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Create the future of food with children: Qualitative insights into children's perception of plant-based meat, fish, and dairy alternatives

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ABSTRACT

Children's food preferences are a major influence on what is served for dinner in the household. However, little is known about children's perceptions of plant-based foods. This study aimed to better understand how 9- to 11-year-old children perceive plant-based meat and dairy alternatives. Different types of plant-based alternatives were investigated: meat and fish substitutes (legumes, nuts), replacements (tofu, tempeh), and analogues, as well as dairy substitutes. These alternatives were placed in a meal context, considering the influence of dish composition. The study combined design probes, interviews, and cooking sessions as different qualitative methods to explore children's perceptions. First, design probe packages with creative assignments were given to the children. Afterwards, one-to-one interviews were conducted to elaborate on the input gained from the assignments. Lastly, children created in small groups a pizza with plant-based alternatives. Results showed that taste was the topic mentioned most in both positive and negative ways. Initially, children generally had positive taste expectations for the analogues, while their taste expectations for substitutes and replacements were more negative. However, during the cooking session, there was no considerable difference in their actual taste perceptions of analogues, substitutes, and replacements. This highlights the importance of studying perceptions of plant-based alternatives in a real-life meal context, where substitutes and replacements can, next to analogues, also be an integral part of a meal. Although previous research shows that animal welfare is an important driver for children to choose plant-based alternatives, this study showed that animal welfare is linked to plant-based meat analogues only. Therefore, actively linking animal welfare to substitutes and replacements may help to guide children and their households towards a plant-forward diet with more plant-based ingredients such as vegetables, legumes, and grains.

1. Introduction

The current food production system is a major contributor to worldwide environmental change, which highlights the necessity of transitioning towards more sustainable food production and consumption (Willet et al., 2019). Especially animal-based food production and consumption have a negative impact on the environment (Steinfield et al., 2006), the natural needs of animals (Hartmann & Siegrist, 2020), and human health (Aiking et al., 2006; Kumar et al., 2017). A protein transition is needed in which animal-based food is substituted for plant-based alternatives (Willet et al., 2019) as this benefits human health, the environment, and animal welfare (Estell et al., 2021; He et al., 2020; Pritulska et al., 2021; Willet et al., 2009).

Plant-based alternatives encompass substitutes, replacements, and analogues and can be either whole plant foods rich in protein or other protein rich sources (Abbaspour et al., 2023). Plant-based *substitutes* have similar culinary properties as their animal-based counterpart and some nutritional qualities similar to their counterpart (e.g., nuts, legumes, plant-based milk/yoghurt/cheese). Plant-based *replacements* have similar nutritional profiles as their animal-based counterparts and might have some similar culinary properties (e.g., tofu, tempeh). Plant-based *analogues* have both the culinary and nutritional

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characteristics of the animal-based food counterparts (Abbaspour et al., 2023).

The assortment of plant-based alternatives is expanding and ranges from plant-based dairy alternatives (e.g., milk, yoghurt, cream, butter, cheese, ice cream) to plant-based meat and egg alternatives (McCarthy et al., 2017; Pritulska et al., 2021; Schiano et al., 2020). To successfully launch novel food products and increase consumer acceptance of such (novel) plant-based alternatives, a thorough understanding of consumers' product perception of these novel foods is needed (Gorman et al., 2021; Rondoni et al., 2021; Szenderák et al., 2022; Tuorila & Hartmann, 2020).

1.1. Children's role in the protein transition

Attempts to direct consumers towards plant-based alternatives has limited potential unless children are inclined to eat them (McBey et al., 2019). Understanding children's perception of plant-based alternatives is needed to effectively transit from an animal-to a more plant-based diet for three reasons: children have fewer preconceptions about plant-based alternatives, can be introduced to plant-based alternatives at an early age, and have impact on household food choices. First, the basis of food acceptance or rejection can especially be understood by researching children. Studying children's attitude towards plant-based alternatives can increase the understanding about adults' resistance to reduce their animal-based food consumption (Hahn et al., 2021). Children are less preconceived and more pure-hearted as they do not have prior negative experience with plant-based analogues of the first generation that were of less taste and textural quality.

Secondly, children are the consumers of the future and eating habits acquired in childhood continue into adulthood. Flavour experiences in early childhood can shape food preferences, which can persist in later life (Ventura & Worobey, 2013). Familiarization with food during childhood is therefore crucial as it determines which food products become accepted and included in an individual's diet (Tuorila & Hartmann, 2020). Thus, children should already be acquainted with the advantages and usage of plant-based alternatives (Elzerman et al. (2021)). As the dietary patterns and habits of children are still limited and less robust (McBey et al., 2019), childhood is considered a unique life stage in which plant-based diets are more easily incorporated (Hahn et al., 2021). Increased exposure to and experience with plant-based alternatives can change current beliefs and can increase familiarity (De Oliveira Padilha et al., 2022; Hoek et al., 2013). Targeting eating patterns of younger children would therefore be effective since plant-based alternatives could become part of their food repertoire (McBey et al., 2019).

Lastly, children's food preferences influence food consumption in the household (Hahn et al., 2021). Children are argued to have a pivotal role as actors of environmental change, starting at the dinner table (McBey et al., 2019). Although parents are the final decision-makers, children participate as initiator in the food buying process by expressing the food they want and by offering ideas. Currently, children have most influence on the choice for energy-dense (high in fat and sugar) and easy to prepare products or meals. This might be explained by the fact that these food categories are more directed at children in stores and marketing (Nørgaard et al., 2007). Therefore, novel food products should attract the awareness of children to impact them and to enable them to inspire their parents (Nørgaard et al., 2007) to integrate plant-based alternative consumption in the household.

1.2. Children's perception of plant-based food alternatives

So far, most research has focused on understanding adults' perception of plant-based alternatives. Only a small number of studies focused on children's perception, preferences, or attitudes regarding these alternatives. Westling et al. (2022) investigated via a paper questionnaire the perceived tastiness of plant-based sausage rolls amongst children aged 10 year and older. Despite the positive flavour perceptions of the prototype sausage rolls, most of children suggested that they should be tastier and fresher. Besides improving the taste, it was suggested that highlighting the uniqueness and naturalness of plant-based alternatives could positively impact children's perceptions of these products. Nevertheless, the fixed questionnaire format might have influenced the direction of the gained insights as children could only choose from predetermined sensory and non-sensory attributes that were selected by the researchers.

Palacios et al. (2010) also investigated children's sensory evaluation of animal-based and soy-based products through a tasting session followed by a self-administered questionnaire. Cow milk variants were preferred over the soy-based beverage although chocolate flavoured soy-based beverages were liked more than the unflavoured ones. Older children aged 13 to 16 disliked the taste of soy-based beverages more than younger children aged 8 to 12. This suggests that younger children are likely to accept non-dairy milk substitutes more easily than older children do. Due to the quantitative approach of this study, the reasoning behind the liking or disliking of the beverages remains unknown.

Colombo et al. (2021) applied a more explorative, qualitative approach and used focus group discussions to explore children's perceptions of a plant-based school lunch intervention. The 11- to 15-year--old children indicated that a lack of tastiness was an important reason for the limited acceptance of plant-based alternatives; plant-based dishes should be seasoned better to get accepted. Besides the taste of the dishes, smell, appearance, and familiarity were considered important factors influencing the perception of plant-based school dishes. On the other hand, current eating habits and peer pressure were considered to have a negative impact on perception of plant-based alternatives as they constrain the consumption of unfamiliar food. The qualitative approach of this study allowed for a wide exploration of children's experiences and perceptions. Several suggestions were made to increase acceptance of plant-based school dishes, amongst others the involvement of children in making the dishes. However, the study did not yet explore the effect of such a cooking session on children's perception and liking of the dishes.

Lise et al. (2023) in fact investigated the effect of 10- to 17-year-old children's involvement in co-creating vegan dishes, followed by a questionnaire. The results of their questionnaire pointed out that jointly cooking a vegan meal shapes a shared identity and pro-vegan norms. The pro-vegan norms can foster a pro-vegan identity and therewith influence attitudes and dietary behaviour with regards to plant-based alternatives. Although the researchers in this study were present to help pupils understand the questionnaire, the researchers express uncertainty about the suitability of the measure for the specific age group. The used questionnaire was adapted from research with adults samples, and it remains unclear whether children could really accurately answer the questions and statements given.

Until now, research on children's perception of plant-based alternatives focused mainly on the school setting, older children, and one specific product or dish. In these few studies, research methods were used that were adapted from regular methods used with adult participants. In addition, most of these methods limit a more detailed, in-depth exploration of the relatively new research area because of the predefined set of variables and responses.

Besides, the studies that were conducted in these school settings focused on teenage children. This is remarkable, regarding the fact that especially younger children aged 7 – 11 years start to develop more sophisticated attempts to influence consumption choices in the household. Children aged between 8 and 14 years are also argued to have more power and influence in the household than younger children (John, 2008; Nørgaard et al., 2007). At this age, children start to bargain, compromise, and persuade by really interacting with the caregiver (s). They play a more active role in buying decisions as they learn to reason and negotiate for certain products they want (John, 2008).

Also, studies so far focused on a few specific dishes or products, overlooking meal composition complexity and variety possibilities. A diversity of plant-based alternatives is currently available on the market, ranging from substitutes, to replacements, to analogues. Nevertheless, a comparison of children's perception towards these various plant-based food alternatives is lacking.

1.3. Research aim and question

This research aims to gain insight into 9- to 11-year-old children's perception of various plant-based meat and dairy alternatives through methods that suit the preferences and competences of children. The research question of this study is: 'What is the perception of 9- to 11-year-old children towards plant-based meat and dairy alternatives?'. The study combines design probes, interviews, and cooking sessions as different innovative qualitative methods that align with the communication preferences and competences of children. Therewith, the study also places the plant-based alternatives in a meal context, taking into account the setting of consumption and dish composition. Additionally, the study focuses on plant-based substitutes (nuts, legumes, plant-based dairy substitutes), replacements (tofu, tempeh), and analogues as it is expected that children's perceptions of these various types of plant-based alternatives differ.

2. Methods

This study used thematic analysis to investigate children's perceptions of plant-based alternatives. Thematic analysis is a method for identifying, analysing, and reporting patterns and describing data in detail (Braun & Clarke, 2006). Different qualitative methods were combined to understand children's perceptions in three consecutive stages:

1. Design probe packages with creative assignments were given to the children. These assignments were performed individually, in the daily life context, and focused on children's experiences regarding (plant-based) food.
2. One-to-one interviews were conducted to elaborate on the input gained from the performed assignments.
3. Cooking sessions in which children created in small groups a plant-based pizza.

An in-depth and detailed description of the methods has been published in earlier work (Pater et al., 2024a).

2.1. Ethical considerations

The Social Sciences Ethics Committee (SEC) of Wageningen University & Research approved the study design (reference number 2022-28-Pater). Participants and their caregiver(s) were informed about the general purpose of the study and were introduced to the researcher in an information leaflet in advance. Caregivers gave written informed consent for their child to participate in the study. Children verbally assented to participate in each of the distinctive research activities. Participation was voluntary and all information was treated confidentially.

2.2. Participants

Children aged 9–11 years were recruited for the study through purposive convenience sampling. The children were recruited via four primary schools that were reached through contacts in the researchers' social environment. The schools were located in four Dutch municipalities in both urban and rural areas. Children were recruited based on their age, willingness, and availability to take part in the study. Children and caregivers received a €50 voucher upon completion of the study as a reward. The study aimed to reach a diverse sample of children with respect to age, gender, and frequency of plant-based alternative consumption.

2.3. Data collection procedure and materials

Prior to the data collection, caregivers and children received an information leaflet with general background questions and questions about dietary restrictions. Caregivers filled in the answers to these background questions and dietary restrictions and handed over the leaflet to the teacher or researchers in person or online.

The study consisted of three consecutive stages in which different methods were applied: a design probe box, a one-to-one interview, and a cooking session. The study design was pilot tested for comprehensibility, relevance, reliability, and time expenditure. The pilot test was conducted with five participants from a primary school located in a Dutch municipality different from the four schools involved in the main study. Based on the pilot test, necessary adaptions to the design were made. Participants of the pilot study did not participate in the main study.

In the first research stage, children received a design probe box. Design probes, in literature also referred to as cultural probes, are little packages that include diverse types of visual or art-based activities or small assignments to be performed in the everyday life environment. The activities are used to prepare participants to discuss relevant topics in follow-up sessions (Sleeswijk Visser et al., 2005). The design probe box in this study contained five diverse art-based assignments with varying items and tools to live up to the diverse preferences and competences of individual children (see Fig. 1 for the box). As a first assignment, children unboxed a box with plant-based alternatives and shared a video with their first impressions.

An overview of products used in this unboxing activity can be found in Fig. 2. Products for the unboxing assignment were chosen based on different types of meat/fish alternatives and the products' fit with the Dutch dietary guidelines. Moreover, different brands were used to minimize the influence of brand preferences or familiarity on children's perception.

After the unboxing assignment, children performed in their preferred order four other creative assignments: they filled in a friendship book and a plant-based chocolate gift survey, and they designed a plant-based dinner and plant-based dessert recipe.

The design probe activities were performed in the children's home setting. Children could freely choose when to conduct the activities in a time span of two weeks in the beginning of 2023. Each activity was designed to last approximately 5 min. Caregivers were asked to take a picture or video of every activity outcome of their children and send it via WhatsApp to the researcher.

Fig. 1. The design probe box with assignments and art-based materials.

Fig. 2. The food products used in the unboxing assignment of the design probe box (i.e., almonds, salmon analogue, tofu pieces, kidney beans, chicken analogue).

The second research stage consisted of one-to-one interviews with children. The outcomes of the activities of the design probe box served as elicitation in the individual interviews. Children were asked to explain their artworks in their own wording and based on this explanation, follow-up questions were asked. An in-depth interview guide was developed, consisting of open-ended questions aimed to explore the perception of children regarding plant-based alternatives.

The interviews were conducted face-to-face between January and April 2023 by one female researcher (L.P, PhD candidate). The researcher had previous experiences with interviewing children. The interviews took place in a quiet secluded room at the child's primary school. Each interview lasted for approximately 20 – 30 min and was audio recorded.

In the third research stage, children participated in a pizza cooking session with their classmates. At every cooking session, 3 to 6 children were present, supervised by 2 researchers. The main researcher (L.P.) facilitated the discussion while the other researcher provided practical assistance. The session partly followed the study set-up of Velázquez et al. (2022), who co-created a healthy dairy product with children. The cooking session in the current study started with a general introduction, where the researcher instructed the children to create a pizza without animal-based ingredients. Afterwards, children discovered and explored the various pizza toppings available by tasting and observing (see Table 1).

Table 1
Overview of the available pizza toppings during the cooking session.

Category	Products
Dairy substitutes	Plant-based grated Gouda cheese
	Greek white cheese block
Meat/fish analogues	Vuna (plant-based tuna)
	Plant-based ham
	Plant-based salami
Meat replacements	Plant-based tofu pieces
Meat substitutes	Kidney beans
	Nut mixture unroasted
Vegetables	Red/yellow bell pepper
	Leek
	Mushroom
	Tomato
	Onion
	Corn

Toppings were selected that were common on a pizza, but also invited children to be creative. The vegetables were chosen based on their familiarity and consumption frequency in the Netherlands. The plant-based alternatives were chosen based on diversity (ranging from substitutes to analogues) and compliance to Dutch dietary guidelines. After the instruction and tasting and observing, children were asked to create the pizza as a group. While the pizzas were being baked, children created a poster about their pizza. The poster template asked children to fill in the name of the pizza and reasons why others should choose this pizza. Next, children consumed their created pizza with the other members of the group. During the tasting, some questions were asked by the researcher about the palatability of the created pizza.

The cooking sessions took place between February and April 2023 at the primary schools of the children during school hours. The sessions lasted for approximately 30 – 40 min. The cooking session was audio recorded after permission.

2.4. Data analysis

All gathered data was analysed using the five-step approach discussed by Bingham (2023). The data was first organised and then sorted by one researcher. Through open coding, understanding of the data was created. Based on the open coding, themes were developed to interpret the data and, in the end, explain the data in light of existing research.

Children's input from the design probe box was analysed to obtain an overview of their perception on (plant-based) food. Data on the influence of household dynamics on children's perceptions are reported elsewhere (Pater et al., 2024b).

Qualitative visual content analysis with deductive and inductive coding allowed to evaluate the art-based material systematically (Bell, 2004). The unboxing videos, one-to-one interviews, and the discussions of the cooking session were transcribed and extended with researcher notes. Atlas.ti 24 was used to organize and code the data in a systematic way. One researcher reviewed the data independently and highlighted relevant text segments. The text segments were discussed with a second researcher to identify emerging themes and construct a code book. Afterwards, inductive coding was applied in which themes were identified that emerged after reviewing the data. First, two researchers independently coded the data of five participants with the help of the developed codebook. Afterwards, the coding was compared and consensus on the reliability and validity of the codes was discussed. Patterns between codes were identified to be able to answer the research question of this study.

3. Results

This section presents the study's results, distinguishing between children's perceptions of 1) meat and fish alternatives and 2) dairy alternatives. Both positive and negative perceptions are discussed, with results organized according to the three methods used (design probe box assignments, one-to-one interview, cooking session).

3.1. Sample description

A total of 40 children and their caregiver(s) initially showed interest in participating in the study. Three children were not able to continue the study due to personal circumstance or time pressure within the family. The final sample consisted of 37 children: 16 children identifying as female and 21 children identifying as male. Ages of the participants ranged from 9 to 11 years at the data collection time. Most children consumed animal-based food quite often, while plant-based alternatives were consumed less. Only one of the children was vegetarian but did still consume dairy products. Table 2 displays children's consumption frequency of animal-based food and plant-based alternatives per week. For the cooking session, the children were divided into 10 groups.

Table 2
Number of children (n = 37) per animal-based food and plant-based alternative according to consumption frequency.

	Meat	Fish	Dairy	Meat alternative	Fish alternative	Dairy alternative
Never	2	11		16	35	31
1–2 days a week	6	25	4	17	2	4
3–4 days a week	5	1	6	2		1
5–6 days a week	15		6	2		
7 days a week	9		21			1

3.2. Meat and fish conception and perception

Table 3 provides an overview of the positive and negative perceptions expressed by children/groups with regards to animal-based meat or fish consumption. When talking with children in one-to-one interviews about animal-based meat and fish, many children (n = 24) referred to a pleasant taste as driver for animal-based food preference or consumption. Child 8 (girl) explained the favourable taste and the suitability of animal-based meat for certain meals: "*Yes, I really like it and I think sometimes it really goes with the meal. So yes, then it just fits in nicely*". Interestingly, some children (n = 5) referred to the consumption of animal-based meat or fish as beneficial for animal welfare. Reasons for the positive perception regarding animal welfare of meat and fish are the abundance of animals, animals being already dead, or the continuous birth of new animals. Child 19 (boy) illustrates this view: "*But it also makes sense to kill them [animals], because otherwise there are too many animals again … Because all of that [meat] will eventually spoil, and then you have another problem. Then you just killed animals for nothing*".

The favourable taste of animal-based meat and fish was also a point of discussion in the cooking session in some of the groups (n = 2). Nevertheless, opinions on animal-based meat are a bit more divided in these cooking sessions, as some groups (n = 2) also negatively refer to the taste of animal-based meat and fish, especially to the taste of tuna.

3.3. Plant-based meat and fish alternative conception and perception

When talking about alternatives to meat and/or fish in the one-to-one interviews, most of the children (n = 19) did have a valid idea about the concept. On the one hand, some children described alternatives in general terms such as 'vegetarian' or 'without animals'. On the other hand, some children expressed concrete examples ranging from nuts to salad to a cheeseburger. Several children (n = 14) were not able to express the concept of meat/fish alternatives. A limited number of children (n = 4) wrongly interpreted the concept and for instance referred to chicken nuggets or croquette as meat alternatives. After the discussion about the concept, the researcher provided a definition of fish and meat alternatives to ensure the children had a similar understanding.

Table 3
Number of children/groups mentioning a negative or positive aspect of animal-based meat or fish consumption.

	Unboxing (n = 37 children)	Interview (n = 37 children)	Cooking (n = 10 groups)
Negative			
Taste		4	2
Environmental impact		1	
Positive			
Taste	1	24	2
Healthiness		5	
Animal welfare		5	
Meal suitability		4	1
Familiarity		3	
Curiosity arousing		1	
Inclusion in recipe		1	
Naturalness		1	

3.3.1. Positive perceptions towards plant-based meat and fish alternatives

Children expressed their perception implicitly through created artworks in the design probe assignments and explicitly in spoken form during the unboxing video, interviews, and cooking session. Factors explicitly mentioned by children to positively influence their attitude towards meat and fish alternatives differed per alternative type and per research method. Table 4 shows a summary of the factors verbally mentioned to contribute to a positive perception.

3.3.1.1. Design probe box assignments. The artworks created by the children in the design probe box assignments gave some first insights into their perceptions on plant-based alternatives. Children first got familiar with the plant-based alternatives via an unboxing assignment in which they orally evaluated various specific exemplars of meat/fish alternatives. Overall, a majority of children (n = 25) showed a positive perception of the (expected) taste of the salmon or chicken analogue. This (expected) taste was mentioned by fewer children as positive for the tofu product (n = 14) and kidney beans (n = 10) and never positively mentioned for the almonds. However, the positive perception of the taste of analogues can have been caused by mixing up the analogue with the animal-based fish/meat product. The following quote illustrates this: "*Salmon fillet. Well, I do really like salmon*" (Child 14, girl).

Besides taste, product appearance of the analogues (n = 8) and tofu product (n = 6) was also perceived positively by some children. Only a few children talked positively about the appearance of almonds (n = 3) or kidney beans (n = 2). Although appearance of kidney beans was not mentioned often in a positive way, some children (n = 4) explained that the processing of legumes into a complete meal would result in a more positive perception. Interestingly, children's positive perception of the appearance of the analogues and tofu was sometimes explained by the perceived familiarity with regularly consumed meat products. Child 6 (boy) stated about the tofu pieces: "*This one seems tasty too, because it just looks like chicken*". The analogues and tofu were also the only products that were by some children associated with animal welfare: "*I think it is good that it is not made of animals because then more and more animals will die*" (Child 26, boy).

The general positive perceptions of meat or fish analogues came also back in the created artefacts. When asking children about their dream meal without meat, the majority of the children (n = 15) created a meal with a fish or meat analogue. Only three children incorporated nuts, two children incorporated tofu, and two children incorporated legumes. Many children (n = 14) left out any meat or meat alternative component by adding more vegetables or creating a naturally meatless dish such as pancakes. Three children did include animal-based meat in their crafted meal, which indicates that the concept of plant-based alternatives was not yet clear to them.

3.3.1.2. One-to-one interview. In the follow-up one-to-one interviews, children elaborated on their created artworks and their perceptions of plant-based alternatives. In the interviews, children shared a broader perspective on plant-based alternatives in general, not linked to specific products. As in the design probe box assignments, a majority of children (n = 22) again positively talked about the pleasant (expected) taste of meat/fish analogues. Child 8 (girl) stated: "*Well, I have never had a vegetarian croquette, but I think it would be nice, because a [animal-based] croquette is nice too. So then that one [analogue] actually seems tasty to me too …*". In contrast to the analogues, fewer children expressed a positive viewpoint towards the taste of nuts (n = 8), legumes (n = 6), or tofu/tempeh (n = 5). Sometimes, tofu was also linked to an animal-based meat counterpart: "*Some things, for example that tofu or something like*

Table 4
Number of children/groups positively or negatively discussing factors for meat/fish analogues, substitutes (nuts and legumes) and replacements (tofu/tempeh).

		Positively discussed											Negatively discussed								
		Food intrinsic			Food extrinsic				Meal context		Child		Food intrinsic				Meal context	Child			
		Taste	Product appearance	Smell	Texture	Animal welfare	Healthiness	Packaging	Environmental friendliness	Processing in meal	Meal suitability	Curiosity	Familiarity	Taste	Product appearance	Smell	Texture	Meal suitability	Unfamiliarity	
Unboxing (n=37)	Analogues	25	8			4	1	7		1		1	7	5	5		2		1	
	Nuts		3				2	1					1	15	1					
	Legumes	10	2				1			4				15	4		1			
	Tofu/ tempeh	14	6		1	2	1	2	1				4	5	9					
Interview (n=37)	Analogues	22	7			6	3		2	3	1	5	7	21	4		1		1	
	Nuts	8					1			1				3						
	Legumes	6			1		1			1			4	8			1			
	Tofu/ tempeh	5						1		2		1	1	3	1				1	
Cooking (n=10)	Analogues	3	2	2							1	2	1	3	3	4				
	Nuts	3					1					1		4			1	1		
	Legumes													1						
	Tofu/ tempeh	2	2										1	2	1		1			

that, that actually tastes like regular [animal-based] minced meat. So, I would think that; oh yeah that is a really good one" (Child 8, girl).

Next to taste, few children (n = 7) positively mentioned the influence of analogues' appearance. The perception of analogues' appearance was mainly positive because of the analogues' resemblance with regularly consumed meat products: Child 7 (boy) expressed such a positive perception of the appearance of meat analogues. Asking him about the reason for this perception, he indicated: "*Well because it looked kind of the same [as animal-based chicken]*". While appearance of meat analogues was positively evaluated by children, none of the children spoke positively about the appearance of nuts, legumes, or tofu/tempeh.

Children's positive perception towards familiar products might explain the relevance of taste and appearance similarity of analogues with animal-based meat/fish. Children explained that familiarity with a product contributes to a positive perception. This is mainly expressed by some children (n = 7) with regards to meat analogues. Child 32 (boy) elaborated on his choice for a chicken analogue in his favourite dream meal: "*… I ate veggie meat at McDonalds quite often … Yes, because when I take a burger, I always take veggie chicken and that's vegetarian and I am already very used to that*". Some children (n = 4) also expressed a positive perception of legumes because of their familiarity with legumes. Child 16 (girl) explained why she chose to incorporate legumes in her dream meal: "*Because I do know the taste of those, and I can also taste the difference a bit. I thought that would be nice*".

Out of all types of plant-based alternatives, only meat analogues were linked to animal welfare and only by few children (n = 6). Child 16 (girl) illustrates this when talking about vegetarian bacon: "*Because veggie bacon, that is just, yes, I don't really like it, but it is nice to eat. Because it is quite a shame to shoot animals now, just because people want to eat meat. That is a shame too, so sometimes I eat vegetarian and sometimes I do not*". None of the children made such a link with animal welfare when it came to nuts, legumes, or tofu/tempeh as alternatives.

3.3.1.3. Cooking session. In the cooking session, children got in touch with various plant-based alternatives by creating in groups a pizza with plant-based toppings. While choosing ingredients and creating the pizza, some groups (n = 3) positively talked about the taste of the plant-based analogues. A positive taste was also mentioned by some groups for the almonds (n = 3) and tofu pieces (n = 2), and never for the kidney beans. Next to taste, the product appearance (n = 2) and smell (n = 2) of the analogues was also positively mentioned by some groups. Some children discussed: "*Looks very tasty though. Ham? Does indeed look very tasty*" (School 3 group 3). The positive perception of the taste, appearance, and smell of meat and fish analogues can be linked with the perceived suitability of these ingredients for a pizza. While group 3 from school 3 talked about their choice for ham, they explained: "*That goes well with pizza*".

Besides intrinsic product characteristics contributing to a positive perception, some groups showed that curiosity can lead to a positive perception. Curiosity was expressed for analogues (n = 2) and nuts (n = 1). The following quote illustrates how curiosity towards nuts was expressed: "*Uhm yes sausage you have that more often [on pizza] and it is also nice to try something different*" (Group 3 school 2).

After constructing the pizza, children created a poster and discussed what was good about their pizza and why other consumers should choose their specific pizza when eating in a restaurant. This conversation was focused on the pizza as a dish and not on the single ingredients. Similar to previous research phases, almost all groups (n = 9) talked again about the taste. The tastiness of the whole pizza was used to convince others to eat the pizza. The appearance of the pizza was another intrinsic product attribute sometimes (n = 2) mentioned.

Besides the taste of the pizza, a majority of the groups (n = 6) also referred to the innovative or unique character of their pizza as reason for others to choose it: "*Because it's very different from other pizzas*" (School 2 group 1). In addition, several groups (n = 5) mentioned the pizza being

home-made (by children) as potential motivator for other consumers to choose their pizza.

Furthermore, the vegetarian character of the pizza was an often (n = 6) discussed factor and proposed as an important argument to convince others to consume the pizza. This vegetarianism was often directly linked to animal welfare. Group 2 of school 2 for instance discussed why their pizza should be eaten by others: "*Because no animals are put in … then the animals can still live. Be able to live a longer life*". Sometimes dietary patterns of other consumers were stressed as the importance of the pizza being vegetarian: "*Because some people can … people can be vegetarian*". Some groups (n = 2) also discussed that the organic character of the pizza would convince others to eat it. A group discussed the addition of the EU-logo for organic production: "*And of course [we have to add] a leaf with those little stars and then 'bio' in it, that is always there too, isn't it?"* (School 2 group 2).

Some groups (n = 4) discussed the healthiness of their created pizza as a positive aspect. In general, the groups thought the healthiness of pizza could persuade others to consume it. In some cases, the healthiness was clearly attributed to the vegetables chosen: "*Because the pizza does have a lot of vegetables and so on*" (School 4 group 1).

During the poster creation, the pizza was baked to be tasted by the group afterwards. All groups (n = 10) talked positively about the taste of the pizza during the tasting. Most of the children in the group referred to the pizza as tasty: "*This is really the tastiest pizza ever!"* (School 2 group 1). Some children even wanted to bake the pizza at home: "*This is really the tastiest [pizza] I have cooked in the world. I am going to pass the recipe on to my parents*" (School 2 group 2) or "*The pizza at home I also like, but I personally like this one better than the pizza at home*" (School 2 group 1). Some of the groups (n = 4) also talked about the tasty appearance of the pizza. Furthermore, a few groups (n = 2) addressed the nice smell of the pizza: "*Hmm, it smells delicious*" (School 2 group 3). In addition, two groups talked about the pleasant texture of the pizza, which was attributed to the melted cheese substitute on top.

3.3.2. Negative perceptions towards plant-based meat and fish alternatives

Factors explicitly mentioned by children to negatively influence their attitude towards meat and fish alternatives differed per alternative type and per research method. A summary of the factors explicitly contributing to a negative perception can be found in Table 4.

3.3.2.1. Design probe box assignments. Children expressed their viewpoint on various plant-based alternatives via the unboxing assignment. Overall, most of the children had a negative perception towards the (expected) taste of the almonds (n = 15) and kidney beans (n = 15). Fewer children communicated a negative perception towards the salmon or chicken analogue (n = 5) or the tofu pieces (n = 5). Although only a few children had a negative taste perception of tofu pieces, relatively many children (n = 9) had a negative perception towards its appearance. Child 8 (girl) illustrates this: "*It looks like minced meat, but it looks a bit like dried out earth. Nah, a bit like rabbit droppings. It looks, I do not think it looks super tasty*". Only a few children had this negative perception of the appearance of the salmon or chicken analogue (n = 5), kidney beans (n = 4), and nuts (n = 1).

3.3.2.2. One-to-one interview. As in the unboxing video of the design probe box, a majority of children (n = 21) expressed in the interviews negative perceptions around the unpleasant (expected) taste of meat or fish analogues. Child 19 (boy) elaborates on this: "*I do not really like vegetarian burgers. I tasted it once and there is almost no flavour to it*". Adversely, fewer children expressed a negative viewpoint towards the taste of legumes (n = 8), nuts (n = 3), or tofu/tempeh (n = 3).

Besides taste, product appearance of meat analogues was negatively addressed by a few children (n = 4). Child 1 (girl) referred back to the salmon analogue received in the design probe box activities: "*Well I found that salmon just looking very slimy*". Only one child said something negative about the appearance of tofu in the interview while none of the children had a negative perception towards the appearance of nuts or legumes.

3.3.2.3. Cooking session. While choosing ingredients and creating the pizza, some groups (n = 3) negatively talked about the taste of the plant-based analogues. A child in group 1 from school 2 explained why she did not want plant-based ham on the pizza: "*Because that ham that did not seem particularly tasty to me. I did eat something like that once and it was not particularly tasty*". This example at the same time suggest that children might connect the plant-based analogue with the animal-based meat counterpart in their mind. It was not clear whether children compared the plant-based analogue with a previously eaten plant-based analogue or the animal-based counterpart. Therefore, it remains unclear whether children have a negative perception of the plant-based analogue specifically or of the animal-based meat counterpart. Such a negative perception towards taste was mentioned more often for the nuts (n = 4), and less often for the tofu/tempeh (n = 2), and kidney beans (n = 1). The negative taste perception of the nuts could be due to unsuitability of this ingredient on a pizza: "*We all do not like nuts very much. For on a pizza, I do not think that is very tasty anyway*" (School 3 group 2).

In addition to taste, product appearance and smell of the alternatives was sometimes negatively perceived. This negative perception was only pronounced towards the smell of analogues (n = 4). Two children in group 2 from school 3 for instance discussed the plant-based salami analogue: "*I smell something that does not smell good in here. That is the salami.*". For the product appearance, groups expressed a negative attitude towards analogues (n = 3) and tofu/tempeh (n = 1). A child in group 2 from school 2 explained: "*I thought that ham looked a bit strange, because I always have ham with a white edge, which is fatty, which is tastier though. And here it is just one colour, which is white/orange*".

When tasting the pizza, children in three groups were a bit hesitant about the flavour of the pizza. They did not directly state that the pizza was not tasty at all, but they said: "*[It is] not very tasty*" (School 3 group 3).

3.4. Dairy conception and perception

Table 5 provides an overview of the positive and negative perceptions expressed by children/groups with regards to animal-based dairy products. When talking with the children about animal-based dairy in the one-to-one interviews, many children (n = 13) addressed the taste as a contributor to the positive perceptions towards dairy. Child 11 (boy) for instance explained "*I also just really like vanilla custard because it is very sweet*". Child 18 (boy) refers to the taste of milk: "*I like milk a lot"*. Also, familiarity with dairy plays a big role in the positive perceptions of many children (n = 9): "*Because I'm used to it and I like it very much*" (Child 14, girl). Child 33 (girl) explained why she would prefer animal-based yoghurt over plant-based yoghurt substitutes: "*Because I am just used to that*". Additionally, healthiness (n = 4) was positively addressed by a few children. This healthiness is often addressed in general terms or

Table 5
Number of children/groups mentioning a negative or positive aspect of animal-based dairy consumption.

	Unboxing (n = 37 children)	Interview (n = 37 children)	Cooking (n = 10 groups)
Negative			
Taste		5	2
Animal welfare		1	
Positive			
Taste		13	2
Familiarity		9	
Healthiness		4	
Convenience		1	

related to the bones: "*Yes, it is just healthy and good for the bones*" (Child 8, girl).

Only a few children had a negative perception towards the taste of dairy (n = 5). Child 15 (girl) for instance elaborated on this: "*I find yoghurt a bit sour and milk I do not like that*". Interestingly, dairy products are barely (n = 1) related to animal welfare by the children. Only child 1 (girl), who is vegetarian, refers to this: "*[It is bad] because the calves have to pull the milk out of the cow*".

The pleasant taste of dairy is also discussed in the cooking session by some groups (n = 2). Children refer positively to the taste of animal-based cheese. Nevertheless, some groups (n = 2) also talked negatively about the taste of animal-based dairy in these sessions, as shown in this explanation: "*I do not like cheese that much*" (School 2 group 3).

3.5. Plant-based dairy alternative conception and perception

When talking in the interviews about dairy substitutes, only a minority of the children (n = 13) had a valid conception of this. Some of the children referred to general aspects such as products not made of cow milk or vegan products. Many of these children however came up with specific examples, referring to coconut, soy, oat, or almond milk. This conception could come from the information provided in the design probe box. In the dessert manager assignment, children received some information about dairy substitutes, in which the examples of soy, almond, coconut, and oat alternatives were mentioned.

Some children (n = 4) misunderstood the concept of dairy substitutes and talked about animal-based products in their conception of dairy substitutes. They for instance referred to goat milk or eggs. After the discussion about the concept, the researcher provided a definition of dairy alternatives to ensure the children had a similar understanding.

3.5.1. Positive perceptions towards plant-based dairy alternatives

Children expressed their perception of dairy substitutes implicitly through created design probe artworks and explicitly in spoken form during the interview and cooking session. Factors explicitly positively mentioned by children differed per dairy substitute and per research method. A summary of the factors explicitly contributing to a positive perception can be found in Table 6.

3.5.1.1. Design probe box assignments. In this research, children first got in touch with the concept of dairy substitutes via the dessert manager assignment. Children got information about dairy substitutes not being made of cowmilk but for instance of coconut, soy, nuts, or oats. After reading this information, children created their favourite plant-based dessert. Many children (n = 14) just left out the dairy component and based their dessert mainly on fruits. Some children (n=5) substituted animal-based fat for plant-based fat substitutes. Some children substituted animal-based milk by specific plant-based milk substitutes: soy milk (n = 6), coconut milk (n = 4), or oat milk (n = 2). Two children incorporated plant-based cream substitutes in their dessert, and one other child specifically referred to soy cream as ingredient. Animal-based yoghurt or quark was by some children substituted for soy yoghurt or quark (n = 3), a general plant-based yoghurt substitute (n = 1), or nut yoghurt (1). Only one child added a plant-based ice cream substitute to the recipe while one other child specifically mentioned coconut ice cream. Only one child incorporated animal-based dairy in the dessert recipe.

3.5.1.2. One -to-one interview. In the interviews, children talked about the concept of plant-based dairy substitutes. Moreover, children were shown an example package of a plant-based soy yoghurt to make the concept more vivid. For quark and yoghurt alternatives, some children (n = 7) expressed a positive perception towards its (perceived) taste. Also, some children talked positively about the expected taste of ice cream alternatives (n = 5). Child 26 (boy) explained: "*Well I actually*

Table 6
Number of children/groups positively or negatively discussing factors for distinct dairy substitutes.

		Positively discussed								Negatively discussed				
		Food intrinsic		*Food extrinsic*			*Meal context*	*Child*		*Food intrinsic*			*Food extrinsic*	*Child*
		Taste	Texture	Animal welfare	Healthiness	Environmental friendliness	Meal suitability	Allergens	Curiosity	Familiarity	Taste	Product appearance	Price	Unfamiliarity
Interviews (n=37)	Ice cream	5			1				4		1			2
	Cheese	1							1		1			
	Milk	1				1		1	3	3	3	2		2
	Cream									2				
	Pudding			2	1				3	1				
	Yogurt/ quark	7		3	6	2		1	5	2	6	1	2	2
Cooking (n=10)	Ice cream	1												
	Cheese	2	2				3				2	1		1
	Milk													
	Cream													
	Pudding													
	Yogurt/ quark													

think vegan Ben&Jerry's might be slightly tastier than the regular [animal-based] one". Some children expressed curiosity to try various dairy substitutes, mainly yoghurt or quark (n = 5), ice cream (n = 4), pudding (n = 3), or milk (n = 3). Child 37 (girl) for instance expressed willingness to try plant-based yoghurt substitutes: "*Well I am just curious about the taste and to see if it [plant-based yoghurt substitute] tastes the same [as dairy yoghurt]*".

The animal welfare concept was not often addressed by children related to dairy substitutes. Only three children expressed animal welfare to contribute to a positive perception towards yoghurt or quark alternatives. Two children related animal welfare to puddings. Child 29 (boy) stated his willingness to consume vegan crème brûlée instead of animal-based crème brûlée: "*For the animals, I just love animals*".

The resemblance of plant-based milk (n = 3), cream (n = 2), yoghurt (n = 2), or pudding (n = 1) substitutes with their animal-based counterpart product was positively perceived by some children, resulting in perceived familiarity. Child 13 (girl) explains her preference for soy quark: "*Because I think that is most like yoghurt or quark, something like that*".

Furthermore, some children (n = 6) positively related plant-based yoghurt substitutes to healthiness. They mainly based this relation on the exemplar product that was brought to the interview. Child 25 (boy) explained: "*What I do like about it is that it is very healthy, healthier than normal yoghurt too in my opinion*".

3.5.1.3. Cooking session. Two types of plant-based cheese substitutes were offered in the cooking sessions as possible pizza topping. Some groups (n = 2) talked positively about the (expected) taste of the cheese substitutes. In the end, all groups chose to add the plant-based grated cheese substitute to their pizza. While tasting the pizza, children of school 3 group 3 stated: "*This [plant-based substitute] is pretty good*". Two groups also discussed the pleasant texture of the plant-based cheese substitutes: "*Guys, try that [plant-based feta substitute], if this goes in the oven, we will get nicely melted cheese*" (School 3 group 3). In addition, some groups (n = 3) also expressed suitability of cheese as ingredient on a pizza, leading to a positive perception. A child from school 2 group 3 convinced the others: "*Yes but that is the way it should be, cheese belongs on a pizza*". When discussing the pizza taste, three groups even mentioned that they would add more cheese next time: "*And [we should] add a lot more cheese!*" (School 1 group 1). The examples show that the positive perceptions about the plant-based cheese substitutes might be related to the perceptions of animal-based cheese as groups sometimes seemed unaware of the differences between the plant-based substitute and animal-based cheese.

3.5.2. Negative perceptions towards plant-based dairy alternatives

Children also explicitly in spoken form shared some factors contributing to a negative perception of plant-based dairy substitutes in the interviews and cooking session. A summary of the factors explicitly contributing to a negative perception can be found in Table 6.

3.5.2.1. One-to-one interview. During the interviews, only three children commented unprompted on the flavour of plant-based milk substitutes: "*That Alpro milk really; blèh. Yes, very gross"* (Child 12, boy). Some children (n = 6) negatively referred to the (expected) taste of plant-based yoghurt substitutes when shown the exemplar product. Child 26 (boy) stated: "*Yeah soy, I usually do not like that very much actually*".

Besides taste, unfamiliarity with plant-based dairy substitutes played a negative role for some children. Unfamiliarity with plant-based ice cream (n = 2), milk (n = 2), or yoghurt (n = 2) substitutes negatively influenced their perception. Child 32 (boy) for instance explained he would not substitute cow's milk in pancakes for plant-based milk substitutes: "*Well soy, I have never tasted that, but I am used to real cow's milk*". Child 37 (girl) is also reluctant to try plant-based milk or ice cream substitutes: "*Well, I have never drunk it, or eaten it, but it seems to me that [animal-based] ice cream is tastier*".

Interestingly, some children (n = 2) referred to the price of plant-based dairy substitutes as contributor to a negative perception. The price of plant-based yoghurt substitutes was for instance mentioned to be too expensive. Child 8 (girl) illustrates this: "*And often this [plant-based yoghurt substitute] is also a little bit more expensive, because it is just a little bit less [volume], but then maybe you could also make it cheaper … if you see for example this is 5 euros and the other one is 4 euros then you more easily grab the one without soy*".

3.5.2.2. Cooking session. Only very few groups commented negatively on the plant-based cheese substitutes on the pizza. In two groups, children negatively referred to its taste: "*Not my cheese flavour, I only like one cheese: the young mature, 48+*" (School 3 group 1). Also, appearance of the feta cheese was negatively mentioned in one of the groups: "*Looks horrible. Looks more like cheese. Like that goat cheese*" (School 1 group 1). However, in these cases the children seemed to compare the plant-based cheese substitutes with animal-based cheese and transferred their disliking of that cheese on this plant-based substitute.

3.6. Desires protein transition

When children were asked in the interviews about their desires regarding the protein transition, the large majority of the children (n = 27) talked about something related to taste or flavour. Sixteen children mentioned a preference for products that mimicked animal-based meat or dairy: "*Yes I would prefer what looks like meat, that looks like that, which is actually not meat but vegetarian that is fine with me*" (Child 20, boy). Some children (n = 6) also just expressed that the alternative protein product should be tasty. Few children (n = 3) specifically expressed a preference for more herbs or spices or flavour (n = 2).

Children also talked about preferences regarding the packaging. Six children highlighted the necessity to clearly communicate the plant-based nature through the packaging to avoid misleading consumers. Child 13 (girl) explained this: "*Not that you want to eat real meat, and for example in the supermarket, you suddenly see one of those packages and then all of a sudden it is vegetarian*". Three children expressed to want less packing material and three other children mentioned the need for colourful packaging with images to attract people to the product.

Other themes that popped up regarding desires in the protein transition were an increase in the availability of alternatives, an increase in product volume, cheaper prices, or secretly hiding the plant-based nature of the product. Child 8 (girl) for instance mentioned the availability and accessibility issue: "*Yes that it is really more visible, because now you mainly see real meat and then, you could for example display the fake ones a little more*".

4. Discussion and conclusion

This research aimed to gain insight into 9- to 11-year-old children's perception of plant-based meat, fish, and dairy alternatives. Children expressed their perceptions through design probe activities, one-to-one interviews, and cooking sessions. This study was the first to focus on children's perception of different types of plant-based alternatives. Also, the combination of traditional and participatory research methods gave a holistic view on children's perceptions. The insights help to understand children's wishes, needs, and preferences with regards to the protein transition.

Previous research suggests that adult's current eating practices and habits (Boukid, 2021; Grasso et al., 2021; Laila et al., 2021; Michel et al., 2021; Schiano et al., 2022; Tarrega et al., 2020; Varela et al., 2022) as well as the perceived preparation difficulty can hinder willingness to adopt a more plant-based diet (Alcorta et al., 2021; McBey et al., 2019). These elements can be overcome when targeting children as they are still in the process of

forming practices and habits and can be learned how to cook with plant-based ingredients. This is in line with Colombo et al. (2021) who propose amongst others that children's involvement with and exposure to these plant-based alternatives can increase acceptance of plant-based meals.

4.1. Reflection on children's perception of plant-based meat and fish alternatives

Overall, taste is the topic discussed most by children both positively and negatively when it comes to all types of plant-based meat or fish alternatives. Initial taste expectations in the design probe assignments were more positive for meat and fish analogues than for substitutes and replacements. However, children's positive perception of analogues shifted towards a less positive and more negative viewpoint during subsequent interviews and cooking sessions. This perception shift can be explained by expectations that are created through meat analogues' resemblance with animal-based meat. As Elzerman et al. (2021) argue, the perception is determined by the (in)difference of the analogue with the animal-based counterpart. Initially, the similar appearance of meat analogues and animal-based meat might create positive expectations of the meat analogues. However, when actually considering and tasting the products in interviews and cooking sessions, these expectations are unsatisfactorily met. The taste differences between the analogues and animal-based meat or fish then results in less positive or more negative perceptions.

Interestingly, during the cooking session, there was no substantial difference in children's actual taste perceptions of analogues, substitutes, and replacements. Therewith, it can be argued that placing the plant-based alternatives in a meal context diminishes the higher preference for analogues. The Health Council of the Netherlands recommends eating more legumes and nuts and varying protein sources (Health Council of the Netherlands, 2023). For plant-based substitutes and replacements, the absence of an expected resemblance with animal-based meat or fish works in their favour in a meal context. Although children in this study expressed the desire for plant-based analogues mimicking animal-based meat, fish, or dairy, it remains questionable whether these analogues really help them meeting expectations and accepting alternatives. Exposing children to plant-based alternatives that do not mimic the appearance and taste of animal-based foods, seems to have potential in substituting and lowering animal-based food consumption.

A strength of the current study was the incorporation of the plant-based alternatives in a meal context. The meal context provides a more accurate reflection of actual eating situations. Nevertheless, the gathered insights are limited to the specific pizza meal used in this study, which can be seen as a weakness. It became clear that nuts, legumes, and tofu are not regarded as suitable products in a pizza. The ingredient and meal choice in this study might have affected children's expressed perceptions. As argued by Elzerman et al. (2021), the perceived appropriateness of an ingredient with a dish also determines its acceptance. Future research could therefore focus on the use of nuts, legumes, and tofu as meat alternatives in other, more suitable dishes.

Smell and appearance were also important intrinsic attributes that influenced children's perceptions, which is in line with findings by Colombo et al. (2021). Whereas product appearance can contribute to both positive and negative perceptions, smell mainly results in positive perceptions. Positive product appearance perceptions were especially linked to meat analogues and not so much to meat substitutes or replacements. This suggests improvement possibilities for the presentation of nuts, legumes, and tofu to make their appearance more favourable for children. Nevertheless, the study showed that appearance of meat or fish alternatives in general becomes less important when these alternatives are presented in a meal context. Fewer children addressed the product appearance in the cooking session compared to the design probe activities and interviews. Often, scientific research evolves around the study of one single product. However, the current study shows the importance of putting a product in a dish and meal context as this can alter focus points and perceptions and mimics more a real-life situation. Presenting single products in a meal combination or familiar dish can mask, lift, or enhance the flavour (Elzerman et al., 2021; Hoek et al., 2013).

Besides the importance of intrinsic attributes, this study showed that the extrinsic attribute animal welfare also influences children's perceptions. In particular, meat analogues were often positively perceived due to their higher animal friendliness compared to animal-based meat. Substitutes and replacements as meat alternatives were not associated with animal welfare as the children do not have the global picture of the protein transition. Moreover, the importance of animal welfare disappeared in the cooking sessions. Although previous research (Pater et al., 2022) shows that animal welfare is an important driver for children to choose meat alternatives, animal welfare is only linked to meat analogues. Therefore, it is crucial to link plant-based substitutes and replacements directly with animal welfare to nudge children towards the consumption of plant-based alternatives. Moreover, the decrease of the importance of animal welfare in cooking situations might mimic what happens in real life; consumers are increasingly concerned with animal welfare but do not buy more animal friendly products. This phenomenon can be attributed to an attitude-behaviour gap, where interest in animal welfare does not result in buying more animal friendly food products (Cornish et al., 2019). Highlighting the animal friendliness of plant-based alternatives also during consumption at the dinner table might increase their acceptance amongst children. In the same eating context, curiosity might also help children to choose and accept plant-based alternatives. This study showed that product familiarity became less important when cooking in the cooking session. Involving children in the cooking of meals with plant-based alternatives might therewith reduce children's automatic preference for familiar foods such as animal-based meat. Collier et al. (2021) argued that for adults, lack of experience with plant-based alternatives can create uncertainty about the quality and taste. For children, unfamiliarity with plant-based alternatives can be decreased through a cooking session with these products. By the experience of cooking with these products, children's perception can become more favourable as they become more certain about the quality and taste.

4.2. Reflection on children's perception of plant-based dairy substitutes

When it comes to dairy substitutes, children were less outspoken compared to their perceptions of meat and fish alternatives. In general, children came up with fewer themes and topics that explained their perception of dairy substitutes. This could be due to the relative diminished focus in the study on plant-based dairy alternatives compared to plant-based meat and fish alternatives. The concept of plant-based dairy alternatives was less visible in the research since no plant-based dairy alternatives were for instance incorporated in the unboxing activity. This diminished visibility might have made the concept less concrete for children.

For plant-based dairy substitutes, taste was again the most mentioned topic in both a negative and positive way. Interestingly, negative taste perceptions were not mentioned about the cheese when it was presented on the pizza, highlighting the relevance of putting single ingredients in a meal context. Nevertheless, it would be interesting for future research to focus on other types of dairy substitutes as well in co-creation, such as yoghurt, milk, or cream substitutes.

Animal friendliness was, opposed to meat alternatives, not a topic often discussed by children in relation to dairy substitutes. McBey et al. (2019) argue that animal welfare is likely not to be a driver amongst adults for vegetarianism as knowledge about animal welfare is considered low. This might be true for children as well when it comes to dairy substitutes. McBey et al. (2019) state that ethical concerns rarely motivate consumption of dairy alternatives since these alternatives have a weaker link with animal suffering. This finding indicates that linking animal welfare more clearly to dairy substitutes might help children

accepting these alternatives if needed in the protein transition. Future research should investigate the influence of animal welfare information regarding dairy (alternatives) on children's perception and acceptance of these alternatives.

4.3. Conclusion

An overview of the outcomes of this study is presented in Fig. 3. The primary focus of 9- to 11-year-old children's perceptions regarding plant-based meat, fish, and dairy alternatives revolves mainly around taste. This study shows that taste is always the main point addressed by children when discussing plant-based food alternatives. This taste perception can be either positive or negative, depending on the child and type of alternative. Nevertheless, the taste perception differs per research method and type of plant-based food alternative. The greater preference for plant-based analogues as opposed to plant-based substitutes and replacements decreases when interacting with these products in a cooking session.

This study shows the necessity of studying children's perception of plant-based alternatives in a real-life meal context. This gives a more holistic, rich, and contextualized understanding of children's wishes and preferences. Inviting children to really interact and cook with these alternatives can result in more positive perceptions towards less familiar alternatives.

Besides taste, animal welfare is an important factor for children in the perception of plant-based meat or fish analogues. Plant-based meat or fish analogues are often positively related to animal welfare, which drives acceptance of these products. Contrary, animal welfare is not as much linked to substitutes and replacements (i.e., nuts, legumes, tofu/tempeh, dairy substitutes). Clarifying the link between these types of alternatives and the protein transition can positively impact children's perception of these alternatives.

This understanding of the importance of taste, meal context, and animal welfare in children's perception of plant-based alternatives is needed to effectively promote the transit from an animal-to a plant-based diet. Considering children's perceptions can help in tailoring the protein transition towards the needs and wishes of the future generation and shaping future food habits.

CRediT authorship contribution statement

Lotte Pater: Writing – original draft, Visualization, Validation, Project administration, Methodology, Investigation, Data curation, Conceptualization. **Elizabeth H. Zandstra:** Writing – review & editing, Supervision, Conceptualization. **Vincenzo Fogliano:** Writing – review & editing, Supervision, Conceptualization. **Bea L.P.A. Steenbekkers:** Writing – review & editing, Supervision, Methodology, Conceptualization.

Data availability

The raw data that supports the findings of this study are not openly available due to reasons of sensitivity and are available upon reasonable request from the corresponding author.

Ethical statement

The research was performed in compliance with relevant laws and institutional guidelines and the Social Sciences Ethics Committee (SEC) of Wageningen University & Research approved the study design (reference number 2022-28-Pater). Participants and their caregiver(s) were informed about the general purpose of the study and were

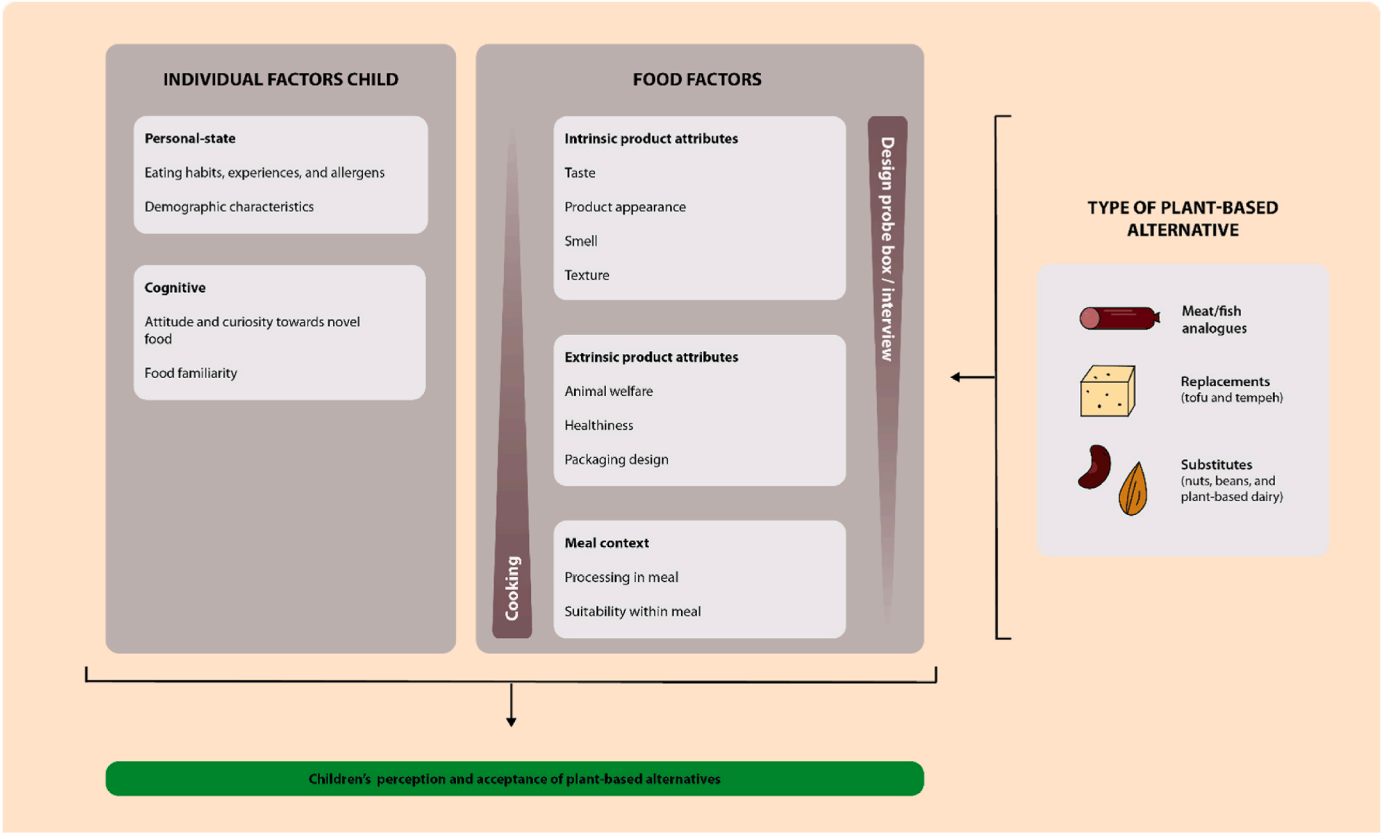

Fig. 3. Summary of factors influencing 9- to 11-year-old children's perception of plant-based food alternatives, with influence of food factors varying by research method and type of plant-based alternative.
The shaded arrows' colour and thickness illustrate the focal points of the insights obtained through different research methods.

introduced to the researcher in an information leaflet in advance. Caregivers gave written informed consent for their child to participate in the study. Children verbally assented to participate in each of the distinctive research activities. Participation was voluntary and all information was anonymized and treated confidentially.

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Data availability

Data will be made available on request.

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