Journal of Educational and Developmental Psychology; Vol. 14, No. 2; 2024
ISSN 1927-0526 E-ISSN 1927-0534
Published by Canadian Center of Science and Education

Mother-Child Conversations about the Impact of Nutrition and Activities on a Short and Long-Term Basis

Lakshmi Raman[1] & Mark Manning[1]

[1] Department of Psychology, Oakland University, Rochester, USA

Correspondence: Lakshmi Raman, Department of Psychology, Oakland University, 654 Pioneer Drive, Rochester, MI 48309-4482. E-mail: raman@oakland.edu

Received: March 9, 2024 Accepted: April 30, 2024 Online Published: June 3, 2024

doi:10.5539/jedp.v14n2p1 URL: http://doi.org/10.5539/jedp.v14n2p1

Abstract

The following two studies examined mother-child conversations about the outcomes of engaging in healthy and unhealthy eating and physically active and sedentary activities. Study 1 (n= 29 mother-child dyads, M age = 4.6 years) examined the impact of healthy and unhealthy eating on a short and on a long term basis. Study 2 (n = 34 mother-child dyads, M age = 4 years 8 months) examined the impact of physically active and sedentary activities on a short and on a long term basis. Overall for Study 1, preschoolers elicited significantly more physiological and physical responses. For Study 2, preschoolers gave significantly more physiological and physical utterances than their mothers did. The results of these two studies demonstrate that preschoolers draw predominantly on the biological domain when reasoning about the impact of engaging in healthy/unhealthy nutrition and physically active and sedentary activities on a short and on a long-term basis.

Keywords: long-term basis, mother-child conversations, nutrition

1. Introduction

There has been a plethora of studies that have examined preschoolers' recognition of biological processes demonstrating that preschoolers show a scientific understanding of the causes of biological processes such as illness, growth and nutrition. (Raman & Gelman, 2005; Legare, Wellman, & Gelman, 2009). However, there has been little research that has examined maternal knowledge with preschoolers' knowledge in the biological domain of nutrition and activities.

The following two studies examine the role of mother-child conversations and how they might be influencing the mechanism of conceptual development among preschoolers in the biological domain. Study 1 examines mother-child conversations about the impact of eating healthy/unhealthy foods on a short and on a long-term basis. Study 2 examines mother-child conversations about the impact of engaging in sedentary/physically active activities on a short and long-term basis.

There are both theoretical and practical implications of these studies. Theoretically, the results will inform us what kinds of explanations mothers and their children use to examine the effects of nutrition and activities on a short and long-term basis. This will shed light on the categories that preschoolers use to explain biological events. Practically, these results will inform educators and practitioners to the kind of explanations preschoolers can comprehend so that they can tailor their explanations to this population.

1.1 Children's Recognition of the Impact of Food on Biological Processes

Although there have not been any studies that examine mother-child conversations about nutrition, there have been several experimental studies in the area of children's understanding of the cause and consequence of eating. Xu and Jones (2016) examined the influences of age, family socio-economic status, and parents' food knowledge on preschool, kindergarten, and second grade students' conceptual understanding of food and nutrition. Significant differences were found in total food knowledge, food-body and food-fat knowledge scores between preschool and second grade students. Interestingly, socioeconomic status had no significant impact on children's conceptual understanding of food and there was no clear correlation for food knowledge between children and their parents.

In another study, Raman, Marchak, and Gelman (2020) compared preschoolers' and adults' understanding of the causal consequences of different foods and activities on height and weight. The results suggest that children's and adults' strongest links were between unhealthy food and greater weight, suggesting that the role of food tends to predominate in people's conceptions of body size.

Thibaut, Lefraire and Fourant (2020) conducted two experiments in which they examined 6-, 8-, 10-year-old children's understanding of short- and long-term effects of foods. The results indicated that even 6 year olds could distinguish the differing impact of consuming foods on a short or on a long-term basis (although they were less accurate than the older children). This suggests that by the elementary school years, children have a rudimentary idea of the impact of time on biological processes.

Slaughter and Ting (2010) administered an open-ended interview about food and nutrition to Australian preschoolers, first graders, third graders, sixth graders, ninth graders, and adults. They found that psychological reasoning about food and nutrition was rare in all age groups but between the ages of 5 and 8 years, there were significant increases in mechanistic and vitalistic reasoning about food and nutrition. At age 11 and again at age 14 physiological reasoning increased significantly. Contrary to other studies that were conducted in the United States, physiological responses were generated at a later age among Australian children. These findings can inform professionals who seek to communicate effectively with children of different ages about food and nutrition.

A few studies have also examined the role of nutrition on biological and psychological factors. Raman (2014) examined children's and adults' beliefs about the impact of nutrition on growth and mood states. In the first two studies, preschoolers through adults judged the impact of healthy and unhealthy nutrition on height and weight. In the third and fourth studies, participants judged the impact of healthy and unhealthy nutrition on positive and negative mood states. The results demonstrated that preschoolers reasoned that the consumption of both healthy and unhealthy foods would result in growing taller and fatter. Second graders demonstrated more differentiated reasoning as they reasoned that healthy foods would result in an increase in height but that both healthy and unhealthy foods would result in an increase in weight. When it came to mood states, preschoolers associated eating healthy foods with a positive mood state and unhealthy foods with a positive and negative mood state. The results demonstrated that younger children exhibit a co-existence of an ontologically distinct theory of biology as well as a theory of cross-domain interaction when reasoning about the impact of food on biological and psychological processes.

Raman (2011) examined the role of psychobiological labels such as tasty ("yummy") and not tasty ("yucky") foods on growth and illness. Studies 1 and 3 examined the role of tasty and not tasty foods on height, weight, and illness, respectively. Study 2 controlled for the possibility that participants were responding to the positive and negative valence of the terms "yummy" and "yucky" in Study 1. Results revealed that young children entertain psychobiological causes for growth but not for illness. These results suggest that young children selectively applied psychobiological causes to explain different biological processes.

Another factor that could possibly have an influence on height but definitely on weight is the impact of engaging in physically active/sedentary activities. However, there have been very few studies that have investigated children's understanding of physical activities which can have a significant impact on body weight. Trost, Morgan, Saunders, Felton, Ward and Pate (ANONYMISED) evaluated 4th-grade students' understanding of the concept of physical activity and assessed the effects of two interventions to enhance the students' understanding of this concept. Students were randomly assigned to either the video group (where they watched a 5-min video describing physical activity), the verbal group (which listened to a generic description of physical activity) and the control group which received no instruction. Compared to controls, students in the verbal and video group demonstrated significantly higher scores, with the video group scoring significantly higher than the verbal group. These results indicate that, without intervention, children have a limited understanding of the concept of physical activity.

Raman (2019) examined if 4–5 year olds, 7–8 year olds and adults recognized the impact of physical and sedentary activities on weight. The results demonstrated that compared to 7 and 8 year olds, 4 and 5 year olds had a difficult time in making a clear distinction between the impact of physical and sedentary activities on weight. This suggests that preschoolers have an impoverished recognition of the impact of activities on weight compared to children in middle childhood. This indicates that parents and educators need to further emphasize the importance of physical activities in maintaining a healthy lifestyle in early childhood.

While the above studies have all investigated children's thinking about the impact of food and activities, there has been very little work that has examined the role of mother-child conversations on the impact of nutrition and activities. The following two studies examine the kinds of outcomes mothers and their preschoolers generate when presented with healthy/unhealthy foods or with physically active/sedentary activities. Given that the participants in these studies are not being provided pre-determined responses they can select from, mother-child conversations can elicit a rich amount of knowledge about what mothers and children think about the outcomes of nutrition and activities.

2. Study 1

This study examines mother-child conversations about the role of healthy/unhealthy nutrition on a short and long-term basis.

2.1 Method

2.1.1 Participants

A total of 29 mother-child dyads that took part in this study. The mean age of the children was 4.6 years. The participants were primarily Euro-American from middle class families.

2.1.2 Procedure

Prior to the study, we piloted 15 preschoolers and adults by presenting them with a variety of foods and asked them to say which ones they thought were healthy and unhealthy. We then selected the foods that both preschoolers and adults said were healthy or unhealthy.

For the actual study, mother-child dyads who signed a parental consent form were invited to participate in the P.I.'s lab. Each dyad was presented with a book that described 6 healthy foods and 6 unhealthy foods being eaten either on a short term (e.g., "today") or long term (e.g., "every day") basis. The healthy foods were turkey, apples, oatmeal, broccoli, carrots and strawberries. The unhealthy foods were chicken nuggets, hot dogs, pop tarts, French fries, chocolate and donuts. An example of a healthy food being eaten on a short term basis is the following:

'This is Mary (point to a picture of Mary). Mary eats a lot of broccoli. Do you think it is good for Mary to eat a lot of broccoli today?' Why or why not?

The vignettes for the long term condition were identical except that they described the character in the vignette eating the food everyday (Mary eats a lot of broccoli everyday). All the testing sessions were audiotaped for transcription pu

Coding: The verbal responses were blind coded independently by two research assistants. First, all responses were classified either as on task or off task. On task responses would be those that are directly relevant to the question asked. Off task responses are those that do not have anything to do with the task. Examples of on task responses would be (eating broccoli everyday is good because it has vitamins in it or broccoli makes you grow taller). Off task responses would be (my favorite pizza is pepperoni or my friend and I love going to McDonalds to eat French Fries). Only the on task responses were coded for this study.

Category Coding: Categories were generated for the on-task responses and each of the utterances were assigned to a certain category. Examples of categories were physical or physiological outcomes. Examples of responses in the physical category were 'she will grow taller', 'she will get heavier'. Examples of physiological responses included 'it is good for your heart', 'it makes your bones stronger'. The main distinction between physical and physiological categories was that physical categories were primarily responses that focused on external outcomes of eating healthy/unhealthy foods. Physiological responses were those that referred to internal consequences of eating the foods. There were no pre-determined categories, the categories generated were based on the verbal responses that were generated.

2.1.3 Data Analyses

There were 16 mother-child dyads in the short-term condition and 13 mother-child dyads in the long-term condition. We used multilevel logistic regression models fit with lme4 (Bates et al., 2015) in R (R Core Team, 2021) to explore hypotheses for both the food (Study 1) and activity (Study 2) studies with on-task utterances nested within person or dyads. With multilevel models we can appropriately account for within cluster (e.g., food or activity type) and between cluster (i.e., condition) differences. We used an overdispersion parameter to estimate within-cluster variance in the outcome, which we then used to estimate the intraclass correlation coefficient (ICC) for each outcome (Manning et al., 2015). We used effect codes [1, -1] for categorical predictors to maintain interpretable main effects in models with categorical interactions. To examine the effects of food type (healthy [1] vs unhealthy [-1]) and condition (long term [1] vs short term [-1]) on children's responses, we restricted the data to children's on-task utterances which were nested within each child, and we modeled the probability that the utterance was in response to a question posed by the child's mother ("Yes" = 1, "No" = 0) with a random intercept model. We fit an unadjusted model in which the outcome was regressed unto main effects of, and interaction between, food type and condition, followed by an adjusted model with separate indicators for the proportions of mother's utterances that were physiological and physical. We used a likelihood ratio test (LRT) to determine whether the adjusted model had significantly improvement in model fit.

We examined the effects of dyad member (child [1] vs mother [-1]), food type and condition on the probability that utterances were either physiological or physical ("Yes" = 1, "No" = 0) using similar models with utterances nested within dyad. Separate models were used for each outcome (i.e., physiological and physical utterance). Random effects were specified for the intercept and the main effect of dyad member.

2.1.4 Descriptives

We excluded two dyads where there were more than one child present. For the child only model, we also excluded one dyad for which the *child* only had one on-task utterance. This yielded 990 utterances nested within 23 children for the child-only models, and 3289 utterances nested within 24 dyads for the dyad models.

2.2 Child Only Model

ICC indicated that 6.0% of the variance in the probability of children responding to mothers' questions was due to between-child differences. LRT indicated that the adjusted model had significant improved model fit compared to the unadjusted model, $\Delta X^2(2) = 11.56$, $p < .01$. Parameter estimates and odds ratios for the unadjusted and adjusted models are presented in Table 1. Results of the unadjusted model showed main effects of condition and food type; however, when the percent of mothers' physiological and physical responses were added to the model the condition effect was not statistically significant. This is likely due to the significant effect of condition on the probability that mothers' made physical utterances as indicated by the results of the dyad models below. The adjusted model indicated main effects of food type ($b = 0.34$, $p < .01$) such that discussing healthy foods increased the log-odds of children responding to mother's questions. There was also a main effect of the percent of mothers' physical utterances ($b = 0.16$, $p < .01$) such that more physical utterances increased the log-odds of children responding to mother's questions. Predicted probabilities by condition are presented in Figure 1.

Table 1. Child Only Model results - Food

Fixed effects:	B	b	OR	95% CI for OR	
				2.5%	97.5%
Intercept	-1.79**	-2.33**	0.10	0.06	0.16
Condition	0.34*	0.20	1.22	0.94	1.60
Food Type	0.34**	0.34**	1.40	1.17	1.68
Mom Perc Physiological Resp	--	0.05	1.05	0.99	1.12
Mom Perc Physical Resp	--	0.16**	1.17	1.06	1.29
Condition * Food Type	-0.11	-0.11	0.90	0.75	1.08
Random effects:	Variance	Variance			
Intercept	0.35	0.12			

Note. * = $p < .05$, ** = $p < .01$. *b* = regression coefficient, OR = Odds ratio (for adjusted model only).

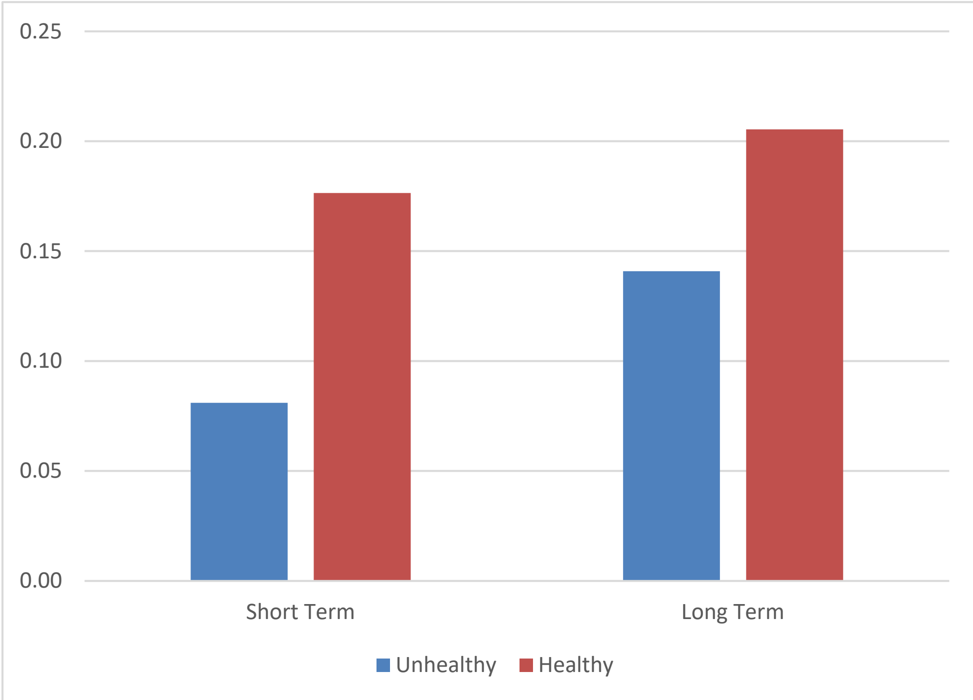

Figure 1. Probability of Children's 'Yes' Responses for food

2.3 Dyad Models

ICC indicated that 4% of the variance in the probability that utterances were physiological was due to between-dyad differences. Parameter estimates and odds ratios for the model predicting the physiological utterances outcome are presented in the left-most column of Table 2. Children were more likely to indicate a physiological response (*b* = 0.46, *p* = .02), and physiological responses were more likely for health foods (*b* = 0.20, *p* < .01). Predicted probabilities are presented in Figure 2.

Table 2. Dyad Models Results

	Physiological Utterance				Physical Utterance			
Fixed effects:	*B*	*OR*	95% CI for OR		*b*	*OR*	95% CI for OR	
			2.5%	97.5%			2.5%	97.5%
Intercept	-2.62**	0.07	0.05	0.10	-4.84**	0.01	0.00	0.02
Child	0.46*	1.58	1.09	2.31	-0.01	0.99	0.48	2.05
Food Type	0.20**	1.22	1.07	1.38	0.65**	1.92	1.29	2.86
Condition	-0.10	0.90	0.67	1.22	0.92**	2.52	1.29	4.90
Child * Food Type	-0.02	0.98	0.86	1.12	-0.02	0.98	0.66	1.46
Child*Condition	-0.22	0.80	0.55	1.15	0.01	1.01	0.59	1.73
Food Type * Condition	-0.01	0.99	0.87	1.13	-0.50*	0.61	0.41	0.90
Child * Food Type * Condition	-0.04	0.96	0.84	1.09	0.13	1.14	0.77	1.70
Random effects:								
	Variance				Variance			
Intercept	0.39				1.16			
Child	0.65				0.37			

Note. * = *p* < .05, ** = *p* < .01. *b* = regression coefficient, OR = Odds ratio.

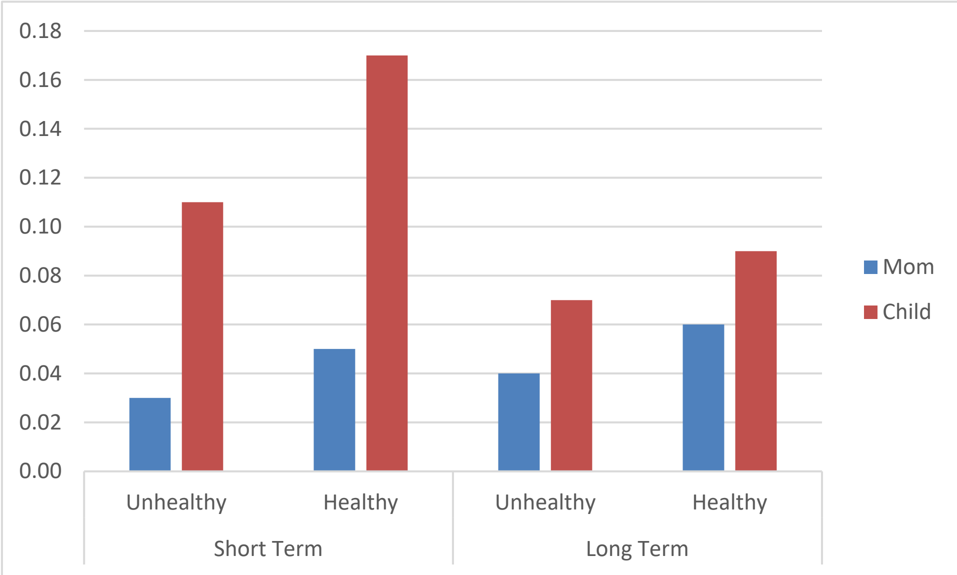

Figure 2. Probability of physiological utterances in the mother-child dyad model for food

ICC indicated that 2% of the variance in the probability that utterances were physical was due to between-dyad differences. Model results (Table 2 right-most columns) indicated main effects of both food type (b = 0.65, p < .01) and condition (b = 0.92, p < .01), which were qualified by a significant interaction between the two (b = -0.50, p = .01). We probed the interaction with methods outlined by Preacher et al. (2006). As represented in Figure 3, results indicated that the slope for the effect of food type was significant only in the Short Term condition (b = 1.15, p < .01), but not in the Long Term condition (b = 0.15, *ns*).

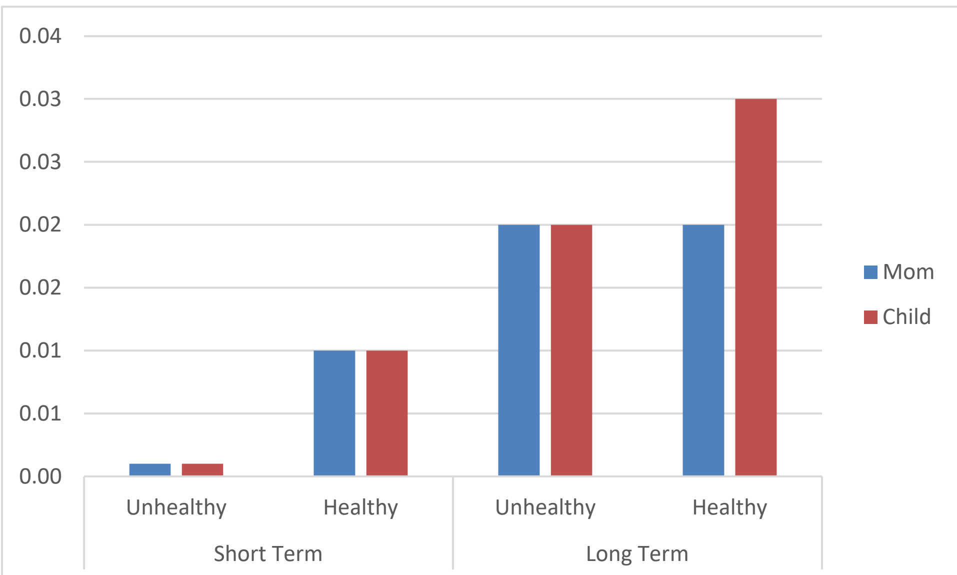

Figure 3. Probability of physical utterances in the mother-child dyad for food

2.4 Discussion

This study examined mother-child conversations about the role of eating healthy and unhealthy foods on a short and long-term basis. The results indicate that for both the short and the long term conditions, children generated significantly more ‘yes’ answers to the question of whether it was good to eat healthy foods on a short-term basis (today) or on a long-term basis (everyday). This suggests that they seem to have a recognition that overall healthy foods are better to eat than unhealthy foods when they were asked if it was good to eat the foods on a short-term or long-term basis.

The child only responses yielded a significant main effect for condition and food type. However when mother's responses were added, condition was not significant but food type was with healthy foods promoting an increase in children's responses.

When analyzing the dyad model, children generated significantly more physiological utterances. Overall, physiological utterances were generated significantly more often for eating healthy foods. For physical utterances, there was a significant difference for the food type (healthy vs. unhealthy) with children generating significantly more physical responses for eating healthy foods. Participants also generated significantly more physical utterances with healthy foods but only a short term basis (i.e., eating the foods today). These results concur with Thibaut, Lefraire and Fourant (2020) who found that although 6 year old children could differentiate the short and long term effects of food, they were far less clear about the temporal impact of consuming food in comparison to 8 and 10 year old children.

The finding of this study raise a few questions. First, why is it that preschoolers think that physical outcomes will occur when consuming healthy foods on a short-term basis and second, why are preschoolers generating significantly more physiological responses than their mothers are? In response to the first question, it might be possible that preschoolers are making the assumption that eating a healthy food 'today' means that the food will be eaten in the future as well. Second, mothers might be simplifying their responses when discussing this task with their preschoolers so that it is easier for their children to comprehend what they are saying. Thus, they are not generating as many physiological responses. These results are similar to the findings of Gelman et al., (1998) where mothers did not always take opportunities to explain events to their children. Another reason why children might be generating more physiological responses than their mothers is that children might have heard about the physiological benefits of eating healthy foods not only from their parents but also from other sources such as in their preschool and the media. Raman (2011) found that when preschoolers were asked why we eat, they selected physiological responses for all the main meals. However, they also selected physiological responses for eating snacks. These results go along with the current findings of this study where preschoolers not only select physiological reasons in a forced-response task but they also spontaneously generate physiological responses when discussing the impact of consuming healthy and unhealthy foods.

It is important to point out that although preschoolers are generating responses exclusively from the biological domain and their responses are in the same categories as their mothers, we cannot conclude that mothers are exclusively contributing to their children's knowledge about the impact of eating healthy and unhealthy foods. Mothers could be one source where children are getting their information from but there are also other sources such as the media that both children and their mothers might be exposed to, which in turn could be influencing their responses. These results concur with other research in the area of children's understanding of nutrition that preschoolers primarily draw upon the biological domain when assessing the impact of eating healthy and unhealthy foods on a short term and a long term basis.

3. Study 2

This study examined mother-child conversations about the impact of sedentary and physically active activities on a short and long-term basis.

3.1 Methods

3.1.1 Participants

There were a total of 34 mother-child dyads. The mean age of the children was 4 years and 8 months. The participants were primarily Euro-American from middle class families.

3.1.2 Procedure

Mother-child dyads who signed a parental consent form were allowed to participate. Each dyad was presented with a book that described 4 physically strenuous activities and 4 sedentary activities that the character in the vignette engaged in either on a short term basis (i.e., engaged in the activity 'today') or on a long term basis (i.e., engaged in the activity "every day"). The physically strenuous activities were swimming, jumping on a trampoline, playing in the playground, and playing soccer. The sedentary activities were sitting on the couch, watching TV, reading, and taking a nap. An example of a short term vignette that describes physically strenuous activities was the following

'This is Mary (point to a picture of Mary). Mary eats swims a lot. Do you think it was good for Mary to swim a lot today? Why or why not?

The vignettes for the long term condition were identical except that they described the character in the vignette engaging in the activity everyday (e.g., "Mary swims a lot everyday"). All the testing sessions were audiotaped for transcription purposes.

3.2 Results

Coding: Similar to Study 1, the verbal responses were blind coded independently by two research assistants. First, all responses were classified either as on task or off task. On task responses would be those that are directly relevant to the question asked. Off task responses are those that do not have anything to do with the task. Examples of on task responses would be (swimming is good for you and makes you grow taller). Off task responses would be (I love going swimming with my friends). Only the on task responses were coded for this study.

Category Coding: The on-task verbal responses were assigned to different groups or categories such as physical or physiological outcomes. Examples of responses in the physical category were 'swimming makes you grow', 'it is good exercise'. Examples of physiological responses included 'it is healthy for your body', 'it makes your bones stronger'. The main distinction between physical and physiological categories is that physical categories were primarily responses that focused on external outcomes of engaging in physically active/sedentary activities. Physiological responses were those that referred to internal consequences of engaging in that activity. Like Study 1, there were no pre-determined categories, the categories generated were based on the verbal responses that were generated.

3.3 Descriptives

Eighteen dyads participated in the short-term condition and 16 dyads participated in the long-term condition. We excluded one dyad for which the mother had no on-task utterance as this precluded controlling for proportion of physiological and physical utterances. This yielded 1380 utterances nested within 34 children for the child-only models, and 4133 utterances nested within 34 dyads for the dyad models.

3.4 Child-Only Model

ICC indicated that 21% of the variance in probability of children's responses to mother's question was due to between-child differences. The results of the LRT failed to support significant model improvement for the adjusted model compared to the unadjusted model, $\Delta X^2(2) = 0.56$, *ns*. Results indicated no significant effects of activity type or condition on probability of children's responses (Table 3).

Table 3. Child Only Model results - Activities

Fixed effects:	Estimate	Estimate	OR	2.5%	97.5%
Intercept	-0.91**	-0.95**	0.39	0.21	0.72
Condition	0.13	0.02	1.02	0.62	1.67
Activity Type	-0.06	-0.06	0.95	0.83	1.07
Mom Perc Physiological Resp	--	-0.08	0.92	0.73	1.18
Mom Perc Physical Resp	--	0.03	1.03	0.93	1.14
Condition * Activity Type	-0.05	-0.05	0.95	0.84	1.08
Random effects:	Variance	Variance			
Intercept	1.19	1.17			

Note. * = $p < .05$, ** = $p < .01$. b = regression coefficient, OR = Odds ratio (for adjusted model only).

3.5 Dyad Models

ICC indicated that 2% of the variance in the probability of physiological utterances was due to between-dyad differences. Parameter estimates for the final model are presented in the left-most columns of Table 4. There were significant main effects of condition and child on the odds of physiological responses. Physiological responses were less likely in the long-term condition ($b = -0.61$, $p < .01$), and more likely for children ($b = 0.70$, $p < .01$). Predicted probabilities are presented in Figure 4.

ICC indicated that 2.5% of the variance in the probability of physical utterances was due to between-dyad differences. Parameter estimates for the final model are presented in the right-most columns of Table 4. Results indicated significant main effects such that physical responses were more likely to uttered by children ($b = 0.56$, $p < .01$), for physical activities ($b = 0.33$, $p < .01$), and in the long-term condition ($b = 0.44$, $p < .01$). There were no statistically significant interactions. Predicted probabilities are presented in Figure 5.

Table 4. Dyad Model Results - Activities

	Physiological Utterance				Physical Utterance			
Fixed effects:			95% CI for OR				95% CI for OR	
	Estimate	OR	2.5%	97.5%	Estimate	OR	2.5%	97.5%
Intercept	-4.21**	0.01	0.01	0.02	-2.98**	0.05	0.04	0.07
Child	0.70**	2.01	1.31	3.10	0.56**	1.75	1.32	2.32
Activity Type	-0.18	0.83	0.65	1.08	0.33**	1.39	1.21	1.59
Condition	-0.61**	0.54	0.36	0.82	0.44**	1.55	1.18	2.03
Child * Activity Type	-0.10	0.90	0.70	1.16	0.07	1.07	0.94	1.22
Child*Condition	0.12	1.12	0.79	1.61	-0.15	0.86	0.66	1.12
Activity Type * Condition	0.06	1.06	0.82	1.37	-0.06	0.94	0.82	1.08
Child * Activity Type * Condition	0.14	1.15	0.89	1.49	-0.12	0.89	0.78	1.02
Random effects:	Variance				Variance			
Intercept	0.63				0.38			
Child	0.32				0.35			

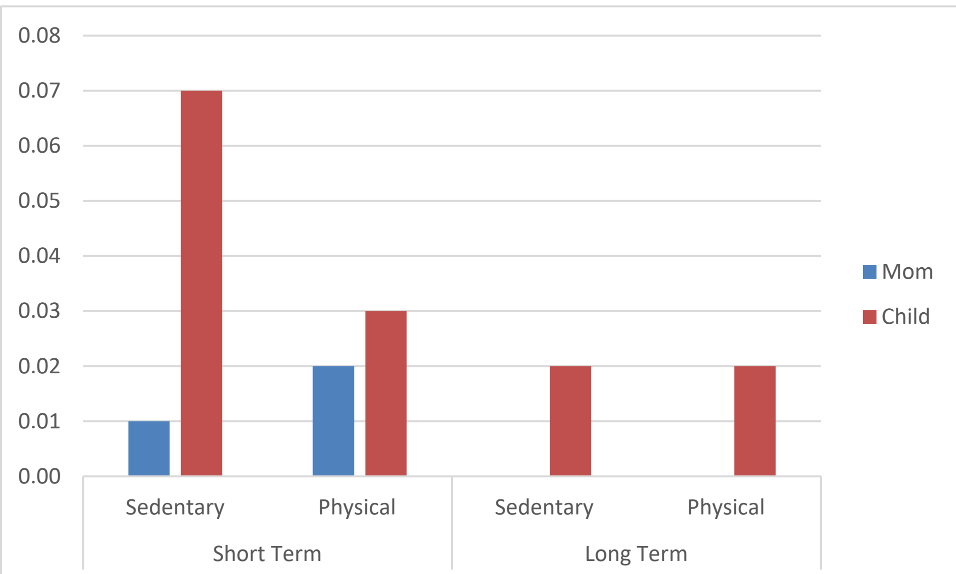

Figure 4. Probability of physiological utterances in the mother-child dyad for activities

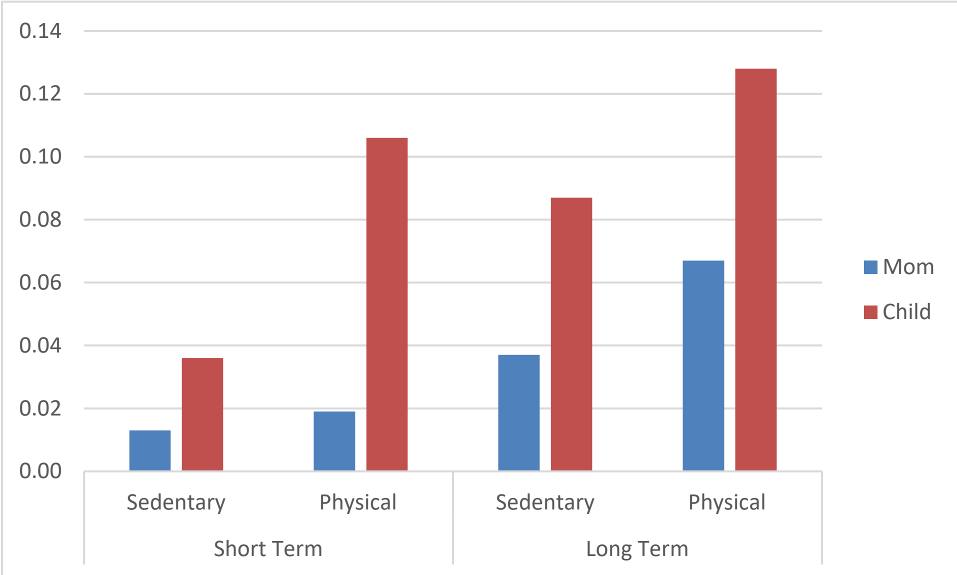

Figure 5. Probability of physical utterances in the mother-child dyad for activities

3.6 Discussion

This study examines mother-child conversations about the impact of engaging in physically active and sedentary activities on a short term and long term basis. When physiological responses were analyzed for the dyad model, children gave significantly more physiological utterances than their mothers. Overall the significant effect for condition indicated that physiological responses were less likely in the long term condition. This an interesting finding as one would have expected physiological responses to be generated more when activities are engaged in, on a long-term basis rather than a short-term basis. One would expect running over a period of time to have more health effects than running just on one day. This finding suggests that children do not have an appreciation of the physiological effects of engaging in an activity over a longer period of time. This finding is similar to the findings of Study 1 where preschoolers generated more physical responses when healthy foods were consumed on a short-term basis.

When the dyad model for physical responses were analyzed, the main effects showed that children gave significantly more physical utterances than their mothers did. More physical utterances were generated in the long-term term condition and more physical utterances were generated for physically strenuous activities. It is interesting that children generated more physical utterances than their mothers did and that physical responses were generated in the long term condition. This is in contrast to physiological utterances where participants seem to generate less physiological utterances in the long-term condition (maybe due to the fact that physiological changes are not directly observable).

Similar to Study 1, children generated significantly more physiological utterances than their mothers did. There could be a couple of reasons for this unexpected finding. First, since this study examines activities, that might have primed children to think more about physical outcomes (as evidenced by more physical utterances generated for physically active activities). Second, mothers might have simplified their responses when talking to their children about the possible outcomes which in turn could have resulted in the occurrence of less physiological responses being generated from the mothers. Third, the mothers were asking their children the questions in the vignette which in turn elicits the child to answer these questions. In other words, the mothers might have taken a secondary role since the task was aimed to elicit responses from the children.

These results also demonstrate that children have a fragile understanding of the impact of time on the consequences of engaging in physically strenuous and sedentary activities. Overall the results in this study have demonstrated that preschoolers rely heavily on the biological domain when assessing the impact of engaging in active and sedentary activities.

4. General Discussion

These two studies have demonstrated that preschoolers draw heavily on the biological domain when reasoning about the outcomes of eating healthy/unhealthy foods or engaging in physically active/sedentary activities. The finding that is worth discussing across both studies is that for both foods and activities, preschoolers generated significantly more physiological outcomes than their mothers did. Since physiological responses were classified as those that referred to internal attributes (strong bones, it will make you sick, gives you strong teeth, etc.) these results demonstrate that preschoolers can make internal causal attributions of the effects of foods and activities. Raman (2011) has demonstrated that preschoolers do select physiological responses for why we eat different meals. The results of Study 1 not only corroborate these results but also demonstrate that preschoolers can spontaneously generate physiological responses for biological processes. This lends support to the model that preschoolers draw on the biological domain to reason about the effects of biological processes such as nutrition and activities.

When we compare the results of eating healthy and unhealthy foods on a short term and long term basis, participants produced significantly more physiological and physical responses for healthy foods suggesting that the focus is on the benefits of eating healthy foods rather than focusing on the detrimental impact of eating unhealthy foods. However, fewer physical responses were produced in the long term condition indicating that children have a difficult time assessing the impact of consuming heathy and unhealthy foods on a long-term basis.

Children also produced significantly more physical responses for healthy foods in the short term condition. As mentioned earlier, children might be making the assumption that someone who eats a food ‘today’ is going to eat it on a regular basis. It could also be that children are given the input that eating healthy foods will have physical outcomes without any mention of the frequency of eating that food (eat your broccoli, it will make you grow tall). This in turn could contribute to preschoolers have a difficult time when it comes to assessing the impact of eating a food just once or on a daily basis.

When we compare engaging in physically active or sedentary activities on a short term and on a long term basis, children gave significantly more physiological and physical responses than their mothers did. This could be because of the context of the study where we are asking them about activities. Like Study 1, preschoolers had a difficult time recognizing the impact of activities in the short condition as they generated a greater number of physiological responses in the short term condition. However, they generated a greater number of physical responses in the long run. This is the opposite of Study 1 where participants generated less physical responses in the long term condition. Participants do seem to recognize that engaging in strenuous activities will have more physical consequences. These results concur with Trost, Morgan, Saunders, Felton, Ward and Pate (ANONYMISED) and Raman (2011) that indicates that although children draw on the biological domain to assess the impact of physically strenuous and sedentary activities, they have a fragile understanding of the engaging in these activities.

One of the limitations of these studies is that the participants who enrolled in these studies are primarily from White middle class families. This limits the generalizability of the results of this study to this population. Given that obesity exists across all socioeconomic groups (CDC), future studies should try to recruit families from lower socioeconomic families to see what kind(s) of reasoning children and mothers from these socioeconomic groups use to reason about nutrition and activities.

There are multiple venues for future directions. First, it might be helpful to be more specific about how often the food is consumed. So instead of saying ‘today’ for the short-term condition, it might be beneficial to state the frequency and say ‘just once’ and ‘many times’ for the long-term condition.

Second, instead of having a between subjects condition design, it might be interesting to having a between subjects food and activities design. Thus, participants would be presented with either healthy or unhealthy foods but the type of food would be presented on both a short-term and long-term basis. This might be a more sensitive test to see if presenting the foods on both the short and long-term condition in a single task will result in participants recognizing the impact the differing timelines.

In conclusion, these two studies clearly demonstrate the preschoolers draw heavily on the biological domain when engaging in social conversations about the impact of nutrition and activities. These studies point to the importance of mother-child conversations to explore children’s developing ideas about biological events.

Funding

None.

Informed Consent

Obtained.

Provenance and Peer Review

Not commissioned; externally double-blind peer reviewed.

Data Availability Statement

The data that support the findings of this study are available on request.

Competing Interests Statement

The authors declare that there are no competing or potential conflicts of interest.

References

Bates, D., Maechler, M., Bolker, B., & Walker, S. (2015). Fitting Linear Mixed-Effects Models Using lme4. *Journal of Statistical Software, 67*(1), 1-48. https://doi.org/10.18637/jss.v067.i01

Gelman, S. A., Coley, J. D., Rosengren, K. S., Hartman, E., Pappas, A., & Keil, F. C. (1998). Beyond labeling: The role of maternal input in the acquisition of richly structured categories. *Monographs of the Society for Research in Child development*, i-157. https://doi.org/10.2307/1166211

Legare, C. H., Wellman, H. M., & Gelman, S. A. (2009). Evidence for an explanation advantage in naïve biological reasoning. *Cognitive psychology, 58*(2), 177-194. https://doi.org/10.1016/j.cogpsych.2008.06.002

Manning, M., Burnett, J., & Chapman, R. (2015). Predicting Incongruence between Self-reported and Documented Colorectal Cancer Screening in a Sample of African American Medicare Recipients. *Behavioral medicine* (Washington, D.C.), 1-10. https://doi.org/10.1080/08964289.2015.1011600

Preacher, K. J., Curran, P. J., & Bauer, D. J. (2006). Computational Tools for Probing Interactions in Multiple Linear Regression, Multilevel Modeling, and Latent Curve Analysis. *Journal of Educational and Behavioral Statistics, 31*(3), 437. https://doi.org/10.3102/10769986031004437

R Core Team. (2021). R: A language and environment for statistical computing. In R Foundation for Statistical Computing. Retrieved from http://www.R-project.org/

Raman, L., Marchak, K. A., & Gelman, S. A. (2020). Children's understanding of food and activities on body size. *Cognitive Development, 54*, 100865. https://doi.org/10.1016/j.cogdev.2020.100865

Raman, L. (2019). Do children recognize the impact of physical and sedentary activities on weight?. *Journal of Child and Family Studies, 28*, 3161-3169. https://doi.org/10.1007/s10826-019-01492-8

Raman, L., Cosby, J., & Hodroj, L. (2018). How do children associate food type to illustrated height and obesity?. *Journal of Child and Family Studies, 27*, 1940-1949. https://doi.org/10.1007/s10826-018-1025-4

Raman, L. (2014). Children's and adults' understanding of the impact of nutrition on biological and psychological processes. *British Journal of Developmental Psychology, 32*(1), 78-93. https://doi.org/10.1111/bjdp.12024

Raman, L. (2011). Does "Yummy" Food Help You Grow and Avoid Illness? Children's and Adults' Understanding of the Effect of Psychobiological Labels on Growth and Illness. *Child Development Research, 2011*. https://doi.org/10.1155/2011/638239

Raman, L., & Gelman, S. A. (2005). Children's understanding of the transmission of genetic disorders and contagious illnesses. *Developmental Psychology, 41*(1), 171. https://doi.org/10.1037/0012-1649.41.1.171

Slaughter, V., & Ting, C. (2010). Development of ideas about food and nutrition from preschool to university. *Appetite, 55*(3), 556-564. https://doi.org/10.1016/j.appet.2010.09.004

Thibaut, J. P., Lafraire, J., & Foinant, D. (2020). A time for a meal? Children's conceptions of short-term and long-term effects of foods. *Cognitive Developmnt*. https://doi.org/10.1016/j.cogdev.2020.100885

Xu, T., & Jones, E. (2016). An investigation of children's understanding of food and nutrition. *Early Childhood Education Journal, 44*(4), 289-297. https://doi.org/10.1007/s10643-015-0716-3