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Effects of Parent-Child Collaborative Vegetable-Cooking on Psychological Development

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Abstract

This study examines the parent-child relationship in the context of collaborative vegetable cooking and its impact on children's psychological development, with a focus on non-cognitive abilities. A questionnaire survey was conducted among parents (n = 793) with first-born children aged 3 - 12 years. Psychological and behavioral development scores were assessed for parent-child dyads, categorized into three groups based on their collaborative cooking experience: a group with collaborative vegetable-cooking experience (n = 420), a group with collaborative cooking experience excluding vegetables (n = 133), and a group with no collaborative cooking experience (n = 240). The scores for the parent-child collaborative vegetable-cooking group were significantly higher across all six psychological and behavioral development items compared to both the non-vegetable collaborative cooking group and the non-collaborative cooking group. The collaborative cooking group including vegetables was further analyzed based on the level of the child's involvement in the cooking process. Results indicated that the group where tasks were primarily left to the children scored significantly higher in both behavioral outcomes and satisfaction for both parents and children during co-cooking. Creating opportunities for parents to allow their children to actively participate in diverse vegetable cooking processes independently may positively influence children's psychological development, particularly their non-cognitive abilities.

Keywords

Food Education, Collaborative Cooking, Vegetable Cooking, Parent-Child Relationship, Non-Cognitive Development

1. Introduction

Although there is no longer a unified ideal way that a family should be in Japan, the nuclear family remains central. The concentration of the Japanese population in large cities and the rapid growth of the single household are important factors. Households across Japan are divided into 54% of the nuclear family type, 38% single households, with other households, including multigenerational families living together, amount to 8% of the total (Ministry of Health, Labour and Welfare in Japan, 2020). In modern Japan, there are many time constraints that fall on a single family that fall less onerously upon nuclear families due to their collaboration, it is necessary to routinely and consciously incorporate the scenes of emotional interaction, where relatedness between parent and child is more likely to occur, relative to the viewpoint of psychological development of the parent and child.

Parent-child co-preparation of meals is an emotional interaction in everyday life, a form of parent-child collaborative work. Parent-child co-cooking promotes children's psychological development and leads to positive parental thoughts and behaviors; prior research suggests that co-cooking experiences with diluted lactic beverages and hot cake mixes can foster psychological development, including non-recognition abilities and the acquisition of new cognitive abilities for children and their parents (Kotani et al., 2016; Tajima et al., 2018). Collaborative cooking experiences produce parent-child communication and have the potential to guide the growth of non-cognitive abilities as well, including children's social skills, challenging their minds by solving problems, producing curiosity, identifying the psychological importance that co-cooking experiences have. However, it is not yet clear what cooking experiences drive psychological development most effectively. Dilution-type lactic beverages and hot cake mixes, which are easy to use in cooking, show a special and non-routine recreational proximity component for dietary habits. Vegetable dishes are attracting attention as dishes that can be naturally encountered in daily eating experiences and that can include complex cooking processes. Previous studies of the cooking of vegetables indicate an experiential program of vegetable cooking has a positive impact on children's self-efficacy in cooking among terms of non-cognitive abilities (Jarpe-Ratner et al., 2016). However, the impact that psychological development of everyday co-cooking in the home is not a temporary event and has not yet been tested so far.

In addition, we conducted a survey research experience using the questionnaire method, with the purpose of estimating the influence of the ideal means of parent-child co-cooking on the child's psychological development, focusing on vegetable dishes, as these can be regularly cooked at home with diverse accompanying elements and using cooking processes.

2. Method

We adopted a survey method using a questionnaire, conducted among parents with first children between 3 and 12 years old, looking back one year from the

time of the survey. Vegetable dishes were defined as raw vegetable salads, hot vegetable salads, potato salads, dressings, stir-fries, stews, soups, noodles, rice dishes, and all other dishes using vegetables, including dishes that also contain meat, fish, and eggs.

Some respondent mothers indicated that their parent-child collaborative cooking with vegetables took place at least once a month (parent-child collaborative cooking with vegetables group, n = 420), those that indicated that did not have collaborative cooking experience with vegetable cooking but did cook collaboratively at least once a month (parent-child collaborative non-vegetable cooking, n = 133), and those who responded that they did not have parent-child collaborative cooking experience (parent-child collaborative cooking, inexperienced group, n = 240) based on a pre-survey concerning their food education experience. In each group, the sizes of children's age groups (1 - 2, 3 - 4, or 5 - 6 years of primary school) and male-to-female ratio were almost equal. In addition, in the vegetable cooking and the non-vegetable cooking, the frequencies of collaborative cooking between about once a month and more than once a week were equally assigned as far as possible (Table 1).

Table 1. Breakdown of assignment by segment of survey subjects.

Group	Age	Co-cooking frequency	n	%
Group of parents and children who have experience cooking vegetable dishes together	The first year of kindergarten (3 - 4 years old)	At least once a week	35	4.4
		About once a month	35	4.4
	The second year of kindergarten (4 - 5 years old)	At least once a week	35	4.4
		About once a month	35	4.4
	The third year of kindergarten (5 - 6 years old)	At least once a week	35	4.4
		About once a month	35	4.4
	The first grade of elementary school (6 to 7 years old)	At least once a week	35	4.4
		About once a month	35	4.4
	The third grade of elementary school (8 to 9 years old)	At least once a week	35	4.4
		About once a month	35	4.4
	The fifth grade of elementary school (10 to 11 years old)	At least once a week	35	4.4
		About once a month	35	4.4
Group of parent-child co-cooking experiences other than vegetable cooking	The first year of kindergarten (3 - 4 years old)	At least once a week	2	0.3
		About once a month	20	2.5
	The second year of kindergarten (4 - 5 years old)	At least once a week	4	0.5
		About once a month	20	2.5

Continued

Group of parent-child co-cooking experiences other than vegetable cooking	The third year of kindergarten（5 - 6 years old)	At least once a week	1	0.1
		About once a month	14	1.8
	The first grade of elementary school (6 to 7 years old)	At least once a week	2	0.3
		About once a month	20	2.5
	The third grade of elementary school (8 to 9 years old)	At least once a week	5	0.6
		About once a month	20	2.5
	The fifth grade of elementary school (10 to 11 years old)	At least once a week	6	0.8
		About once a month	19	2.4
Parent-child co-cooking naive group	The first year of kindergarten (3 - 4 years old)	-	40	5.0
	The second year of kindergarten (4 - 5 years old)	-	40	5.0
	The third year of kindergarten (5 - 6 years old)	-	40	5.0
	The first and second grade of elementary school (6 - 8 years old)	-	40	5.0
	The third and fourth grade of elementary school (8 - 10 years old)	-	40	5.0
	The fifth and sixth grade of elementary school (10 - 12 years old)	-	40	5.0
Total			793	100.0

2.1. Questionnaire Survey

A questionnaire survey was conducted using an internet research company (Cross Marketing Inc.). Responses were collected from July to August 2021. The questionnaire included 8 screening questions, 21 face sheet questions, 151 questions on psychological and behavioral development, and 180 questions in total on the ideal means of action and psychological development for joint cooking among parents and children. Items were drawn from the following instruments: the Behavioral Rating Item (Miki, Kotani, & Ohsawa, 2015) (**Table 2**), Parental Nutrition Attitude Scale (Nakamichi & Nakazawa, 2003), Parental Self-esteem Emotion (Yamamoto, Matsumoto, & Yamanari, 1982; Susaki & Anii, 2013), Parental Dietary Awareness Survey (Takahata et al., 2006) (**Table 3**), Children's Social Skills Scale (Nakadai & Kanayama, 2002), Children's Self-esteem Emotion (Yamamoto, Matsumoto, & Yamanari, 1982; Susaki & Anii, 2013), and Critical Thought Attitude Scale (Hirayama & Kusumi, 2004) (**Table 4**). Responses to question items related to psychological development were collected on a 4-point Likert scale questionnaire, from "not at all (1)," to "not very much (2)," "slightly so (3)," and "very much so (4)." The approximate daily vegetable intake of the children was also administered using a 4-point Likert scale, from 0 to less than 0.5 cups (1), more than 0.5 cups to less than 1 cup (2), more than 1 cup to less than 2 cups (3). and more than 2 cups (4).

Table 2. Breakdown of assignment by segment of survey subjects.

Question group	Content of questions	I	II	Factor name
Child's perspective from the parent's perspective	When you are cooking, does your child seem happy when you are entrusted with the task?	0.964	−0.238	Child's communication skills: 9 items (α = 0.92)
	Does your child feel happy or satisfied when you are cooking?	0.933	−0.133	
	Is your child concentrating when you are cooking?	0.751	0.052	
	Is your child motivated and proactive when you are cooking?	0.723	−0.018	
	Do your children actively seek praise and approval from their parents when they are cooking?	0.675	0.043	
	When you are cooking, does your child express himself or herself by expressing his or her impressions of what he or she has done or made?	0.617	0.231	
	When you are cooking, does your child respond properly to your parents' proposes (instructions, questions, and suggestions)?	0.538	0.256	
	When you are cooking, do your children actively accept your parents' proposes (instructions, questions, suggestions, assessments), such as "Oh, I see," or "I understand"?	0.529	0.279	
	When you are cooking, do your children actively ask you questions, suggestions, requests, or orders?	0.454	0.314	
	When you are cooking, does your child think of other ways to cook or arrange things for the next time he or she cooks?	−0.23	0.968	Independent thinking and behavior of children: 7 items (α = 0.88)
	When you are cooking, do your children talk about what went well and what didn't, such as "what to do next" to make use of their experience?	−0.066	0.854	
	When you are cooking, does your child devise his or her own way of doing things when things don't go well?	0.112	0.741	
	When you are cooking, does your child act in consideration of his or her parents' feelings?	0.103	0.614	
	When you are cooking, do your children listen to their parents' opinions and work on it in their own way?	0.096	0.612	
	When you are cooking, does your child think and work on his or her own, using what he or she has learned before?	0.282	0.577	
	When cooking, does your child do things his or her own way without listening to his or her parents?	−0.044	0.547	

Continued

Child's perspective from the parent's perspective	Inter-factor correlation I	–	0.669**	
	Inter-factor correlation II		–	
Appearance of the parent	When you are cooking, do you feel your child's growth from what he or she says and does?	0.986	−0.204	Parent's cooperative skills: 8 items (α = 0.92)
	When you are cooking, do you give your child an evaluation (praise, point out, etc.) or feedback?	0.854	−0.077	
	Do you feel happy or satisfied when you are cooking?	0.711	0.089	
	When you are cooking, do you sometimes admire what your child says or does?	0.604	0.192	
	Do you support your child's activities while you are cooking?	0.594	0.211	
	When you are cooking, do you tolerate your child's mistakes to some extent?	0.557	0.217	
	When you are cooking, do you focus and watch intently what your child is doing?	0.535	0.23	
	When you are cooking, do you actively respond to your child's suggestions (questions, requests, and impressions)?	0.462	0.315	
	When you are cooking, do you ask questions or give instructions that make your child think?	−0.023	0.795	Parents' receptive parenting skills: 6 items (α = 0.83)
	When you are cooking, do you put yourself in your child's shoes and give suggestions, instructions, and advice?	0.059	0.763	
	When you are doing logic, do you tolerate your child's antics to some extent?	−0.121	0.619	
	Do you respect your child's pace and way of doing things when you are cooking?	0.257	0.505	
	When you are cooking, do you share your experiences and knowledge with your children?	0.22	0.486	
	When you are cooking, do you leave as much to your child as possible?	0.161	0.458	
	Inter-factor correlation I	–	0.763**	
	Inter-factor correlation II		–	
Parent-child interaction	When you are eating something cooked together, do you and your child enjoy interacting with each other?	0.892		Parent-child satisfaction: 6 items (α = 0.93)
	When you are eating something cooked together, do you and your child enjoy interacting with each other?	0.884		

Continued

Parent-child interaction	When you and your child are eating cooked food together, do you and your child have a lively conversation?	0.88
	When you are cooking together, do you and your child enjoy interacting with each other?	0.855
	When you are cooking together, is the interaction between you and your child smooth?	0.847
	When you are cooking together, do you and your child have a lively conversation?	0.821

Note: α, Cronbach's α coefficient (approximately between the sub-items constituted).

Table 3. Results of the factor analysis of the mother's development.

Question group	Content of questions	I	II	Factor name
Parental care attitude	When my children are playing alone and I think they are bored, I join them and play with them.	0.852	−0.215	Response: 7 items (α = 0.84)
	When I am at home, I have time to spend with my children, such as playing ball or playing games.	0.771	−0.141	
	I show my affection by hugging my child and saying kind words	0.68	0.034	
	When I go out somewhere and feel that my child is tired, I rest or hold him/her.	0.628	0.002	
	When I think my child is frustrated, I ask him, "What's wrong?"	0.56	0.22	
	When a child behaves incorrectly, I ask why he or she did it and discuss what should have been done.	0.483	0.251	
	When I go out with my family, I try to take in the places my children want to go as much as possible, not just for the convenience of their parents.	0.458	0.22	
	In places where it is necessary to be quiet, such as libraries and movie theaters, I make the child quiet	−0.038	0.798	Control: 4 items (α = 0.74)
	When my child does not keep the promise he has made to me, I will teach him that promise again	0.036	0.781	
	When a child is playing with a friend and forcibly takes a toy that the friend is using, I make him return it	0.021	0.533	
	When a child doesn't do what he is supposed to do, I say, "Do it."	−0.103	0.523	
	Inter-factor correlation I	–	0.391**	
	Inter-factor correlation II		–	

Continued

Parental self-esteem	I think I have many good qualities.	0.832	0.073	Positive parental self-esteem:5 items (α = 0.88)
	I think, at least, of a valuable person.	0.826	0.102	
	I am positive about myself.	0.765	−0.041	
	For the most part, I am satisfied with myself.	0.728	−0.11	
	I think I can do things as well as people can.	0.665	−0.087	
	I sometimes think I'm a total wretch.	−0.031	0.838	Negative parental self-esteem: 3 items (α = 0.80)
	I sometimes think of myself as a useless person.	0.069	0.808	
	I am afraid that no matter what I do, I will fail.	−0.05	0.608	
	Inter-factor correlation I	–	−0.393**	
	Inter-factor correlation II		–	
Parental food awareness survey	I believe that the dining table is a place where people gather to heal their hearts.	0.904	−0.078	Aggressiveness and perceived utility of table interaction: 5 items (α = 0.87)
	I want to cherish mealtime.	0.881	−0.106	
	I think that the dining table is a place to nurture children's minds.	0.869	−0.104	
	I enjoy eating with my children.	0.731	0.04	
	I want my children to eat their parents' homemade cooking.	0.404	0.325	
	I enjoy cooking.	−0.109	0.864	Aggressiveness of food preparation: 6 items (α = 0.83)
	I am devising ways to enjoy eating.	0.155	0.688	
	I cook with my children.	0.162	0.537	
	I'm not confident about cooking	−0.174	0.534	
	I want to cherish the taste of my home.	0.369	0.46	
	I incorporate seasonal events and seasonal festivals into my diet.	0.357	0.408	
	Inter-factor correlation I	–	0.696**	
	Inter-factor correlation II		–	

Note: α, Cronbach's α coefficient (approximately between the sub-items constituted).

Table 4. Results of the factor analysis of child development.

Question group	Content of questions	I	II	III	
Child social skills scale	Children are more likely to change their minds and come to terms with their peers when confronted.	0.807	−0.057	0.019	Self-control: 4 items (α = 0.84)

Continued

Child social skills scale	Children are the ones who control their feelings in situations of conflict with their peers.	0.76	−0.024	0.07	
	Children are the ones who respond appropriately when their peers say unpleasant things to them.	0.717	0.082	0.02	
	Children are the ones who feel comfortable receiving criticism without being offended.	0.702	0.042	−0.065	
	Children are the ones who actively talk to their peers.	−0.061	0.893	−0.008	
	Children are the ones who invite their friends to various activities	0.047	0.834	−0.028	Assertiveness: 3 items (α = 0.86)
	Children make friends easily.	0.054	0.721	0.04	
	Children are willing to help their peers in classroom activities.	−0.084	0.111	0.851	
	Children help teachers without being told.	0.046	−0.041	0.838	Cooperativity: 3 items (α = 0.83)
	Children willingly put away play equipment and teaching materials in the classroom.	0.072	−0.061	0.669	
	Inter-factor correlation I	–	0.408**	0.51**	
	Inter-factor correlation II		–	0.436**	
	Inter-factor correlation III			–	
Child's self-esteem	Children seem to think they have a variety of good qualities.	0.791	−0.031		
	Children seem to believe that they are at least as valuable as people.	0.775	−0.034		
	Children seem to be positive about themselves.	0.768	0.005		Positive child's self-esteem: 5 items (α = 0.87)
	Children seem to think they can do things as well as others.	0.718	0.077		
	The child, on the whole, seems satisfied with himself.	0.717	−0.049		
	Children sometimes seem to think they're a total mess.	0.036	1.005		
	Children seem to think they are useless in some way	0.048	0.726		Negative child's self-esteem: 3 items (α = 0.77)
	Children seem to think that no matter what they do they will fail.	−0.138	0.498		
	Inter-factor correlation I	–	−0.158**		
	Inter-factor correlation II		–		

Continued

Child's critical thinking attitude scale	Children are good at thinking about complex problems in sequence.	0.896	−0.132	Logical and intensive attitudes: 6 items (α = 0.87)
	Children seem to be confident in thinking things correctly.	0.864	−0.068	
	Children are able to continue to deal with such difficult issues as those that do not occur in one line.	0.761	0.027	
	Children try to think from as many perspectives as possible, not just one or two.	0.63	0.136	
	Children are the ones who can concentrate well when working on a problem.	0.508	0.143	
	A child is a person who listens to people who don't like you.	0.497	0.212	
	Children seem to want to know more about any topic.	−0.047	0.916	Curiosity: 4 items (α = 0.84)
	Children seem to want to learn as much as possible, even if it may or may not be useful.	0.09	0.809	
	Children seem to want to ask questions that they don't know.	−0.048	0.681	
	Children seem to like trying new things.	0.079	0.559	
	Inter-factor correlation I	–	0.552**	
	Inter-factor correlation II		–	

Note: α, Cronbach's α coefficient (approximately between the sub-items constituted).

2.2. Ethics

Data were collected according to the ethical principles set forth in the Declaration of Helsinki (World Medical Association, 2000), the Code of Conduct of the American Psychological Association (APA, 2017), and the Code of Conduct of the Japanese Psychological Association (Japanese Psychological Association, 2009).The investigator described the objectives and methods of the survey in a document accessible to the subjects to allow them to be fully informed concerning their participation and were able to make decisions. The study data were anonymized, and means was used to store the subject's name or identity. The subjects were instructed that they were free to participate or cease participation in the study at any time, and they provided written informed consent after submitting a questionnaire.

2.3. Statistical Analyses

Factor analyses were performed using maximum likelihood promax rotation, and the factors were set so that the Cronbach's alpha factor was 0.7 or higher. Intergroup comparisons were assessed using parametric methods, assuming normality according to prior work in the field of psychology (Kotani et al., 2016; Kuroiwa,

Tajima, & Miki, 2018; Tajima et al., 2018). For each item, inter-group comparisons among between the three groups were performed using the Tukey test, and comparisons between two groups were performed using an unpaired t-test. Data are presented as means ± SDs. Hazard ratios of less than 5% were considered to indicate significance. In addition, we performed structural covariance analyses (AMOS) for the causal estimation of the respective factors. Statistical analyses were performed using SPSS 27.0 software (IBM Corp., NY, USA). In previous work, no major psychological development was seen between age groups, (Tajima et al., 2018), so all ages from early childhood to middle childhood were included in the analysis.

3. Results

3.1. Results of Factor Analysis for Each Item and Determination of Synthetic Variables

To organize question items consisting of multiple items, based on the results of factor analysis (maximum likelihood promax rotation), the sum for each item constituting a factor at the factor level was calculated in the form of a synthetic variable. The synthetic variable items for mother-child interactions were child communication power (α = 0.92), child's independent thinking and behavior (α = 0.88), parent coordination power (α = 0.92), parent's receptive parenting power (α = 0.83), and parent-child satisfaction (α = 0.93) (**Table 2**). The synthetic variable items for maternal development were response (α = 0.84), control (α = 0.74), positive parental self-affirmation (α = 0.88), negative parental self-affirmation (α = 0.80), positive table interaction (α = 0.87), and positive food preparation (α = 0.83) (**Table 3**). The synthetic variable items for offspring development were self-control (α = 0.84), assertiveness (α = 0.86), coordination (α = 0.83), positive self-affirmation of offspring (α = 0.87), negative self-affirmation of offspring (α = 0.77), logical and focused attitudes (α = 0.87), and curiosity (α = 0.84) (**Table 4**).

3.2. Comparison of Mean Psychological and Behavioral Development Scores Related to Maternal and Child Development by Experiences of Collaborative Vegetable Cooking

Psychological development in parent-child behavior and satisfaction in mother-child interactions were assessed in five items, namely, children's communication ability, children's independent thoughts and behaviors, ability of parental coordination, parents' receptive parenting ability, and parent-child satisfaction (**Figure 1**). In all of these items, the parent-child collaborative cooking experience group of vegetable cooking had a significantly higher score than the parent-child collaborative cooking experience group without vegetable cooking ($p < 0.001$). Parental development was assessed in terms of response, control, self-affirmation, positive and table interactions, and positive eating readiness (**Figure 2**). In the four items outside of than the control, the vegetable cooking group had significantly higher scores than the non-vegetable cooking group and the

no cooking group ($p < 0.001$).

Children's development was assessed in six items, namely, self-control, assertiveness, coordination, self-affirmation, logical and intensive attitudes, and curiosity (Figure 3). In all six items, the vegetable cooking group scored significantly higher than the non-vegetable group and the non-cooking group ($p < 0.05$ or $p < 0.001$).

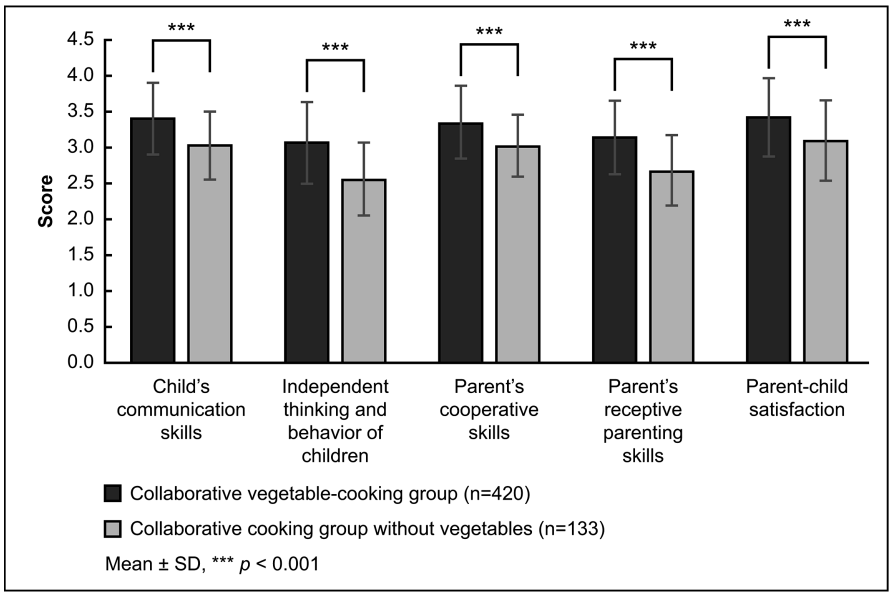

Figure 1. Relationship between Parent-child Co-cooking and Parent-child Behavior and Satisfaction.

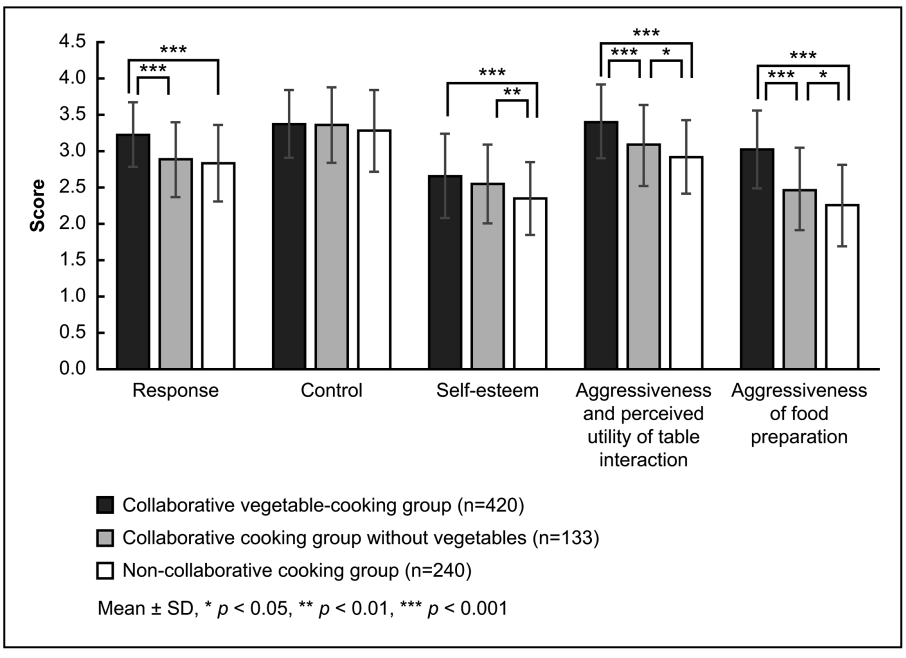

Figure 2. Psychological development of parents in the collaborative vegetable-cooking group, the collaborative non-vegetable co-cooking group except, and the noncollaborative cooking group.

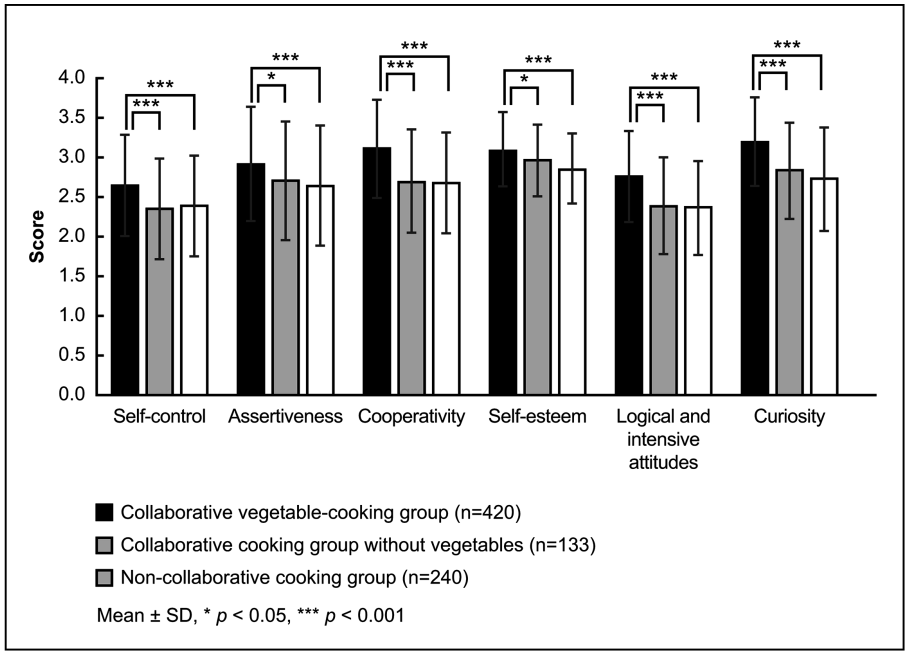

Figure 3. Psychological development of children in the collaborative vegetable-cooking experience group, the collaborative cooking without vegetables group, and the noncollaborative cooking group.

3.3. Mean Psychological and Behavioral Development Scores Related to Maternal and Child Development in Collaborative Vegetable Cooking

The results for the approximate daily vegetable intake of the children participants are shown in **Figure 4**. Children in the parent-child collaborative cooking experience group of vegetable cooking had significantly higher scores than the other groups ($p < 0.001$).

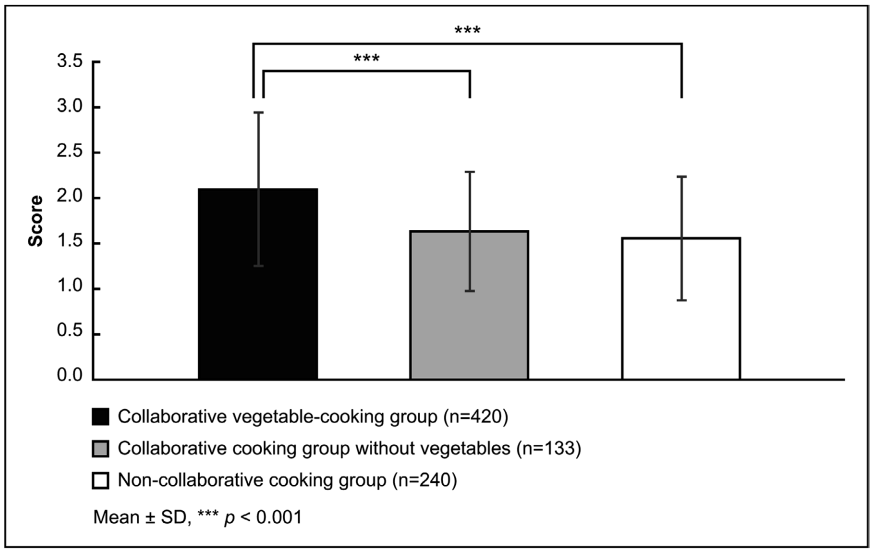

Figure 4. Vegetable intake in the collaborative vegetable cooking group, the collaborative cooking group without vegetables, and the noncollaborative cooking experience group.

We conducted a covariance structural analysis to determine the effects of mother-child interactions on children's vegetable intake, child development, maternal development, and the effects of children on maternal development. We conducted a covariance structure analysis that took the procedure of a multi-population simultaneous analysis to examine the influence between the variables by dividing them into a parent-child collaborative cooking experience group of vegetable cooking and a parent-child collaborative cooking experience group other than vegetable cooking (Figure 5). The maximum likelihood method was used for parameter estimation. CFI = 0.89 and RMSEA = 0.06 were found for the model and indicated good fit. Analysis in Fig. 5 indicated a significant path coefficient between mother-child interaction and children's vegetable intake in the vegetable co-cooking group (β = 0.17, $p < 0.001$), but no significant path coefficient was found in the general (non-vegetable) co-cooking group (β = −0.03, ns), suggesting that mother-child reciprocal negotiation with vegetable co-cooking experience could have impacted children's vegetable intake. Mother-child interactions also showed that both vegetable and non-vegetable cooking groups had significant positive path coefficients with child development (β = 0.55, $p < 0.001$; β = 0.46, $p < 0.001$) and significant positive path coefficients with maternal development (β = 0.53, $p < 0.001$; β = 0.53, $p < 0.001$), suggesting that the mother-child co-cooking experience itself had an impact on both mother and child development. In addition, a significant positive path coefficient was seen between child development and maternal development (β = 0.34, $p < 0.001$; β = 0.27, $p < 0.01$), which suggests that parental development is guided according to child development.

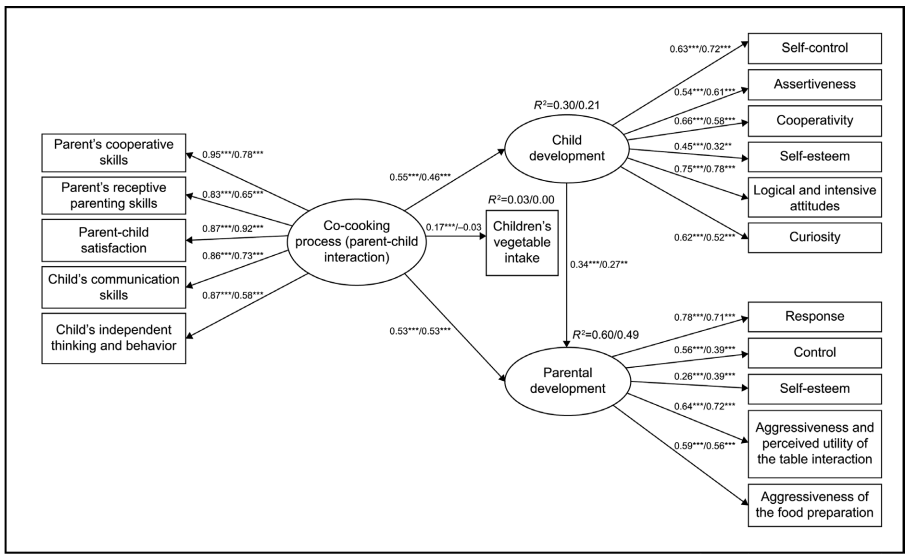

Figure 5. Estimating the influence of the presence of vegetable co-cooking on parent-child collaborative cooking on children's vegetable intake and parent-child development (multi-population simultaneous and covariance structural analysis). The values are standardized estimates. The vegetable co-cooking group/general co-cooking group are shown in order. $^{**}p < 0.01$, $^{***}p < 0.001$, $\chi^2 = 678.04$, df = 206, CFI = 0.89, RMSEA = 0.06, SRMR = 0.07.

3.4. Causal Direction in the Relationship between Parent-Child Behavior and Child Vegetable Intake and Parent-Child Development in Co-Cooking.

We conducted a covariance structure analysis to estimate the effects of mother–child interactions on children's vegetable intake and child development and on maternal development, as well as the effects of children on maternal development. We conducted a covariance structure analysis using a multi-population simultaneous analysis to examine the mutual influence among the variables by group (Figure 5). The maximum likelihood method was used for the parameter estimation. Goodness of fit was positively evaluated, CFI = 0.89 and RMSEA = 0.06. The analyses given in Figure 5 indicate a significant path coefficient between mother–child interaction and children's vegetable intake in the vegetable co-cooking group ($\beta = 0.17$, $p < 0.001$), but no significant path coefficient was seen in the general co-cooking group ($\beta = -0.03$, ns), which suggests that mother–child reciprocal negotiation with the vegetable co-cooking experience could have impacted children's vegetable intake. The assessment of mother–child interactions also showed that both the vegetable and non-vegetable cooking groups had significant and positive path coefficients for child development ($\beta = 0.55$, $p < 0.001$; $\beta = 0.46$, $p < 0.001$), as well as significant positive path coefficients for maternal development ($\beta = 0.53$, $p < 0.001$; $\beta = 0.53$, $p < 0.001$), suggesting that the mother–child co-cooking experience itself impacts both maternal and child development. In addition, a significant positive path coefficient was seen between child development and maternal development ($\beta = 0.34$, $p < 0.001$; $\beta = 0.27$, $p < 0.01$), suggesting that parental development is guided by child development.

3.5. Relationship between Children's Independence and Parent-Child Behavior and Satisfaction in Cooking Vegetable Dishes

In the parent–child vegetable-co-cooking experience groups (n = 420) in which the parents' and children's feelings of satisfaction with the behavior of the parents and children were divided into three groups (Group A; "Parents are doing the cooking"; Group B; "Parents and children are cooking together"; Group C; "It is left to the children") in cooking processes (choosing food, washing ingredients, cooking, tasting, and arrange in a serving dish) (Table 5). In all items, the group who responded that activities were to be left to the child had significantly higher scores than the other groups ($p < 0.05$).

Table 5. Relationship between children's autonomy and parent–child behavior and satisfaction in vegetable co-cooking.

		Group A (n = 207)	Group B (n = 182)	Group C (n = 31)
Choose foods	Child's communication skills	3.29 ± 0.52	3.48 ± 0.44c	3.47 ± 0.57
	Child's independent thinking and behavior	2.90 ± 0.56	3.20 ± 0.53c	3.24 ± 0.63e
	Parent's cooperative skills	3.28 ± 0.50	3.40 ± 0.50	3.39 ± 0.59

Continued

Choose foods	Parent's receptive parenting skills	3.00 ± 0.48	3.26 ± 0.51c	3.33 ± 0.53e
	Parent-child satisfaction	3.32 ± 0.54	3.49 ± 0.54b	3.58 ± 0.50d
Wash foods		Group A (n = 72)	Group B (n = 163)	Group C (n = 185)
	Child's communication skills	3.18 ± 0.51	3.40 ± 0.52b	3.46 ± 0.47f
	Child's independent thinking and behavior	2.82 ± 0.51	3.11 ± 0.57b	3.10 ± 0.57e
	Parent's cooperative skills	3.09 ± 0.56	3.36 ± 0.51c	3.41 ± 0.46f
	Parent's receptive parenting skills	2.87 ± 0.50	3.20 ± 0.50c	3.18 ± 0.49f
	Parent-child satisfaction	3.15 ± 0.60	3.45 ± 0.53c	3.48 ± 0.50f
Tear food		Group A (n = 29)	Group B (n = 121)	Group C (n = 270)
	Child's communication skills	2.89 ± 0.68	3.34 ± 0.46c	3.46 ± 0.46f
	Child's independent thinking and behavior	2.64 ± 0.60	3.06 ± 0.56b	3.10 ± 0.55f
	Parent's cooperative skills	2.96 ± 0.67	3.29 ± 0.51b	3.40 ± 0.47f
	Parent's receptive parenting skills	2.71 ± 0.50	3.13 ± 0.52c	3.19 ± 0.49f
	Parent-child satisfaction	2.96 ± 0.70	3.35 ± 0.51b	3.49 ± 0.51fg
Cut food		Group A (n = 80)	Group B (n = 227)	Group C (n = 113)
	Child's communication skills	3.33 ± 0.60	3.35 ± 0.46	3.51 ± 0.49dg
	Child's independent thinking and behavior	2.90 ± 0.62	3.04 ± 0.54	3.21 ± 0.57fg
	Parent's cooperative skills	3.28 ± 0.60	3.31 ± 0.47	3.44 ± 0.50
	Parent's receptive parenting skills	2.98 ± 0.56	3.11 ± 0.47	3.30 ± 0.50fh
	Parent-child satisfaction	3.31 ± 0.63	3.39 ± 0.53	3.54 ± 0.49dg
Cook by heating		Group A (n = 177)	Group B (n = 180)	Group C (n = 63)
	Child's communication skills	3.33 ± 0.55	3.39 ± 0.46	3.55 ± 0.45e
	Child's independent thinking and behavior	2.95 ± 0.57	3.10 ± 0.55a	3.24 ± 0.57e
	Parent's cooperative skills	3.28 ± 0.55	3.34 ± 0.48	3.50 ± 0.45e
	Parent's receptive parenting skills	3.03 ± 0.52	3.16 ± 0.48a	3.39 ± 0.49fh
	Parent-child satisfaction	3.34 ± 0.58	3.44 ± 0.52	3.56 ± 0.48d
Seasoning		Group A (n = 161)	Group B (n = 203)	Group C (n = 56)
	Child's communication skills	3.31 ± 0.55	3.42 ± 0.46	3.50 ± 0.48d
	Child's independent thinking and behavior	2.89 ± 0.57	3.13 ± 0.53c	3.28 ± 0.57f
	Parent's cooperative skills	3.25 ± 0.52	3.38 ± 0.49a	3.46 ± 0.50d
	Parent's receptive parenting skills	2.99 ± 0.48	3.18 ± 0.50b	3.38 ± 0.49fg
	Parent-child satisfaction	3.32 ± 0.58	3.46 ± 0.51a	3.53 ± 0.51d

Continued

Taste		Group A (n = 62)	Group B (n = 249)	Group C (n = 109)
	Child's communication skills	3.10 ± 0.63	3.39 ± 0.47c	3.54 ± 0.41fg
	Child's independent thinking and behavior	2.74 ± 0.60	3.07 ± 0.54c	3.20 ± 0.54f
	Parent's cooperative skills	3.09 ± 0.59	3.34 ± 0.49b	3.47 ± 0.44fg
	Parent's receptive parenting skills	2.86 ± 0.53	3.14 ± 0.48c	3.29 ± 0.50fg
	Parent-child satisfaction	3.13 ± 0.61	3.43 ± 0.52c	3.55 ± 0.50f
arrange in a serving dish		Group A (n = 92)	Group B (n = 197)	Group C (n = 131)
	Child's communication skills	3.21 ± 0.59	3.38 ± 0.48a	3.52 ± 0.43fg
	Child's independent thinking and behavior	2.77 ± 0.58	3.07 ± 0.56c	3.24 ± 0.49fg
	Parent's cooperative skills	3.16 ± 0.59	3.35 ± 0.49b	3.44 ± 0.43f
	Parent's receptive parenting skills	2.88 ± 0.53	3.15 ± 0.48c	3.29 ± 0.47fg
	Parent-child satisfaction	3.21 ± 0.61	3.42 ± 0.52b	3.55 ± 0.50f

Data are shown as means±SDs, Group A; "Parents are doing the cooking"; Group B; "Parents and children are cooking together"; Group C; "It is left to the children""; Tukey test for group comparison: a,, $p < 0.05$ Group B vs. Group A; b, $p < 0.01$ Group B vs. Group A; c, $p < 0.001$ Group B vs. Group A; d, $p < 0.05$ Group C vs. Group A; e, $p < 0.01$ Group C vs. Group A; f, $p < 0.001$ Group C vs. Group A; g, $p < 0.05$ Group C vs. Group B; h, $p < 0.01$ Group C vs. Group B.

4. Discussion

This questionnaire-based study was conducted among mothers with first children aged 3 - 12 years to identify the influence of parent-child collaborative cooking on the psychological development of parents and children. The results showed that the vegetable-cooking group had a significantly higher score for six items in parent-child psychological and behavioral development and for children's vegetable intake than the non-vegetable co-cooking and non-co-cooking groups. Previous studies suggest that co-cooking promotes psychological development in children's behavior and the satisfaction of parents and children. However, specific objects and special materials were observed in previous studies, such as diluted lactic beverages and hot cake mixing (Kotani et al., 2016; Kuroiwa, Tajima, & Miki, 2018; Tajima et al., 2018). This study focused on vegetable cooking, including both routine and diverse ingredients and processes, producing a more distinct impact on the quality of parent-child interactions and on the development of the parent and child (children's non-recognition and cognitive abilities and mothers' nurturing attitudes). This finding is significant, not only because it confirmed the importance of the experience of parent-child co-cooking but also because it suggested a general and wide-ranging influence of vegetable dishes as cooking objects.

A stratified analysis of vegetable parent-child co-cooking group according to the level of involvement of children in each of the vegetable cooking processes showed that, where cooking tasks were left to children, significantly higher scores were found in both the behavior and satisfaction of parents and children. Leaving

cooking tasks to the child has a positive impact on their communication and their independent thinking and behavior, as well as parental coordination, receptive parenting acuity, and parent-child satisfaction; these may be important factors leading to psychological development.

Covariance structural analysis (multi-population simultaneous analysis) was conducted across the vegetable and the non-vegetable co-cooking groups, to estimate the causal relationship between the mother-child co-cooking experience and the interaction in mother-child co-cooking, the child's development (social-emotional and cognitive development), the mother's development [response to children (response and control), social-emotional development (self-esteem), positive attitude toward eating education activities], and the interaction and causal relationship between mother-child co-cooking and the child's vegetable intake. The results showed that both the parent-child co-cooking experience group of vegetable cooking and the parent-child co-cooking experience group other than vegetables were considered influential on the development of both mother and child through the pathway along which child development affects the mother's development, indicating the significant contribution that parent-child co-cooking makes to the development of mother and child. In addition to confirming that child development is achieved through collaborative activities (Tajima, 2003), it has been suggested that collaborative cooking has an impact on the general development of parents and children (Kotani et al., 2016). However, the impacts of mother-child interactions on children's vegetable intake were only seen in the group of parent-child co-cooking experiences of vegetable cooking, suggesting that the experience of dealing with vegetable cooking contributes to the specific developmental of the habit of eating vegetables. This supports the context-dependent and domain-intrinsic theory of development (Bronfenbrenner, 1977), in which experience domains develop, suggesting the importance of experiencing the co-cooking of vegetable cooking for the purpose of increasing vegetable intake. The experience of co-cooking vegetables was associated with a higher daily vegetable intake. One possible contributor to this is that vegetable co-cooking with parents and children produced a higher chance of repeatedly consuming vegetables and an increased preference for vegetables. It has been reported that eating vegetables has a positive impact on children's taste development and increases the likelihood of preferring vegetables (Anzman-Frasca et al., 2012). Multiple environmental factors, including cooking and harvesting experience and parental attitudes, affect children's preference for vegetables (Yonezawa et al., 2024). Further, greater preference for vegetables influences subsequent vegetable intake (Fletcher et al., 2017). The results of this study suggest that the parent-child vegetable co-cooking is related to the frequency of vegetable consumption, vegetable preferences, and higher vegetable intake scores.

This study examines the effects of vegetable cooking on the behavior and development of parents and children, but future studies should examine the relationships between the various features of vegetable cooking behavior, including

such certain specific kinds of vegetable cooking characteristics. For example, the predictions shown in **Figure 6** could be considered. Vegetable cooking was examined here because it is closely related to various cooking processes, ingredients, and healthy meals. Various cooking processes are considered to be prone to self-efficacy as a result of the physical sensation of improving cooking skills (Cunningham-Sabo & Lohse, 2013; Zahr & Sibeko, 2017; Overcash et al., 2018). Moreover, the physical sensations of changing color, shape, and scent are easy to obtain from the diverse food materials, leading to an increase in speech between parent and child (Hanaoka et al., 2018). In addition, the close association between vegetables and a healthy diet has been suggested to impact on QOL gains and mental health as well (Saxe-Custack et al., 2021). **Figure 6** is a conceptualized figure connecting previous studies. Future research is required to clarify cause and effect more directly. The limitations of this study include the subjectivity and variability in children's assessments as reported by their parents. In our target population in Japan, various confounding factors (income, education, living environment, etc.) are evident in parents' and children's backgrounds. Long-term follow-up or intervention studies with children are required in certain populations. Additionally, this study primarily focuses on non-cognitive abilities; therefore, a more comprehensive assessment of child development should be considered in future studies.

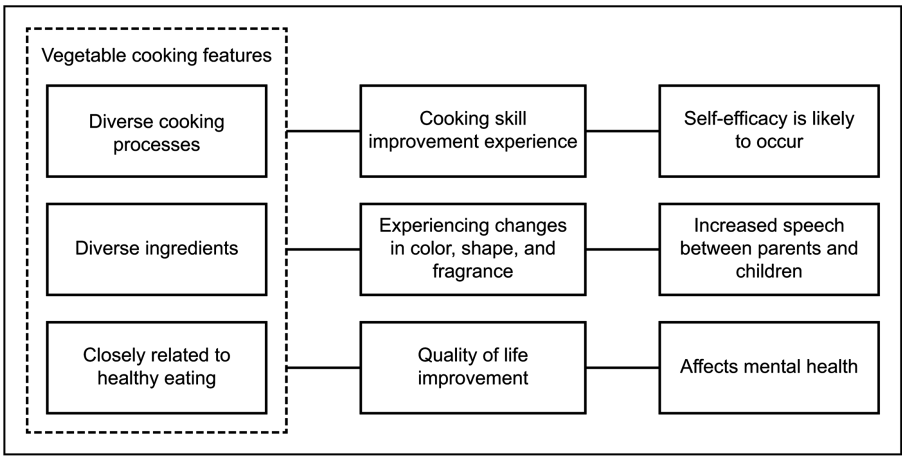

Figure 6. Predicting the impact of the features of vegetable cooking and parent-child co-cooking on psychological development.

5. Conclusion

Parent-child vegetable compared with parent-child non-vegetable co-cooking and no co-cooking suggested that there was a positive association in psychological development centered on children's non-cognitive abilities.

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Conflicts of Interest

M. O., K.H., Y.T., and T.T. are employees of Kewpie Corporation. The remaining authors have no other conflicts of interest to declare.

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