

## Short communication

# Origins of intrusions in children's dietary recalls: data from a validation study concerning retention interval and information from school food-service production records

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Submitted 26 March 2008: Accepted 9 September 2008: First published online 10 November 2008

### Abstract

*Objective:* To use data from a published validation study concerning retention interval and school food-service production records to examine intrusions (uneaten items reported eaten) in the school-meal parts of 24 h recalls.

*Design:* For that study, children were observed eating two school meals (breakfast, lunch) and interviewed under one of six conditions from two target periods (previous day (PDTP), prior 24 h (24TP)) crossed with three interview times (morning, afternoon (AIT), evening). For the present article, a catalogue was constructed of foods available for that study's school meals. The study's intrusions were classified as stretches (on children's meal trays but uneaten), internal confabulations (in children's school food-service environments for that meal but not on children's trays) or external confabulations (not in children's school food-service environments for that meal). Occurrence, types and amounts of intrusions were investigated.

*Setting/subjects:* Six schools; sixty fourth-grade children (ten per condition).

*Results:* For breakfast, for the 24TP *v.* PDTP, reported items were less likely to be intrusions, internal confabulations and external confabulations; and intrusions were more likely to be stretches. For lunch, for the 24TP-AIT condition *v.* the other five conditions, reported items were less likely to be intrusions and external confabulations. Mean amounts reported eaten were smaller for stretches than for internal confabulations or external confabulations at breakfast, and for stretches than for internal confabulations at lunch.

*Conclusions:* Accuracy was better for the 24TP (with fewer intrusions of which proportionally more were stretches which had smaller amounts reported eaten) than for the PDTP. Studies with 24 h recalls should minimize retention interval to improve accuracy.

**Keywords**  
Children  
Dietary recalls  
Intrusions  
Retention interval  
Validation

In dietary-reporting validation studies, reported information (e.g. 24 h dietary recall (24hDR)) is compared with reference information (e.g. direct observation) independent of the subject's memory. Such studies indicate that although matches (items eaten and reported eaten) are common, so too are intrusions (uneaten items reported eaten) and omissions (items eaten but unreported)<sup>(1)</sup>. The present article focuses on intrusions.

The origins (or sources) of intrusions in children's dietary recalls are unclear. Some investigators<sup>(2–4)</sup> have speculated that intrusions in the school-meal parts of children's 24hDRs

reflect confusion with temporally nearby school meals. A better understanding of the origins of intrusions may help to develop methods to decrease the frequency of intrusions in children's dietary recalls, and thus provide more accurate assessment of children's intake. In children's validated recalls of school-meal intake, intrusions may be classified by type as stretches (on children's trays for that meal), internal confabulations (available in children's school food-service environments for that meal but not on children's trays) or external confabulations (not available in children's school food-service environments for that meal).

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Episodic memories are context-bound (i.e. certain events occurred in specific contexts) while semantic memories are situation-independent knowledge (e.g. general or generic information)<sup>(5)</sup>. The source monitoring perspective<sup>(6)</sup> is concerned with factors that influence the ability of individuals to attribute episodic memories to the events in which they actually occurred and to distinguish memories of experiences from general or generic information. According to the source monitoring perspective, accurate self-reporting of intake requires a person to differentiate among several sources of information (or lists of food items); the occurrence of intrusions, and their types, reveals the success with which these sources are differentiated. For example, items on children's school-meal trays constitute two sources – items eaten (in any non-zero amount) and items not eaten; when children fail to differentiate between these two sources, stretches occur. A third source is items available in children's school food-service environments for that meal but not on children's trays; when children fail to filter out this source, internal confabulations occur. A fourth source is all other items (e.g. from other school meals and non-school meals); when children fail to filter out this source, external confabulations occur. The number of stretches should decrease and the number of external confabulations should increase as the retention interval (time between when the event(s) happen(s) and the report occurs) increases<sup>(7)</sup>.

Results from a small dietary-reporting validation study<sup>(8)</sup> illustrate how retention interval influences intrusions in children's 24hDRs. Mean intrusion rate (percentage of reported food items not observed eaten) for the school-meal parts of the 24hDR was significantly greater (i.e. worse) for interviews about the previous-day target period (PDTP, midnight to midnight of the day before the interview; 54%) than the prior-24-hours target period (24TP, 24 h immediately preceding the interview; 29%). However, the interaction of target period (TP) with interview time (IT) was not significant, although mean intrusion rates exhibited the expected pattern (i.e. worse for the PDTP as the interview time went from morning to evening; better for the 24TP when the interview time was close to the preponderance of that day's intake). Specifically, for the PDTP, mean intrusion rates for interviews in the morning, afternoon and evening were 44%, 56% and 61%, respectively; for the 24TP, mean intrusion rates for interviews in the morning, afternoon and evening were 37%, 17% and 33%, respectively.

For the present article, data from this small dietary-reporting validation study<sup>(8)</sup> were used, along with school food-service production records (completed by school food-service managers to comply with federal regulations to document availability of food items at each school meal), to examine the occurrence of intrusions, types of intrusion and amounts reported eaten for types of intrusion in the school-meal parts of children's 24hDRs.

## Experimental methods

Approvals were obtained from the appropriate human research committees. Details of the sample, design, observations, interviews and quality control have been described elsewhere<sup>(8)</sup>. For clarity, a brief summary of details is included herein.

### Sample

In the autumn of 2002, all 443 fourth-grade children from six schools in one district in South Carolina, USA were invited to participate; 312 (70%) agreed by providing written child assent and parental consent.

### Design

Each of sixty randomly selected fourth-grade children was observed eating two consecutive school meals (breakfast, lunch) and interviewed once to obtain a 24hDR under one of six conditions from two TPs (PDTP, 24TP) crossed with three ITs (morning, afternoon (AIT), evening). For example, consider a 24hDR obtained in an interview at 14.00 hours on Tuesday. For the PDTP, the 24hDR concerns intake between midnight on Sunday and midnight on Monday; whereas for the 24TP, the 24hDR concerns intake between 14.00 hours on Monday and 14.00 hours on Tuesday. Each condition had ten children (five girls). Six to nine of the ten children in each condition were black.

### Observations

Dietitians used established procedures to observe children eating meals obtained at school<sup>(9–12)</sup>. Most foods were served to children because offer-versus-serve<sup>(13)</sup>, in which children may refuse some items, was not implemented. Interobserver reliability, assessed weekly, met conventional criteria<sup>(8,14–16)</sup>.

### Interviews

Morning and afternoon interviews were conducted in person at school after breakfast and lunch, respectively. Evening interviews were conducted by telephone between 18.30 and 21.00 hours. (A previous validation study<sup>(11)</sup> found no significant effect of interview modality, i.e. telephone *v.* in person, on fourth-grade children's reporting accuracy.) Dietitians who had not conducted observations used written interview protocols (described elsewhere<sup>(8)</sup>) that were multiple-pass and modelled on the Nutrition Data System for Research (NDSR; Nutrition Coordinating Center, University of Minnesota, Minneapolis, MN, USA). Instead of using NDSR software, interviewers wrote on paper forms information that children reported during interviews. Interviews were audio-recorded and transcribed. Quality control for interviews, assessed daily on one randomly selected interview per interviewer, indicated that protocols were followed<sup>(8,17)</sup>. Each interviewed child was mailed a \$US 15 cheque.

### **Classification of reported food items and amounts**

Analyses concerned foods (because intake was reported as foods) and were restricted to school meals (because only those meals were observed). As in previous studies<sup>(9–12)</sup>, reported items were considered items eaten 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, reported mealtimes to within one hour of observed mealtimes, and reported consuming non-zero quantities. Each item reported eaten in any non-zero amount at a school meal was classified as a match or as an intrusion according to criteria used previously<sup>(9–12)</sup>. Specifically, an item reported eaten at a school meal was classified as a match if a child was observed to have eaten that item at that meal; otherwise, the item was classified as an intrusion. Reported items were classified as matches unless reports clearly did not describe items observed eaten. Examples of items classified as matches included all kinds of white milk (e.g. skimmed, 1% fat, whole) and all types of pizza (e.g. cheese, sausage). Examples of items classified as intrusions included fruit juices (e.g. orange observed, grape reported), milk flavours (e.g. white observed, strawberry reported), ready-to-eat cereal (e.g. sphere-shaped observed, flake-shaped reported) and vegetables (e.g. carrots observed, cabbage reported). For the present article, each intrusion was further classified as a stretch (on the child's tray for that meal), an internal confabulation (available in the child's school food-service environment for that meal but not on the child's tray) or an external confabulation (not available in the child's school food-service environment for that meal). As in previous studies<sup>(9–12)</sup>, amounts observed eaten and/or amounts reported eaten were recorded qualitatively and assigned numerical values as none = 0.00, taste = 0.10, little bit = 0.25, half = 0.50, most = 0.75, all = 1.00 or the actual number of servings if >1 serving was observed eaten and/or reported eaten.

### **Availability of food items in school food-service environments**

For the present article, a catalogue was constructed of items available for specific meals in school food-service environments. Production records listed 999 items (breakfast *n* 402; lunch *n* 597); 376 additional items (breakfast *n* 162; lunch *n* 214) were observed during specific meals. Finally, fifty-two more items (all lunch) were assumed available for specific unobserved lunches. (For example, if hot dogs were on a school's production record for a specific lunch but mustard was not, mustard was assumed available and added to the catalogue for that lunch.) In the set of 999 items, all kinds/flavours of ready-to-eat cereal, milk and juice were considered available daily for breakfast, and all kinds/flavours 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 ready-to-eat cereal, milk and juice in general terms but rarely listed specific kinds/flavours.) Various kinds of ice cream were assumed available daily for lunch. (Production records never listed ice cream, but various kinds were observed sold à la carte during lunch at most schools on most school days.) To further classify each intrusion as a stretch, an internal confabulation or an external confabulation, the observation form and/or availability catalogue were checked to identify availability of that item on the child's tray and/or in the child's school food-service environment for that meal.

### **Analyses**

Analyses were conducted for breakfast and lunch separately because many items differed for these meals; also, in the cafeteria, children typically sat as they arrived at school to eat breakfast, but with their classes to eat lunch. Comparisons of key interest were between the TPs, each of which had thirty interviews if all ITs per TP were considered.

The  $\chi^2$  test was used to analyse the frequency distributions of interviews with zero to six intrusions and with one to six intrusions. Two-sample tests of proportion were used to analyse percentages of intrusion-free interviews. ANOVA was used to analyse numbers of items observed eaten, numbers of items reported eaten and amounts reported eaten by type of intrusion.

Logistic regression was used to model each of seven outcomes. The first model investigated (i) the likelihood that a reported item was an intrusion. Given the variety of types of intrusion, a model was fit to investigate each type: (ii) the likelihood that a reported item was a stretch; (iii) the likelihood that a reported item was an internal confabulation; and (iv) the likelihood that a reported item was an external confabulation. Finally, models were fit to investigate the likelihood that an intrusion was one of the three types: (v) the likelihood that an intrusion was a stretch; (vi) the likelihood that an intrusion was an internal confabulation; and (vii) the likelihood that an intrusion was an external confabulation. Odds ratios and 95% confidence intervals were used to describe significant results from the seven models for breakfast and from the seven models for lunch.

An intrusion could be classified as a stretch only if there was at least one item observed uneaten on the tray of the child who reported it. Thus, for the subset of children who had at least one item observed uneaten, the four logistic-binomial models for stretches (second and fifth models for breakfast and for lunch) were repeated to determine likelihoods conditioned on the possibility of reporting stretches. Results essentially agreed with those from the full sample, so only results from the full sample are provided.

For the same subset of children, a logistic-binomial model was fit to investigate the likelihood that items

observed uneaten on children's meal trays were stretches. For each child in the subset, a discriminability measure was calculated to reflect the ability to discriminate between what was eaten (and should have been reported) and what could have been eaten but was not (and should not have been reported); this was analysed using ANOVA.

Predictors in each model included TP, IT, the TP  $\times$  IT interaction, race and sex. For each analysis, a full model was fit; then a backwards stepwise model was estimated with non-significant ( $P > 0.40$ ) predictors removed; and a final model was constructed from these results. Because intrusions were the focus of the present article, food item (rather than child) was the unit of analysis. These units of analysis are not independent and identically distributed because an individual child could have several reported items and intrusions. To account for this non-independence, inferences utilized empirical standard errors from the modified sandwich variance estimator (which adjusted for multiple food items per child);  $P$  values are conservative<sup>(18)</sup>.

Analyses used STATA version 9.2 (Stata Inc., College Station, TX, USA) and SAS version 9.0 (SAS Institute, Inc., Cary, NC, USA) statistical software packages, with two-tailed  $P$  values.

## Results

Table 1 shows the mean numbers of items observed eaten and items reported eaten, by meal and condition. For each meal, the six conditions and two TPs did not vary significantly for items observed eaten (all  $P > 0.14$ ) or for items reported eaten (all  $P > 0.29$  (ANOVAs)).

For breakfast, there were forty-one intrusions among seventy-three reported items from interviews about the PDTP, and twenty-five intrusions among eighty-three reported items from interviews about the 24TP. For lunch, there were forty-four intrusions among ninety-six reported items from interviews about the PDTP, and twenty-four intrusions among eighty-seven reported items from interviews about the 24TP.

Table 1 also shows the distributions, by meal and condition, of the number of interviews with zero to six intrusions. For breakfast, the frequency distributions of interviews with zero to six intrusions by TP did not differ whether intrusion-free interviews were included ( $P = 0.166$ ) or excluded ( $P = 0.604$  ( $\chi^2$  test)). For lunch, the frequency distributions of interviews with zero to six intrusions by TP differed when intrusion-free interviews were included ( $P = 0.049$ ) but not when they were excluded ( $P = 0.600$  ( $\chi^2$  test)). The percentage of intrusion-free interviews was greater for the 24TP than for the PDTP (breakfast: 44% and 14%, respectively,  $P = 0.0231$ ; lunch: 45% and 8%, respectively,  $P = 0.0033$ ; two-sample tests of proportion).

Table 1 shows the types of intrusion and the amounts reported eaten for types of intrusion, by meal and condition.

Mean amounts reported eaten (in servings) were smaller for stretches (0.44) than for internal confabulations (0.83) or external confabulations (0.79) at breakfast (all  $P \leq 0.001$ ), and for stretches (0.61) than for internal confabulations (0.96) at lunch ( $P < 0.001$  (ANOVAs)).

No significant effects were found for the proportion of items observed uneaten that were stretches (breakfast: all  $P > 0.156$ ; lunch: all  $P > 0.447$ ; logistic-binomial models) or for the discriminability measure (breakfast: all  $P > 0.081$ ; lunch: all  $P > 0.121$ ; ANOVAs).

## Likelihood of intrusions and types of intrusion

### Breakfast

For interviews about the 24TP *v.* PDTP, a reported item was less likely to be an intrusion (OR = 0.30; 95% CI 0.15, 0.61;  $P = 0.001$ ), an internal confabulation (OR = 0.26; 95% CI 0.07, 0.93;  $P = 0.039$ ) or an external confabulation (OR = 0.35; 95% CI 0.13, 0.90;  $P = 0.030$ ); and an intrusion was more likely to be a stretch (OR = 4.93; 95% CI 1.15, 21.08;  $P = 0.032$ ). For the remaining three outcome variables, no significant effects were found.

### Lunch

For the 24TP-AIT condition *v.* the other five conditions, a reported item was less likely to be an intrusion (OR = 0.05; 95% CI 0.01, 0.36;  $P = 0.003$ ) or an external confabulation (OR = 0.02; 95% CI  $> 0.00$ , 2.69;  $P = 0.007$ ). For the remaining five outcome variables, no significant effects were found.

## Discussion

For each school meal, although the number of items reported eaten did not differ by TP or TP  $\times$  IT condition, there were more intrusion-free interviews for the 24TP than for the PDTP. For breakfast, compared with the PDTP, reported items for the 24TP were approximately one-fourth to one-third as likely to be intrusions, internal confabulations and external confabulations, and intrusions were approximately five times as likely to be stretches. For lunch, for the 24TP-AIT condition *v.* the other five conditions, reported items were one-twentieth and one-fiftieth as likely to be intrusions and external confabulations, respectively. Specifically, for lunch, of the six conditions, the 24TP-AIT condition, which had the shortest retention interval, had the most items reported eaten ( $n$  36) and the best accuracy because it had the fewest intrusions ( $n$  3) and external confabulations ( $n$  1).

As anticipated<sup>(7)</sup>, stretches accounted for a larger percentage of intrusions for interviews about the 24TP than the PDTP. Not anticipated were the findings concerning smaller mean amounts reported eaten (in servings) for stretches than internal confabulations and external confabulations at breakfast, and for stretches than internal confabulations at lunch.



**Table 1** Number of items observed eaten, number of items reported eaten, distributions of number of intrusions with zero to six intrusions, types of intrusions and amounts reported eaten (in servings) for types of intrusion, by meal and condition\*

Meal and condition	Types of intrusion <sup>†</sup>																									
	Number of items observed eaten			Number of items reported eaten			Number of intrusions with 0, 1, 2, 3, 4, 5 and 6 intrusions, respectively <sup>§,  </sup>			Stretch			Internal confabulation			External confabulation										
	Mean	SD	SD	Mean	SD	SD	1	2	3	4	5	6	Mean	SD	SD	Item	n	Mean	SD	SD	Item	n	Mean	SD	SD	
	Mean	SD	SD	Mean	SD	SD	n	Mean	(in servings)**	Mean	(in servings)**	Mean	(in servings)**	Mean	(in servings)**	n	Mean	(in servings)**	Mean	(in servings)**	n	Mean	(in servings)**	Mean	(in servings)**	
<b>Breakfast</b>																										
PDTP-MIT (10/7)††	3.80	1.14	0.49	3.29	0.49	0	0	0	0	0	0	0	0.90	0.22	0.22	5	8	0.78	0.34	0.34	8	0.78	0.34	0.34	0.34	
PDTP-AIT (10/7)	3.10	0.88	1.35	3.14	1.35	1	1	1	1	1	1	1	0.50	0.00	0.35	4	4	0.68	0.40	0.40	7	0.68	0.40	0.40	0.40	
PDTP-EIT (9/8)	3.00	1.00	1.41	3.50	1.41	2	0	2	5	0	1	0	0.38	0.18	0.64	5	9	0.83	0.25	0.25	9	0.83	0.25	0.25	0.25	
Subtotal (29/22)	3.31	1.04	1.13	3.32	1.13	3	3	6	8	2	2	1	0.42	0.14	0.46	14	24	0.77	0.32	0.32	24	0.77	0.32	0.32	0.32	
24TP-MIT (10/9)	2.70	0.82	1.32	3.33	1.32	3	3	2	4	0	0	0	0.46	0.39	0.00	2	4	1.00	0.00	0.00	4	1.00	0.00	0.00	0.00	
24TP-AIT (10/9)	3.20	0.92	0.88	3.44	0.88	5	1	3	0	0	0	0	0.50	0.00	0.00	3	3	1.00	0.00	0.00	3	1.00	0.00	0.00	0.00	
24TP-EIT (10/7)	2.90	0.88	0.90	3.14	0.90	2	2	3	2	1	0	0	0.38	0.18	0.00	1	5	0.60	0.38	0.38	5	0.60	0.38	0.38	0.38	
Subtotal (30/25)	2.93	0.87	1.03	3.32	1.03	7	11	5	8	0	1	0	0.44	0.29	0.26	6	12	0.83	0.31	0.31	12	0.83	0.31	0.31	0.31	
<b>Lunch</b>																										
PDTP-MIT (10/8)	5.20	0.63	1.98	4.25	1.98	3	2	3	1	2	0	0	0.70	0.52	0.00	2	6	0.68	0.38	0.38	6	0.68	0.38	0.38	0.38	
PDTP-AIT (10/8)	5.90	1.45	1.19	3.38	1.19	1	0	4	2	2	0	0	0.10	0.00	0.29	3	10	0.80	0.26	0.26	10	0.80	0.26	0.26	0.26	
PDTP-EIT (10/9)	5.80	1.23	2.03	3.89	2.03	1	0	0	4	3	1	0	0.25	0.00	0.00	3	15	0.72	0.30	0.30	15	0.72	0.30	0.30	0.30	
Subtotal (30/25)	5.63	1.16	1.75	3.84	1.75	5	2	11	6	5	0	1	0.49	0.47	0.18	8	31	0.74	0.29	0.29	31	0.74	0.29	0.29	0.29	
24TP-MIT (10/6)	4.90	1.73	1.51	3.33	1.51	1	1	2	2	1	0	0	0	0	0.00	3	6	0.75	0.27	0.27	6	0.75	0.27	0.27	0.27	
24TP-AIT (10/9)	5.50	1.27	1.32	4.00	1.32	2	7	1	1	0	0	0	0.75	0.35	0.00	0	1	1.00	0.00	0.00	1	1.00	0.00	0.00	0.00	
24TP-EIT (10/7)	5.30	1.89	2.15	4.43	2.15	2	2	2	2	1	0	1	0.75	0.35	0.00	1	9	0.76	0.37	0.37	9	0.76	0.37	0.37	0.37	
Subtotal (30/22)	5.23	1.61	1.65	3.95	1.65	4	10	5	4	2	0	1	0.75	0.29	0.00	4	16	0.77	0.32	0.32	16	0.77	0.32	0.32	0.32	

\*Each of sixty randomly selected fourth-grade children was observed eating two consecutive school meals (breakfast, lunch) and interviewed once to obtain a 24 h dietary recall (24hDR) under one of six conditions created by crossing two target periods (TP; previous day (PDTP), midnight to midnight of the day before the interview); prior 24 hours (24TP, 24 h immediately preceding the interview)) with three interview times (IT; morning (MIT); afternoon (AIT); evening (EIT)). There were ten children (five girls) with six to nine black children in each of the six conditions.  
<sup>†</sup>Mean numbers of items observed eaten (in any non-zero amount) did not vary by condition (breakfast:  $P > 0.20$ ; lunch:  $P > 0.46$ ) or TP (breakfast:  $P > 0.14$ ; lunch:  $P > 0.27$ ; separate ANOVA).  
<sup>‡</sup>Mean numbers of items reported eaten (in any non-zero amount) did not vary by condition (breakfast:  $P > 0.31$ ; lunch:  $P > 0.43$ ) or TP (breakfast:  $P > 0.29$ ; lunch:  $P > 0.30$ ; ANOVA).  
<sup>§</sup>An intrusion was an item reported eaten at a school meal that was not observed eaten at that school meal.  
<sup>||</sup>For breakfast, the frequency distributions of number of intrusions with zero to six intrusions by TP did not differ whether intrusion-free interviews were included ( $P = 0.166$ ) or excluded ( $P = 0.604$ ). For lunch, the frequency distributions of number of intrusions with zero to six intrusions by TP differed when intrusion-free interviews were included ( $P = 0.049$ ) but not when they were excluded ( $P = 0.600$  ( $\chi^2$  test)). The percentage of intrusion-free interviews was greater for the 24TP than for the PDTP (breakfast: 44% and 14%, respectively,  $P = 0.0231$ ; lunch: 45% and 8%, respectively,  $P = 0.0033$ ; two-sample tests of proportion).  
<sup>¶</sup>Each intrusion was further classified as a stretch (on the child's tray for that meal), an internal confabulation (available in the child's school food-service environment for that meal but not on the child's tray) or an external confabulation (not available in the child's school food-service environment for that meal).  
<sup>\*\*</sup>Observed amounts and reported amounts of standardized school-meal servings were recorded using a qualitative scale and assigned numeric values as none = 0.00, taste = 0.10, little bit = 0.25, half = 0.50, most = 0.75, all = 1.00 or the actual number of servings if  $> 1$ . Mean amounts reported eaten (in servings) were smaller for stretches (0.44) than for internal confabulations (0.83) or external confabulations (0.79) at breakfast (all  $P \leq 0.001$ ), and for stretches (0.61) than for internal confabulations (0.96) at lunch (all  $P < 0.001$  (ANOVAs)).  
<sup>††</sup>The first number in parentheses indicates the number of children observed eating the school meal; the second number indicates the number of interviews for which reported meals met criteria to be considered the school meal. (For breakfast, the numerator for the PDTP-EIT is 9 instead of 10 because one child obtained a school breakfast but was observed to eat none of it.) Reported items were considered items eaten 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, reported mealtimes to within one hour of observed mealtimes, and reported consuming non-zero quantities.

There are several limitations. The retention-interval dietary-reporting validation study<sup>(8)</sup> included only fourth graders and had a small sample of only sixty children with ten per condition. Similar investigations from retention-interval dietary-reporting validation studies with larger samples and other grade levels of children are needed.

An important strength of the current investigation is that it concerned the understudied yet critical topic of intrusions. In addition, the retention-interval dietary-reporting validation study<sup>(8)</sup> had several methodological strengths. Observations (conducted in a manner and setting to minimize reactivity) were used to validate these meals in children's 24hDRs; this provided objective information about actual consumption and avoided the use of other self-report methods (e.g. food records) by children to compare with their own 24hDRs. For both observations and interviews, quality control was assessed throughout data collection (not just during training prior to data collection).

Despite the small sample<sup>(8)</sup>, results for TP and TP × IT condition illustrate the influence of retention interval on both the occurrence and the types of intrusion in the school-meal parts of children's 24hDRs. These findings, along with findings that amounts reported eaten varied by type of intrusion, have implications for the accuracy of 24hDR and nutrient profiles calculated from 24hDRs<sup>(19–21)</sup>. Psychologically informed analyses of data from additional dietary-reporting validation studies could guide the refinement of methods to decrease intrusions in children's 24hDRs and thereby improve accuracy in non-validation studies. Multiple and consecutive days of school-meal observations per child could provide insight into the origins of intrusions classified as external confabulations.

In conclusion, when designing non-validation studies that include 24hDRs, accuracy could be improved by minimizing the retention interval – using the 24TP instead of the PDTP. This conclusion is supported by the present article's results that the 24TP had fewer intrusions of which proportionally more were stretches, which had smaller mean amounts reported eaten. Furthermore, due to the influence of retention interval on accuracy, publications of studies that utilize 24hDRs should specify the TP and IT of 24hDRs.

## Acknowledgements

*Sources of funding:* Grant R01HL63189 from the National Heart, Lung, and Blood Institute (NHLBI) of the National Institutes of Health (NIH) supported data collection. Grant R01HL73081 from NHLBI of NIH supported the additional analyses and manuscript preparation. S.D.B. was Principal Investigator for both grants. The content of this article is solely the responsibility of the authors and does not necessarily represent the official views of NHLBI or NIH.

*Declaration of conflict of interest:* No author has any conflict of interest.

*Contributions of authors:* Study concept – S.D.B., A.F.S.; study design – S.D.B., A.F.S.; recruitment of schools and subjects, acquisition of data, data coding and entry, quality control – S.D.B., C.H.G.; data programming – J.A.R.; statistical analysis and interpretation of data – J.W.H., J.A.R., S.D.B., A.F.S.; drafting manuscript – S.D.B.; revising manuscript – all authors; obtained funding – S.D.B.

*Acknowledgements:* Children and staff of Willis Foreman, Southside, Rollins, Hephzibah, Glenn Hills and Blythe Elementary Schools, the School Nutrition Program, and the Richmond County (GA) Board of Education are appreciated for allowing data collection. The authors thank Alyssa J. Mackelprang and Elizabeth J. Herron for their comments on earlier versions of this manuscript.

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