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Sources of Intrusions in Children's Dietary Recalls from a Validation Study of Order Prompts

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Abstract

Validation-study data and foodservice production records were analyzed to test hypotheses concerning sources of intrusions (reports of uneaten items) in the school-meal parts of children's dietary recalls. Each child was observed eating school meals on two days, and interviewed the morning after each observation day; one interview used forward-order (morning-to-evening) and one used reverse-order (evening-to-morning) prompts. Lunch intrusions were likelier to have been available in the foodservice environment at lunch as day before the interview came closer, and on days before than after the interview. Temporal dating errors are contributing sources of intrusions in the school-lunch parts of children's recalls.

Keywords

Children; dietary recalls; intrusions

Introduction

The global obesity epidemic among children (Wang & Lobstein, 2006) makes accurately assessing children's dietary intake a health priority. Children eat meals at which parents are not present (e.g., at school), so parents cannot be expected to accurately report their children's intake. Therefore, children must report this information. The 24-hour dietary recall (24hDR) is a tool commonly used for this purpose (Frank, 1991).

Dietary-reporting validation studies, wherein reported information is compared to reference information from a method independent of the child's memory (Domel, 1997), allow identification of matches (correct reports of items eaten), omissions (failures to report items eaten), and intrusions (reports of non-eaten items) (Smith, Jobe, & Mingay, 1991). Most studies lack reference information, so reported information is analyzed without differentiating between matches and intrusions.

School-meal observations in the USA allow collection of reference information to validate parts of children's 24hDRs (Simons-Morton & Baranowski, 1991). Dietary-reporting validation studies of children's 24hDRs indicate omissions and intrusions (e.g., Baranowski

et al., 2002; Baxter et al., 2003; Crawford, Obarzanek, Morrison, & Sabry, 1994). This article focuses on intrusions.

In 24hDRs, children are to report memories of specific eating episodes; that intrusions are reported indicates children are not entirely successful at this. From where do intrusions originate? Tulving (1972) distinguished between episodic (context-bound [i.e., particular events occurred in particular contexts]) and semantic (situation-independent knowledge [e.g., general information]) memory. Smith et al. (1991) referred to an individual's memory for particular meals and snacks as "specific memories" and to general knowledge about personal intake as "generic information". Suppose a child usually eats Cheerios, white milk, and orange juice for breakfast, but one day ate pancakes, syrup, and chocolate milk. In a 24hDR, the child might correctly report the unusual breakfast items or incorrectly report the usual breakfast items. The correctly reported items are likely based on specific episodic memory for the target breakfast; the incorrectly reported items may be based on generic information or memory of another episode wherein these items were consumed – a temporal dating error. Smith et al. (1991) suggested that intrusions would be expected if dietary reporting involves compromises between specific memories and generic information.

Publications of dietary-reporting validation studies (Baranowski et al., 2002; Crawford et al., 1994) include speculation that children's intrusions may be misreports of temporally nearby meals, or products of fantasy. The former are reports of specific memories of wrong episodes; the latter may be reports of generic information. Because many school breakfast and school lunch items differ, intrusions are likely to refer to items that are meal-specific instead of cross-meal. Therefore, breakfast items should be intruded in reports of breakfast, and lunch items should be intruded in reports of lunch.

For this article, data from a dietary-reporting validation study concerning the effect of order prompts on children's reporting accuracy for school meals (Baxter et al., 2003) were used, along with school foodservice production records, to investigate sources of intrusions in the school-meal parts of children's 24hDRs. Two hypotheses concerned, for each intrusion, availability of that item in the school foodservice environment at the respective school meal on particular days during the week of the interview. **Hypothesis 1 (H₁):** Intrusions should refer to items whose availability at the respective school meal *decreased* from the observation day to the pre-observation day to two-days-pre-observation to three-days-pre-observation.

Hypothesis 2 (H₂): Intrusions should refer to items whose availability at the respective school meal was greater on the observation than post-interview day, and on the pre-observation than post-interview day.

Methods

The original publication of this validation study provides details concerning the sample, design, observations, interviews, quality control, criteria to be considered school meals, and classification of reported items as matches or intrusions (Baxter et al., 2003). Approval was obtained from the appropriate institutional review boards. Each of 121 children (60 Black [29 girls], 61 White [29 girls]; mean age=10.20 years [SD=0.58]) was observed eating school breakfast and school lunch on each of two days separated by ≥ 29 days. Each child was interviewed about the previous day's intake in the morning after breakfast on each day after being observed; one interview used forward-order (morning-to-evening) and one used reverse-order (evening-to-morning) prompts. Analyses were restricted to reports of school meals.

To assess availability in school foodservice environments of items referred to by intrusions, an availability file was constructed for school days of interest for interviews with ≥ 1 intrusion; these days included the observation day, pre-observation day, two-days-pre-observation, three-

days-pre-observation, interview day, and post-interview day. Each entry was a food item available in a school's foodservice environment for a particular meal on a day of interest. The core set of 4658 items (breakfast-1972; lunch-2686) was from production records completed by school foodservice personnel for each school meal each school day. For this core set, all kinds/flavors of milk, juice, and ready-to-eat cereal were considered available daily for breakfast, and all kinds/flavors of milk were considered available daily for lunch. (Schools offered these items as the daily "cold breakfast" option. Milk was available daily for breakfast and lunch. Production records listed these general items, but specific kinds/flavors were never listed.) Next, 305 items (breakfast-35; lunch-270) were added that were observed available during particular school meals but were not listed on production records. Finally, 366 items (breakfast-15; lunch-351) were added that were assumed available in particular school foodservice environments for particular meals even though these items were neither listed on production records nor observed at those schools for those meals. For example, if hamburgers were on a school's production record for a particular lunch, but mustard was not, then mustard was assumed available and added to the availability file for that lunch. Various kinds of ice cream were considered available at every lunch. (Production records never listed ice cream, but observers noted it was sold during lunch on most days.) For each intrusion, the availability file was consulted to determine whether that item was available in the child's school foodservice environment for the respective school meal on as many as possible of the days of interest.

Analyses were conducted for breakfast and lunch separately using Stata (9.2, Stata, Inc., College Station, TX, USA) and SAS (9.0, SAS Institute, Inc., Cary, NC, USA). Intrusion was the unit of analysis for each hypothesis.

H₁

A logistic regression model was fit to investigate the effect of time before the interview day (1=observation day, 2=pre-observation day, 3=two-days-pre-observation, 4=three-days-pre-observation), sex, race (Black, White), interview sequence (first, second), order prompts (forward, reverse), and all two-way interactions involving sex, race, sequence and order prompts on the probability that intrusions refer to items available at the respective school meal. For each analysis (breakfast, lunch), a full model was fit; next, a backwards stepwise model was estimated with non-significant variables and non-significant interactions ($p > 0.40$) removed, and a final model was specified. Because each child had two interviews and could have multiple reported items and intrusions, each model utilized empirical standard errors from the modified sandwich variance estimator, so p values are conservative (Williams, 2000).

H₂

A one-sided paired t-test was used to compare availability at the respective school meal for each pair of days. Due to two comparisons, a p value < 0.025 was considered significant.

Results

Of the 242 interviews, 178 and 208 contained reported meals that met criteria to be considered school breakfast and school lunch, respectively; 130 and 124 of these respective interviews contained intrusions and were included in the current analyses. Intrusions accounted for 214 of 483 and 198 of 730 items reported eaten at school breakfast and school lunch, respectively. For breakfast, the largest percentages of intrusions by meal component were beverage (46%) and bread (40%); for lunch, they were vegetable (27%), combination entrée (25%), and beverage (18%).

H₁

Breakfast—Proportions of intrusions available in school foodservice environments by total intrusions were 180/214=0.84, 125/143=0.87, 65/82=0.79, and 34/42=0.81 for the observation day, pre-observation day, two-days-pre-observation, and three-days-pre-observation, respectively.¹ Logistic regression showed neither a significant effect of time (odds ratio=1.12, $p=0.390$) nor any other significant effects or interactions.

Lunch—Proportions of intrusions available in school foodservice environments by total intrusions were 80/198=0.40, 76/156=0.49, 23/88=0.26, and 12/52=0.23 for the observation day, pre-observation day, two-days-pre-observation, and three-days-pre-observation, respectively.¹ Logistic regression showed a significant effect of time (odds ratio=1.31, $p=0.006$) but no other significant effects or interactions. Intrusions in the school lunch parts of 24hDRs referred to items that, for each day (that week) closer to the interview, were 1.31 times likelier to have been available in the child's school foodservice environment at lunch.

H₂

The Table provides information by meal concerning availability of items referred to by intrusions on pairs of days.

Breakfast—Paired t-tests showed no significant differences in proportions of intrusions available in school foodservice environments between either pair of days: observation (138/166=0.83) and post-interview (133/166=0.80), $t(165)=1.51$, $p=0.0661$; and pre-observation (85/95=0.89) and post-interview (79/95=0.83), $t(94)=1.75$, $p=0.0416$. (Recall the H₂ significance level=0.025.)

Lunch—Paired t-tests showed that proportions of intrusions available in school foodservice environments were significantly greater on the observation (65/141=0.46) than post-interview day (45/141=0.32), $t(140)=3.36$, $p=0.0005$; and on the pre-observation (49/99=0.49) than post-interview day (29/99=0.29), $t(98)=3.76$, $p=0.0002$. Intrusions in the school lunch parts of 24hDRs referred to items whose availability that week in the school foodservice environment at lunch was greater on days before than after the interview.

Discussion

A significant trend was found for time before the interview day on availability that was consistent with H₁ for lunch but not breakfast. For both availability comparisons for before to after the interview day, the proportions differed significantly in the direction consistent with H₂ for lunch but not breakfast. Results from both hypotheses are consistent with the notion that temporal dating errors are sources of intrusions in the school lunch parts of children's 24hDRs.

Intrusions were fairly equal between breakfast and lunch. However, more interviews lacked meals that met criteria to be considered breakfast than lunch, more interviews (with reported meals that met criteria to be considered school meals) had zero intrusions for lunch than breakfast, and the proportion of reported items that were intrusions was larger for breakfast than lunch.

Several points should be considered concerning the significant findings for both hypotheses for lunch but not breakfast. Children experienced another school breakfast on the interview

¹Availability could not be assessed for weekend days or holidays *before* the interview day; thus, denominators for the pre-observation day, two-days-pre-observation, and three-days-pre-observation only included intrusions from interviews with that day as a school day.

day between the to-be-reported school breakfast and interview. More time elapsed between eating the to-be-reported school breakfast and interview than between eating the to-be-reported school lunch and interview. More school breakfast than school lunch items were available daily, as indicated by proportions for H_1 (from 0.79 to 0.87 for breakfast; from 0.23 to 0.49 for lunch). Two considerations stem from this difference. First, that results supported both hypotheses for lunch but not breakfast may be an artefact of characteristics of the availability file. Different conclusions might be obtained with more detailed knowledge concerning 1) specific kinds/flavors of milk, juice, and ready-to-eat cereal available daily at school breakfast, and specific kinds/flavors of milk and ice cream available daily at school lunch, and 2) children's actual consumption daily at school meals instead of consumption on the observation day and availability on other days that week.

The second, and potentially more interesting, consideration is the possibility that *how* children report school breakfast and school lunch during 24hDRs may differ due to the differing natures of school meals. Children's reports of school lunch may involve specific recollective effort that is not always successful, whereas reports of school breakfast may tend to involve, or be supplemented by, generic dietary information. This second consequence has implications for studies that rely on children's 24hDRs to investigate breakfast intake (e.g., Rampersaud, Pereira, Girard, Adams, & Metzl, 2005).

The primary limitation of this investigation is that because dietary-reporting validation studies are expensive to conduct, previously-collected validation-study data and school foodservice production records were analyzed. Knowledge of each child's actual consumption was limited to two school meals on each of two observation days separated by ≥ 29 days.

Strengths include that analyses concerned a topic speculated about in publications, but not systematically studied. Intrusions were identified by comparing reports to observations—a method independent of the child's memory. Quality control was assessed regularly throughout data collection.

Results indicate that temporal dating errors are contributing sources of intrusions in the school lunch parts of children's 24hDRs. Thus, the occurrence of intrusions might be decreased by modifying interview techniques to help children report the correct, specific episodes of eating. In contrast, the lack of significant results for hypotheses concerning the school breakfast parts of children's 24hDRs provide no evidence of specific temporal dating errors as sources of intrusions, but also provide no affirmative evidence for reliance on generic dietary information. To further differentiate between temporal dating errors and generic dietary information as sources of intrusions, dietary-reporting validation studies with consecutive observation days per child are needed to expand information about availability with actual consumption.

Research is limited by the effectiveness of its tools. Methodological research to enhance the accuracy of children's 24hDRs is critical to advance the study of obesity and nutrition-related disorders in children.

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Table

Availability of items referred to by intrusions, by meal, on pairs of days for Hypothesis 2^a

School breakfast				
		Post-interview day		
		Yes	No	Total
Observation day	Yes	130	8	138
	No	3	25	28
	Total	133	33	166 ^b
		Post-interview day		
		Yes	No	Total
Pre-Observation day	Yes	76	9	85
	No	3	7	10
	Total	79	16	95 ^c
School lunch				
		Post-interview day		
		Yes	No	Total
Observation day	Yes	36	29	65
	No	9	67	76
	Total	45	96	141 ^d
		Post-interview day		
		Yes	No	Total
Pre-Observation day	Yes	23	26	49
	No	6	44	50
	Total	29	70	99 ^e

^aSchool-meal observations (breakfast and lunch) were conducted on Mondays through Thursdays. Interviews were conducted on Tuesday through Friday mornings (on the day after school-meal observations). Reported items were considered items at school meals only if children identified “school” as the meal’s location, referred to breakfast as “school breakfast” or “breakfast”, referred to lunch as “school lunch” or “lunch”, and reported mealtimes to within one hour of observed mealtimes. Items reported eaten that differed from items observed eaten and were classified as intrusions included fruit juices (e.g., grape observed, apple reported), milk flavors (e.g., strawberry observed, white reported), ready-to-eat cereals (e.g., donut-shaped observed, flake-shaped reported), and vegetables (e.g., carrots observed, broccoli reported). Items reported eaten that were similar to items observed eaten and were classified as matches included all types of pizza (e.g., sausage, cheese) and all types of white milk (e.g., skim, 1%, whole). Suppose that during an interview on Wednesday morning about Tuesday’s intake, a child reported having eaten a waffle for school breakfast but had not been observed eating a waffle at school breakfast on Tuesday, so waffle was an intrusion. According to the availability file, waffles were available for breakfast in the child’s school foodservice environment on Monday (pre-observation day), but not on Tuesday (observation day), Wednesday (interview day), or Thursday (post-interview day). A total of 242 interviews were conducted with 72 interviews conducted on Tuesdays, 69 on Wednesdays, 51 on Thursdays, and 50 on Fridays. There were two school holidays during the data collection period, and both were on Fridays; nine of the 51 interviews on Thursdays were followed by school holidays on Fridays.

^bThere were 166 intrusions for this comparison because post-interview day availability could not be determined for 48 intrusions in interviews on days followed by non-school days.

^cThere were 95 intrusions for this comparison because pre-observation day availability could not be determined for 71 intrusions in interviews on days preceded by non-school days.

^dThere were 141 intrusions for this comparison because post-interview day availability could not be determined for 57 intrusions in interviews on days followed by non-school days.

^eThere were 99 intrusions for this comparison because pre-observation day availability could not be determined for 42 intrusions in interviews on days preceded by non-school days.