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"I prepared my own carrots". The effect of participation in an out-of-home cooking session on Dutch 4–6-year-old children's vegetable consumption

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ABSTRACT

Involvement in vegetable preparation is thought to be an effective strategy to increase children's vegetable intake, but the evidence from experimental studies is scarce. A between-subject experiment was executed in a restaurant setting to investigate the effect of participation in vegetable preparation on 4–6-year-old children's vegetable intake. After a baseline evening meal, intervention children (N = 50) participated in a vegetable preparation session together with an enthusiastic chef. Control children (N = 51) participated in small groups in a book-reading activity. Subsequently, they ate an evening meal. Follow-up sessions at one month and three months were included to assess possible longer-term effects. Vegetable intake was the main outcome. Secondary outcomes were vegetable choice and involvement in food-related activities at home. For all four sessions, children's vegetable intake ranged between 50 and 60 g in both conditions ($p > 0.05$). Participation in carrot preparation did not increase children's vegetable intake. Involvement in food-related activities at home remained stable in the intervention group, whereas it decreased slightly in the control group ($p = 0.01$). A cluster analysis identified four distinct vegetable eating patterns over time, suggesting that there are different segments of children. To conclude, participating once in an out-of-home vegetable preparation session with an enthusiastic chef did not influence children's intake of a familiar vegetable, but it may support their general involvement in food-related activities at home.

1. Introduction

Whereas the health benefits of consuming sufficient vegetables are well-known (Aune et al., 2017; Boeing et al., 2012; Oyebode, Gordon-Dseagu, Walker, & Mindell, 2014), children's vegetable consumption is below the recommendations in many countries (Lynch et al., 2014; Van Rossum et al., 2016). Research has shown that low vegetable intake during childhood may lead to inadequate intake of vegetables later in life (Kelder, Perry, Klepp, & Lytle, 1994; Nicklaus, Boggio, Chabanet, & Issanchou, 2004; Skinner, Carruth, Wendy, & Ziegler, 2002). Therefore, identifying effective strategies to encourage children's vegetable intake is crucial to establish healthy eating habits in childhood.

Involvement in vegetable preparation has been identified as a promising strategy to encourage children's vegetable intake (Caraher, Seeley, Wu, & Lloyd, 2013; Hersch, Perdue, Ambroz, & Boucher, 2014; Seeley, Wu, & Caraher, 2010). Also parents perceive this as an effective strategy to increase children's vegetable acceptance (Casey & Rozin, 1989). Over the last decennia, the use of pre-prepared and ready-to-eat foods has increased, the choice to cook from scratch with raw ingredients is made less often, and consequently, cooking has become more deskilled (Dougherty & Silver, 2007). This deskilling may lead to a lack of opportunity for children to interact playfully with real foods at home, imitating grown-up cooking behaviour and learning to acquire healthy cooking skills. This deskilling may in turn negatively influence their future eating patterns (Caraher, Dixon, Lang, & Carr-Hill, 1999; Hersch et al., 2014; Levy & Auld, 2004; Seeley et al., 2010).

Different theoretical perspectives are thought to underlie a positive effect of involvement in vegetable preparation. First, especially for young children, preparation of food may familiarize the children with the food product and familiarity is a strong predictor of liking (Aldridge, Dovey, & Halford, 2009; Birch, 1979; Cooke, 2007). Secondly, when humans put effort into a product by making or constructing it themselves, they attach higher value to this product (the so-called 'IKEA-effect' or 'I designed it myself' effect). People like self-prepared products – such as Lego, boxes, origami, cell phone covers, *t*-shirts and skis – more than similar products that are not prepared by

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themselves (Franke, Schreier, & Kaiser, 2010; Norton, Mochon, & Ariely, 2012). This effect has also been shown for foods. Subjects who made milkshakes themselves liked this milkshake more and consumed more of it than subjects who consumed the same milkshake which was pre-prepared (Dohle, Rall, & Siegrist, 2014). In line with this, research has indicated that when children prepare and grow their own veggies and fruit, they like them more, and will consume more of them (Gibbs et al., 2013; Libman, 2007; Wang et al., 2010). A third hypothesis is related to the self-determination theory. By preparing foods themselves, children's feelings of autonomy may be stimulated. In addition, by preparing food together with other children or their parents, children's feelings of relatedness may be encouraged. Finally, the act of successful preparation may booster children's feelings of competence. These three biological needs – autonomy, relatedness and competence – have been linked to a higher intrinsic motivation according to self-determination theory (Deci, Eghrari, Patrick, & Leone, 1994; Ryan & Deci, 2000). As a result of this higher motivation, children's vegetable consumption may be enhanced after being involved in vegetable preparation.

Several cross-sectional studies indicate that participation in meal preparation is related to healthier diets. Chu et al. showed that a higher frequency of helping to prepare and to cook food at home was associated with higher fruit and vegetable preferences, higher fruit and vegetable intake, a better quality of the diet and a higher self-efficacy for selecting and eating healthy foods among 10–11-year-old children (Chu, Farmer, et al., 2013; Chu, Storey, & Veugelers, 2013). Furthermore, the project EAT showed significant associations between the frequency of a composite food-related activities score (making a shopping list, preparation of different foods/meals, and buying vegetables) and the likelihood of meeting dietary objectives for fat, calcium, fruit, vegetables and whole-grain consumption. In addition, the frequency of preparing food for dinner was associated with higher intakes of fibre, folate, and vitamin A and a lower frequency of fast-food use (Larson, Perry, Story, & Neumark-Sztainer, 2006; Larson, Story, Eisenberg, & Neumark-Sztainer, 2006). Finally, the study of Anliker et al. (1992) showed that 3-year-old children who were more involved in food-related activities at home had significantly higher nutrition awareness scores and consumed more protein and vitamin C. Although these studies indicate that preparing food or being involved in food-related activities are associated with healthier diets, causality of the relationship cannot be inferred from these cross-sectional studies.

School-based nutrition education programs with a cooking component have also demonstrated positive effects on children's knowledge, preferences, willingness to taste fruit and vegetables, and their intake of fruit and vegetables (Gatto, Ventura, Cook, Gyllenhammer, & Davis, 2012; Gibbs et al., 2013; Robinson-O'Brien, Story, & Heim, 2009; Seeley et al., 2010; Wang et al., 2010). The majority of these studies are multicomponent, consisting of a combination of gardening, food preparation and tasting. These interventions underline that cooking activities offer great opportunities to teach children about food and healthy eating and have potential to influence children's nutrition behaviour. Nevertheless, the evidence is relatively scarce and the studies do not provide any insight into the effectiveness of the separate components of these comprehensive programs (Hersch et al., 2014; Robinson-O'Brien et al., 2009; Wang et al., 2010). Due to these limitations and the lack of longer term-measures, there is a need to further investigate the effect of cooking initiatives (Hersch et al., 2014; Reicks, Kocher, & Reeder, 2018; Robinson-O'Brien et al., 2009; Seeley et al., 2010).

The literature focusing on the effect of participation in vegetable preparation on its own is limited. In one study, children aged 6–10 years prepared a lunch meal together with a parent at a research location, resulting in an increased salad intake (van der Horst, Ferrage, & Rytz, 2014). However, the intervention children also increased their intake of chicken and pasta compared to the control group, which may be undesirable from a public health perspective. Another study showed that 7–11-year-old children who participated in a 1-h cooking workshop in a culinary centre led by researchers, were more willing to taste unfamiliar snacks containing vegetables, but there was no difference in food intake (Allirot, da Quinta, Chokupermal, & Urdaneta, 2016).

The aim of this study was to investigate the effect of participation in an out-of-home cooking session on children's intake of a familiar vegetable (carrot). Whereas previous studies with younger children focus on food preparation together with a family member or with researchers, our study made use of an enthusiastic chef to involve and activate the children in carrot preparation. To extend the findings of the above-mentioned studies, a baseline vegetable intake measurement was included to control for potential differences between the study groups. Moreover, the cooking session in our study was restricted to the preparation of vegetables only, as vegetables are the target food that should be encouraged. Because eating habits are established early in life (Nicklaus et al., 2004; Skinner et al., 2002), we focused on young children aged 4–6 years. It was hypothesized that children who participated in the carrot preparation session, would increase their subsequent vegetable intake (primary outcome), would more frequently choose carrots over another vegetable in their subsequent meal, and might show an increased involvement in food-related activities at home (secondary outcomes). A secondary objective was to explore individual responsiveness to the intervention, because recent studies indicate large variation in children's responsiveness to vegetable interventions (Caton et al., 2012; Hausner, Olsen, & Møller, 2012; Zeinstra, Kooijman, & Kremer, 2017).

2. Materials & methods

2.1. Design

A between-subject design was used with an intervention (N = 50) and a control group (N = 51). The study was executed in a restaurant setting. At baseline, all children ate a typical Dutch evening meal (potatoes, meat and vegetables) together with one of their parents. Before the second meal, intervention children participated in an interactive vegetable preparation session, whereas control children participated in a book reading activity. To investigate longer-term effects of the intervention, a third and fourth evening meal were scheduled one and three months after the intervention session (see Fig. 1). During the four sessions, the children received a meal consisting of mashed potatoes, boiled vegetables and sausages. Each time, the children could choose

Session	Baseline	Intervention			1-month follow-up		3-month follow-up
	week 1	week 2		…	week 6	…	week 16
Intervention (N=50)	Evening meal	Participation in vegetable preparation	Evening meal		Evening meal		Evening meal
Control (N=51)	Evening meal	Book reading activity	Evening meal		Evening meal		Evening meal

Fig. 1. Design of the study where the effect of participation in vegetable preparation on children's vegetable intake was investigated.

between two familiar vegetables (green beans or carrots) to investigate whether children were more likely to choose carrots if they prepared the carrots themselves. Vegetable intake was the main outcome. Secondary outcomes were vegetable choice (as indicator of liking) and children's involvement in food-related activities at home. This study received approval from the Medical Ethical Committee of Wageningen University.

2.2. Participants

Four to six-year-old children and their parents were recruited via four primary schools in Wageningen and Bennekom, The Netherlands. A sample size calculation with a significance level of $p = 0.05$, a power of 80%, an SD of 36 g (Ocke et al., 2008) and an expected difference between the two conditions of 20 g, showed that fifty children were required per condition. Children were randomly assigned to the intervention or control group on condition that there were similar numbers of children in each condition that preferred carrots over green beans and vice versa.

Three hundred fifty parents received an information pack. One hundred and fourteen parents (33%) signed the informed consent for their child and themselves. Participants who missed the baseline or intervention session were excluded from the analyses, as well as participants who joined only one session. The final sample included 101 children (50 intervention, 51 control). Four children missed the 1-month follow-up (two for each condition) and 15 children missed the 3-months follow-up (intervention: $N = 8$; control: $N = 7$). One of these children missed both follow-up sessions.

2.3. Meal time procedures

Children and one of their parents came to the Restaurant of the Future four times to consume an evening meal. Each evening meal lasted between 30 and 45 min and took place between 4:45 pm and 6:00 pm, as this is the usual time for Dutch children's evening meal.

Each parent–child couple was guided by a trained research assistant during the whole meal. After being seated and receiving a glass of water, the children were presented two plates with one vegetable each (carrots or green beans) and they were asked to indicate which one they would like to eat. Subsequently, the meal was served. Parents and children were told to eat as much as they wanted. Eating time was not restricted. After finishing the main course, the research assistants brought the plates with left-overs to the weighing kitchen (outside view of participants) and dessert was served. When leaving the restaurant, the children received a small gift to thank them for their participation.

Parents were asked not to give their children food one hour before the dinner session. Furthermore, parents were asked to refrain from controlling the eating behaviour of their child, from focusing on the vegetables, and from sharing food with their child during the meal. To prevent this focus on vegetables, parents were advised to talk about other topics than eating, such as the school day, friends or hobbies.

2.4. Intervention activity

Before the second meal, intervention children participated in an interactive cooking session, whereas control children participated in a book reading activity. Both activities lasted 15 min and were done in small groups of six children. In both conditions, parents were present to help the children feel at ease, but they were asked to not actively participate. The participant information stated that the child would be allocated to a pleasant activity before the meal such as tinkering, reading, cooking, and parents only saw the activity of their own child. After the activities, the meal proceeded as in the other sessions. During the cooking session, children were actively involved in the preparation of carrots under supervision of an enthusiastic, professional chef. The chef showed a dedicated interest towards the carrots, had an energetic attitude towards the children, and showed an eagerness to include (involve) them in the preparation process. The children wore chef's hats and participated by washing carrots, watching the chef chop carrots, tasting a raw carrot piece, putting the carrots into the pan and watching them when boiling. Control children listened to a story – not related to food or eating – which was read to them by an enthusiastic volunteer from the local library.

2.5. Meal composition

Boiled carrots and green beans were selected for this study, as they are familiar vegetables to Dutch children (Ocke et al., 2008). Because intervention effectiveness may vary for familiar versus unfamiliar vegetables (Nekitsing, Blundell-Birtill, Cockroft, & Hetherington, 2018), the aim of our study was to increase intake of familiar vegetables and earlier research (Zeinstra, Koelen, Kok, & de Graaf, 2010) confirmed that these vegetables are suitable for research with Dutch children of this age. The serving sizes of the meal components were based on the Dutch dietary recommendations (www.voedingscentrum.nl). Children received 130 g of vegetables (200 g for parents), 130 g of mashed potatoes (250 g for parents), 60 g of Frankfurter sausages (also 60 g for parents), and vanilla custard or yoghurt as dessert (150 g for both children and parents). The parent was served the same type of vegetable and dessert as the child. There was a meatless alternative to the wiener sausages for vegetarian children and parents.

2.6. Measurements

2.6.1. Meal intake and vegetable choice during the sessions

The amount of food – vegetables, staple, meat, and dessert – before and after the meal was weighted per meal component to the nearest 0.1 g (Kern & Sohn EMB600-1 weighing scales). Intake was calculated by subtracting the leftover weight from the weight served. During each meal, children's vegetable choice was recorded.

2.6.2. Parental questionnaire

Before the study started, parents completed a questionnaire to assess children's age, gender, height, weight, breastfeeding duration, and the education level of the parents. BMI z-scores for the child were calculated using the WHO anthropometric calculator (WHO v3.2.2, www.who.int/childgrowth/software/en/). In addition, parents completed the eight dimensions (35 items) of the validated Child Eating Behaviour Questionnaire (Wardle, Guthrie, Sanderson, & Rapoport, 2001) and the 6-item version of the Food Neophobia Scale for children (Cooke, 2007; Pliner, 1994). The items in both these questionnaires were scored on a 5-point scale, ranging from never to always, or from totally disagree to totally agree. The item scores were averaged per dimension and a higher score indicates a stronger presence of the characteristic.

A 5-point scale ranging from 1 = 'dislike a lot' to 5 = 'like a lot' was used to assess the child's liking for mashed potatoes, wiener sausages, dessert and for 17 vegetables (nine raw and eight boiled vegetables), including boiled carrots and green beans.

Four items about the child's involvement in food-related activities were included. Involvement was defined as participating in the processes around food management, such as growing food, doing groceries, setting the table, washing, cutting, preparing and serving (Anliker et al., 1992). The four items in our study operationalizing this concept, were: "My child helps setting and cleaning the table"; "My child helps to prepare evening meals"; "My child is involved in grocery shopping"; and "My child is involved in deciding which foods will be served for dinner". Answer categories were on a 5-point scale ranging from 1 = never to 5 = always. Directly after the 3-months follow-up meal, child involvement was measured again via the same four items to determine whether changes occurred due to the intervention. Cronbach's alpha for the involvement scale was 0.58 at baseline and 0.62 at 3-months follow-up which were considered acceptable (Hair, Anderson,

Tatham, & Black, 1998).

2.6.3. Statistical analysis

Results were analysed using IBM SPSS Statistics (v23). P-values of < 0.05 were considered statistically significant. Participant characteristics were shown as means and standard deviations or frequencies. Differences between the two conditions were tested with independent T-tests, Fisher exact tests and Chi-square analyses.

Children's vegetable intake was not normally distributed, and therefore, non-parametric tests were applied. Mann-Whitney was used to examine differences in intake between the two conditions for each meal separately. To investigate changes in vegetable intake, pairwise comparisons were made between baseline and the other three sessions (Wilcoxon signed rank-test) per experimental condition. The total numbers of children that chose carrot or green bean were calculated per session. Subsequently, the intervention and control group were compared on the number of switches regarding their vegetable choices between baseline and the other three sessions by using Chi-square analyses. The change in children's involvement in food-related activities between baseline and 3-months follow-up was analysed by an independent T-test.

A K-means cluster analyses was performed to identify different segments of children based on their vegetable intake over the four eating sessions. Subsequently, these segments were tested for differences regarding socio-demographic and child eating behaviour characteristics with ANOVA and Bonferroni post-hoc analyses or Chi-square for category variables.

3. Results

3.1. Participant characteristics

Table 1 shows the participant characteristics. There were no significant differences between the two conditions, except for a higher liking of mashed potatoes in the control group ($p = 0.02$; parent-reported). The sample was highly educated with about 85% of the mothers highly educated, 12–15% middle and only 0–4% were low educated ($p = 0.29$).

3.2. Children's food intake

During all four meals, children ate almost the whole meat portion (range: 55–59 g) and dessert portion (range: 120–128 g). There were no significant differences between the two groups for meat intake ($p > 0.27$ for all four sessions) or dessert intake ($p > 0.45$). Children ate about a third of the mashed potatoes portion (range: 41–48 g). There were no significant differences between the two conditions at the first three sessions ($p > 0.10$). At the 3-month follow-up session, control group children ate more mashed potatoes (mean: 59.2 g ± 47; $N = 44$; $p = 0.02$) than the experimental group (mean: 36.1 g ± 43; $N = 42$).

Children's vegetable intake during the four evening meals varied between 50 and 60 g (See Fig. 2). There were no significant differences in vegetable intake between the intervention and control group at any time point ($p = 0.17$; $p = 0.33$; $p = 0.82$; $p = 0.94$ respectively). For both conditions, children's vegetable intake at baseline did not differ significantly from their intake at the intervention session (I: $p = 0.64$; C: $p = 0.21$), at 1-month follow-up (I: $p = 0.99$; C: $p = 0.10$) and at 3-months follow-up (I: $p = 0.97$; C: $p = 0.41$).

Table 1
Characteristics of the children that participated in the study regarding participation in vegetable preparation: mean ± SD or percentages.

	Intervention (N = 50)	Control (N = 51)	p-value
Age (years)	5.2 ± 0.8	5.2 ± 0.6	0.79
Gender male (%)	32 (64%)	26 (51%)	0.23
z-BMI	−0.1 ± 1.4	−0.5 ± 1.0	0.16
Neophobia score [1]	3.3 ± 1.1)	3.0 ± 1.1	0.66
Boiled carrot liking [2]	3.1 ± 1.0	3.1 ± 1.1	0.98
Green bean liking [2]	3.6 ± 1.0	3.9 ± 1.0	0.22
Liking mashed potatoes [2]	2.9 ± 1.2	3.5 ± 1.0	**0.02**
Liking wiener sausages [2]	4.4 ± 0.9	4.3 ± 1.0	0.57
Involvement in food-related activities [1]	2.9 ± 0.5	3.0 ± 0.5	0.33
Education level mother N [3] (%)			0.29
Low	0 (0%)	2 (4%)	
Middle	7 (15%)	6 (12%)	
High	40 (85%)	42 (84%)	

[1] Measured on a 5-point scale ranging from 1 = never to 5 = always.
[2] Measured on a 5-point scale from 1 = 'dislike a lot' 5 = 'like a lot'.
[3] Lower N due to incomplete questionnaires: Intervention N = 47; Control N = 50.

3.3. Vegetable choices

Table 2 shows the numbers of children per condition who chose carrots for each evening meal separately and the number of switches regarding children's vegetable choice. During the first session, 55% of the control children chose carrots, whereas 66% of the intervention children chose carrots (Chi-Square: $p = 0.31$). After the intervention, 49% of the control children chose carrots against 66% of the intervention children (Chi-Square: $p = 0.11$).

The majority of children (56–78%) stuck to the choice they made at baseline. Furthermore, similar numbers of children per condition switched from green beans towards carrots or the other way around. Chi-Square was not significant for any of the comparisons, indicating that the pattern of switches did not differ between the intervention and control group.

3.4. Home involvement in food-related activities

The change in children's involvement in food-related activities between baseline and 3-months follow-up was different for the intervention and control group (T-test: $p = 0.01$). Control children's involvement decreased from 3.04 ± 0.5 to 2.87 ± 0.6 ($N = 45$), whereas involvement in food-related activities remained stable in the intervention group (2.9 ± 0.5; $N = 44$).

3.5. Cluster analysis

On the basis of children's vegetable intake patterns over the four sessions, four clusters were identified in this sample of 4–6-year-old children (Fig. 3). The largest cluster ($N = 39$) consisted of children that ate consistently low amounts of vegetables (< 30 g); the minimal eaters. A second cluster ($N = 17$) showed children that ate consistently high amounts of vegetables (> 100 g); the large eaters. The cluster 'first surprise – medium eaters' ($N = 18$) consisted of children who ate a large portion during the first session (~100 g), and then decreased to a lower stable level of vegetable intake (~60 g). The smallest cluster ($N = 9$) was called the longer-term increasers, because it encompassed children who ate low levels during the first two sessions (~30 g) and then increased their intake during the follow-up sessions towards 100 g. The distribution of intervention and control children did not differ between the clusters ($p = 0.74$).

Minimal eaters were significantly younger and had a lower liking for boiled vegetables (see Table 3). The longer-term increasers had a lower liking for raw carrots compared to the other clusters ($p = 0.02$) and a similar trend was seen for raw vegetables ($p = 0.08$). The distribution of maternal education differed among the clusters ($p = 0.04$), with relatively more highly educated mothers among the large eaters and relatively more lower educated mothers among the longer-term

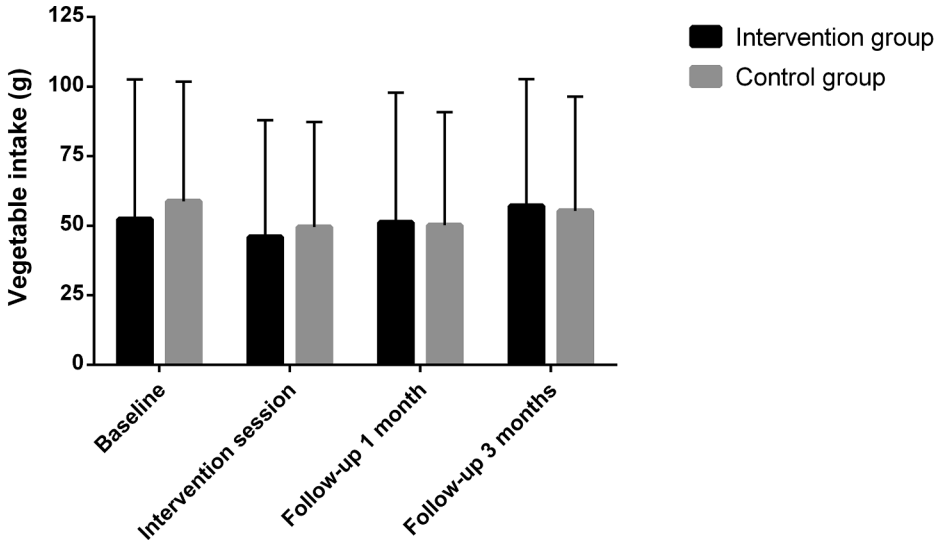

Fig. 2. Children's vegetable intake (mean and SD) during the four evening meals, separately for the intervention and control group.

Table 2
The number (%) of carrot choosers during each evening meal and the number of switches between baseline and each subsequent session separately for the intervention (I) and control group (C).

	Baseline		Intervention session		1-month follow-up		3-months follow-up	
	I (N = 50)	C (N = 51)	I (N = 50)	C (N = 51)	I (N = 48)	C (N = 49)	I (N = 42)	C (N = 44)
Carrot choosers	33 (66%)	28 (55%)	33 (66%)	25 (49%)	28 (58%)	21 (43%)	23 (55%)	24 (55%)
No switch[1]	–	–	28	30	37	38	30	32
Switch: carrot to bean[1]	–	–	11	12	7	8	8	6
Switch bean to carrot[1]	–	–	11	9	4	3	4	6
Chi-Square	–		p = 0.49		p = 0.50		p = 0.36	

[1] Compared to baseline session.

increasers. There were no significant differences between the clusters regarding gender, z-BMI, breastfeeding duration, neophobia or any of the CEBQ dimensions.

4. Discussion

The aim of this study was to investigate whether participation in an out-of-home vegetable preparation session given by an enthusiastic chef could increase children's intake of a familiar vegetable. The intervention showed no effect on children's vegetable intake or their vegetable choice. There seemed to be a slight positive effect for involvement in food-related activities at home. Finally, based on children's vegetable eating patterns over the four eating sessions, four clusters of children were identified which differed regarding age, vegetable liking and maternal education.

Our finding that children's vegetable intake did not increase due to

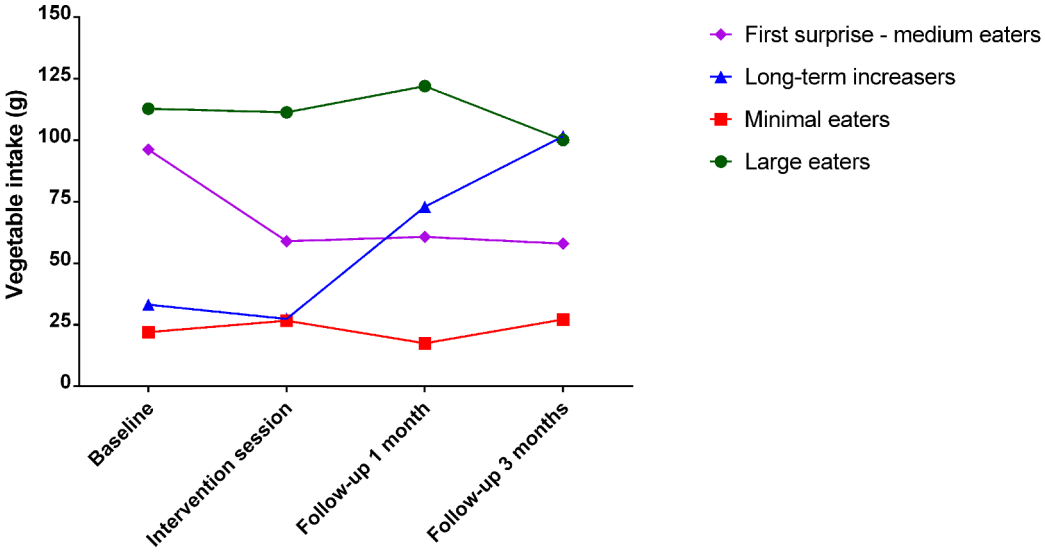

Fig. 3. The four clusters of vegetable eaters that were identified on the basis of children's vegetable intake over the four evening meals.

Table 3
Overview of characteristics that differed significantly between the four clusters of vegetable eaters.

	Large eaters (N = 17)	Minimal eaters (N = 39)	First surprise – medium eaters (N = 18)	Longer-term increasers (N = 9)	p-value
Age (years)	5.6 ± 0.6 [a]	4.9 ± 0.7[b]	5.5 ± 0.6 [a]	5.3 ± 0.5 [ab]	0.03
Liking raw carrots [1]	4.1 ± 1.1 [a]	3.5 ± 1.3 [a]	3.6 ± 1.4 [a]	2.4 ± 1.1[b]	0.02
Liking raw vegetables [1,2]	3.5 ± 0.8	3.1 ± 1.1	3.1 ± 0.9	2.5 ± 1	0.08
Liking boiled carrots [1]	3.5 ± 0.7 [a]	2.8 ± 1.1[b]	3.6 ± 0.8 [a]	3.2 ± 0.8 [ab]	0.01
Liking green beans boiled [1]	3.8 ± 0.9	3.5 ± 1.0	4.1 ± 0.8	3.8 ± 1.1	0.27
Liking boiled vegetables [1,3]	3.6 ± 0.3 [a]	3.1 ± 0.7[b]	3.7 ± 0.6 [a]	3.5 ± 0.8 [a]	< 0.01
Maternal education					0.04
low	–	–	–	11%	
middle	–	18%	22%	22%	
high	100%	82%	78%	67%	

[1] Measured on a 5-point scale from 1 = 'dislike a lot' to 5 = 'like a lot'.
[2] Mean value over 9 vegetables.
[3] Mean value over 8 vegetables.

participation in vegetable preparation is in contrast with several studies that did find positive effects of cooking and food preparation activities on children's vegetable intake (Caraher et al., 2013; Liquori, Koch, Ruth Contento, & Castle, 1998; van der Horst et al., 2014). There are a number of possible reasons why no effect was observed. One explanation may be that the children participated in one single session of vegetable preparation only. Although some studies have demonstrated positive effects on intake (Levy & Auld, 2004; van der Horst et al., 2014) or willingness to taste (Allirot et al., 2016) after already one cooking session, the majority of studies used multiple cooking sessions (Hersch et al., 2014; Seeley et al., 2010). It is possible that – especially for children aged 4–6 years – more cooking sessions are needed to increase their vegetable intake, since they are at their peak level of neophobia and pickiness (Dovey, Staples, Gibson, & Halford, 2008). The study of Anliker et al. (1992) among 3-year-olds suggests that young children can benefit from participation in the cooking process. Moreover, the results of the Cookshop program at schools suggest that – especially for younger children – cooking experiences may be a promising approach to increase their vegetable preferences and intake (Liquori et al., 1998). Therefore, future research should confirm whether participation in multiple vegetable preparation sessions can increase 4–6-year-old children's vegetable intake.

Secondly, it is possible that the use of an enthusiastic chef was not effective in this age group. In the study of Allirot et al. (2016), where also an unfamiliar person (researcher) performed the preparation session, an effect on willingness to try was found among 7–11-year-old children, but there was no effect on their intake. Therefore, it needs to be investigated which person is most suited in conducting these cooking sessions: an unfamiliar professional (i.e. chef), a familiar professional (i.e. teacher) or a familiar relative (i.e. parents/grandparents).

Thirdly, despite the fact that the cooking session was meant to actively involve the children, it is possible that their participation in this group cooking activity was insufficient to reach the feelings of successful completion, achievement, and autonomy that are needed to boost their intrinsic motivation and feelings of proudness (Franke et al., 2010; Norton et al., 2012; Seeley et al., 2010; van der Horst et al., 2014). Due to their young age, the children were not allowed to cut with knifes or boil the carrots by themselves and it is possible that this caused the children to experience a feeling of unsuccessful completion of the cooking process. This reasoning is in line with Horst et al. (van der Horst et al., 2014), who found the largest effect on vegetable intake for salad, where children had the highest level of involvement. It would be interesting to perform a similar study among this age group using an easy vegetable product that can be fully prepared by the children themselves, such as a salad or a smoothie.

Fourthly, verbal and non-verbal responses of the parents and children during and after the activities indicated that the children enjoyed both the cooking and the reading activity. In addition, they were allowed to choose between two vegetables, and having a choice is generally appreciated by children (Olsen, Ritz, Kramer, & Møller, 2012; Zeinstra, Renes, Koelen, Kok, & de Graaf, 2009) and can enhance children's vegetable intake (Rohlfs Domínguez et al., 2013). It is possible that these two effects may have overruled a participation effect. On the other hand, the pleasant atmosphere and having a choice were present in both conditions, and vegetable intake did not increase during the intervention. This suggests that these effects did not play a substantial role in children's vegetable intake in our study.

Finally, the restaurant setting was chosen to make the cooking session a special event and – as such – more memorable. It cannot be ruled out that the chosen eating context was too special or unfamiliar for these young children, and this could have overshadowed the participation effect. The experimental studies of Horst et al. and Allirot et al. (Allirot et al., 2016; van der Horst et al., 2014) were also performed in an unfamiliar out-of-home setting, but targeted older children (> 6 years).

We hypothesized that children in the intervention group would be more likely to choose carrots after the cooking session. Although a small trend was observed that preparing a vegetable may maintain children's interest in this vegetable ($p = 0.11$), the patterns of change between baseline and other sessions never reached significance between the two conditions, implying that there was no robust effect of the intervention on children's vegetable choice, indicating no change in their preference for carrots due to the intervention.

It was interesting that involvement in food-related activities at home remained stable for the intervention group and slightly decreased in the control group during the study period of three months. Merely looking at their child's participation in vegetable preparation may have triggered the parents of the intervention children to continue with involving their child in food-related activities, preventing the small drop in involvement that was seen in the control group. Alternatively, our study and previous studies have shown that children like these hands-on activities of food preparation (Heim, Stang, & Ireland, 2009) and consequently, the intervention children may have asked their parents more often to be involved in food-related activities. Furthermore, an overreporting effect – due to an increased awareness of child participation in food-related activities among intervention parents who saw the cooking activity – cannot be ruled out. Nonetheless, caution is needed for this finding, because the changes in our study were small. Still, it would be interesting in future studies to assess effects that occur in the home situation due to out-of-home cooking programs.

The cluster analyses implies that there may be distinct segments of children, which each may need their own strategy for enhancing their intake of a familiar vegetable. Child age, vegetable liking and maternal education typified the different segments, which is in line with earlier identified determinants (Caton et al., 2014; Rasmussen et al., 2006; Zeinstra et al., 2017). The largest segment (40% of the children) were

the minimal eaters who consistently ate low amounts of vegetables. Previous studies indicate that these children seem to be resistant to interventions (Caton et al., 2012; Hausner et al., 2012; Zeinstra et al., 2017) and novel approaches are needed to encourage their vegetable intake. The first surprise – medium eater group may have been overwhelmed by the setting during the first session. This implies that – especially for this group – a baseline familiarisation session is important to assess children's habitual vegetable intake. The increased vegetable intake during follow-up in the small group of learners could suggest a positive effect of the pleasant atmosphere and having a choice that becomes apparent with some delay (Zeinstra et al., 2017). Although the numbers of children were small, such a segmented approach may contribute to our understanding of the psychological mechanisms involved in food choice and eating behaviour (Köster, 2003). Future studies may use an a priori measure of intake of the target vegetable(s) as a personal child characteristic, thereby enabling researchers to select more homogeneous groups of children with regard to their eating behaviour regarding the target vegetable (for example, children that consistently reject a target vegetable). In turn, one could then try to develop more personalised strategies to increase children's vegetable intake to a higher level.

A strength of our study is the experimental design with actual vegetable intake as the main outcome. Intake is a measure of high validity that does not rely on the cognitive abilities of the children (Fishbach & Maimaran, 2014). Including follow-up measurements is another strength that has been recommended based on limitations of earlier studies (Reicks et al., 2018; Robinson-O'Brien et al., 2009; Seeley et al., 2010). Finally, we focused on the preparation of vegetables only, which is an advantage from a public health perspective. Other studies have shown that involvement in meal preparation may also lead to a higher energy intake from the self-prepared meals (Chu, Farmer, et al., 2013; Dohle et al., 2014; van der Horst et al., 2014), which is often undesirable. Because vegetables contain hardly any energy, the effect of a higher vegetable intake on total energy intake is very small.

The limitations of our study should be acknowledged. First, the sample was highly educated. Because involvement in food preparation may be more common among children from lower socio-economic background (Larson, Story, et al., 2006) and their vegetable intake is often lower (Rasmussen et al., 2006), it would be interesting to investigate whether cooking interventions are more effective for increasing vegetable intake among children with a less affluent background. Secondly, we did not include a measure of proudness or achievement. This would have been valuable for interpretation purposes, but we felt that the session would become too long for children's attention span (Guinard, 2000) and it would have been difficult to obtain such measures in a reliable way from children of this age (Liquori et al., 1998). Future research should develop and include simple, child-friendly measures to assess children's feelings of accomplishment and proudness. Thirdly, to minimize the heterogeneous influences of the parents, we controlled the responses of the parents during the evening meals. This may have been a bit unnatural. Moreover, it is possible that parental responses and the parent–child conversations after meal preparation, such as parents complimenting and praising the child or recalling together the steps of the cooking process, may influence children's eating behaviour more than the act of preparation itself. So, for future research, it would be interesting to measure these parental responses and the parent–child conversations during and after meal preparation and explore which are most supportive for increasing the child's vegetable intake.

4.1. Conclusion

In conclusion, participating once in an interactive out-of-home vegetable preparation session did not increase vegetable intake among 4- to 6-year old children, but might have a small positive effect on children's involvement in food-related activities at home. Future research should study the effects of participation in vegetable preparation by focussing on more familiar settings, using multiple preparation sessions, taking into account various child segments, investigating which person is most effective in conducting the cooking sessions, and including parent–child interactions during and after vegetable preparation, in order to further identify effective conditions for cooking interventions.

Author contributions

GZ and SK designed the study with input from MV. GZ and MV coordinated the execution of the intervention. All authors contributed to the data analyses. GZ wrote and revised the manuscript with critical input from SK and MV. All authors have read and approved the final manuscript.

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CRediT authorship contribution statement

Gertrude G. Zeinstra: Conceptualization, Investigation, Formal analysis, Writing - original draft, Writing - review & editing. **Milou Vrijhof:** Investigation, Formal analysis, Writing - review & editing. **Stefanie Kremer:** Conceptualization, Supervision, Writing - review & editing.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.foodqual.2020.104022.

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