Chapter 3. RESULTS.

3.1. Pilot questionnaire.

Results from the pilot questionnaire are provided in **Table 3.** For both the café latte and the flapjack, a higher percentage of volunteers preferred perceived satiation (PS) cue 1 compared to PS cue 2. The percentage of volunteers having no preference for either cue with the café latte (40%) was equal to the percentage who preferred cue 1 (40%). The percentage of volunteers having no preference for either cue with the flapjack (55%) was higher than the percentage who preferred cue 1 (40%). On the basis of these results, cue 1, 'How full do you think you would be after consuming this amount of food/drink?' was selected as the PS cue for use with all test foods and drinks in the study.

Table 3. Percentage preference for PS cues (*n*=20) explored using the pilot questionnaire. Cue 1: How full do you think you would be after consuming this amount of food/drink?; Cue 2: How much of another product do you think you would be able to consume after eating/drinking this amount of food/drink?

Cue	**Café latte (%)**	**Flapjack (%)**
1	40	40
2	10	5
1 or 2	40	55
Neither 1 or 2	10	0

3.2. Participants.

The mean age of participants who completed the study (± SEM) was 24.9 ± 6.5 y. Mean BMI was 23.3 ± 2.4 kg/m^2. Mean dietary restraint, disinhibition and hunger scores were 4.4 ± 3.8, 4.8 ± 2.2 and 6.3 ± 2.8, respectively.

3.3. Normality.

The KS test showed normal distribution of liking scores for all test foods/ drinks (p>0.05) except for the banana (p<0.01) and the chocolate bar (p<0.05). In contrast, the assumption of normality was violated for all familiarity scores (p<0.001) except for cornflakes (p<0.01).

VAS ratings for fullness were normally distributed under all conditions (p>0.05). In contrast, the KS test showed violation of normality for hunger scores assessed at baseline (VAS 0) and pre-test (VAS 2) under conditions H (p<0.01) and F (p<0.05), respectively. Normality for thirst scores was also violated at baseline (VAS 0) under condition HPS (p<0.01).

PS ratings were normally distributed for all foods (p>0.05) except crisps under condition FPS (p<0.05). In contrast, the KS test showed violations of normality for the portion estimates of all foods/drinks under all conditions (p<0.001, except for crisps, condition FPS; hot chocolate, condition F and ice-cream, conditions FPS and HPS, where p<0.01).

The use of parametric techniques (e.g. ANOVA, t-tests and Pearson's product-moment correlation test) requires data to be normally distributed. However, violation of normality does not necessarily indicate heterogeneous data, but may reflect the nature of the construct being measured (Pallant, 2007), e.g. portion estimates tend to be similar and narrowly distributed. A statistician (Colin Sinclair) confirmed that since our data were numeric continuous and *n* was close to thirty, they could be assumed to be normal, so allowing the use of parametric techniques. As recommended by Minke (1997), the Greenhouse-Geisser correction was used to assess significance levels from ANOVAs where sphericity was violated, so decreasing the chances of type 1 and type 2 errors during interpretation of results (see section 2.4).

3.4. Appetite sensation ratings.

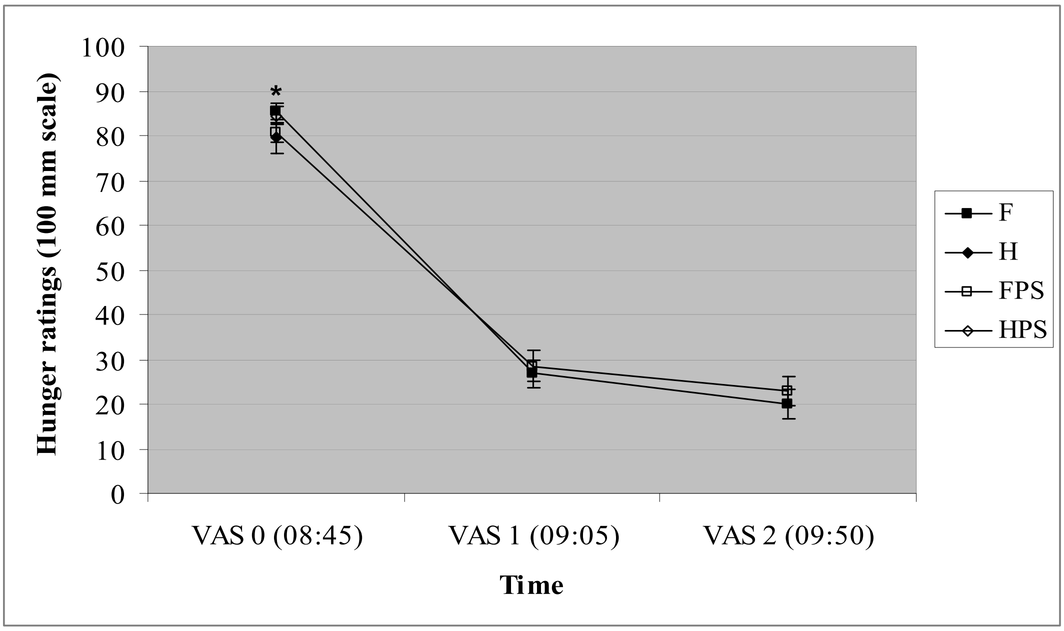
Means and standard errors for hunger, fullness and thirst ratings at each time point, under each condition are shown in **Figures 1, 2 and 3,** respectively. Hunger ratings were highest on arrival (VAS 0, 08:45) and decreased following the breakfast pre-load (conditions F and FPS, VAS 1, 09:05) and again following the post pre-load wait period (conditions F and FPS, VAS 2, 09:50). In accordance with these results, fullness ratings were lowest on arrival, but increased following the breakfast pre-load (conditions F and FPS, VAS 1, 09:05). A further increase in fullness was seen after the post pre-load wait period under condition F at 09:50. However, fullness ratings at

09:50 under condition FPS were slightly lower than at 09:05, although they were still substantially higher than fullness ratings on arrival under all conditions (08:45).

Thirst ratings were highest on arrival, but were reduced following consumption of fluid with the breakfast pre-load (conditions F and FPS, VAS 1, 09:05). At 09:50, following the post pre-load wait period, an increase in thirst ratings was seen under conditions F and FPS. However, thirst ratings at 09:50 were still substantially lower than on arrival (08:45) under all conditions.

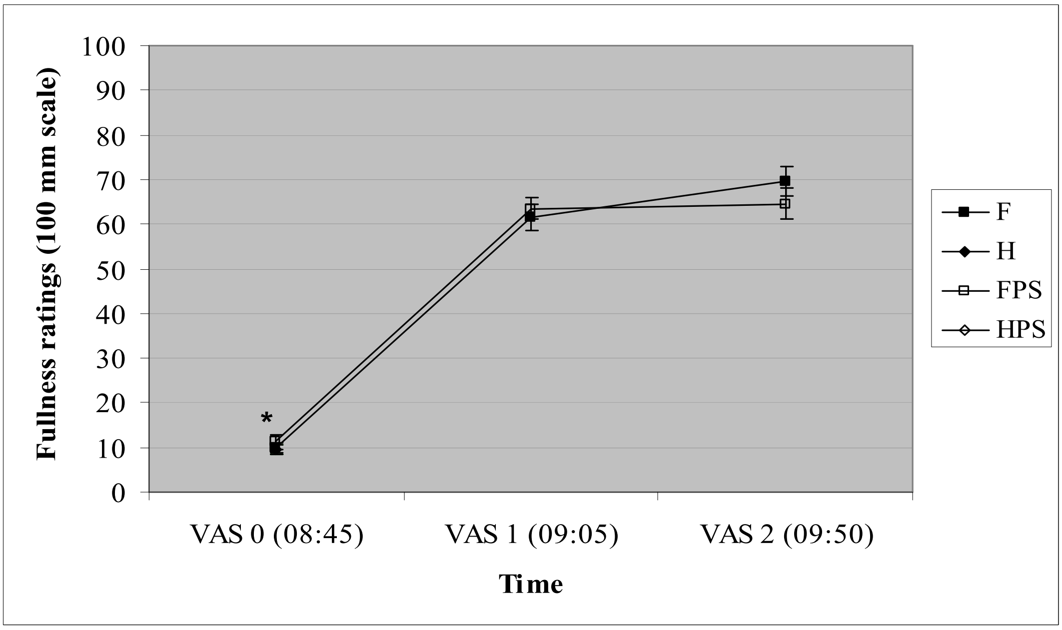
One-way repeated measures ANOVAs, using the Bonferonni correction, were conducted to compare mean hunger, fullness and thirst ratings under each condition at each time point. Results showed a significant main effect of time on hunger [$F(3.93) = 145.63$, $p<0.001$], fullness [$F(3.71) = 188.99$, $p<0.001$] and thirst ratings [$F(7) = 19.05$, $p<0.001$]. Pairwise comparisons indicated hunger and thirst ratings were significantly higher under all conditions at 08:45 compared with 09:05 and 09:50 ($p<0.001$ and $p<0.05$, respectively). In contrast, fullness ratings were significantly lower on arrival (08:45) under all conditions compared with fullness ratings at 09:05 and 09:50 ($p<0.001$). These results confirm the effect of the breakfast intervention and the robustness of the data.

Figure 1. Mean hunger ratings (±SEM) at each time point according to condition (*n*=27). *Abbreviations: F*, fullness; *H*, hunger; *FPS*, fullness with PS cue; *HPS*, hunger with PS cue.



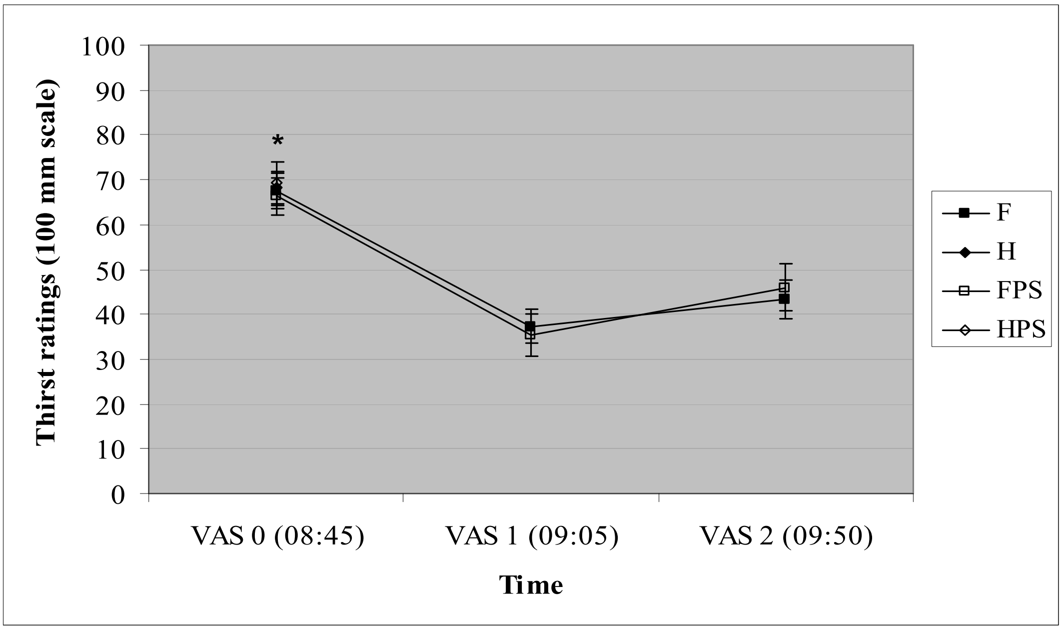
*Differs from VAS 1 and VAS 2 with *p*<0.001.

Figure 2. Mean fullness ratings (±SEM) at each time point according to condition (*n*=27). *Abbreviations: F*, fullness; *H*, hunger; *FPS*, fullness with PS cue; *HPS*, hunger with PS cue.



*Differs from VAS 1 and VAS 2 with *p*<0.001.

Figure 3. Mean thirst ratings (±SEM) at each time point according to condition (*n*=27). *Abbreviations: F*, fullness; *H*, hunger; *FPS*, fullness with PS cue; *HPS*, hunger with PS cue.



*Differs from VAS 1 and VAS 2 ($p<0.01$), except for VAS 0 condition F compared with VAS 1, condition F and VAS 0, condition H compared with VAS 1, condition FPS, where $p<0.05$.

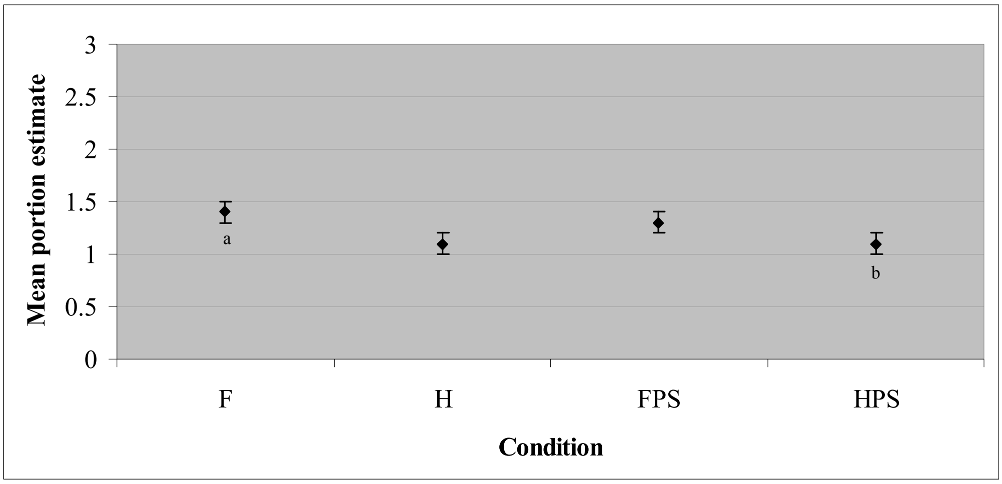
3.5. Effect of appetite status and PS cue on portion size estimation.

Mean portion size estimates and standard errors for each test food/drink under each condition are shown in **Figures 4 - 11.** The smallest mean estimate (0.8 portions) was for the banana under conditions H and HPS. The largest mean estimate (2.6 portions) was for the crisps under condition F. The modal and median estimates were both 1.0, irrespective of condition.

Mean estimates were larger under conditions F and FPS compared with conditions H and HPS for all foods and drinks. One-way repeated measures ANOVAs were conducted to compare mean estimates for each food and drink under each condition. Results showed a significant main effect of condition on mean portion estimates for all foods and drinks as follows: for chocolate bar, $F(3) = 6.03$, $p<0.01$; for muffin, $F(3) = 4.16$, $p<0.01$; for banana, $F(1.89) = 4$, $p<0.05$; for cola, $F(2.12) = 3.45$, $p<0.05$; for cornflakes, $F(2.33) = 4.28$, $p<0.05$; for crisps, $F(2.36) = 7.18$, $p<0.01$; for hot chocolate, $F(3) = 6.7$, $p<0.001$; for ice-cream, $F(3) = 4.19$, $p<0.01$. Pairwise comparisons using the Bonferonni correction indicated mean portion estimates were significantly larger under specific conditions as follows: F compared with HPS for the cola, chocolate bar, crisps and hot chocolate ($p<0.05$); FPS compared with HPS for the muffin and hot chocolate ($p<0.05$) and F compared with H for the crisps ($p<0.01$). Differences in mean portion estimates between specific conditions were not detected for the banana, cornflakes or ice-cream, although the overall effect of condition remained significant.

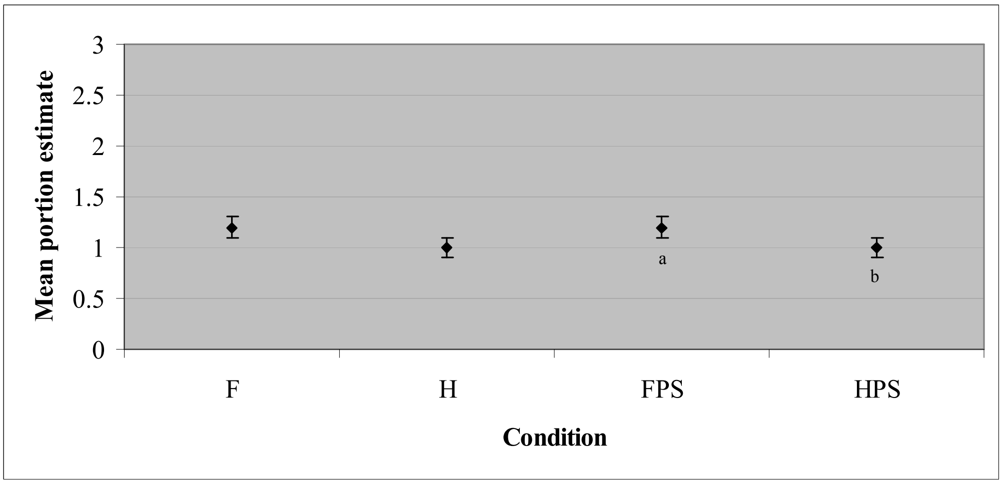
Pairwise comparisons also revealed several trends in certain foods when comparing mean portion estimates amongst conditions. Mean estimates for the muffin and cornflakes tended to be larger under condition F compared with H ($p=0.084$ and $p=0.053$, respectively) and smaller when comparing condition H with FPS ($p=0.088$ and $p=0.068$, respectively). When comparing condition F with H and FPS with HPS, mean portion estimates for the chocolate bar tended to be larger for the F conditions ($p=0.061$). Also, mean portion estimates for the ice-cream tended to be larger when comparing condition F with HPS ($p=0.09$). Overall, results showed that portion size estimates were smaller when participants were hungry compared with when they were full.

Figure 4. Mean portion estimates (±SEM) for chocolate bar according to condition (n=27). Amount of chocolate bar displayed (85 g) corresponds to: 8.5 portions (DOM UK); 2 portions (FSA); 2.5 portions (ADA) and 2 portions (FDA)[1]. *Abbreviations: F*, fullness; *H*, hunger; *FPS*, fullness with PS cue; *HPS*, hunger with PS cue.



Means marked with different letters are significantly different (p<0.01).

Figure 5. Mean portion estimates (±SEM) for muffin according to condition (n=27). Amount of muffin displayed (140 g) corresponds to: 11.5 portions (DOM UK); 1.5 portions (FSA); 5 portions (ADA) and 2.5 portions (FDA). *Abbreviations: F*, fullness; *H*, hunger; *FPS*, fullness with PS cue; *HPS*, hunger with PS cue.



Means marked with different letters are significantly different (p<0.05).

[1] For details on portion size guidance schemes, please refer to Section 1.4).

Figure 6. Mean portion estimates (±SEM) for banana according to condition (*n*=27). Amount of banana displayed (140 g) corresponds to: 2 portions (DOM UK); 0.8 portions (FSA); 1 portion (ADA) and 0.5 portions (FDA). *Abbreviations: F*, fullness; *H*, hunger; *FPS*, fullness with PS cue; *HPS*, hunger with PS cue.

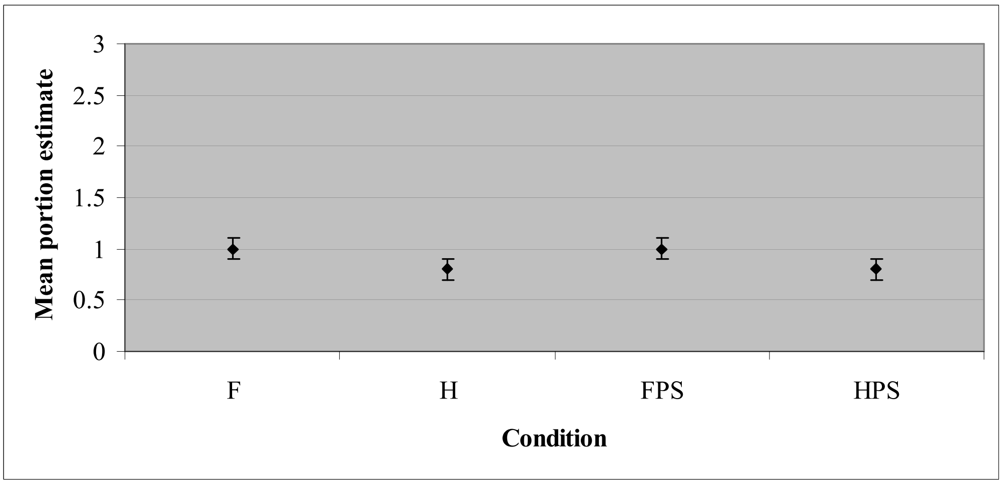
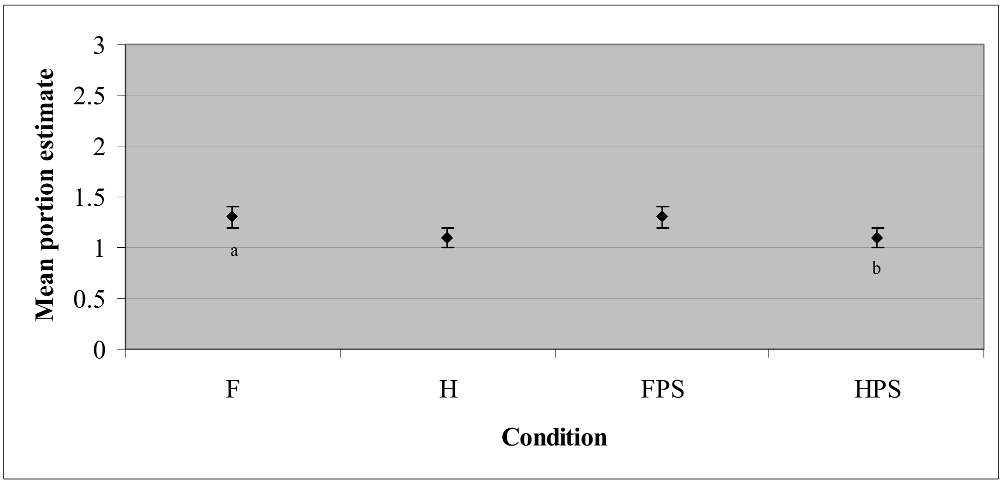


Figure 7. Mean portion estimates (±SEM) for cola according to condition (*n*=27). Amount of cola displayed (500 ml) corresponds to: 4 portions (DOM UK); 2 portions (FSA); 1.5 portions (ADA) and 2 portions (FDA). *Abbreviations: F*, fullness; *H*, hunger; *FPS*, fullness with PS cue; *HPS*, hunger with PS cue.



Means marked with different letters are significantly different (p<0.05).

Figure 8. Mean portion estimates (±SEM) for cornflakes according to condition (n=27). Amount of cornflakes displayed (63 g) corresponds to: 3 portions (DOM UK); 2 portions (FSA); 3 portions (ADA) and 2 portions (FDA). *Abbreviations: F*, fullness; *H*, hunger; *FPS*, fullness with PS cue; *HPS*, hunger with PS cue.

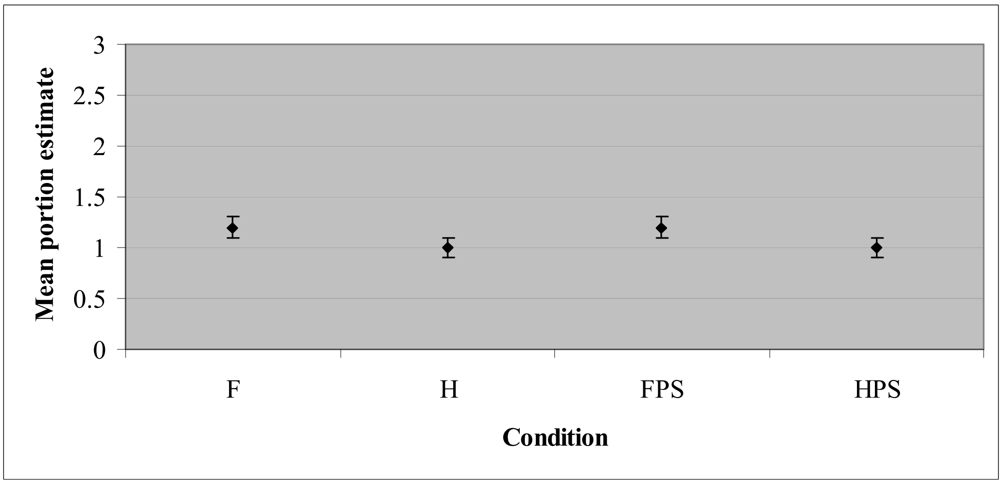
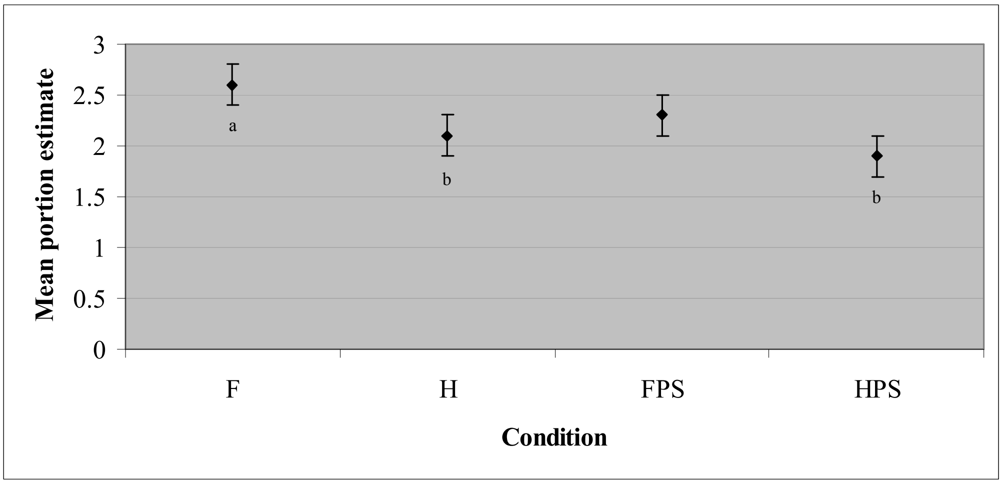
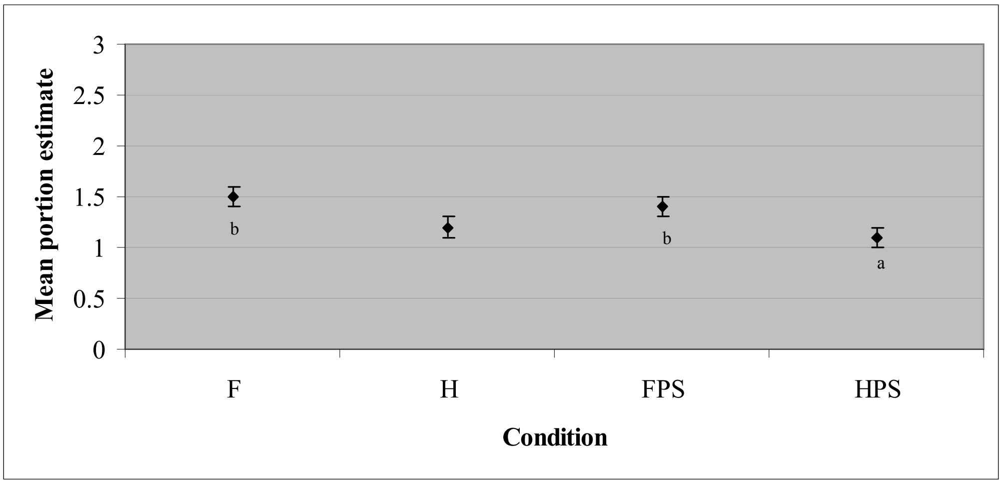


Figure 9. Mean portion estimates (±SEM) for crisps according to condition (n=27). Amount of crisps displayed (150 g) corresponds to: 15 portions (DOM UK); 4 portions (FSA); 7 portions (ADA) and 5 portions (FDA). *Abbreviations: F*, fullness; *H*, hunger; *FPS*, fullness with PS cue; *HPS*, hunger with PS cue.



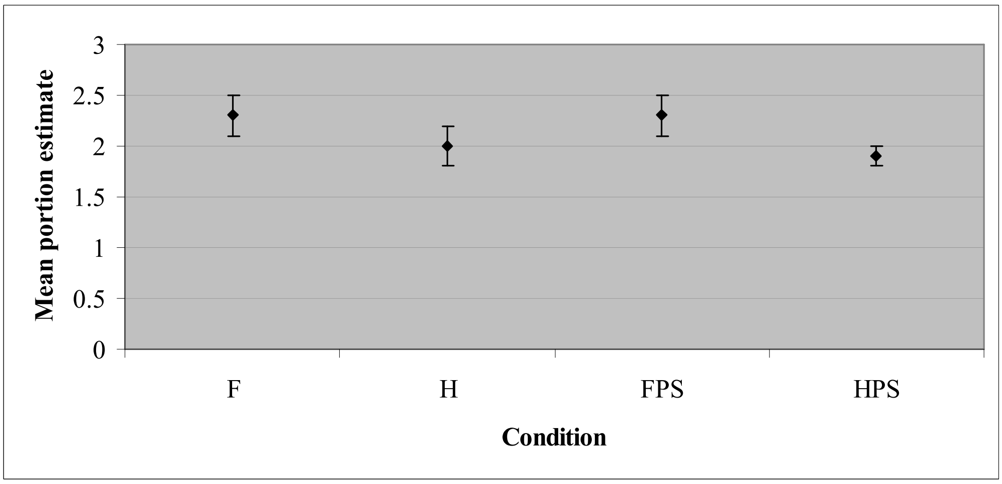
Means marked with different letters are significantly different (p<0.01).

Figure 10. Mean portion estimates (±SEM) for hot chocolate according to condition (*n*=27). Amount of hot chocolate displayed (473 ml) corresponds to: 5.5 portions (DOM UK); 2.5 portions (FSA); 2 portions (ADA) and 2 portions (FDA). *Abbreviations: F*, fullness; *H*, hunger; *FPS*, fullness with PS cue; *HPS*, hunger with PS cue.



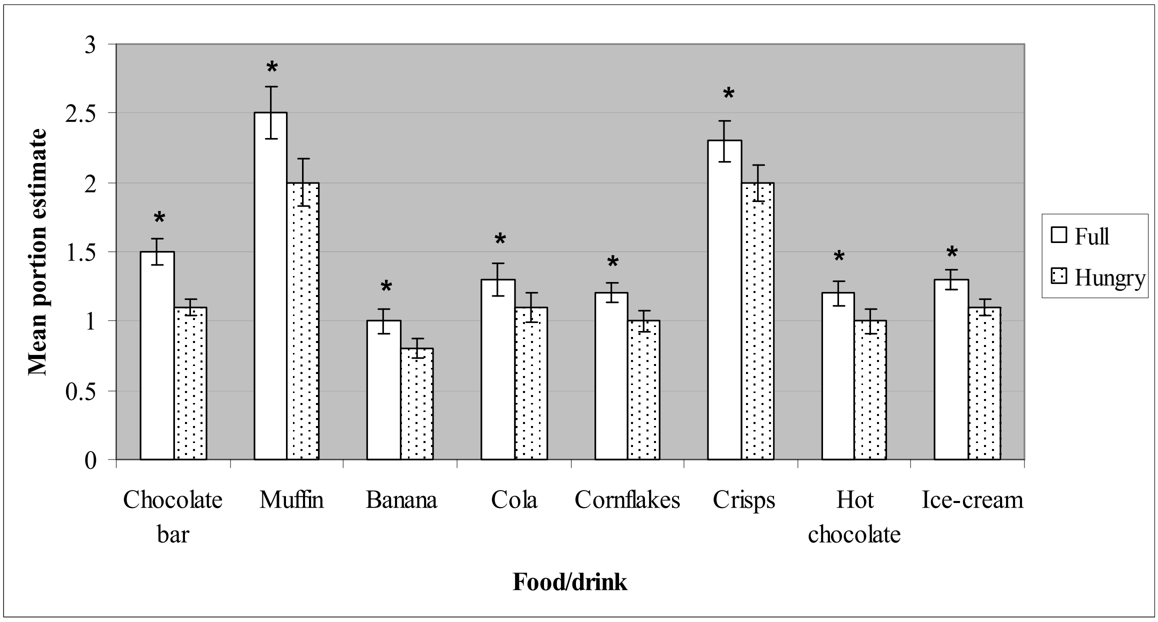
Means marked with different letters are significantly different: F and FPS, $p<0.01$; FPS and HPS, $p<0.05$.

Figure 11. Mean portion estimates (±SEM) for ice-cream according to condition (*n*=27). Amount of ice-cream displayed (427 g) corresponds to: 24.5 portions (DOM UK); 5.5 portions (FSA); 6 portions (ADA) and 3.5 portions (FDA). *Abbreviations: F*, fullness; *H*, hunger; *FPS*, fullness with PS cue; *HPS*, hunger with PS cue.



Nested ANOVAs were conducted to assess the independent and interactive effects of hunger and PS cue on mean portion size estimates for each food and drink. Mean estimates were derived from pooled data as follows: hunger (H+HPS); fullness (F+FPS); PS cue (FPS+HPS) and no PS cue (F+H). Results showed a significant main effect of hunger on mean portion size estimates for all foods and drinks as follows: for chocolate bar, $F(1) = 13.41$, $p<0.01$; for muffin, $F(1) = 15.46$, $p<0.01$; for banana, $F(1) = 9.45$, $p<0.01$; for cola, $F(1) = 10.12$, $p<0.01$; for cornflakes, $F(1) = 8.62$, $p<0.01$; for crisps, $F(1) = 11.84$, $p<0.01$; for hot chocolate, $F(1) = 15.7$, $p<0.01$; for ice-cream, $F(1) = 10.72$, $p<0.01$. These results confirmed that for all foods and drinks, mean portion size estimates were significantly smaller when participants were hungry compared with when they were full ($p<0.01$, **Figure 12**). In contrast there was no significant effect of PS cue on mean portion size estimates for any of the test foods or drinks ($p>0.05$) as suspected from the repeated measures ANOVAs (**Figures 4 – 11**). However, a trend was observed for mean portion estimates of the crisps to be smaller in the presence (2.1 ± 0.16) as opposed to the absence of the PS cue (2.3 ± 0.19) ($p=0.07$). There was no significant interaction of hunger and PS cue on mean portion estimates for any of the test foods/drinks ($p>0.05$).

Figure 12. Mean portion estimates for test foods and drinks under full and hungry conditions (pooled data, *n*=54, see text).

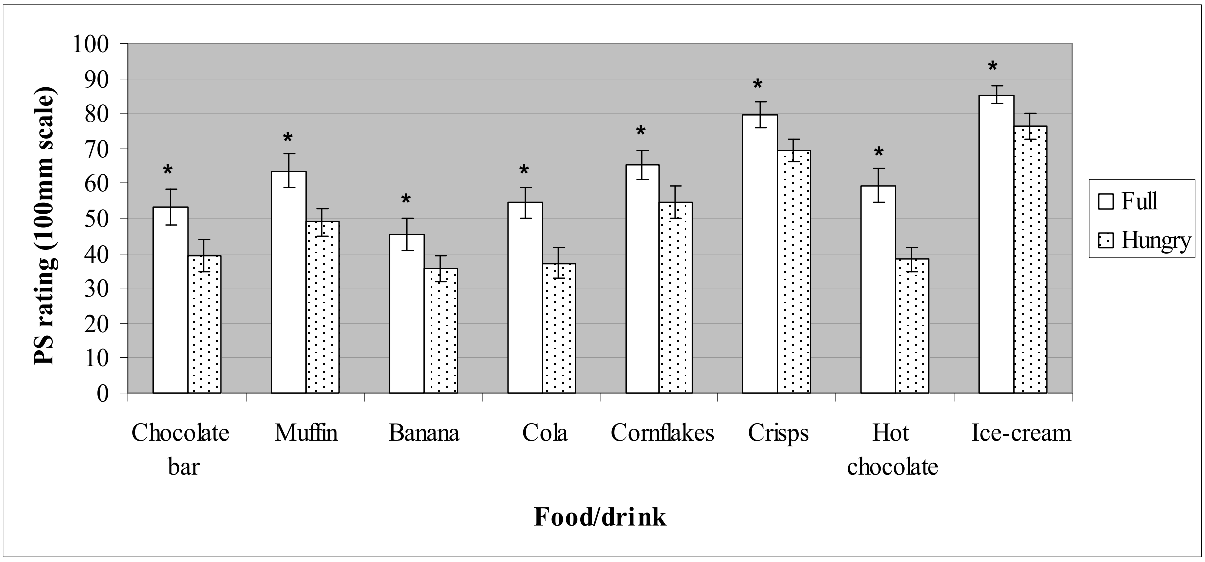


*Differs from hungry conditions with $p<0.01$.

3.6. Effect of appetite status on PS VAS ratings.

Mean PS VAS ratings for foods and drinks under full and hungry conditions were compared using paired sample *t*-tests. Results showed mean PS ratings were significantly higher in all foods and drinks under full conditions compared with hungry conditions, as follows: for chocolate bar, $t(26) = 3.37$, $p<0.01$; for muffin, $t(26) = 4.69$, $p<0.001$; for banana, $t(26) = 2.38$, $p<0.05$; for cola, $t(26) = 3.89$, $p<0.01$; for cornflakes, $t(26) = 3.13$, $p<0.01$; for crisps, $t(26) = 3.32$, $p<0.01$; for hot chocolate, $t(26) = 5.51$, $p<0.001$; for ice-cream, $t(26) = 3.37$, $p<0.01$ (**Figure 13**).

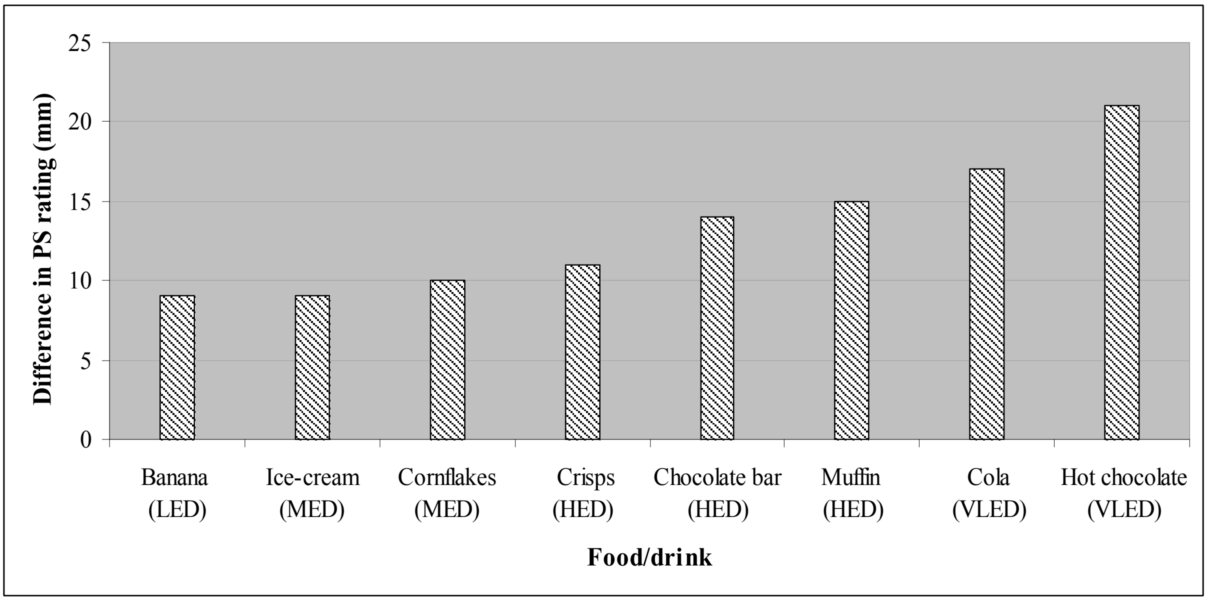
Figure 13. Mean PS ratings for foods and drinks under full and hungry conditions (n=27), recorded in response to the following PS cue 'How full do you think you would be after consuming this amount of food/drink?'



*Differs from hungry condition as follows: muffin and hot chocolate, p<0.001; chocolate bar, cola, cornflakes, crisps and ice-cream, p<0.01; banana, p<0.05.

On exploring specific differences in mean PS VAS ratings for each food and drink under full and hungry conditions, results showed that variations were greater in foods of HED (crisps, chocolate bar, muffin) and beverages than in foods of lower energy densities (banana, ice-cream, cornflakes) (**Figure 14**). Overall these results indicate that PS is affected by appetite status and possibly food form (liquid vs. solid), plus knowledge of the energy density of the food.

Figure 14. Differences in PS ratings between full and hungry conditions for each food and drink.



3.7. The relationship between food attributes and PS VAS ratings.

The Pearson's product-moment correlation test was used to investigate the relationship between PS VAS ratings and energy density of test foods, under conditions FPS and HPS. Results showed a weak positive correlation between PS VAS ratings and energy density of test foods under full (**Figure 15**) and hungry (**Figure 16**) conditions ($r = 0.20$, $n = 162$, $p<0.05$ and $r = 0.16$, $n = 162$, $p<0.05$, respectively). Percentage variance showed that energy density was responsible for 4% of the variance in PS VAS ratings under full conditions and 3% under hungry conditions[1]. Drinks were excluded from the analysis as research suggests that caloric beverages promote a distorted perception of satiety, perhaps due to physiological

[1] Percentage variance calculated as follows: (r^2) x 100.

mechanisms within the body being less precise in detecting energy contained in liquids than in solid foods (Burger et al. 2007; Almiron-Roig et al. 2003).

Figure 15. Correlation between PS ratings and energy density under full conditions (*r* = 0.20, *n* = 162, *p*<0.05).

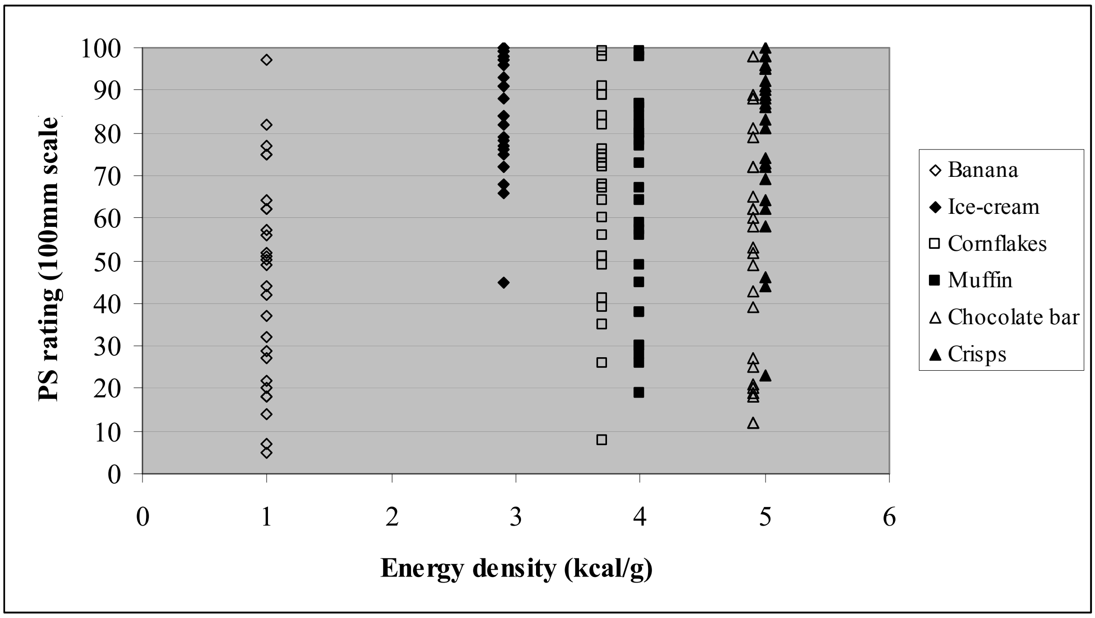
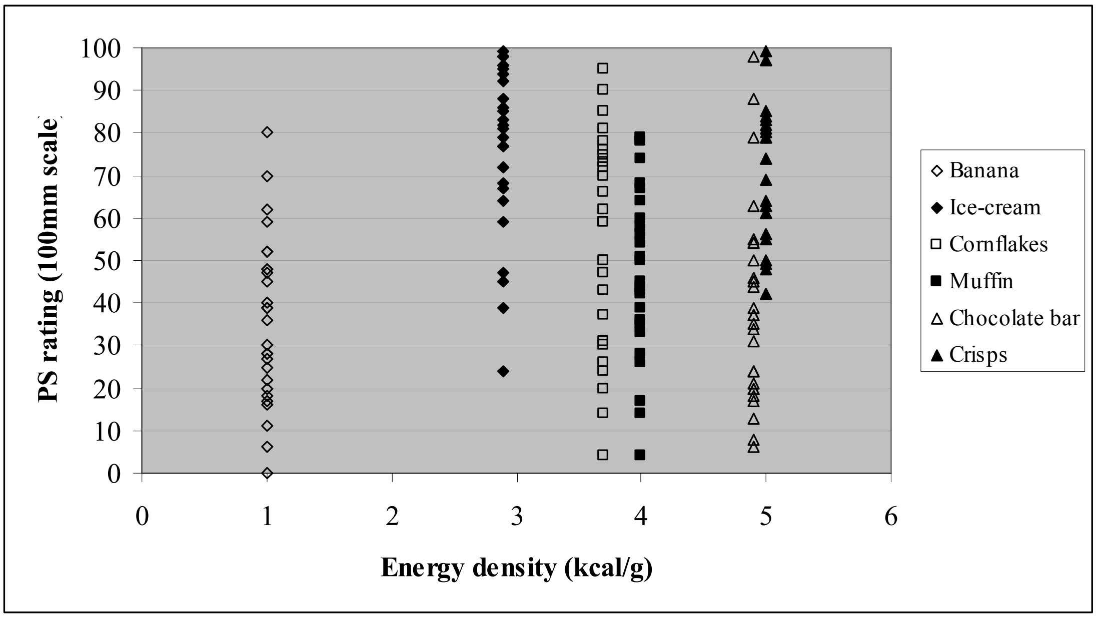


Figure 16. Correlation between PS ratings and energy density under hungry conditions (*r* = 0.16, *n* = 162, *p*<0.05).



The Pearson's product-moment correlation test was used to investigate the relationship between PS VAS ratings and weight of test foods, under conditions FPS and HPS. Results showed a weak positive correlation between PS VAS ratings and weight of test foods under full and hungry conditions ($r = 0.40$, $n = 162$, $p<0.001$ and $r = 0.44$, $n = 162$, $p<0.001$, respectively). Percentage variance showed that weight of food was responsible for 16% of the variance in PS VAS ratings under full conditions and 19% under hungry conditions. Drinks were excluded from the analysis for reasons discussed above.

Finally, the Pearson's product-moment correlation test was used to investigate the relationship between PS VAS ratings and energy load of test foods, under conditions FPS and HPS. Results showed a close to modest positive correlation between PS VAS ratings and energy load of test foods under full conditions ($r = 0.47$, $n = 162$, $p<0.001$). Under hungry conditions, the strength of the correlation between PS VAS ratings and energy load of test foods increased to modest positive ($r = 0.50$, $n = 162$, $p<0.001$). Percentage variance showed that energy load was responsible for 22% of the variance in PS VAS ratings under full conditions and 25% under hungry conditions. Drinks were excluded from the analysis for reasons discussed above.

Overall, these results indicate that energy load had the greatest influence on PS VAS ratings, followed by weight and energy density.

3.8. Effect of appetite status on accuracy of portion size estimation.

In order to visualise the difference between mean portion size estimates for each food and drink and actual portion sizes displayed, a percent error was calculated using the portion size standards from: Dietitians in Obesity Management (DOM) UK (2005), the Food Standards Agency (FSA) (2002) (Crawley, 2002), the American Dietetic Association (ADA) (2007) and the US Food and Drug Administration (FDA) (2001) (**Tables 4 – 7**, respectively). Since a nested ANOVA showed no significant effect of PS cue on mean portion estimates, mean estimates presented in each table were derived from pooled data as follows: fullness (F + FPS) and hunger (H + HPS).

When comparing percentage error values for each food and drink under full and hungry conditions, values were always greater when subjects were hungry compared with when they were full, irrespective of the standard used for comparison (**Tables 4 – 7**). The only exception was for the banana with respect to government standards (FSA and FDA). Compared with FSA standards, the percentage error value for the banana under full conditions was 25%. However, under hungry conditions, compared with FSA standards, the portion size estimate for the banana was correct. Compared with FDA standards, under full and hungry conditions, percentage error values for the banana were 100% and 60%, respectively. Therefore, with reference to government standards, percentage error values for the banana were greater under full rather than hungry conditions. These results thus confirm that portion sizes of all foods and drinks, except the banana, were estimated with more accuracy when people were full compared with when they were hungry, irrespective of the standard used for comparison. For all the foods and drinks used in the study, compared with all four standards and the banana compared with health professional standards (DOM UK and ADA), inaccuracies under both conditions occurred in a negative direction and were therefore due to underestimation. Therefore, since percentage error values were greater under hungry compared with full conditions (**Tables 4 – 7**), these results further confirm the results from repeated measures and nested ANOVAs, i.e. portion size estimates were larger in all foods and drinks when people were full compared with when they were hungry (**Figure 12**). In contrast, percentage error values for the banana based on government standards occurred in a positive direction and were therefore due to over rather than under estimation (**Tables 5 and 7**). However, since these percentage error values were larger under full compared with hungry conditions, this also confirms the results from repeated measures and nested ANOVAs, i.e. portion size estimates were larger in all foods and drinks when people were full compared with when they were hungry. Results also showed that that the banana was the only test item in the study which was over estimated or estimated correctly.

Table 4. Percentage error of mean portion size estimates for each food and drink under full and hungry conditions (pooled data, *n*=54, see text) based on standards from **Dietitians in Obesity Management (DOM) UK (2005)**[1]. *Abbreviations: F,* full; *H,* hungry; *SEM,* standard error of the mean.

Food/Drink	Standard portion size	Mean estimate (±SEM)	% error[a]
Chocolate bar	8.5	**1.3 (±0.09) (F)**	**-84.7 (F)**
		1.1 (±0.08) (H)	-87.1 (H)
Muffin	11.5	**1.2 (±0.07) (F)**	**-89.6 (F)**
		1.0 (±0.06) (H)	-91.3 (H)
Banana	2	**1.0 (±0.08) (F)**	**-50.0 (F)**
		0.8 (±0.05) (H)	-60 (H)
Cola	4	**1.3 (±0.06) (F)**	**-67.5 (F)**
		1.1 (±0.05) (H)	-72.5 (H)
Cornflakes	3	**1.2 (±0.06) (F)**	**-60 (F)**
		1.0 (±0.06) (H)	-66.7 (H)
Crisps	15	**2.5 (±0.14) (F)**	**-83.3 (F)**
		2.0 (±0.13) (H)	-86.7 (H)
Hot-chocolate	5.5	**1.5 (±0.08) (F)**	**-72.7 (F)**
		1.1 (±0.05) (H)	-80 (H)
Ice-cream	24.5	**2.3 (±0.11) (F)**	**-90.6 (F)**
		2.0 (±0.10) (H)	-91.8 (H)

[a]Percentage error calculated as follows: [(mean estimate - standard) / standard] x 100 (Blake et al. 1989).

[1] For a full description of test foods/drinks and details of standards used to calculate amounts displayed, see Appendices 14 and 16.

Table 5. Percentage error of mean portion size estimates for each food and drink under full and hungry conditions (pooled data, *n*=54, see text) based on standards from the **Food Standards Agency (FSA) (2002)** (Crawley, 2002). *Abbreviations: F,* full; *H,* hungry; *SEM,* standard error of the mean.

Food/Drink	Standard portion size	Mean estimate (±SEM)	% error[a]
Chocolate bar	2	**1.3 (±0.09) (F)**	**-35.0 (F)**
		1.1 (±0.08) (H)	-45.0 (H)
Muffin	1.5	**1.2 (±0.07) (F)**	**-20.0 (F)**
		1.0 (±0.06) (H)	-33.3 (H)
Banana	0.8	**1.0 (±0.08) (F)**	**25.0 (F)**
		0.8 (±0.05) (H)	0 (H)
Cola	2	**1.3 (±0.06) (F)**	**-35.0 (F)**
		1.1 (±0.05) (H)	-45.0 (H)
Cornflakes	2	**1.2 (±0.06) (F)**	**-40.0 (F)**
		1.0 (±0.06) (H)	-50.0 (H)
Crisps	4	**2.5 (±0.14) (F)**	**-37.5 (F)**
		2.0 (±0.13) (H)	-50.0 (H)
Hot-chocolate	2.5	**1.5 (±0.08) (F)**	**-40 (F)**
		1.1 (±0.05) (H)	-56.0 (H)
Ice-cream	5.5	**2.3 (±0.11) (F)**	**-58.2 (F)**
		2.0 (±0.10) (H)	-63.6 (H)

[a]Percentage error calculated as follows: [(mean estimate - standard) / standard] x 100 (Blake et al. 1989).

Table 6. Percentage error of mean portion size estimates for each food and drink under full and hungry conditions (pooled data, *n*=54, see text) based on standards from the **American Dietetic Association (ADA) (2007)**. *Abbreviations: F,* full; *H,* hungry; *SEM,* standard error of the mean.

Food/Drink	**Standard portion size**	**Mean estimate (±SEM)**	**% error**[a]
Chocolate bar	2.5	**1.3 (±0.09) (F)**	**-48.0 (F)**
		1.1 (±0.08) (H)	-56.0 (H)
Muffin	5	**1.2 (±0.07) (F)**	**-76.0 (F)**
		1.0 (±0.06) (H)	-80.0 (H)
Banana	1	**1.0 (±0.08) (F)**	**0 (F)**
		0.8 (±0.05) (H)	-20.0 (H)
Cola	1.5	**1.3 (±0.06) (F)**	**-13.3 (F)**
		1.1 (±0.05) (H)	-26.7 (H)
Cornflakes	3	**1.2 (±0.06) (F)**	**-60.0 (F)**
		1.0 (±0.06) (H)	-66.7 (H)
Crisps	7	**2.5 (±0.14) (F)**	**-64.3 (F)**
		2.0 (±0.13) (H)	-71.4 (H)
Hot-chocolate	2	**1.5 (±0.08) (F)**	**-25.0 (F)**
		1.1 (±0.05) (H)	-45.0 (H)
Ice-cream	6	**2.3 (±0.11) (F)**	**-61.7 (F)**
		2.0 (±0.10) (H)	-66.7 (H)

[a]Percentage error calculated as follows: [(mean estimate - standard) / standard] x 100 (Blake et al. 1989).

Table 7. Percentage error of mean portion size estimates for each food and drink under full and hungry conditions (pooled data, *n*=54, see text) based on standards from the **Food and Drug Administration (FDA) (2001)**. *Abbreviations: F,* full; *H,* hungry; *SEM,* standard error of the mean.

Food/Drink	Standard portion size	Mean estimate (±SEM)	% error[a]
Chocolate bar	2	**1.3 (±0.09) (F)**	**-35.0 (F)**
		1.1 (±0.08) (H)	-45.0 (H)
Muffin	2.5	**1.2 (±0.07) (F)**	**-52.0 (F)**
		1.0 (±0.06) (H)	-60.0 (H)
Banana	0.5	**1.0 (±0.08) (F)**	**100.0 (F)**
		0.8 (±0.05) (H)	60.0 (H)
Cola	2	**1.3 (±0.06) (F)**	**-35.0 (F)**
		1.1 (±0.05) (H)	-45.0 (H)
Cornflakes	2	**1.2 (±0.06) (F)**	**-40.0 (F)**
		1.0 (±0.06) (H)	-50.0 (H)
Crisps	5	**2.5 (±0.14) (F)**	**-50.0 (F)**
		2.0 (±0.13) (H)	-60.0 (H)
Hot-chocolate	2	**1.5 (±0.08) (F)**	**-25.0 (F)**
		1.1 (±0.05) (H)	-45.0 (H)
Ice-cream	3.5	**2.3 (±0.11) (F)**	**-34.3 (F)**
		2.0 (±0.10) (H)	-42.9 (H)

[a]Percentage error calculated as follows: [(mean estimate - standard) / standard] x 100 (Blake et al. 1989).

To quantify the degree of discrepancy, mean portion estimates under full and hungry conditions were compared with actual portion sizes based on all four standards (DOM UK, the FSA, the ADA and the FDA) using one-sample *t*-tests. Since nested ANOVA showed no significant effect of PS cue on mean portion estimates, mean estimates presented in each table were derived from pooled data before.

Results showed that mean portion estimates were significantly smaller than actual portions displayed based on DOM UK standards for all foods and drinks, irrespective of appetite status (p<0.001) (**Table 8**). This was also true when comparing mean portion estimates with actual amounts displayed based on FSA, ADA and FDA standards (p<0.001), except for the banana (**Tables 9, 10 and 11,** respectively). Mean estimate for the banana under both conditions was significantly larger than the actual amount displayed based on FDA standards (p<0.001). Also, mean estimate for the banana under full conditions was significantly larger than the amount displayed based on FSA standards (p<0.05), although there was no significant difference under hungry conditions (p>0.05). Mean estimate for the banana under hungry conditions was significantly smaller than the actual amount displayed based on ADA standards (p<0.001), although there was no significant difference under full conditions (p>0.05). The banana was the only food where differences between mean portion estimates and actual portions sizes based on some standards failed to reach statistical significance.

Table 8. Comparison of mean portion estimates (pooled data, *n*=54, see text) under full and hungry conditions with actual amounts displayed based on standards from **Dietitians in Obesity Management (DOM) UK (2005)** using one sample *t*-tests. *Abbreviations: F,* full; *H,* hungry; *SEM,* standard error of the mean.

Food/Drink	Standard portion size	Mean estimate (±SEM)	*t* value[a]	*p* value
Chocolate bar	8.5	**1.3 (±0.09) (F)**	***t* = -81.80 (F)**	***p*<0.001 (F)**
		1.1(±0.08) (H)	*t* = -88.37 (H)	*p*<0.001 (H)
Muffin	11.5	**1.2 (±0.07) (F)**	***t* = -147.69 (F)**	***p*<0.001(F)**
		1.0(±0.06) (H)	*t* = -162.90 (H)	*p*<0.001(H)
Banana	2	**1.0 (±0.08) (F)**	***t* = -12.83 (F)**	***p*<0.001(F)**
		0.8(±0.05) (H)	*t* = -24.66 (H)	*p*<0.001(H)
Cola	4	**1.3 (±0.06) (F)**	***t* = -47.77 (F)**	***p*<0.001(F)**
		1.1(±0.05) (H)	*t* = -53.77 (H)	*p*<0.001(H)
Cornflakes	3	**1.2 (±0.06) (F)**	***t* = -29.79 (F)**	***p*<0.001(F)**
		1.0(±0.06) (H)	*t* = -33.27 (H)	*p*<0.001(H)
Crisps	15	**2.5 (±0.14) (F)**	***t* = -88.12 (F)**	***p*<0.001(F)**
		2.0(±0.13) (H)	*t* = -100.01 (H)	*p*<0.001(H)
Hot-chocolate	5.5	**1.5 (±0.08) (F)**	***t* = -52.30 (F)**	***p*<0.001(F)**
		1.1(±0.05) (H)	*t* = -86.47 (H)	*p*<0.001(H)
Ice-cream	24.5	**2.3 (±0.11) (F)**	***t* = -196.16 (F)**	***p*<0.001(F)**
		2.0(±0.10) (H)	*t* = -216.81 (H)	*p*<0.001(H)

[a]Degrees of freedom (*df*) = 53.

Table 9. Comparison of mean portion estimates (pooled data, *n*=54, see text) under full and hungry conditions with actual amounts displayed based on standards from the **Food Standards Agency (FSA) 2002** (Crawley, 2002) using one sample *t*-tests. *Abbreviations: F,* full; *H,* hungry; *SEM,* standard error of the mean.

Food/Drink	**Standard portion size**	**Mean estimate (±SEM)**	***t* value[a]**	***p* value**
Chocolate bar	2	**1.3 (±0.09) (F)**	***t* = -7.51 (F)**	***p*<0.001 (F)**
		1.1(±0.08) (H)	*t* = -10.98 (H)	*p*<0.001 (H)
Muffin	1.5	**1.2 (±0.07) (F)**	***t* = -4.32 (F)**	***p*<0.001(F)**
		1.0(±0.06) (H)	*t* = -7.62 (H)	*p*<0.001(H)
Banana	0.8	**1.0 (±0.08) (F)**	***t* = 2.57 (F)**	***p*<0.05(F)**
		0.8(±0.05) (H)	*t* = -0.26 (H)	*p*>0.05(H)
Cola	2	**1.3 (±0.06) (F)**	***t* = -12.79 (F)**	***p*<0.001(F)**
		1.1(±0.05) (H)	*t* = -16.84 (H)	*p*<0.001(H)
Cornflakes	2	**1.2 (±0.06) (F)**	***t* = -13.12 (F)**	***p*<0.001(F)**
		1.0(±0.06) (H)	*t* = -16.56 (H)	*p*<0.001(H)
Crisps	4	**2.5 (±0.14) (F)**	***t* = -10.80 (F)**	***p*<0.001(F)**
		2.0(±0.13) (H)	*t* = -15.51 (H)	*p*<0.001(H)
Hot-chocolate	2.5	**1.5 (±0.08) (F)**	***t* = -13.52 (F)**	***p*<0.001(F)**
		1.1(±0.05) (H)	*t* = -27.24 (H)	*p*<0.001(H)
Ice-cream	5.5	**2.3 (±0.11) (F)**	***t* = -28.09 (F)**	***p*<0.001(F)**
		2.0(±0.10) (H)	*t* = -34.01 (H)	*p*<0.001(H)

[a]Degrees of freedom (*df*) = 53.

Table 10. Comparison of mean portion estimates (pooled data, *n*=54, see text) under full and hungry conditions with actual amounts displayed based on standards from the **American Dietetic Association (ADA) (2007)** using one sample *t*-tests. *Abbreviations: F,* full; *H,* hungry; *SEM,* standard error of the mean.

Food/Drink	Standard portion size	Mean estimate (±SEM)	*t* value[a]	*p* value
Chocolate bar	2.5	**1.3 (±0.09) (F)**	***t* = -13.23 (F)**	***p*<0.001 (F)**
		1.1(±0.08) (H)	*t* = -16.93 (H)	*p*<0.001 (H)
Muffin	5	**1.2 (±0.07) (F)**	***t* = -54.50 (F)**	***p*<0.001 (F)**
		1.0(±0.06) (H)	*t* = -61.97 (H)	*p*<0.001 (H)
Banana	1	**1.0 (±0.08) (F)**	***t* = 0 (F)**	***p*>0.05 (F)**
		0.8(±0.05) (H)	*t* = -4.33 (H)	*p*<0.001 (H)
Cola	1.5	**1.3 (±0.06) (F)**	***t* = -4.01 (F)**	***p*<0.001 (F)**
		1.1(±0.05) (H)	*t* = -7.61 (H)	*p*<0.001 (H)
Cornflakes	3	**1.2 (±0.06) (F)**	***t* = -29.79 (F)**	***p*<0.001 (F)**
		1.0(±0.06) (H)	*t* = -33.27 (H)	*p*<0.001 (H)
Crisps	7	**2.5 (±0.14) (F)**	***t* = -31.89 (F)**	***p*<0.001 (F)**
		2.0(±0.13) (H)	*t* = -38.56 (H)	*p*<0.001 (H)
Hot-chocolate	2	**1.5 (±0.08) (F)**	***t* = -7.06 (F)**	***p*<0.001 (F)**
		1.1(±0.05) (H)	*t* = -17.37 (H)	*p*<0.001 (H)
Ice-cream	6	**2.3 (±0.11) (F)**	***t* = -32.52 (F)**	***p*<0.001 (F)**
		2.0(±0.10) (H)	*t* = -38.84 (H)	*p*<0.001 (H)

[a]Degrees of freedom (*df*) = 53.

Table 11. Comparison of mean portion estimates (pooled data, *n*=54, see text) under full and hungry conditions with actual amounts displayed based on standards from the Food and Drug Administration **(FDA) (2001)** using one sample *t*-tests. *Abbreviations: F,* full; *H,* hungry; *SEM,* standard error of the mean.

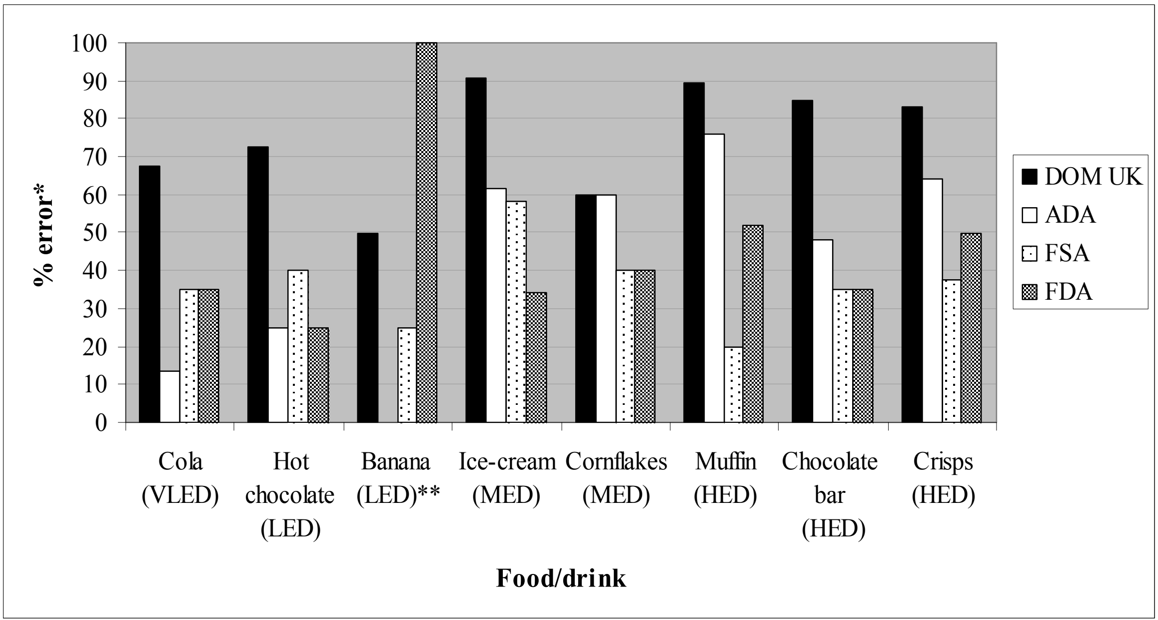
Food/Drink	Standard portion size	Mean estimate (±SEM)	*t* value[a]	*p* value
Chocolate bar	2	**1.3 (±0.09) (F)**	***t* = -7.51 (F)**	***p*<0.001 (F)**
		1.1(±0.08) (H)	*t* = -10.98 (H)	*p*<0.001 (H)
Muffin	2.5	**1.2 (±0.07) (F)**	***t* = -18.65 (F)**	***p*<0.001 (F)**
		1.0(±0.06) (H)	*t* = -23.15 (H)	*p*<0.001 (H)
Banana	0.5	**1.0 (±0.08) (F)**	***t* = 6.42 (F)**	***p*<0.001 (F)**
		0.8(±0.05) (H)	*t* = 5.84 (H)	*p*<0.001 (H)
Cola	2	**1.3 (±0.06) (F)**	***t* = -12.79 (F)**	***p*<0.001 (F)**
		1.1(±0.05) (H)	*t* = -16.84 (H)	*p*<0.001 (H)
Cornflakes	2	**1.2 (±0.06) (F)**	***t* = -13.12 (F)**	***p*<0.001 (F)**
		1.0(±0.06) (H)	*t* = -16.56 (H)	*p*<0.001 (H)
Crisps	5	**2.5 (±0.14) (F)**	***t* = -17.83 (F)**	***p*<0.001 (F)**
		2.0(±0.13) (H)	*t* = -23.19 (H)	*p*<0.001 (H)
Hot-chocolate	2	**1.5 (±0.08) (F)**	***t* = -7.06 (F)**	***p*<0.001 (F)**
		1.1(±0.05) (H)	*t* = -17.37 (H)	*p*<0.001 (H)
Ice-cream	3.5	**2.3 (±0.11) (F)**	***t* = -10.40 (F)**	***p*<0.001 (F)**
		2.0(±0.10) (H)	*t* = -14.79 (H)	*p*<0.001 (H)

[a]Degrees of freedom (*df*) = 53.

3.9. Order of accuracy of mean portion size estimates according to DOM UK, FSA, ADA and FDA standards.

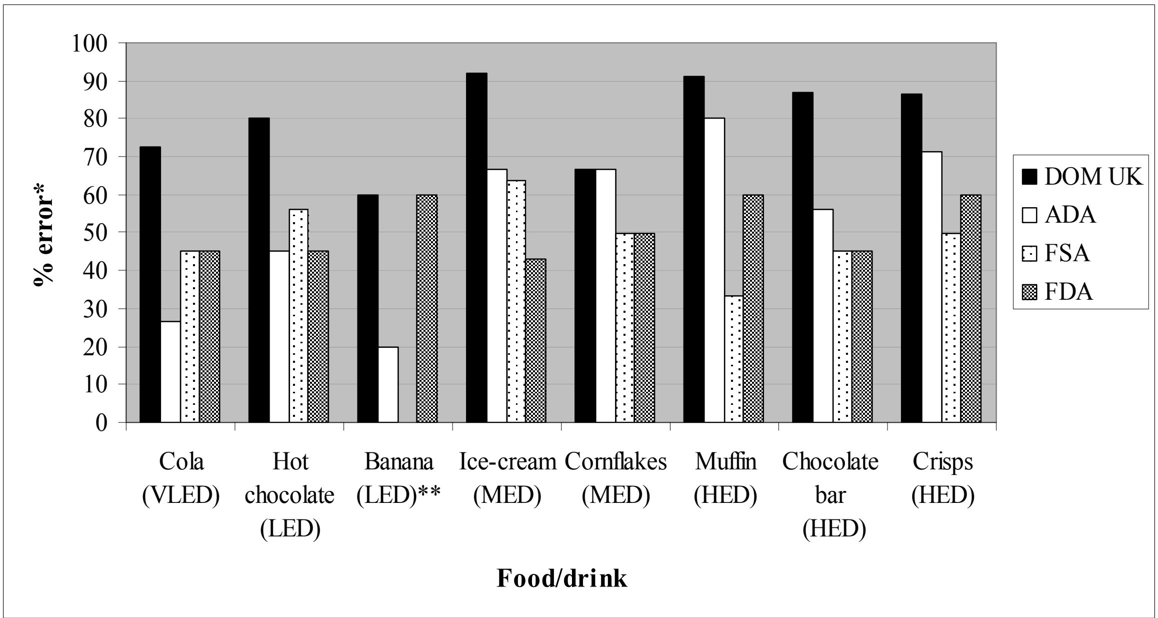
Percentage error values for each food and drink were used to determine the order of accuracy of mean portion estimates under full and hungry conditions with reference to DOM UK, FSA, ADA and FDA standards (**Figures 17 and 18**). In each case, order of accuracy was determined using absolute error values, since the magnitude of the error, rather than the direction of the inaccuracy, was most important for the purpose of this analysis.

Figure 17. Percentage error of mean portion size estimates for each food and drink under full conditions based on DOM UK, ADA, FSA and FDA standards.



*Values are absolute.
**Banana estimated correctly according to ADA standards.

Figure 18. Percentage error of mean portion size estimates for each food and drink under hungry conditions based on DOM UK, ADA, FSA and FDA standards.



*Values are absolute.
**Banana estimated correctly according to FSA standards.

Order of accuracy according to each standard under full and hungry conditions has been summarised in **Table 12**. As expected, according to health professional standards (DOM UK and ADA), both drinks and all high energy dense (HED) foods (crisps, chocolate bar and muffin) were estimated with less accuracy than the low energy dense (LED) banana. The banana was estimated with the most accuracy according to health professional standards, irrespective of condition. Also, according to DOM UK standards, cornflakes, which are MED, were estimated with more accuracy than any other food or drink except the LED banana, under both conditions. However, this was not true for ADA standards, where cornflakes were estimated with less accuracy than both of the drinks and the HED chocolate bar, irrespective of appetite status. According to DOM UK standards, the item estimated with the least accuracy was the MED ice-cream, irrespective of condition. In contrast, the item estimated with the least accuracy according to ADA standards was the HED muffin, irrespective of condition.

According to FSA standards, both drinks and all HED foods were estimated with less accuracy under hungry conditions than the LED banana, as expected. The banana was the most accurately estimated test item under hungry conditions. However, under full conditions, the banana was estimated with less accuracy than the HED muffin, which was estimated with more accuracy than any of the other foods and drinks. Under both conditions, the food estimated with the least accuracy was the MED ice-cream, as seen with reference to DOM UK standards. The cornflakes, also MED, were estimated with equal accuracy to the hot chocolate, and with less accuracy than all HED foods (muffin, chocolate bar and crisps) and the cola under full conditions. Under hungry conditions, the cornflakes were estimated with equal accuracy to the crisps (HED), and with less accuracy than the muffin (HED), chocolate bar (HED) and cola.

According to the FDA, the LED banana was estimated with the least accuracy under full conditions and also under hungry conditions, alongside two other foods of HED (muffin and crisps). The hot chocolate and the MED ice-cream were estimated with the most accuracy under full and hungry conditions, respectively. The drinks and the HED chocolate bar were estimated with more accuracy than the MED cornflakes, irrespective of condition. However, the remaining HED foods (muffin and crisps) were estimated with less accuracy than the cornflakes and the ice-cream (MED), but with more than or equal accuracy to the LED banana, under both conditions.

Table 12. Order of accuracy of mean portion size estimates under full and hungry conditions with reference to DOM UK (2005), ADA (2007), FSA (2002) and FDA (2001) standards[1]. *Abbreviations: Ban,* banana; *Cho,* chocolate bar; *Col,* cola; *Cor,* cornflakes; *Cri,* crisps; *HED,* high energy density; *Hot,* hot chocolate; *Ice,* ice-cream; *LED,* low energy density; *MED,* medium energy density; *Muf,* muffin; *VLED,* very low energy density.

Standard	Condition	1	2	3	4	5	6	7	8
DOM UK	**Full**	**Ban** (LED)	**Cor** (MED)	**Col** (VLED)	**Hot** (LED)	**Cri** (HED)	**Cho** (HED)	**Muf** (HED)	**Ice** (MED)
	Hungry	**Ban** (LED)	**Cor** (MED)	**Col** (VLED)	**Hot** (LED)	**Cri** (HED)	**Cho** (HED)	**Muf** (HED)	**Ice** (MED)
ADA	**Full**	**Ban** (LED)	**Col** (VLED)	**Hot** (LED)	**Cho** (HED)	**Cor** (MED)	**Ice** (MED)	**Cri** (HED)	**Muf** (HED)
	Hungry	**Ban** (LED)	**Col** (VLED)	**Hot** (LED)	**Cho** (HED)	**Cor**[e] (MED)	**Ice**[e] (MED)	**Cri** (HED)	**Muf** (HED)
FSA	**Full**	**Muf** (HED)	**Ban** (LED)	**Col**[a] (VLED)	**Cho**[a] (HED)	**Cri** (HED)	**Cor**[b] (MED)	**Hot**[b] (LED)	**Ice** (MED)
	Hungry	**Ban** (LED)	**Muf** (HED)	**Col**[c] (VLED)	**Cho**[c] (HED)	**Cor**[d] (MED)	**Cri**[d] (HED)	**Hot** (LED)	**Ice** (MED)
FDA	**Full**	**Hot** (LED)	**Ice** (MED)	**Cho**[f] (HED)	**Col**[f] (VLED)	**Cor** (MED)	**Cri** (HED)	**Muf** (HED)	**Ban** (LED)
	Hungry	**Ice** (MED)	**Cho**[g] (HED)	**Col**[g] (VLED)	**Hot**[g] (LED)	**Cor** (MED)	**Ban**[h] (LED)	**Muf**[h] (HED)	**Cri**[h] (HED)

Foods marked with the same letter were estimated with equal accuracy and their positions within the table are thus interchangeable.

Overall, the food/drink most frequently estimated with the greatest accuracy was the banana (LED), as expected. The food/drink most frequently estimated with the least accuracy was the ice-cream (MED).

With reference to each of the four standards, DOM UK was associated with the highest levels of error overall, except for the banana under full conditions (**Figures 17 and 18**). Government standards (FSA and FDA) were associated with the lowest levels of error for all HED and MED foods, under both conditions. The ADA was associated with the lowest levels of error for the drinks irrespective of condition, and the banana under full conditions. However, according to ADA standards, levels of error for HED/MED foods were higher than levels of error based

[1] Foods/drinks are ordered from most (1) to least (8) accurate.

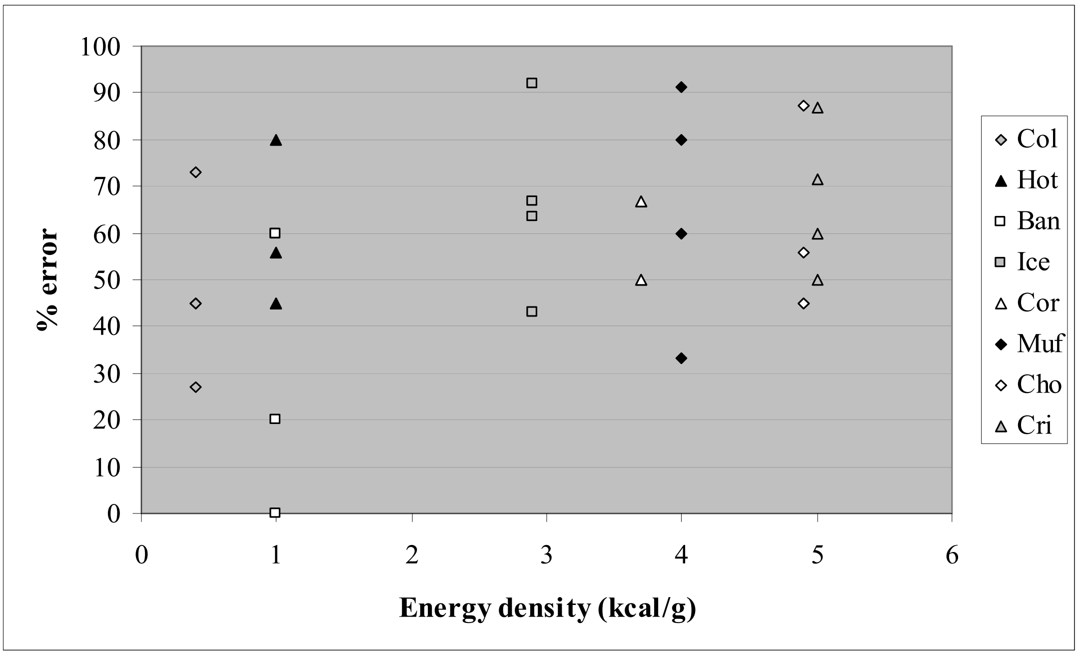
on government standards, but lower than those based on DOM UK standards. The only exception was for the cornflakes where levels of error according to ADA and DOM UK standards were equal when subjects were full and when they were hungry.

3.10. The relationship between percentage error of portion size estimates and food properties, in the presence and absence of drinks.

The Pearson's product-moment correlation test was used to investigate the relationship between percentage error of mean portion estimates and energy density of test foods, in the presence and absence of drinks. As discussed previously, accuracy of portion estimates for all foods and drinks decreased when subjects were hungry compared with when they were full, except for the banana with reference to government standards (FSA and FDA) (see section 3.8). Therefore, to address the worst case scenario, percentage error values used in the correlations were those which had been calculated by comparing mean portion estimates under hungry conditions with actual portions based on all four standards (DOM UK, FSA, FDA and ADA) (**Tables 4-7**).

Results revealed a weak positive correlation between percentage error of mean portion estimates and energy density of test foods, in the presence of drinks ($r = 0.36$, $n = 32$, $p<0.05$) (**Figure 19**). In the absence of drinks, the correlation failed to reach significance, although there was a trend for a weak positive correlation between percentage error of mean portion estimates and energy density of test foods ($r = 0.40$, $n = 24$, $p=0.05$). Percentage variance showed that energy density was responsible for 13% of the variance in percentage error values in the presence of drinks.

Figure 19. Percentage error of mean portion size estimates for each food and drink under hungry conditions based on standards from DOM UK, FSA, ADA and FDA standards. *Abbreviations: Ban,* banana; *Cho,* chocolate bar; *Col,* cola; *Cor,* cornflakes; *Cri,* crisps; *HED,* high energy density*; Hot,* hot chocolate; *Ice,* ice-cream; *LED,* low energy density; *MED,* medium energy density; *Muf,* muffin; *VLED,* very low energy density. (r = 0.36, n = 32, p<0.05).



The Pearson's product-moment correlation test was also used to investigate the relationship between percentage error of mean portion estimates and weight of test foods, in the presence and absence of drinks. As in the case of energy density, percentage error values used in the correlations were those which had been calculated by comparing mean portion estimates under hungry conditions with actual portions based on all four standards (DOM UK, FSA, FDA and ADA) (**Tables 4-7**).

Results revealed no significant correlation between percentage error of mean portion estimates and weight of test foods, in the presence or absence of drinks ($r = 0.01$, $n = 32$, $p>0.05$ and $r = 0.23$, $n = 24$, $p>0.05$, respectively).

Finally, the Pearson's product-moment correlation test was used to investigate the relationship between percentage error of mean portion estimates and energy load of test foods, in the presence and absence of drinks using data as above. Results revealed a weak positive correlation between percentage error of mean portion estimates and energy load of test foods, in the presence of drinks ($r = 0.39$, $n = 32$, $p<0.05$). In the absence of drinks, the correlation failed to reach significance, although there was a trend for percentage error of estimates to increase with increasing energy load ($r = 0.38$, $n = 24$, $p=0.07$). Percentage variance showed that energy load was responsible for 15% of the variance in percentage error values in the presence of drinks.

Overall, these results indicate that energy load had the greatest influence on accuracy of portion size estimates, followed by energy density. Accuracy of portion size estimates was not affected by weight of test foods/drinks.

3.11. Liking and familiarity ratings.

Mean liking and familiarity VAS ratings for each food and drink are shown in **Figures 20 and 21**, respectively. The most liked food was the ice-cream (80.7 ± 3.11[1]) and the least liked food was the cornflakes (60.8 ± 4.82). The food rated as

[1] Mean liking rating (0-100 mm scale) ± SEM.

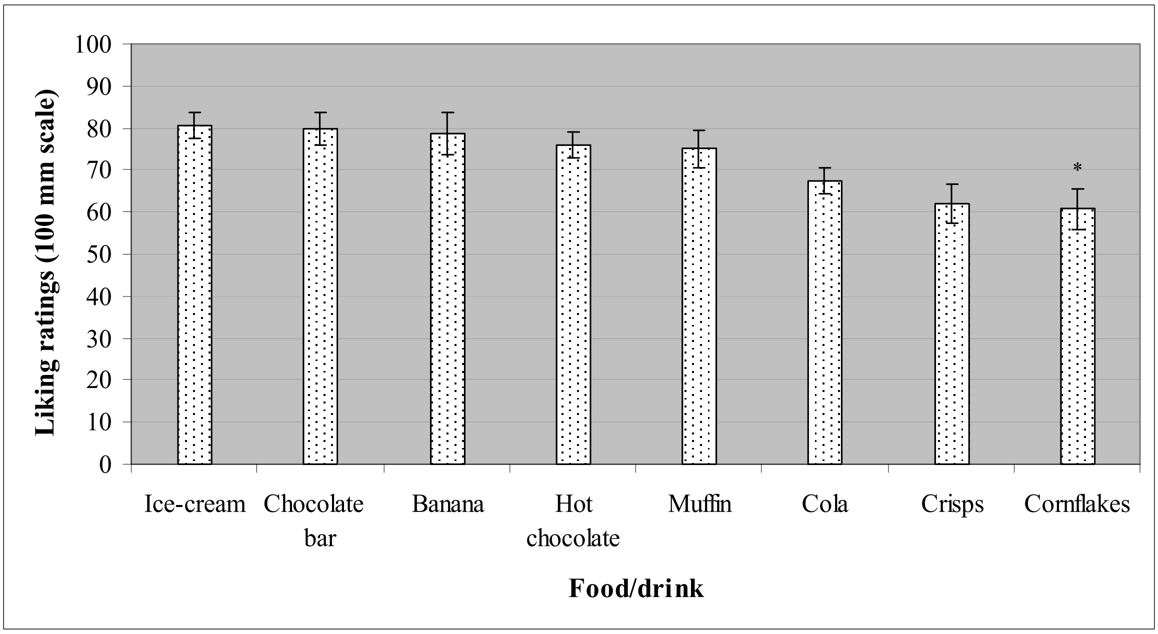
most familiar was the banana (93.4 ± 2.38[1]) and the food rated as least familiar was the cornflakes (81.3 ± 4.56).

Mean liking and familiarity VAS ratings for each food and drink were compared using one-way within subjects repeated measures ANOVA. Results showed a significant main effect of test food/drink on mean ratings for liking and familiarity ($F(7) = 4.27$, $p < 0.001$ and $F(3.75) = 4.09$, $p < 0.01$, respectively). Pairwise comparisons adjusted with the Bonferonni correction revealed that liking ratings for the ice-cream (80.7 ± 3.11) were significantly higher than for the cornflakes (60.8 ± 4.82) ($p < 0.05$). Trends were also observed for mean liking to be higher for the ice-cream (80.7 ± 3.11) than the crisps (61.9 ± 4.67) ($p = 0.05$) and higher for the chocolate bar (79.9 ± 3.96) than the cornflakes (60.8 ± 4.82) ($p = 0.05$).

Pairwise comparisons failed to detect significant differences in familiarity ratings between foods and drinks ($p > 0.05$). However, a trend was observed for mean familiarity to be higher for the banana (93.4 ± 2.38) than the cornflakes (81.3 ± 4.55) ($p = 0.05$) and higher for the chocolate bar (92.3 ± 2.31) than the cornflakes ($p = 0.07$).

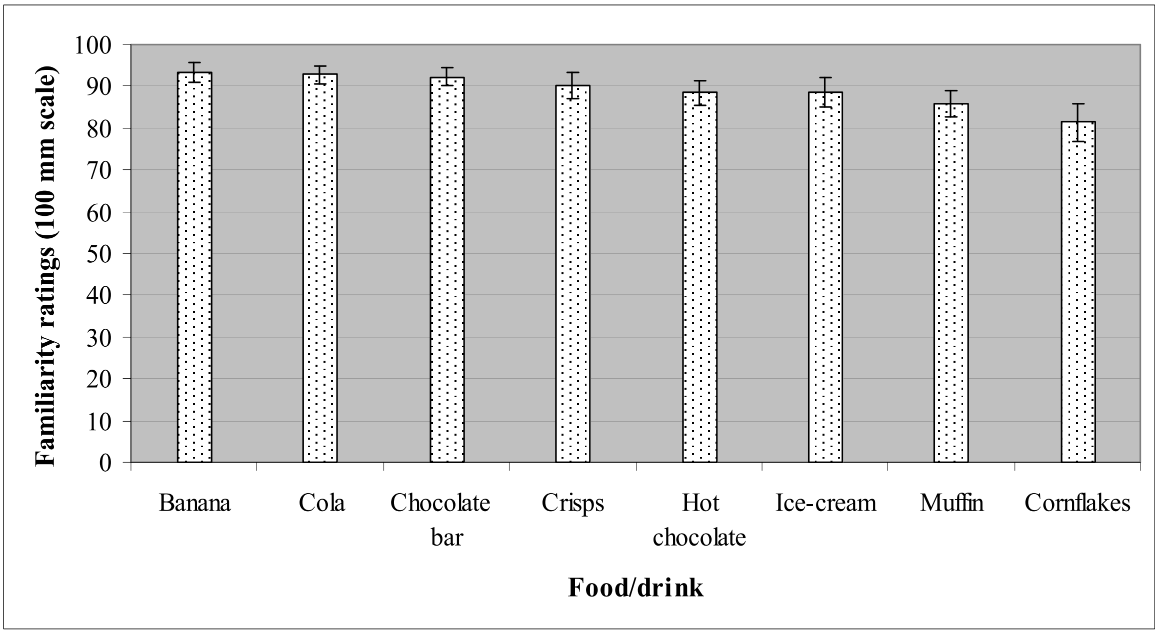
[1] Mean familiarity rating (0-100 mm scale) ± SEM.

Figure 20. Mean (± SEM) liking ratings for the foods and drinks used in the study.



*Differs from ice-cream with $p<0.05$.

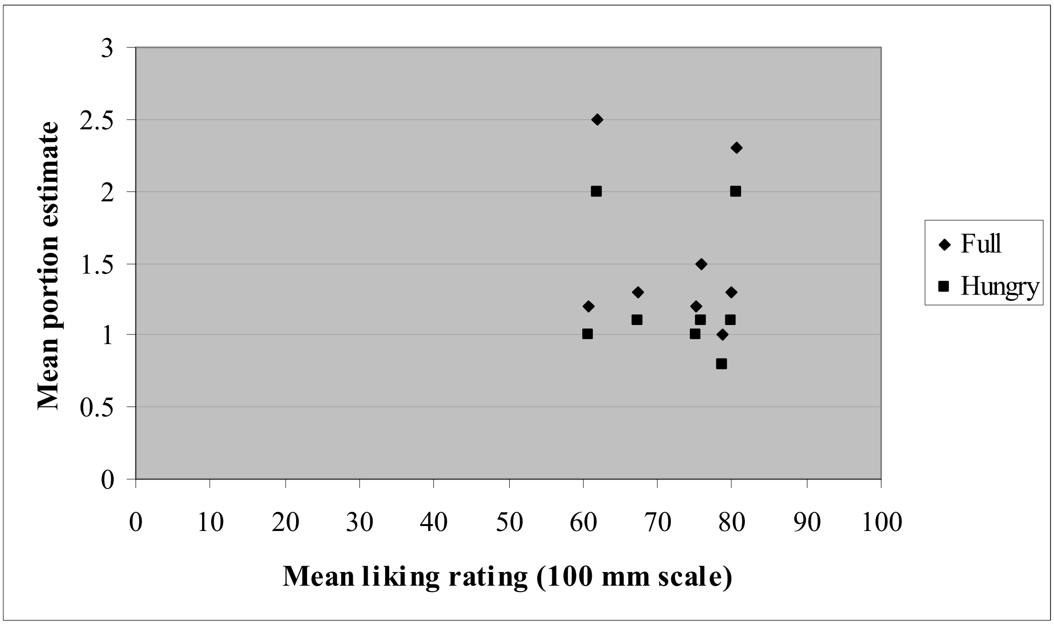
Figure 21. Mean (± SEM) familiarity ratings the foods and drinks used in the study.



3.12. The relationship between liking and portion size estimates and liking and PS ratings.

Mean liking ratings were plotted alongside mean portion estimates for each food and drink under full and hungry conditions (**Figure 22**). Since a nested ANOVA showed no significant effect of PS cue on portion estimates, mean estimates were derived from pooled data as follows: fullness (F + FPS) and hunger (H + HPS).

Figure 22. The relationship between mean liking ratings and mean portion estimates under full and hungry conditions (pooled data, *n*=54, see text).



Overall, results showed no visual relationship between liking and portion estimates. Despite significant differences between liking ratings, the majority of portion estimates tended to fall within a much smaller range (1 and 1.5). The exceptions were the crisps and the ice-cream. Both foods were associated with the largest portion estimates. However, liking ratings for the crisps tended to be lower than for the ice-cream (p=0.05). In fact, apart from the cornflakes, the crisps were the least liked food in the study and the ice-cream was the most liked.

The Pearson's product-moment correlation test was used to investigate the relationship between liking ratings and portion size estimates within each individual for each food and drink (**Table 13**). Correlations were conducted under full and hungry conditions, based on estimates from pooled data as indicated above.

The most significant results were as follows: a modest negative correlation between liking ratings and portion estimates for the banana under full and hungry conditions (r = -0.51, n = 54, p<0.001 and r = -0.52, n = 54, p<0.001, respectively) and for the cola under full conditions (r = -0.53, n = 54, p<0.001); a weak negative correlation between liking ratings and portion estimates for the cola under hungry conditions (r = -0.35, n = 54, p<0.05) and a weak positive correlation between liking ratings and portion estimates for the cornflakes under full conditions (r = 0.28, n = 54, p<0.05). This indicates that individuals who liked the banana and the cola the most estimated them in smaller portion sizes than those individuals who liked them the least. In contrast, individuals who liked the cornflakes the most estimated them in larger portion sizes than those individuals who liked the cornflakes the least.

Table 13. Relationship between liking ratings and portion size estimates under full and hungry conditions (pooled data, *n*=54, see text) explored using Pearson's product-moment correlation test. *Abbreviations*: *F*, full; *H*, hungry.

Food / drink	***r* value**	***p* value**
Chocolate bar	***r* = -0.01 (F)**	***p*>0.05 (F)**
	r = -0.02 (H)	*p*>0.05 (H)
Muffin	***r* = -0.07 (F)**	***p*>0.05 (F)**
	r = -0.06 (H)	*p*>0.05 (H)
Banana	***r* = -0.51 (F)**	***p*<0.001 (F)**
	r = -0.52 (H)	*p*<0.001 (H)
Cola	***r* = -0.53 (F)**	***p*<0.001 (F)**
	r = -0.35 (H)	*p*<0.05 (H)
Cornflakes	***r* = 0.28 (F)**	***p*<0.05 (F)**
	r = 0.16 (H)	*p*>0.05 (H)
Crisps	***r* = -0.03 (F)**	***p*>0.05 (F)**
	r = -0.05 (H)	*p*>0.05 (H)
Hot-chocolate	***r* = 0.1 (F)**	***p*>0.05 (F)**
	r = 0.23 (H)	*p*=0.09 (H)
Ice-cream	***r* = -0.25 (F)**	***p*=0.07 (F)**
	r = 0.06 (H)	*p*>0.05 (H)

The Pearson's product-moment correlation test was also used to explore the relationship between liking and PS VAS ratings within each individual for each food and drink. Correlations were conducted under full and hungry conditions (**Table 14**). Results revealed no significant correlations. However, there was a trend for a weak negative correlation between liking and PS ratings for the banana under hungry conditions (r = -0.36, n = 27, p=0.07). This indicates that individuals who liked the banana the most perceived it to be less filling than individuals who liked the banana the least.

Table 14. Relationship between liking and PS ratings under full and hungry conditions (*n*=27) explored using Pearson's product-moment correlation test. *Abbreviations: F*, full; *H*, hungry.

Food / drink	***r* value**	***p* value**
Chocolate bar	***r* = -0.03 (F)**	***p*>0.05 (F)**
	r = 0.1 (H)	*p*>0.05 (H)
Muffin	***r* = -0.15 (F)**	***p*>0.05 (F)**
	r = -0.04 (H)	*p*>0.05 (H)
Banana	***r* = -0.07 (F)**	***p*>0.05 (F)**
	r = -0.36 (H)	*p*=0.07 (H)
Cola	***r* = -0.30 (F)**	***p*>0.05 (F)**
	r = -0.11 (H)	*p*>0.05 (H)
Cornflakes	***r* = -0.09 (F)**	***p*>0.05 (F)**
	r = 0.06 (H)	*p*>0.05 (H)
Crisps	***r* = 0.11 (F)**	***p*>0.05 (F)**
	r = 0.13 (H)	*p*>0.05 (H)
Hot-chocolate	***r* = 0.19 (F)**	***p*>0.05 (F)**
	r = 0.25 (H)	*p*>0.05 (H)
Ice-cream	***r* = -0.10 (F)**	***p*>0.05 (F)**
	r = -0.10 (H)	*p*>0.05 (H)

3.13. The relationship between familiarity and portion size estimates and familiarity and PS ratings.

The relationship between familiarity ratings and portion size estimates within each individual for each food and drink were explored using Pearson's product-moment correlation test (**Table 15**). Correlations were conducted under full and hungry conditions. Results revealed a weak negative relationship between familiarity ratings and portion estimates for the cola and the ice-cream under full conditions (r = -0.31, n = 54, p<0.05 and r = -0.30, n = 54, p<0.05, respectively). This indicates that individuals who were most familiar with the cola and the ice-cream estimated them in smaller portion sizes than individuals who were least familiar with these items. No significant correlation between familiarity ratings and portion estimates for the chocolate bar, muffin, banana, cornflakes, crisps or hot chocolate were observed under either condition.

Table 15. Relationship between familiarity ratings and portion size estimates under full and hungry conditions (pooled data, *n*=54, see text) explored using Pearson's product-moment correlation test. *Abbreviations*: *F*, full; *H*, hungry.

Food / drink	***r* value**	***p* value**
Chocolate bar	***r* = -0.18 (F)**	***p*>0.05 (F)**
	r = -0.16 (H)	*p*>0.05 (H)
Muffin	***r* = -0.19 (F)**	***p*>0.05 (F)**
	r = -0.09 (H)	*p*>0.05 (H)
Banana	***r* = -0.01 (F)**	***p*>0.05 (F)**
	r = -0.09 (H)	*p*>0.05 (H)
Cola	***r* = -0.31 (F)**	***p*<0.05 (F)**
	r = -0.24 (H)	*p*=0.08 (H)
Cornflakes	***r* = -0.01 (F)**	***p*>0.05 (F)**
	r = -0.05 (H)	*p*>0.05 (H)
Crisps	***r* = 0.10 (F)**	***p*>0.05 (F)**
	r = 0.15 (H)	*p*>0.05 (H)
Hot-chocolate	***r* = 0.01 (F)**	***p*>0.05 (F)**
	r = -0.08 (H)	*p*>0.05 (H)
Ice-cream	***r* = -0.30 (F)**	***p*<0.05 (F)**
	r = 0 (H)	*p*>0.05 (H)

The relationship between familiarity and PS VAS ratings within each individual for each food and drink was also explored using Pearson's product-moment correlation test. Correlations were carried out under full and hungry conditions. Results showed no significant correlations (data not shown).

3.14. Discharge questionnaire.

Fifteen subjects (56%) completed the discharge questionnaire. Of these, only two subjects identified that part of the study was to investigate the effect of appetite status on estimation of portion sizes. The PS cue was not identified as part of the intervention. Subjects were not aware that portion size estimates would be compared to standard portion sizes in portion size guidance schemes.