to increased food intake in general or specifically leads to increased intakes of energy-dense foods. Because eating healthy food is probably not threatening with respect to weight concerns and body image in girls, it might be possible that girls would eat more healthy test food in response to the food commercials than in response to the neutral commercials.

A third possible explanation for the sex difference we found might be related to the content of the food commercials. When we took a closer look at the content of the food commercials we used, it appeared that they might have been slightly more focused on boys than on girls. For example, the commercials contained more boy characters than girl characters, and boys were more often the main character of the food commercials. However, in our food commercials, voice-overs were more often made by females than males. Previously, it was found that boys were the dominant figures and role models in (food) commercials aimed at children (44, 45). That is, male voice-overs are more often used than female voice-overs, more boy characters than girl characters are used, and boys more often demonstrate the advertised product in children's advertising (44). More specifically, in food commercials aimed at children, boys were found to be the main product user in 37% of the advertisement, whereas girls were the dominant user in only 10% of the advertisements. Furthermore, the main character was a boy in 59% of the advertisements, whereas the main character was a girl in 10% of the advertisements. Furthermore, 68% of the food commercials had a male voice-over, whereas 7% of the food commercials had a female voice-over (45). It is possible that the primary focus of food commercials on boys played a role in our experiment, because boys were more affected by the food commercials. Perhaps, food commercials are more focused on boys because boys are more susceptible to food cues in commercials (*see* explanation 1), and advertising companies use this as a marketing strategy. It would be interesting to replicate the current study using food commercials that are not primarily focused on boys to test whether the same results would be obtained.

Some limitations of the present study should be mentioned. First, a participation bias may have occurred, because not all parents gave permission for their child to participate in our study. We had no information on the children who were not allowed to participate; therefore, we were unable to check for differences between participants and nonparticipants. There might have been differences between the children that participated and those who did not, ie the latter group might have been children who are not allowed to eat snack foods. However, our response rate was quite high (80%), and, when studying young children, it is difficult to obtain consent from all parents. Furthermore, although we took great care to create a setting as natural as possible, it was still possible that the children did not exhibit their natural behavior. For example, most of the children were excited about participating in the experiment, which might have influenced their eating behavior. Moreover, not all children have unlimited access to snack food when they watch television at home. The amount of snack food they normally eat in front of the television at home might be largely controlled by their parents. Despite these possible confounders, performing the experiment in a university laboratory would likely have resulted in even less of a natural setting than the children's own school, where they were likely comfortable and at ease. It would be useful to perform a similar study in the children's own homes, with and without their parents being present.

Another limitation of our study was that we did not measure the long-term effects of exposure to food commercials. However, if exposure to food commercials is related to increased food intake in the short term, the effects might be even stronger over the long term. In fact, it is rather surprising that we observed increased food intakes in our study because it is likely that the children we tested had been frequently exposed to food commercials for years, but yet were still affected by them. On the other hand, we had no information on food intakes or on physical activities after the experiment. Whereas it is possible that randomization controlled for the dietary intake and the level of physical activity before the experiment, it could not correct for dietary intake or physical activity after the experiment. Thus, we do not know whether the children compensated for their food intake in the experiment by increasing their physical activity or by reducing their intake after the experiment. In theory, it may even be possible that restrained eaters overconsumed after the experiment, with the commercials acting as a long-term disinhibiting cue. To learn more about the effects of exposure to food commercials on the weight status of the children over time, longitudinal studies are required. Furthermore, to obtain more detailed information on the exact time of food intake in relation to the time of exposure to the commercials, future studies should measure intakes separated into 5 time intervals: before the commercials, during the first commercial break, between the commercial breaks, during the second commercial break, and after the second commercial break. Other suggestions for future research would be to look more closely at the effects of food commercials on food intake, while taking sex-specific characteristics of the commercials into account (ie, by comparing the effects of same-sex and opposite-sex actors on food intake). Furthermore, it would be interesting to measure actual modeling of food intake, by examining whether a child directly imitates the food intake of a child actor on screen. Future studies should also take into account the general daily television watching behavior and eating behavior of the child.

In summary, the results of the present study are the first to show that exposure to food commercials during television viewing leads to increased intakes of snack food by boys. This effect goes beyond the intended brand effects of advertising companies and might suggest that boys will eat any available snack food when exposed to food commercials. In many Western societies, the policies regarding food commercials broadcasted on television at times when children watch frequently is under discussion, and, in

some countries, children are protected from such exposure as much as possible. For example, several years ago, Sweden banned all commercials aimed at children aged <12 y (46). The results of this study suggest that such measures might be effective. Because food is constantly available in Western societies and many children often have free access to snack food, food commercials may cause children, especially boys, to increase their food intake while they are watching television.

The authors' responsibilities were as follows—DJA: study design, data collection, data analysis, and writing of the manuscript; RCMEE: study design, data analysis, and writing of the manuscript (provided substantial advice and feedback); and TVS: study design and writing of the manuscript (provided substantial advice and feedback). None of the authors had a personal or financial conflict of interest.

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