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THE EFFECT OF FOOD AND NUTRITION ON CHILDREN'S MENTAL STATE AND PERFORMANCE

Attitudes, beliefs and perceptions of parents in four European countries

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CONTENTS

LIST OF ABBREVIATIONS

CNS	Central Nervous System
EFA	Essential Fatty Acids
DHA	Docosahexaenoic Acid
EPA	Eicosapentaenoic Acid
(LC)PUFA	(Long Chain) Poly-Unsaturated Fatty Acid
PEM	Protein Energy Malnutrition
IQ	Intelligence Quotient
EU	European Union
DGE	Deutsche Gesellschaft für Ernährung
ADHD	Attention Deficit Hyperactivity Disorder
NGO	Non- Government Organisation
TEA-Ch	Test of Everday Attention for Children
CBCL	Child Behaviour Checklist
TRF	Teacher's Report Form
SES	Socio-Economic Status

LIST OF TABLES

LIST OF FIGURES

1. INTRODUCTION

Nutrition is usually considered to be important for physical health but mental health must be taken as equally important. Research in the field has shown that nutrition is one of many factors that potentially influence a child's development besides genetic, socio-economic, environmental and behavioural factors (Associate Parliamentary & Health, 2008; Bryan et al., 2004). Understanding the relationship between nutrition and mental performance in children is important regarding their attainment and productivity both in school and in later life (Alderman, Behrman, Lavy, & Menon, 1997; Florence, Asbridge, & Veugelers, 2008).

To date, there is a growing body of evidence that diet might influence the development and functioning of the brain which in turn has an effect on mental performance as a functional outcome, especially when the brain is still developing during childhood and early adolescence (Benton, 2008a). A diet containing too many ingredients that are detrimental in excess or lacking essential nutrients is likely to have adverse consequences for mental outcomes (Associate Parliamentary & Health, 2008) whereas a balanced diet is important for physical wellbeing and mental health, with implications for school performance (Associate Parliamentary & Health, 2008; Florence et al., 2008). Thus, children should have a varied diet with good nutritional content and regular intake to ensure the best possible cognitive development and performance (Bellisle, 2004). Since parents are seen as gate keepers to a child's diet and provide the key environment for the development of a child's eating behaviours (Birch & Davison, 2001; K. A. Brown, Ogden, Vogele, & Gibson, 2008), they constitute an important group of consumers for nutritional communication through policies, public health intervention programmes as well as through health claims on functional food products. Parents influence all aspects of a child's life to some degree including the development of food choices as well as controlling the availability and types of food in the home (R. Brown & Ogden, 2004; Golan & Crow, 2004). Moreover, parents' own eating behaviours influence those of their children (Birch & Davison, 2001) and thus the family provides a key environment for young children to learn and develop eating habits and food preferences. As children grow and attend school other people such as peers and teachers become more important influences (Perez-Rodrigo & Aranceta, 2001) and children gradually become more independent of their parents. The family is seen as one of the major contexts of a child's development which includes cognitive development and achievement (Scott-Jones, 1984).

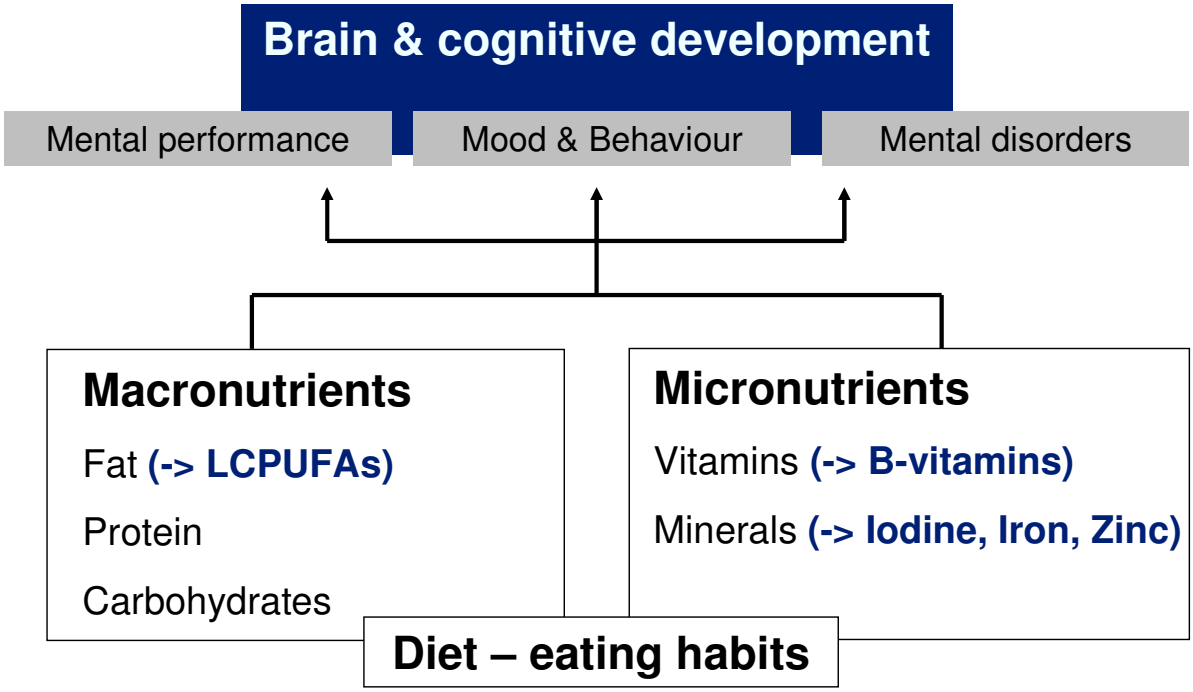
Previous research has highlighted the importance of the home environment on the development of a child's eating behaviours (Birch & Fisher, 1998) and also explored parental views about child feeding (Coveney, 2005; Sherry et al., 2004). Parents' belief systems and attitudes as well as their expectations and aspirations are assumed to be cognitive mediators of their interactions with their children which in turn influence a child's cognitive development e.g. by feeding practices and provision of intellectual stimulation at home (Scott-Jones, 1984). In this context, consumer research to understand parental perceptions, attitudes and beliefs becomes of crucial importance. To date there seems to be, to the best of knowledge, an absence of published research about attitudes, beliefs and perceptions of parents concerning the relationship between a child's diet and their mental state and performance.

The present work aims to qualitatively and quantitatively examine the current perceptions and beliefs of parents of the relationship between what children eat and their mental development, state and performance. The research was divided into three studies, carried out in four European countries and funded within the framework of the NUTRIMENTHE project which aims to further our understanding and knowledge of the effect of nutrition on the mental development and performance in children.

1.1. The effects of diet on the mental performance in children – review of contemporary literature

Diet consists of two major food component groups: macro- and micronutrients which are classified according to their proportional amount in foods. Macronutrients are fat, proteins and carbohydrates whereas vitamins and minerals make up the class of micronutrients (see figure 1). Both groups of nutrients can affect brain and cognitive development which is reflected by outcomes such as mental performance, mood and behaviour as well as mental disorders (Associate Parliamentary & Health, 2008; Joachim Westenhoefer et al., 2004). It is obvious that nutrients are normally not consumed isolated but in the context of a diet. Thus, one cannot disregard the fact that it is the composition of a child's diet and the eating behaviours which play a vital role. This has been shown in several studies examining either the composition of diet or the effect of regularity of meals on a child's mental performance (Benton & Jarvis, 2007; Mahoney, Taylor, Kanarek, & Samuel, 2005; Pollitt, 1995; Taras, 2005a).

Figure 1 Nutrition as an influencing factor on brain functioning and cognitive development



The challenge for research in the field is to identify, specify and characterise the interaction between single nutrients, diet and cognitive development as well as mental performance in children. The research results will have to be transformed into recommendations, intervention programmes and nutritional information aimed at parents and children in order to find expression in a child's every day diet. The following section aims to provide a brief overview of current research in the field of nutrition, cognitive development and mental performance in children.

1.1.1. The effects of nutrients on the structure and function of the developing brain

As the brain develops and grows throughout childhood, one might expect greater demands on the provision of nutrition during periods of rapid growth which if deficient could impair brain structure development. This could have long-term consequences for mental functioning. For instance, brain development during childhood includes that of the frontal lobes - nutrition could affect frontal lobe development, influencing the higher cognitive functions they control (such as focusing attention and inhibiting irrelevant stimulation) (Bryan et al., 2004). On a more detailed level, certain nutrients can affect brain cell integrity and structures, signal transduction and neurotransmission as well as brain energy supply and metabolism (Schmitt, Benton, & Kallus, 2005).

Minerals - Iron, Iodine and Zinc as the major players

Iron may play a critical role in cognitive development and later performance (Thomas, Grant, & Aubuchon-Endsley, 2009). The brain tissue is overall rich in Iron and the most sensitive brain areas are the striatum, hippocampus and cortex. A deficit in iron may mainly act globally on two different levels: on the one hand by less efficient supply of oxygen to the brain, on the other hand by decreasing the activity of the enzyme cytochrome C oxidase in cerebral regions which leads to less energy production in the brain (Lozoff & Georgieff, 2006). A decreased metabolic activity of brain cells is the consequence. Thus, all nervous cell types are affected and as a result iron deficiency during early development perturbs cognitive functions in the long term (Bourre, 2006a).

Other possible pathways could include functional changes of the brain, lags in the myelin formation or alterations in the dopamine system, particularly the dopamine receptors, or delay of the acquisition of motor skills due to constraints of oxygen supply in anaemic infants (Bryan et al., 2004).

There is considerable evidence that iron deficiency anaemia in children in developing countries is associated with impaired cognitive development (Joachim Westenhoefer et al., 2004).

Iodine is required for the production of two thyroid hormones (triidothyronine and thyroxine) both of which are essential for the development and growth of the brain (Bryan et al., 2004). A deficiency of either iodine or thyroid hormones (hypothyroidism) during critical periods of cerebral development induces not only a slowing of the metabolic activity of brain cells but also permanent alterations in the development of the brain. The most obvious sign of this impairment is irreversible mental retardation (Bourre, 2006a). Iodine deficiency is considered the first cerebral disease in the world although being easy to prevent by iodine supplementation, especially during pregnancy when brain development of the fetus is most rapid (Bourre, 2006a). Iodine deficiency is anticipated to lower the IQ on average by 10 to 15 points at a general population level (Delange, 2001), with adverse implications for the socioeconomics of a community.

Zinc plays a role in a multitude of molecular and physiological mechanisms such as gene expression and protein synthesis. Even mild to moderate forms of zinc deficiency in children have been shown associated with reduced development and growth as well as impaired immune function (Bhutta et al., 1999; K. H. Brown, Peerson, Rivera, & Allen, 2002). An insufficient supply of zinc may affect cognitive development by alterations of activity, attention, motor development and neuropsychological behaviour. While the exact mechanisms are not clearly identified yet, it is anticipated that zinc is vital for neurogenisis, neuromigration and synaptogenesis (Bryan et al., 2004) which are all fundamental processes in brain function. In many parts of the world, zinc deficiency is likely to be a major public health problem (Brown KH, 2001).

Role of the B-vitamins

The B-vitamin group comprises vitamin B1 (thiamine), vitamin B2 (riboflavin), vitamin B3 (niacin), vitamin B6 (pyridoxine), vitamin B9, which is known as folate or folic acid, and vitamin B12 (cobalamin). While special emphasis is attributed to folate and its function in neural tube formation during embryogenesis, all B-vitamins have been shown to be essential for normal functioning of the brain (Bourre, 2006a).

Vitamin B1 for instance facilitates the use of glucose, thus ensuring energy production in the brain. A deficiency in this vitamin results in a severe disease (beri-beri) with observed signs of lower intelligence and lassitude, but which are reversible (Bourre, 2006a). The B vitamins folate, cobalamin and pyridoxine share a metabolic pathway that might have acute and long

term effects on the Central Nervous System (CNS) (Bryan et al., 2004). It has been indicated that those vitamins have an influence on cognitive performance through their role in methylation in the CNS which in turn affects the metabolism of neurotransmitters (e.g. dopamine, serotonin), all of which are crucial to psychological and neurological status (Bryan et al., 2004).

Essential fatty acids

Due to its cellular composition, the brain contains a large amount (60%) of lipids (Bryan et al., 2004). Since the human body cannot efficiently synthesise essential fatty acids (EFAs), they must be acquired from food. Consequently, quantity and form of fats consumed may affect brain structure and functioning (Associate Parliamentary & Health, 2008). Polyunsaturated fatty acids (PUFAs) omega-3 and omega-6, particularly Docosahexaenoic acid (DHA) and Eicosapentaenoic acid (EPA), are deemed to be of particular importance for brain development and function. For instance, a deficit in DHA can lead to a reduction of brain signalling by 90% (Associate Parliamentary & Health, 2008). The main mechanism behind the influences of omega-3-PUFAs on cognitive development and functioning seems to be through the maintenance of cell membrane integrity and cell compartment functioning in the CNS (Bourre, 2006a). During fetal development and the postnatal phase, a huge amount of PUFA and long-chain PUFA (LCPUFA) is deposited in the brain. Human breast milk contains n-3 and n-6 LCPUFA, and addition to infant formulae has been suggested some years ago (Koletzko et al., 2001). While many clinical trials found an improvement of biochemical measures of LCPUFA status through supplementation (Fleith & Clandinin, 2005), there is still no consensus about long term neurological benefits from optimising the fatty acid status of infants during the pre-or postnatal phase (Szajewska, Horvath, & Koletzko, 2006).

However, at a later age, omega-3 provision has been associated with improvements in spelling, reading and learning in children with specific motor function impairments (Gomez-Pinilla, 2008). This is consistent with findings that show that brain areas responsible for this kind of higher order cognitive functions, such as the striatum and frontal cortex, are very rich in DHA (Bryan et al., 2004). Much research is ongoing in this area to determine the effects of those EFAs on mental development and performance in children.

Proteins

Particularly during development, the brain needs a sufficient supply of amino acids for the synthesis of certain neurotransmitters (e.g.catecholamines, serotonin), The quality of dietary proteins influences the nature and the quantities of cerebral proteins and neurotransmitters and since the human body does not possess a reserve for proteins, essential amino acids have to be acquired from food every day (Bourre, 2006b). One of those essential amino acids is tryptophan which is required as a precursor for the synthesis of the neurotransmitter serotonin. In addition to modulating appetite and satiety, serotonin also affects sleep and mood. Dietary tryptophan has been shown to have an effect on mood and also on depression (Bourre, 2006b).

On a more general level, protein-energy-malnutrition (PEM) has been identified associated with stunting and impaired IQ and school performance in children by cross-sectional studies (Mendez & Adair, 1999). Results show that PEM in early life has lasting effects up to 15 years of age on school performance and scores of intelligent quota (IQ) which highlights the importance of adequate energy and protein supply in early life (Bryan et al., 2004).

1.1.2. The role of diet on mental state and performance in school aged children

Beyond specific nutrients and their role in cognitive development und function, eating behaviours such as skipping breakfast is considered to potentially contribute to poor academic performance. Breakfast is seen as an important first source of energy for the day, so that the brain can cope with the demands of the morning (Bellisle, 2004). Children and adolescents seem to be most likely to skip breakfast (Rampersaud, Pereira, Girard, Adams, & Metzl, 2005) – this has lead to an increased awareness in public health and the initiation of school breakfast programmes. While skipping breakfast induces short term metabolic changes, it may also affect overall nutritional status (Pollitt, 1995). The effect of breakfast on cognitive performance may be by providing essential nutrients to the brain as well as alleviating hunger. A lack of energy leads to decreased glucose and insulin levels in the body associated with impaired cognitive functioning. If such a lack of energy provision to the brain occurs frequently, it may be reflected in the level of school performance in the long run (Pollitt, 1995). Although breakfast has been observed to have an effect on many areas of brain functioning such as attention and memory, a review of studies examining the relation of diet and school performance in children by Ells et al in 2008 revealed inconclusive results (Ells et al., 2008).

Since children who eat breakfast have been observed to have higher intakes of protein, carbohydrates and other nutrients, they are more likely to meet the daily recommendations (Rampersaud et al., 2005). Thus, children who are nutritionally at risk are suggested to benefit most from having breakfast (Pollitt, 1995; Rampersaud et al., 2005).

A combined breakfast of milk and cereal has been shown to significantly reduce attention decline during the morning when compared to children who had no breakfast or a drink of glucose only (Wesnes, Pincock, Richardson, Helm, & Hails, 2003). Moreover, findings by Benton et al (2007) demonstrated that compared to those children consuming a higher calorie meal, a small, low calorie breakfast significantly lowered levels of attention (Benton & Jarvis, 2007). Supported also by findings from other studies, it is suggested that size and type of the breakfast consumed have an effect on attention and concentration levels through the release rate of glucose to the brain (Benton & Parker, 1998). Thus, maintaining performance would be best supported by a low glycaemic index breakfast containing carbohydrates, protein and fibre (Benton, Maconie, & Williams, 2007).

It has been shown that beyond breakfast which plays an important role in cognitive performance, a steady supply of energy by snacking is also important. A study by Benton et al observed that 9 year old children who had a breakfast of low caloric content were less attentive in class than those who ate a larger breakfast, but this effect could be compensated by a midmorning snack (Benton & Jarvis, 2007). Another study on breakfast and snacking found that a midmorning snack improved memory function in low socioeconomic children even when overall calorie intake was kept constant (Muthayya et al., 2007) - the positive effect of snacking in low socioeconomic children might be due to their poorer nutritional status.

The reported effects of snacking and breakfast indicate that eating habits as well as meal patterns potentially influence children's mental state and performance. Nevertheless these observations, there has been little focus on the importance of other meals than breakfast and their composition.

Since families, and especially parents, influence all aspects of a child's life including eating habits and controlling the types and availability of food at home, it is of crucial importance to evaluate parental belief systems and perceptions in order to guide and substantiate nutritional information and intervention aiming at improving a child's mental state and performance through adequate nutrition.

2. METHODS OF RECRUITMENT AND SAMPLING

2.1. Decision on field access and recruitment process in four European countries

In order to define the field access and recruitment procedure, it was necessary to gain an insight into the different school systems in the four European countries where the study was to be conducted: England, Germany, Hungary and Spain. A summary of the pre-and primary education sector was prepared by each country and served as a basis for discussion. At a first international meeting this information was presented and discussed in order to define the field access strategy for recruitment.

Because of the differences of the school systems of the four participating countries and in order to ensure an easy and most straightforward recruitment process in all countries, it was agreed to recruit parents of children aged 4-10 years through state elementary schools. Children aged 4-10 are an important population group since they start to get in contact with the school environment. Mental performance aspects such as learning, memory, attention etc. begin to play a vital role for the elementary students, their environment (especially parents) and their future educational outlook. Thus, this lifespan is anticipated to evoke high awareness among parents concerning the child's cognitive performance.

2.2. Sampling and recruitment

A similar strategy was employed in all four countries. Parents of children aged 4-10 years were recruited through elementary schools in the state sector in all countries. Letters of invitation were sent to the head teachers of state elementary schools in socioeconomic different districts of each of the participating cities; those who responded with an expression of interest were involved in the study. All participating schools in the four countries distributed letters to parents via their children; parents were asked to volunteer to give a short interview by returning a brief screening questionnaire that collected contact details and socio-demographic background information. Participation was encouraged by entering the names of all volunteers in a draw with prizes of vouchers from the store of the winner's choice. Parents were invited for interview from a variety of age groups, with different levels of education, and with children of different ages and genders. Inclusion criteria were the ability to speak the native language of the particular country and being parent of a child aged 4-10 years.

Background data including the profession /employment status and level of education of participants were recorded in SPSS databases.

Approval for the study was obtained from the relevant Ethics Committees in all three countries, prior to conducting the interviews.

Table 1 Feedback on initial invitation letters and questionnaires

	GER	UK	ESP	HU
sent out	530	500	550	320
received back	73	45	34	93
reply quota	**14%**	**9%**	**7%**	**29%**

Germany

According to a list of all public elementary schools in Munich which was supplied by the municipal administration, one up to three schools from each of the 25 districts of Munich were randomly selected and initially asked per telephone for their interest in taking part in the study. Taking into account socioeconomic factors, schools from different socioeconomic districts were contacted (high, medium and low: rates of unemployment and percentage of immigrants, source: Statistisches Amt der Landeshauptstadt München). Written information material was sent out afterwards and agreement of participation from interested schools was received. Out of 32 contacted schools, six schools didn't show any interest and declined to participate, two schools agreed immediately and the rest of 24 schools had to first discuss this issue internally with the parents' council and staff of teachers. Finally, confirmed participation of seven schools from seven different districts was received. Prior to conducting the interviews, approval of the local school administration in Munich (Staatliches Schulamt München) and the Ethics Committee of the Medical Faculty of the LMU Munich (Ethikkommission der Medizinischen Fakultät der LMU München) were obtained. Participants were contacted by phone and email to make an appointment for an interview to take place at school and further information material as well as a consent form was sent out.

England

In England a sample of state primary schools was identified for participation in the research study, using the Department for Children, Schools and Families (DCSF) Edubase site http://www.edubase.gov.uk). Further information on individual schools was obtained from DCSF performance tables (http://www.dcsf.gov.uk/performancetables) and Ofsted reports (http://www.ofsted.gov.uk). These information sources were used to select schools with different characteristics, which included levels of attainment, uptake of free school meals and numbers of students from ethnic minorities. Letters of invitation were sent to Head teachers of the primary schools; schools involved in the study were those who responded with an expression of interest. Twenty-two schools were approached of which four initially agreed to participate. Subsequently two schools dropped out.

Hungary & Spain

In Pécs (Hungary), all 18 existing state elementary schools were contacted and four schools confirmed their participation. In Spain, permission to contact six public schools was obtained by the local government for educational administration. One of those public schools and 6 of additionally contacted semi-private schools, all from 5 different districts, agreed to participate in the study.

3. THE EFFECT OF DIET ON CHILDREN'S HEALTH AND MENTAL PERFORMANCE - an explorative study on attitudes, beliefs and perceptions of parents in four European countries

3.1. Background

As previously outlined, nutrition is one of a number of factors that may influence a child's cognitive development and mental performance. Understanding the relationship between nutrition and mental performance in children is important concerning their productivity and attainment in school and later life. Since parents are seen as nutritional gatekeepers deemed responsible for their children's diets, their views and beliefs are of crucial importance. To date, to the best of knowledge, there is an absence of published research on parental perceptions of the relationship between nutrition and mental performance in children.

Thus, the present explorative study aims to qualitatively examine the current attitudes, belief systems and perceptions of parents concerning the relationship between what children eat and their mental health and wellbeing. More specifically, the research aims to understand how parents view the effects of food, particularly with regard to mental performance. As the study was conducted in four European countries, cross-country similarities and differences are also explored. Research in this field provides valuable insights for future nutritional communication and intervention.

3.2. Material and Methods

Qualitative interviews were conducted with parents of children aged 4-10 years who were recruited through state schools in the cities and surrounding areas of Munich (Germany), Guilford (UK), Pécs (Hungary) and Granada (Spain). The recruitment of schools and participants was undertaken as outlined in detail in the previous chapter 2.

3.2.1. Qualitative interviews

A semi-structured interview schedule was developed, based on the aim of the study and relevant literature. A list of topics for the interview questions was agreed by the four participating countries, and a preliminary interview format developed. Topics included questions on the parents' beliefs and perceptions of the effects of diet on various outcomes of a child aged 4-10, such as effects on wellbeing and development, physical and mental status, effects of specific foods (positive and negative) as well as prompting for short or long term effects of diet and foods (Figure 2). The preliminary schedule was translated and piloted in all countries to ensure that the type, flow and number of questions were appropriate to the aims of the study and to pre-test for clarity and comprehension. Transcripts of the pilot interviews were evaluated and compared and a final interview schedule agreed. The schedule also included prompts to aid interview progress when parents' answers were brief and to ensure that crucial points were covered.

Interviews were conducted with parents on school premises and lasted 15-20 minutes. All interviews were audio-taped and transcribed with the interviewee's permission.

Figure 2 Basic interview schedule

Questions
Wellbeing and development: Thinking about children in general (aged 4-10) do you think that food has an effect on children's wellbeing and development?
Physical effects: Do you think that what children eat affects them physically?
Mental effects - mood & behaviour: Do you think what children eat affects their mood/behaviour? If so, how and in what ways- positive and negative?
Mental effects – performance: Do you think that food might affect children's mental performance? If so, how and in what ways?
Short and/or long term effects: Do you think that what children eat affects them now or could it affect them in the future?
Foods: Thinking about foods, are there any specific foods that you think affect children, either positively or negatively?

3.2.2. Data analysis

The interviews were transcribed verbatim and checked by the interviewers for accuracy. All transcripts were subjected to thematic analysis (Braun, 2006) using the software NVivo 8. Because of the exploratory nature of our study, we chose thematic analysis as described by Braun & Clarke 2006 to inductively identify, analyse and report on themes that reflect reality without being driven by previous findings our theories. The method of thematic analysis facilitates a more in depth analysis of the interviews compared to other methods such as content analysis, where categories are identified and subjects are counted to get a quantitative rather than a detailed qualitative picture of the research question. Since a in depth analysis can only be realized for a limited number of participants, interviews were initially analysed on a national level (between 23 and 35 interviews per country) rather than on a cross-national level which would have been a total of 124 interviews. A four step approach was undertaken for analysis based on Green et al 2007: immersion in the data by generating thematic maps, coding of the data, creating categories and identifying themes (Green et al., 2007). The analysis continuously moved back and forth between stages. Data were analysed primarily in the national languages in order to minimise the risk of losing participants' meanings. Once the patterns and categories were identified, the final categories and the relevant quotations were translated into English.

Transcripts were analysed by repeatingly reading the entire transcripts to get a feel for the data and national thematic maps produced which presented a comprehensive overview of the content of each data set. Subsequently the four national thematic maps were merged and coding categories were identified resulting in a cross-national coding tree which included definitions of each code to ensure standardized coding (Graneheim & Lundman, 2004). Interview transcripts in each country were then coded using this coding tree while categories were continuously revised and refined through several revision loops and final themes and subthemes were created. For each major theme and subtheme a detailed national analysis with supporting quotations was conducted resulting in final national reports that were translated into English and checked by a second researcher in each country.

In each of the four countries, the reports on national findings included models showing the interrelation of themes as well as translated quotations Based on these national reports, key cross-national themes and relations were identified for comparison in a final step resulting in an international report.

This report was systematically cross-checked in each country for appropriateness of interpretation and quotes.

During the entire analysis, a particular emphasis was placed on identifying the relationship between food and aspects of mental performance, mood and behaviour, resulting in dedicated national models for mental effects. These perceptions of the relationship between diet / foods and mental outcomes were analysed in more detail in order to gain insight into parents' perceptions, beliefs and attitudes concerning the mental effects of diet.

Socio-demographic characteristics of the samples of participants were recorded using SPSS 17.

3.3. Results

Between October 2008 and May 2009 a total of 124 face-to-face interviews with parents took place in the four countries.

3.3.1. Participants

The majority of parents interviewed were mothers (>90%), except for Spain where about 22 % of participants were fathers. Over half of the participants had a college degree or higher (>55 %) except for Spain where about 65% had a lower education level. More than 60 % of parents had two or three children while the rate of single child families was highest in Hungary (39 %) compared to the other countries (17%). Parents were responsible for choosing the food being served at home in all countries (>88 %). More than 60% of parents were in paid employment at the time of the interviews while in Hungary this rate was 100% (Table 2).

Table 2 Characteristics of participating parents in the different European countries (n=124)

		% of parents in				
		Germany n=35	**Spain n=35**	**England n=31**	**Hungary n=23**	**TOTAL n=124**
No of children	1	17,1	17,1	16,1	39,1	21,0
	2	62,9	65,7	45,2	56,5	58,1
	3	11,4	14,3	25,8	4,3	14,5
	4	8,6	2,9	9,7	0	5,6
	5	0	0	3,2	0	0,8
In paid employment	YES	60,0	80,0	71,0	100	75,8
	NO	37,1	20,0	29,0	0	23,4
	missing	2,9	0	0	0	0,8
Highest level of education completed	Primary school	0	25,7	0	0	7,3
	Secondary school age15/16	5,7	17,1	16,1	4,3	11,3
	Secondary school age 17/18	37,1	22,9	3,2	39,1	23,4
	College	25,7	20,0	51,6	30,4	31,5
	University	31,4	14,3	29,0	26,1	25,0
Participant relation to child(ren) aged 4-10	Mother	94,3	77,1	90,3	100,0	89,5
	Father	5,7	22,9	9,7	0	10,5

3.3.2. Thematic Analysis

Three main themes emerged from the interviews with a number of associated subthemes: healthiness of diet, physical effects of diet and mental effects of diet. Summaries of each theme reflecting the views of the majority of parents are presented and supported by relevant quotations from participants which best describe the findings. Out of all relations discovered, the perceptions about diet and its mental effects were extracted. This will be stressed in more detail.

<u>Healthiness of diet - concept of a healthy balanced diet – positive and negative foods</u>

The majority of parents in all four countries spoke of the concept of a balanced healthy diet which should be the ideal aimed for when feeding children. Parents clearly distinguish between positive and negative foods. Vegetables, fruits and full grain foods are seen as positive foods since they contain vitamins and dietary fibre. Diet should be fresh, natural and not ready made as well as containing artificial ingredients. Foods that form part of this ideal diet are described as good, healthy, hearty and are often home-cooked.

„Yes, everything should be covered…enough milk products, fruit and then also vegetables and every once and a while meat and also some sweet stuff. There should not be any prohibitions but it should all be balanced, not too much of one thing and too little of the other." (Germany - P47)

"I think positive is all the healthy stuff isn't it, the fruit the vegetables, you have to have a proper balanced diet with the carbohydrates and everything and everything, that will affect, will affect kids in a positive way." (England – P3)

"We have to keep a balance in that children eat everything but in the right ratio. Proteins, fats and carbohydrates, and from the latter those which are digested more slowly, the wholemeal foods." (Hungary – P21)

" Yes, because just as I said, if they don't have a balanced diet and they don't get enough nutrients necessary for their development, it can affect everything, psychologically, intellectually, physically […] I mean a balanced diet and in the right way." (Spain –P22)

Other foods were referred to in negative terms, being described as junk food, rubbish food, bad food or fast food. Very specific foods were referred to in these terms; including sugar, sweets, ready meals, processed foods and foods rich in fat:

"Erm, obviously if they were to eat a load of what I consider to be junk foods, sweets and cakes and bits they obviously then are going to become obese, and again not willing to participate in exercise and things like that" (England - P3)

"Obesity… much McDonalds and such a things can cause it, we do not eat there regularly, just occasionally, I fight against the fast foods, I cook, well." (Hungary - P06)

„I do not like if they eat sweets and candies, artificially coloured food, what you don't find in nature. We avoid them." (Hungary - P15)

"Negative effects – well too much refined sugars including polyunsaturated fats that somehow, […] we are creating barriers to their future health." (Spain – P54)

„ Well, I think whole grain products, such as whole grain bread, cereals and fruits are positive foods and of course vegetables. And negative ones are sweets [laughes]" (Germany – P07)

The ideal of a healthy balanced diet often conflicts with variable food preferences of children. Parents perceive a constant preference for sugary and fatty foods by children which makes it difficult to get their children to eat healthy foods such as vegetables or fruit. This is perceived to be an exhausting source of conflicts between parents and children and clashes with the parents' ideal of a healthy balanced diet that they see as important for their children. Parents spoke of how these conflicts were resolved, usually by compromise. This strategy involved allowing occasional treats, often associated with special occasions such as birthdays or Christmas.

"She doesn't like…we encourage her to try new things, and she just doesn't really like it. I mean, if she were to eat a hot meal, it would be something like oven chips, beans and chips. And she'd have that every night if she could get away with it every night." (England - P42

„Well, I believe that my great son, despite all efforts, eats way too unhealthy things, too little fruit and too little vegetables. This he just doesn't like. Well, he…Yes. Well, I notice that he is all in all more comfortable, needs longer, shows less motivation […]." (Germany - P11)

"I could make her eat strawberries, for example, promising something in exchange, but I knew she'd like it." (Hungary - P23)

"I suppose that good nutrition affects us all, for example at school age, if we have good eating habits from childhood, because sometimes children are very difficult to feed, for example my daughter doesn't want to eat sometimes, she doesn't want to eat fruit, neither vegetables […] but step by step I'm finding ways to make her eat healthy foods, for example by peeling the fruits and cutting them in squares […] it makes it easier get her to eat. The same with vegetables […]" (Spain – P33)

Physical effects of diet

In all countries, the majority of parents were of the basic opinion that what a child eats affects their development, wellbeing and health. These effects may be direct or indirect, short term or long term and may be positive or negative.

"I strongly believe that there is a very close relationship between nutrition and development. We are what we eat." (Hungary - P03)

"Well if they haven't got the proper diet then I think that they can't keep up physically with what they have to do, and they're not going to grow" (England – P07)

"I'm a great believer in you are what you eat so if you have burgers, burgers, burgers, honestly that won't be good for your health surely…" (P3, England)

"If one does not about growth and physical development then this could have a very bad effect on health and everything". (Spain – P53)

Parents perceive that a poor diet is the primary cause of children being overweight which in turn lowers physical endurance as well as the motivation and ability to do physical exercise. A lack of physical exercise is perceived as being an enhancing factor for the development of obesity rather than as a causal factor for being overweight:

„Overweight. Because it is overweight that promotes physical inactivity, that children don't want to move when they are to fat, too lethargic. This indeed has consequences. Of course (Laughing). And how!" (Germany - P18)

„[…] I see it here, there are really many overweight children and when you are fat and lazy, then you are less motivated and you stay even more on the couch." (Germany - P41)

"If they are overdosed with sugar, so the body could gain weight, hence the demand for greasy and sugar-rich food increases, the children gain weight and move slower, do not do sports, it is a vicious circle." (Hungary - P19)

"Yes, a child that eats bad things is single-sided nourished which you can physically see because it is fat, and that leads to physical impairment, it doesn't play anymore and is being discriminated by others ... well, mainly that" (Spain – P30)

"Erm, obviously if they were to eat a load of what I consider to be junk foods, sweets and cakes and bits they obviously then are going to become obese, and again not willing to participate in exercise and things like that." (England-P12)

A poor diet is seen to have potentially long term consequences for health such as heart and cardiac diseases, oftentimes perceived to directly result from overweight:

„ Yes, certainly, when you are fatter then you certainly tend towards something like diabetes or, I don't know, high blood pressure, all of these, all this relates to nutrition or with the being-fatter, those diseases." (Germany - P26)

"[…] the problems come later, diabetes, high blood pressure, any circulatory system disorders because of being overweight, or digestive problems." (Hungary - P08)

"It leads to obesity in the long run, it is clear. And I mean obesity further causes diseases, such as diabetes, narrow blood vessels." (Hungary - P19)

"Yes, because as they go on they can become obese, they can pick up many diseases, diabetes, heart problems, cholesterol problems, and if you've got a family history of things as well I think you have to be a bit more aware of your family background, if there's problems within the family you should always make sure where this could affect my children when they're older […]"(England-P12)

"I think that if you don't have a balanced diet, well, in the long term you could have problems with obesity and some heart problems." (Spain –P49)

Particularly for many of the German parents an unbalanced and unhealthy diet is also perceived as responsible for the development of signs of deficiency due to a lack of vitamins and minerals. This can in turn lead to illnesses and impairment in growth and development whereas in the short term vitamin deficiencies negatively impact on the immune system, increasing the risk of infections.

„Well, I think when nutrition is not sufficient or deficient in vitamins, then this will, illnesses, children are certainly more susceptible to illnesses, for instance, not that resilient and simply, yes… well, I think that they are simply not that resistant." (Germany - P25)

The effect of what children eat on their energy levels was one of the main effects referred to by the majority of all parents, with food perceived as being the source of a child's energy. Basically, a lack of energy as well as having eaten too much was perceived to cause tiredness whereas an excess of sugar intake was associated with high energy levels leading to hyperactivity.

"Well yes I just, from my own experience, my own two children eat a very good diet, they have a lot of fruit and vegetables in their diet and they have boundless energy" (England –P14)

"Short term it (the diet) could have an influence on all that we have been saying before, when you are in school for example, you notice the tiredness because sometimes they don't have the energy that they should." (Spain – P32)

"If we give fat rich stew to a smaller child, he'll become full and he will suffer from tiredness. On the other hand, if we give some greens which are easier to digest then I think he will have enough energy and he will be more vigorous, able to play, to run […]" (Hungary – P8)

„Well, they simply… Well, when they eat many sweets, they have to release that energy somehow." (Germany – P20)

<u>Mental effects of diet (mental performance, attention & concentration, mood & behaviour)</u>

Perceptions and beliefs about the effects of food on mental performance and behaviour emerged from the interviews, with parents making quite specific connections between food, nutrients and mental effects. An overview of the connections perceived by parents in all four countries is shown in figure 3.

Specific foods and nutrients were perceived to have predominantly negative, short term effects on mental outcomes while positive, longer term effects were associated more generally with a healthy balanced diet. Parents seem to distinguish clearly between short and long term as well as between positive and negative effects.

The predominant aspects of mental performance to emerge, as described by parents, were concentration, attention, mood and behaviour as well as on a more general level, mental fitness and the feeling of well-being. For many of the parents the feeling of well-being achieved by a balanced and healthy diet seems to be a fundamental requirement for good performance.

„It is certainly positive to have a healthy diet so that children can think well, can concentrate and can keep to the point. Yes, there are children who have some kind of disorder but I do think that this is influenced by nutrition, that a child can concentrate more when it has a balanced diet […]"(Germany - P47)

"If they eat healthy, I think that they work better and their concentration is better and I give my children meat and fish to increase their concentration" (England, P8)

"…with a balanced diet, rice, chicken fish…they're happy, they are sitting quietly and I have seen that their behaviour is quite nice after that" (England, P1)

„If he (the son) eats more fruit and vegetables, he will be fresher, more attentive, learning is easier for him. He is better able to concentrate, if he eats healthy foods […]"(Hungary - P05)

„I'm not a scientist but I believe in the saying „a healthy mind is in a healthy body" [...] we try in our family to have a varied diet and doing lot of physical exercise, too […]." (Spain – P45)

Most of the parents in all four countries spoke of foods rich in sugar as negatively influencing mental state and performance. A clear dose-dependent relationship is attributed to sugar and its short term effects – from too low sugar levels resulting in a lack of energy, both reducing mental performance in general, the ability to concentrate and leading to bad mood, up to too high sugar levels causing hyperactive behaviour and an inability to focus and concentrate.

„For instance, in my opinion, when a child is hypoglycaemic […] no matter if in school or in the afternoon when they return from school, from the after school care centre and eat something at home, that they, that this gives back the ability to concentrate better again, for instance, or as I indicated earlier, the more sugar the more nervous. Well, this is really something that I can confirm." (Germany - P9)

"I think if they eat a lot of sugary food all the time, they're more prone to hyper-energy with no real concentration level" (England – P14)

„Too many sweets cause hyperactivity in children…" (Hungary - P19)

„When he (son) is eating too much chocolate, then this is good for the moment, because it improves his ability to concentrate, but this passes quickly and chocolate will provide unnecessary intake of energy." (Hungary - P05)

"Well, as you know sugar makes them change a bit, for example when you give them a lot of sugar in the evening I have the feeling they are climbing up the walls." (Spain – P55)

Food was also perceived to be important in alleviating hunger, which was seen to be a distraction and barrier to concentration and mental performance as well as causing bad moods.

Having eaten too little reduces performance either by being distracted by the feeling of hunger and thinking of food or by a lack of energy which makes the children unable to concentrate and work.

> *"[…] a hungry child, if he is not eating sufficient amounts of food or good quality food… it is harmful to their mental and physical capacities, and concentration, too." (Hungary - P05)*
>
> *"I think if you are hungry you don't concentrate." (England – P7)*
>
> *„Yes,when you leave the house in the morning and haven't eaten something then I think that you can't concentrate because you are hungry and you can't concentrate on anything else and I also think that what you eat is important." (Germany - P34)*
>
> *"If my boys haven't eaten anything since breakfast time again you have that lag, I have two very grumpy children and the energy will go, more likely fights to happen between them because their hungry and tired by that stage, then once they've eaten their fine." (England – P17)*
>
> *"When they are hungry you can tell it from their attention and concentration, children are less receptive in class, they have less concentration even for homework." (Spain – P25)*

The majority of parents in all countries highlighted the importance of having eaten enough and having breakfast before children go to school – energy supply seems to be essential in order to mentally perform well and to concentrate at school.

> *"Yes, I think if they haven't had a good enough breakfast, then how on earth can they concentrate?" (England – P46)*
>
> *"Sure. A child who doesn't have a sufficient intake of calories and energy, depending on the food eaten, it has no attention span and school performance. For example, if a child doesn't have breakfast in the morning or the wrong things for breakfast it may happen that after an hour or two in class, the child just doesn't perform as well as other children." (Spain – P26)*
>
> *„[…] Well one says that when you haven't had a good breakfast that you can't do good work. Well, you should not take a maths test without having breakfast beforehand. Well, I do think that it is important, I insist that they eat something for breakfast even though this might be very little." (Germany - P48)*
>
> *"Attention and concentration relates to whether they had breakfast or not, very significantly." (Hungary - P10)*
>
> *"For example in the morning, as I know, […] children should not start school without breakfast because the blood sugar level will drop and then they can't focus well on things, you could even say that they collapse when they are hungry." (Hungary - P04)*

In contrast to the other countries, over 60% of the German parents think that on a more short term basis a good level of hydration is very important in order to mentally perform better – a lack of hydration is perceived to negatively affect the child by causing mental lethargy or a bad mood. A good and regular supply of liquids seems to be a crucial point.

Noticeably, German parents mention liquids in general rather than giving examples of what kind of liquids are seen to be positive or negative.

„Or as well…That one also drinks a lot, that one can think better […]"(Germany - P20)

„[…] I think that simply a healthy mixture of all, all what the body needs should be in place. What, I believe, is very important are liquids and that enough is being drunk in order to…

Yes, because it makes you floppy and tired when one doesn't drink enough, right?[…]" (Germany - P14)

„The little one drinks very little.[…]and is fagged out and in a bad mod and oftentimes he gains control again when he finally drinks. He simply forgets about it. […] And the big one (older son) likes to reward himself with food, well food plays a major role for him […] (Germany - P11)

The majority of parents in Germany and Hungary were mentioning that either junk foods, foods rich in fat or having eaten unhealthy foods or too much are seen to cause lethargy and thus decrease performance (either mentally or physically) and the feeling of wellbeing, both immediately and for a longer time. About one third of parents in England were referring to a negative impact on physical performance rather than on mental performance. In contrast to the other countries, only 2 Spanish parents mentioned an effect on either physical or mental outcomes by any of those factors.

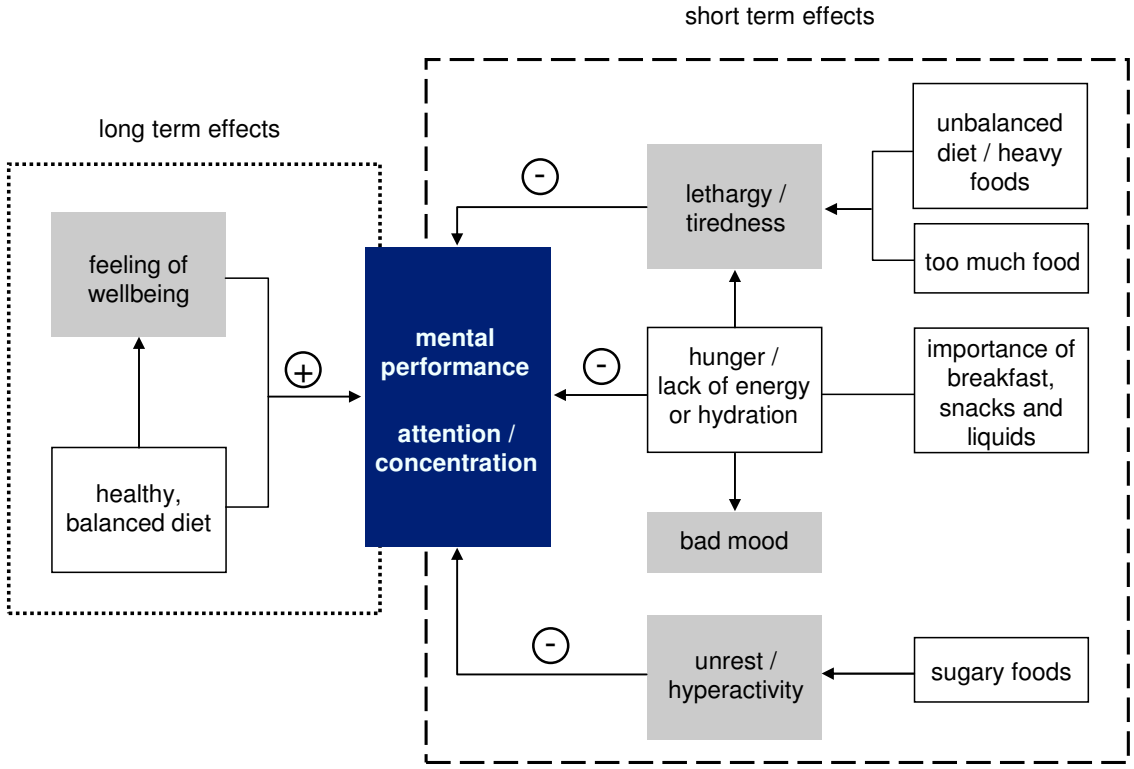
„[…] What one understands as healthy foods, I would simply say, has a positive effect on mental performance, I would simply say. Well, it can be a full grain sandwich, there can be some toppings on it, it can be fruit or vegetables. When you eat too much than the stomach certainly is so tired that mental performance decreases […]"(Germany - P28)

„[…] Well they are so flabby, well when they are so… I have seen that once, when they have eaten too much or those fatty things and then meat, than they are so tired and lazy. Well, one…Yes. You can see it that they don't have any motivation and get into a bad mood and when they eat such light things and…[…]" (Germany - P26)

"If they are hungry, their thoughts focus on eating. If they are full or have eaten too much, they are sleepier or pay less attention." (Hungary - P19)

"[...]if they're not eating healthily they're going to be lethargic and not wanting to run around and jump about and from that point of view." (England-P18)

Figure 3 Mental effects of diet and foods perceived by parents



3.4. Discussion

The present exploratory, qualitative interview study addressed the question whether and how parents relate diet and food to a child's health and mental performance and what are the predominant perceptions and beliefs about this relationship. In summary, the findings reveal a set of commonalities as well as some differences between the countries which might be associated to different cultural backgrounds and health promoting initiatives in the participating countries. Similarities and differences in parental perceptions among different European countries were also found in previous studies on parental views related to infant or child nutrition and feeding practices (Synnott et al., 2007). The following section will discuss the detected parental perceptions in more detail and deriving practical implications will be discussed.

Overall, there is a remarkable degree of similarity across the countries included in the study concerning the concept of a healthy balanced diet and what foods are being seen as positive and negatively influencing a child's health. This basic perception has been also shown by other studies (Hesketh, Waters, Green, Salmon, & Williams, 2005; Lopez-Dicastillo, Grande, & Callery, 2009; Synnott et al., 2007). Parents clearly distinguish between good and bad foods and see the composition of a child's diet as crucial for their physical wellbeing.

Good food is seen to be natural, fresh and home-cooked. Foods considered as positive for a child's health are fruits, vegetables and whole-grain products which contain a high amount of dietary fibre. Negative foods are perceived to be artificial, ready-made and processed foods containing a high proportion of sugar or fats. All parents in all countries stress the preference for sugary and fatty foods over healthy foods such as fruits and vegetables by children, resulting in a permanent conflict when trying to make children eat healthy.

Results show are good awareness by parents of how the diet for children should be composed and what is good and bad foods for a children's health. Nutrition information and education can most likely build up from a solid level of parental knowledge in order to provide detailed information and communicate latest findings in nutritional research. At the same time, barriers to healthy eating e.g. the child's preferences for fatty and sugary foods would have to be taken into account.

Physical effects of diet

In the present interview study, parents in all four countries perceived a poor and unbalanced diet as the primary cause for overweight and not a lack of physical exercise. Basically, diet is perceived to be source of a child's energy. Parents distinguish between too little and too high energy levels, the first one to result in tiredness, the later to lead to hyperactivity. Interestingly, when talking about high energy levels, parents were not referring to overweight but rather to energy loaded behaviour as resulting from high energy intake. Previous nutritional studies have identified the intake of energy as the main determinant of body weight in children (Swinburn, Jolle, Kremer, Salbe, & Ravussin, 2006). Results imply that an improvement of diet in the sense of a more balanced healthy diet containing less energy would have a greater effect on the reduction of obesity rates in children. Our findings support justification that from an interventional perspective there should be placed more emphasis on the improvement of a child's diet through parents since this is perceived to be of greater importance for the prevention of overweight in children than physical activity, as expressed by parents in all four countries. However, this is contrary to current recommendations for the design of intervention programmes such as in Germany, which state that an increase of physical exercise would be more effective than alterations of eating behaviours (Brandt, Moss, Berg, & Wabitsch). In the field of obesity prevention and intervention strategies, the need to involve participants is increasingly recognised and their beliefs are being explored to ensure a targeted approach of engagement (Hart, Herriot, Bishop, & Truby, 2003; Hesketh et al., 2005; Withall, Jago, & Cross, 2009).

Parents in all countries perceive an unbalanced, unhealthy diet not only to be of short/ mid term implication as to an increased body weight of children, but also to be of long term consequences for a child's health. Non-communicable diseases such as heart and cardiac diseases or diabetes are oftentimes directly perceived as consecutive symptoms resulting from overweight. It has been shown by previous studies that consumers rank the non-communicable chronic diseases as high concerns for society but not as low concerns for themselves (e.g. EU funded Health Sense project). Nutritional education and intervention programmes should hence stress in more detail the long term importance of a healthy balanced diet for the prevention of later diseases in order to increase parents' awareness.

The majority of German parents in particular were expressing their views about the importance of a healthy balanced diet to avoid a lack of vitamins and minerals which is seen to cause illnesses, impair growth and development and on a short term basis increase the possibility of infections. Interestingly, the issue of vitamin or mineral deficiencies was of minor importance in the other countries. This may be due to several media campaigns during the last decade which have claimed that Germans are at risk of suffering from vitamin deficiency caused illnesses. Those media campaigns might have led to an increased awareness among parents that an insufficient supply with vitamins or minerals is setting the people at risk of getting ill. These campaigns however did not represent the position of the German Society for Nutrition (DGE) ("DGE-Stellungnahme: Vitaminversorgung in Deutschland ", 2005).

Mental effects of diet

Interestingly, parents in all countries do have a differentiated view on how diet and foods affect children on a mental level. A healthy balanced diet and positive foods such as fruits, vegetables and wholegrain products are perceived to have a positive effect on a child's mental wellbeing and fitness – a relation which has been proven by other studies showing that the variety and quality of diet is positively and independently associated to academic performance in children (Florence et al., 2008).

While this positive relation is seen on a rather general level, specific effects are more attributed to negative and short term mental outcomes associated with specific foods or nutrients (sugar and fats).

For example, parents in all four countries perceive sugar as having a dose-dependent effect: having eaten too little is associated with a lack of energy and low blood sugar levels which lead to mental lethargy, tiredness, bad mood and the inability to concentrate. In contrast, the

intake of too many sweets containing sugar leads to an excess of energy being shown by hyperactive behaviour and also the inability to sit still and concentrate. From a scientific perspective, it is obvious that glucose is the primary source of energy – inadequate supply of glucose to the brain has been shown to result in a significant loss of mental function (Hoyland, Lawton, & Dye, 2008). This perception by parents of too little energy and thus low blood sugar levels having a negative impact on a child's mental performance has been previously scientifically proven (Hoyland et al., 2008). Moreover, an excess of sugar has been shown by several studies associated with behavioural problems and hyperactivity in children, particularly obvious in children with Attention-Deficit-Hyperactivity-Disorder (ADHD) (Associate Parliamentary & Health, 2008; Bellisle, 2004; Benton, 2008a) – supporting the parents' perception of this relation.

In addition, the feeling of hunger, mainly mentioned in the context of a missing breakfast before school, is perceived as an important distracter to a child's ability to concentrate and to mentally perform well. Hunger and the lack of breakfast have been indeed shown as significant factors negatively affecting learning and academic achievement by studies assessing nutritional influences on mental performance in children (Florence et al., 2008; S. Grantham-McGregor, 2005; Hoyland et al., 2008; Hughes & Bryan, 2003).

The interviews highlight that the aim in the parents' eyes is a constant supply of energy which ensures a constant level of attention and concentration – this is seen to be achieved by a healthy balanced diet rather than by specific foods. The interviews also show that parents rate the importance of having breakfast as very high in regards to a child's mental performance. Interestingly, while parents are the opinion that children should have a healthy breakfast, eating something for breakfast at all is perceived to be more important than the breakfast's composition. Breakfast promoting health campaigns should take these perceptions into account and highlight the importance of having the right things for a child's breakfast.

Parents in all four countries were describing unhealthy foods such as sweets and fast foods as mood enhancing foods. Since children are perceived to have a strong preference of sugary and fatty foods (bad foods) over foods seen as healthy (such as fruits and vegetables), the allowance and consumption of such "bad foods" is perceived to enhance mood.

Thus, the mechanism understood by parents lies in the fact that bad foods are seen as a reward by children making them happy when allowed eating and not as an effect of the food itself.

It is obvious that parents in all four countries expressed their views on the effects of diet on mental performance predominantly talking about "attention" and "concentration". This reflects quite a specific and narrow perception of the effects of nutrition on the mental performance of children and doesn't represent the rather broad range of cognitive outcomes parents mention when being asked for their definition of mental performance in children aged 4-10 (study 2, chapter 4 in this dissertation). The term "attention" is seen as a more basic cognitive function among cognitive sciences, and different aspects of attention can be measured using cognitive tests in order to detect nutritional influences. In the scientific field, attention appears to underlie other abilities such as learning, memory or more complex mental abilities (Hughes & Bryan, 2003). Interestingly, parents relate nutritional influences to this basic cognitive function only, with no linkage to any other or higher cognitive abilities.

In line with attention, parents mentioned "concentration" as being influenced by nutrition. Further research would need to identify what exactly the term "concentration" means for parents since there is no scientific equivalent and testing of such an outcome in the area of cognitive sciences and psychology (Ellen Seiss, personal communication). Nutritional education and communication should thus be taking into account to widen parents' knowledge of the effects of foods and nutrients on a child's different cognitive functions.

Another issue revealed to be very important to the majority of German parents only: for German parents the level of hydration of a child seems to play an important role in order to be mentally fit and perform well. Taking in too little liquids during the school day is perceived to be a major cause of lethargy and bad mood as well as the inability to concentrate. The high awareness of this relation might be due to several public health initiatives in Germany that promote good hydration of children in order to be able to concentrate well and to promote performance both physically and mentally (e.g. public health initiative "Trinken im Unterricht" which promotes the availability of liquids at school and especially during classes, www.trinken-im-unterricht.de). The importance and contribution of hydration to a child's wellbeing and especially mental performance would need to be subject of emphasis within health promotion initiatives in England, Hungary and Spain in order to increase parents' awareness of the importance of an optimal level of hydration for mental performance.

In summary, parents in all four participating countries see a relation of diet, foods and nutrients on mental outcomes of children aged 4-10 years. Positive relations are seen on a general level: a healthy balanced diet is associated with the feeling of wellbeing, mental fitness and performance from a mid and long term perspective. In contrast, parents perceive specific foods and nutrients as having rather negative and short term effects on mental outcomes such as attention, concentration, mood and behaviour.

Findings of this study show that there is a wide gap between perceived effects of diet on mental performance by parents and the spectrum of detected nutritional influences on different cognitive modalities in the scientific area. Nutrition communication and intervention would have to take into account this lack of perceptions and knowledge when trying to transliterate scientific findings about the relation of nutrition and mental performance in children to their parents.

Limitations

The methodological approach in the present study calls for some caution when interpreting the differences between the participating countries. Since participants volunteered for the study, the sample may not be representative of the community of parents in terms of knowledge, awareness, socio-demographics or other values. The strength of hypothesis developed from the data in exploratory qualitative research relates to the amount of variation within the context for which it accounts. A maximum of variation within the given practical limitations was nevertheless achieved by recruiting schools from socioeconomic diverse districts in each city and selecting parents of different ages, education level and number of children among the volunteers. It is anticipated in qualitative research, that beyond the number of about 30 cases (interviews), theoretical saturation is achieved. This means that no new themes are expected to occur which are seen to modify the overall construct. Thus, the aim in each country was to reach a number of about 35 interviews enabling the researchers to undertake an in depth thematic analysis. Maximising diversity, reaching saturation and providing descriptions of the sample and context contribute to the analytic generalisability (Curtis, Gesler, Smith, & Washburn, 2000).

Even though there were standardised procedures to increase the objectivity and reliability, including checking the translations by a second researcher in each country, selection bias may have occurred, due to the qualitative nature of the data. However, the results do not claim to reflect an exhaustive census, but they are useful for revealing meaningful patterns which can be quantitatively examined in more detail in further research.

3.5. Conclusions

Most of the research up to date is on parental perceptions of diet on physical outcomes such as obesity or on feeding practices of children (Hart et al., 2003; Hesketh et al., 2005; Withall et al., 2009) while there seems to be an absence of published research on parental perceptions on the effects of diet on mental outcomes. Since mental health and performance has received increased attention from a public health perspective and preventative health strategies incorporating the views of target participants such as parents have been shown to increase the likelihood of success, research on parental perceptions in this area will be of valuable input for effective nutritional communication, education and intervention programmes. From a consumer research perspective, policy makers and food manufacturers will benefit of research in this field, being able to communicate nutritional messages more targeted to parents in order to increase the chance that behaviours will be changed and to promote a healthier lifestyle with mental performance as an important outcome.

Based on the findings of this study, a subsequent quantitative questionnaire has been developed which is currently being applied and is aimed to detect socio-economic differences in the parents' beliefs and attitudes towards the effects of nutrition on a child's health and mental performance.

4. CONCEPT MAPS OF PARENTS' UNDERSTANDING OF MENTAL PERFORMANCE - a qualitative study in three European countries

4.1. Background

Nutritional communication aims to provide to consumers information on the nutritional health effects and properties and of foods and constitutes an important issue in order to reduce the information asymmetry between consumers and stakeholders such as food companies, non-government organisations (NGOs) and governments (van Trijp, 2009). Since knowledge on nutritional effects of foods and their potential health benefits resides in the expert domain of nutritional science, communication to consumers is an essential contribution to the consumer's search and selection process of foods which should lead to actual informed choices for a healthy lifestyle and diet. Targeted and effective nutritional communication to consumers prerequires a certain degree of nutritional knowledge and awareness at the consumer's side which is oftentimes lacking – a factor which increases the danger that nutritional communication is being misinterpreted or does not reach the target audience (van Trijp, 2009). In order to strengthen this need to evaluate consumer understanding of nutritional information in the field of functional foods for instance, an EU Policy on the Regulation on Nutrition and Health Claims in 2006 outlined the issue as a prerequisite in the health claims approval process of food products along with the requirement that health claims must be scientifically substantiated (THE-EUROPEAN-PARLIAMENT & EUROPEAN-UNION, 2007; van Trijp, 2009). This legislation clearly states that "the use of nutrition and health claims shall only be permitted if the average consumer can be expected to understand the beneficial effects expressed in the claim".

This is an important milestone in the history of EU-wide consumer protection which aims to guarantee that consumers can make informed choices that in turn will hopefully stimulate more healthy diets among them (Leathwood, Richardson, Strater, Todd, & van Trijp, 2007). In this context it is of crucial importance to know about parents' understanding and definition of mental performance and to elaborate the level of differentiation they have in mind in order to adequately transliterate scientific findings about nutrition and mental performance in children.

Since 2008, studies from various disciplines have been brought together in the context of an EU funded project (www.nutrimenthe.org) in order to investigate the effects of nutrition on the mental performance of children.

The present study has been conducted in the framework of this international collaboration and aims to get an insight into the parental concepts and understanding of mental performance. Consumer research in this specific field will help formulate more targeted and sensitive communication about the relationship between nutrition and its effects on mental state and performance of children.

4.1.1. The concept of mental performance in cognitive sciences

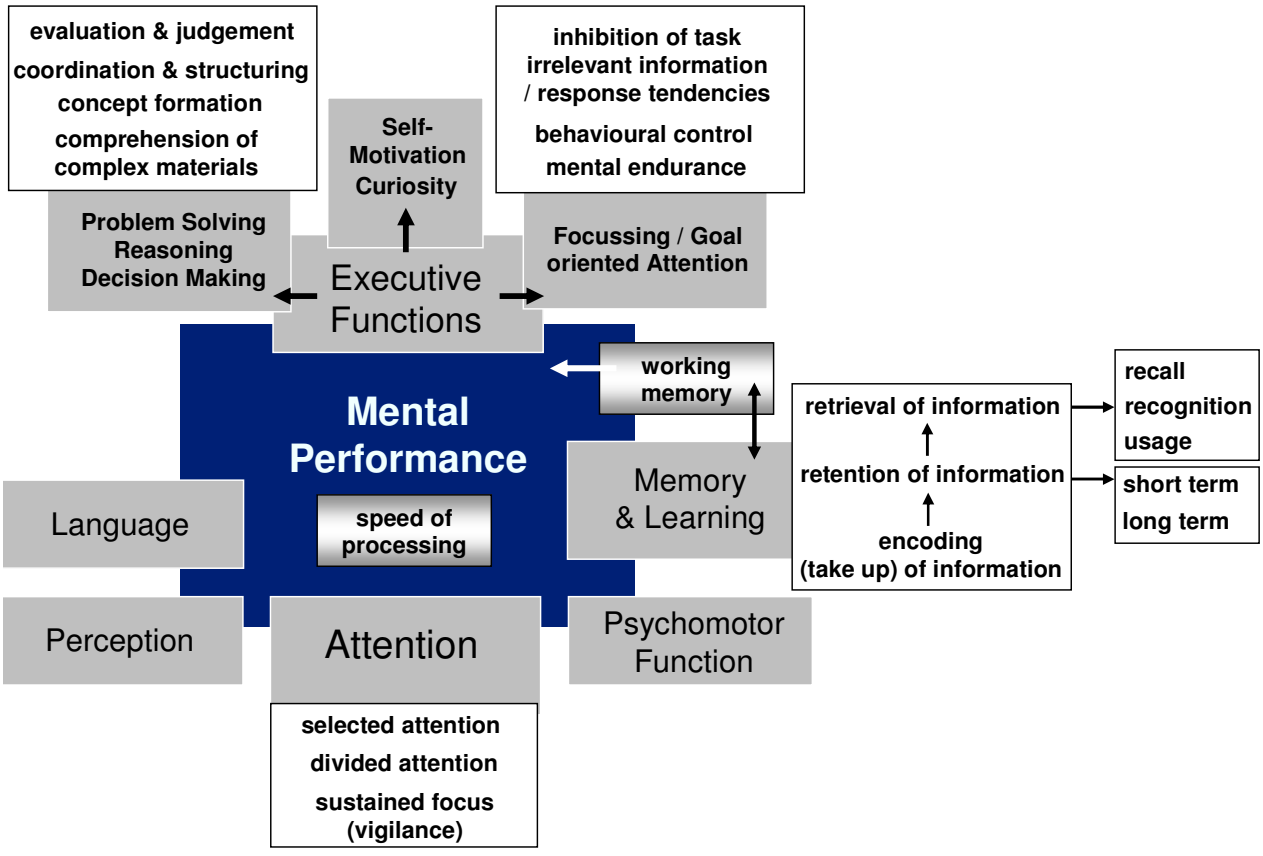
Literature about the relation of nutrition and cognitive performance in children was reviewed in order to elaborate the concept of mental performance from a neuropsychological perspective. Categorisation of mental processes based on literature in this field resulted in an expert model of mental performance which served as a structural guideline and as a reference for the analysis of subsequently conducted qualitative interviews with parents.

Cognition is defined to be a complex, multidimensional set of abilities and there are various approaches to categorise cognitive modalities (Bellisle, 2004). Nutrition and specific food components are one of the possible influencing factors on a child's cognitive functioning and mental performance (Associate Parliamentary & Health, 2008; J. Westenhoefer et al., 2004). It has been shown that nutrition can have broad effects on the brain's macrostructure (e.g. development of the frontal lobes), microstructure (e.g. myelination of neurons) and neuro-transmitter systems (e.g. expression of dopamine or its receptor) – physiological processes which are all associated to cognitive functioning.

Based on the cognitive model of Schmitt et al 2005, cognitive functions can be divided into six areas (figure 4) which are language, psychomotor functions, perception, attention, memory & learning as well as higher order / executive functions. Each of those areas can be further divided into specific cognitive functions. All cognitive processes are very much interlinked and efficient functioning of one cognitive process may depend on other cognitive processes. For instance, efficient saving of new information in the long-term memory cannot take place without corresponding perception and attention for this information as well as applying executive learning strategies (Schmitt et al., 2005). Memory functions, for instance, include short-term and long-term memory encoding of information, storage and retrieval functions as well as working memory (Isaacs & Oates, 2008). Further differentiation can be made between the type of information which is being processed e.g. involving sensory modalities, non-verbal vs. verbal and declarative vs. procedural or episodic information. Attention can be subdivided into selected attention (= the ability to pay attention to those

things that are considered important and to ignore those that are not), divided attention (= the ability to divide attentional processing between more than one task) and the ability to continuously focus (sustained attention or vigilance) (Hughes & Bryan, 2003; Isaacs & Oates, 2008). Of specific importance are the so called "higher order or executive functions" which are defined as "meta"-cognitive abilities that overarch all other cognitive functions. Executive functions involve brain regions of evolutionary younger age such as the frontal lobes – functions which are associated with a child's ability to engage in goal-directed, independent behaviour (Hughes & Bryan, 2003). For example, good executive function is demonstrated by mental flexibility, self-monitoring behaviour, planning and problem solving, rule learning and abstract reasoning (Miyake et al., 2000). Although there are some experimental techniques to measure executive functions in children (Isaacs & Oates, 2008), it has to be taken into account that the full spectrum of executive functions is thought to only develop in later childhood and even into adolescence as myelinisation of frontal lobes continue – a process of maturation which seems to be prerequisite for good higher order cognitive performance (Isaacs & Oates, 2008).

Figure 4 Expert model of Mental Performance



Cognitive functioning can be assessed by a large variety of neuropsychological performance tests. Mental performance is typically defined by the ability to perform a variety of cognitive tasks (Hughes & Bryan, 2003; Joachim Westenhoefer et al., 2004). General tests for the assessment of a child's mental performance are the Test of Everyday Attention for Children (TEA-Ch), the Child Behaviour Checklist (CBCL) and the Teacher's Report Form (TRF). One of the general IQ tests which is widely applied in the field of nutrition research is the Wechsler Intelligence Scale Test (Florence et al., 2008). Beyond general tests for the measurement of overall intelligence, there are specific cognitive tests which try to investigate more or less defined cognitive functions – e.g. different assessment tools for perception, attention or memory processes (Joachim Westenhoefer et al., 2004). Memory is seen as a complex set of processes involving the take up of information (encoding), retention of information (short term and long term) and the retrieval of information (a.o. recognition). Short term memory for example can be evaluated by the "free word recall" test and the ability of recognition of information can be assessed by the so called "word recognition task". A review by Hoyland et al in 2008 showed that macronutrient manipulation (especially glucose) shows the biggest effect on memory tasks. According to the studies reviewed, glucose has been observed to improve tasks on memory and effects were shown on more complex memory tasks with greater cognitive demand (Hoyland et al., 2008).
Moreover, several non-cognitive factors can influence cognitive functioning. These include arousal, which corresponds to the effect of mental fatigue vs. mental activation on performance - over- and under-arousal can decrease mental performance. Mood, motivation and physical discomfort (e.g. hunger) may also affect cognition. These factors can also influence one another (Schmitt et al., 2005).

4.2. Material and Methods

Recruitment of schools and participants was undertaken as outlined in chapter 2. Participants of this study did not take part in the first study (chapter 3).
Qualitative interviews were conducted with parents of children aged 4-10 years who were recruited through state schools in the cities and surrounding areas of Munich (Germany), Guilford (UK) and Granada (Spain) to detect the consumers' definition and understanding of the term mental performance.

4.2.1. Data collection and analysis of interviews

Data were collected via face-to-face interviews. Parents were asked the open-ended question "What do you understand by the term mental performance when thinking of children aged 4-10?" Answers to this question were either audio-taped and transcribed (Germany) or written down manually by the interviewers (England, Spain). The transcripts or notes were subsequently translated into English and analysed qualitatively and quantitatively according to the combined principles of concept and content analysis (Campos & Turato, 2009; Morse, Mitcham, Hupcey, & Tason, 1996; White & Marsh, 2006). Concept analysis methods as originally described by Walker & Avant (1995) have found numerous qualitative applications in nursing research and health care to evaluate concepts of diverse phenomena such as "reflective thinking" in nursing decision making processes (Van Vuuren & Botes, 1999) or the "quality of life definition" (Taylor, Gibson, & Franck, 2008). Quantitative issues were considered by combining principles of concept analysis with categorisation used in content analysis in order to quantify the results.

First, all transcripts were screened for emerging themes in each country. An expert model of mental performance and cognitive abilities including definitions and examples served as a structural outline for classification and allocation of the lay expressions used by parents into cognitive categories, resulting in national thematic maps. Those thematic maps were merged to build an international coding template which was then applied to code all interview transcripts using NVivo8. The prevalence of each category was counted in terms of how often and how many parents referred to each category of cognitive function. This approach enabled to detect country specific concept maps of parents' understanding of mental performance.

4.3. Results

4.3.1. Qualitative interviews with parents

Between January and May 2009 a total of 141 parents of children aged 4-10 years were interviewed. A summary of the number of interviews completed in the individual countries is given in Table 3.

Table 3 Schools recruited and interviews completed

Country	Number of schools recruited	Number of Interviews completed
England	2	53
Germany	7	45
Spain	7	43
TOTAL	**16**	**141**

Across countries the majority of participants were mothers and approximately 70% of all participants had two or more children. Greater than 90% of the participants were responsible for choosing the food at home. In Germany 83% of parents participating were in some form of paid employment, this fell to 66% in England and to 46% in Spain.

Table 4 Characteristics of parents in the different European countries (n=141)

		% of parents in			
		Germany n=45	**England n=53**	**Spain n=43**	**TOTAL n=141**
Age group (years of age)	under 30	2,3	3,8	14,0	6,4
	30-39	33,3	52,8	37,2	41,8
	over 40	64,4	43,4	48,8	51,8
Highest level of education completed	none	0	0	2,3	0,7
	Primary school	0	0	14,0	4,3
	secondary school age 15/17	6,7	18,9	7, 0	11,3
	secondary school age 16/17	11,1	9,4	34,9	17,7
	college	44,4	28,3	9,3	27,7
	university	37,8	43,4	32,6	38,3
In paid employment	YES	84,4	66,0	53,5	68,1
	NO	15,6	34,0	46,5	31,9
Number of children	1	33,3	17,0	30,2	26,2
	2	48,9	54,6	55,9	53,3
	3	15,6	18,9	9,3	14,9
	4	2,2	5,7	2,3	3,5
	5	0	3,8	2,3	2,1
National language as the first language	YES	77,8	94,3	100	60,3
	NO	22,2	5,7	0	39,7
Participant relationship to child(ren) at school	mother	88,9	94,3	86,0	90,1
	father	11,1	5,7	14,0	9,9
Responsible for choosing food served at home	yes	91,1	98,1	95,3	95,0
	no	8,9	1,9	4,7	5,0

4.3.2. Parents' concept of mental performance – England

Parents in England most often used general expressions when describing their understanding of mental performance (58 %) with academic performance being referred to predominantly (see examples of general expressions in table 5). In 42% of the interviews, parents mentioned alertness, attention and / or the ability to concentrate as being representative of the mental performance of a child whereas learning and memory was only mentioned in 25 % of the interviews. 10 parents (19%) referred to aspects of cognitive functions which can be grouped into the category of executive functions, such as problem solving, reasoning and logical thinking. A minority of parents expressed their understanding of mental performance by aspects of social and emotional intelligence (11%), speed of processing (6%) or language abilities (4%).

Table 5 Themes and sub-themes mentioned by parents in England (parents may have made several references to different themes, thus the total of references exceeds the total of parents referring to a theme)

Theme	**Parents (n=53)**		References
	n	**%**	n
General Expressions	**31**	**58**	
academic performance			*15*
thinking			*5*
inherited mental capabilities			*4*
comprehension and understanding			*2*
intelligence			*2*
finding one's bearings in life			*1*
common sense			*1*
awareness			*1*
Alertness, Attention and Concentration	**22**	**42**	
Learning and Memory	**13**	**25**	
Executive functions	**10**	**19**	*11*
problem solving			4
reasoning - logical thinking			3
mental flexibility			1
planning and focusing on goals			1
understanding cause & effect relationsships			1
coordination and structuring			1
Social and Emotional Intelligence	**6**	**11**	
(Speed of) Processing	**3**	**6**	
Language	**2**	**4**	

4.3.3. Parents' concept of mental performance – Spain

The majority (60%) of parents in Spain used general expressions when being asked for their understanding of the term mental performance in children with a special focus on how a child intellectually develops (status of intellectual development at a certain age). 12 % of parents see learning and memory as being representative for mental performance, and 10% refer to either behaviour (in the sense of behavioural control) or reasoning & logical thinking. Only few parents refer to other themes such as psychomotor abilities (7%), perception of environment (5%), attention and concentration, social and emotional intelligence or language (each 2%, overview in table 6).

Table 6 Themes and sub-themes mentioned by parents in Spain (parents may have made several references to different themes, thus the total of references exceeds the total of parents referring to a theme)

Theme	**Parents (n=43)**		*References*
	n	**%**	*n*
General Expressions	**26**	**60**	
(intellectual) development			*12*
academic performance			*4*
thinking			*3*
use and unfold one's mental capacities			*3*
comprehension and understanding			*2*
level of knowledge			*2*
Learning and Memory	**5**	**12**	
Executive functions	**4**	**9**	
behaviour			*2*
reasoning - logical thinking			*2*
Psychomotor abilities	**3**	**7**	
Perception and Environment	**2**	**5**	
Attention and Concentration	**1**	**2**	
Social and Emotional Intelligence	**1**	**2**	
Language	**1**	**2**	

4.3.4. Parents' concept of mental performance – Germany

Due to the availability of literal transcripts of audio-taped interviews, a more detailed analysis of the German parents' concept of mental performance was possible. Analysis shows that 44% of the parents used general expressions when describing their understanding of mental performance such as to use and unfold one's mental capacities or academic performance. Table 7 shows an overview about all emerging themes and sub-themes as well as their prevalence in the German data set.

Table 7 Themes and sub-themes mentioned by parents in Germany (parents may have made several references to different themes, thus the total of references exceeds the total of parents referring to a theme)

Theme	**Parents (n=45)**		*References*
	n	**%**	*n*
General Expressions	**20**	**44**	
use and unfold one's mental capacities			*4*
academic performance			*3*
thinking			*3*
inherited mental capabilities			*3*
level of knowledge			*2*
intelligence			*2*
finding one's bearings in life			*1*
mental fitness			*1*
playing games			*1*
Attention and Concentration	**20**	**44**	
Executive functions	**20**	**44**	
problem solving			*8*
creativity			*6*
mental flexibility			*3*
mental endurance			*3*
coordination and structuring			*3*
reasoning - logical thinking			*2*
rule learning - learning from mistakes			*2*
motivation and curiousity			*1*
planning and focusing on goals			*1*
understanding cause & effect relationsships			*1*
behaviour			*1*
reflection on things			*1*
Learning and Memory	**15**	**33**	
Social and Emotional Intelligence	**10**	**22**	
(Speed of) Processing	**5**	**11**	
Language	**7**	**16**	
Perception and Environment	**4**	**9**	
Psychomotor abilities	**1**	**2**	

Attention and Concentration

44% of parents explained their understanding by using the words "attention" and "concentration" when being asked for their definition of mental performance in children. The ability to pay attention and to concentrate was either generally described or specifically referred to focused or sustained attention. Attention and concentration is understood as an underlying and more basic ability, which plays a key role for mental and thus academic performance. The term concentration was oftentimes mentioned first or as summary to express what is considered essential when thinking about mental performance:

„Concentration, attention and thus being able to handle in a structured way and (…) Yes, concentra-tion is the main thing." (P78)
„Well, yes, what children can perform mentally. Well, how they are being supported, how concentra-tion is (…) yes, concentration as I think, very important, that's what I think it is." (P100)

Executive functions

It shows that many parents (44 %) in Germany understand mental performance as a sort of higher order cognitive function. Parents have a quite differentiated understanding of these higher order cognitive functions with issues of "task and problem-solving" and "creativity" being referred to the most often. Task and problem solving is seen as a more general capability which is required to be good at school. Being able to solve tasks and problems also requires mental endurance:

„[…] that they can follow in school, that they (…) when they are being confronted with problems or challenges there, that they can deal with it. Thus, spur, that they don't give up at once, but that they have the courage to face it. Yes." (P 70)

The factor time and stress is also one aspect which is important for solving problems as well as to be mentally flexible:

„[…] Yes, to paraphrase it in the end, that I'm able to solve problems quickly, also under pressure." (P51)
„[…] in school it is calculations or, or writing or solving problems somehow, that it (the child) can do this also on its own. But actually that mental flexibility to get to an achievement of the one or other kind. That's how I would put it." (P81)

Other expressions about task and problem solving are more general referring to every day life or the social environment:

„[…] Yes, it is difficult, difficult to define. That one can solve tasks with one's own mental abilities, well, in very different areas." (P101)
„[…] mental performance. That is for me, yes, that's what a human being accomplishes within the range of tasks which he faces everyday, this certainly relates to the social environment that has to be harmonious, being relaxed, not being stressed to much and, yes…"(P91)

Creativity and imagination is also seen to be a relevant component of mental performance and mentioned in line not only together with higher order functions but also with aspects of learning, social competence or the ability to concentrate:

„(…) Yes, mental performance is a multi-layered matter. This means of course, A, the opportunity and openness to learn, B, creativity, C, of course mathematical understanding, D, certainly also the mental flexibility to deal with problems, not matter what kind of, if this is, I don't know, human, interpersonal things or factual problems. That's what I would add on all to mental performance." (P97)
„[…] mental performance. This includes in my opinion at the very first that a child, it is about children now, can focus on a thing, that it is also able to creatively deal with things and yes, also develops imagination." (P81)
„I would say when one is able to concentrate but also (…) I would actually add in such things as imagination, when one is being lively and able to take up impressions and process them (…)" (P54)

Being able to plan, organise and structure things is also seen as part of mental performance whereby the ability to pay attention and concentrate seems to be an important underlying prerequisite:

„Well, if a child is fit, if it can concentrate, if it sticks to a work, is receptive, if it continually sticks to a work, if it begins and brings it to an end, if it is then able to organise the workplace accordingly and weighs up when to do what best. So. Well, simply to form the workflow, to execute the work and to focus on a goal, things like that. And concentration. Yes, everything has to do with it." (P82)
„Concentration, attention and thus being able to handle in a structured way and (…) Yes, concentration is the main thing." (P78)

Learning from mistakes or capturing and follow rules is also mentioned as part of mental performance definition as well as controlling behaviour:

"[…] mental performance, maybe also, yes, recognize and accept rules. What else belongs to mental performance? Yes, simply being able to behave […]" (P63)
„To mental performance also belongs being able to estimate one's own performance, self-perception, not over or underestimate oneself, which is what we are doing permanently, being able to learn from mistakes, to notice mistakes and to deal and correct them. Yes, those are the most essential things that belong to cognitive performance, at least at everyday school life." (P86)

Learning and memory

The third predominant theme (33%) which emerged from the interviews was learning and memory. Learning and memorizing things was either described generally or by distinguishing between the take up, storage and usage of information:

„Well, mental performance means the ability to take up information, to process, store and retrieve it into practice or at least to recognise it (…)" (P86)
„By this I mean (…)okay. Mental performance, that is the ability to reproduce what my mind yields, that's how I would put it. Well, what I have learned, what was given to me, yes." (P 75)
„Mental performance. I would say several areas, first certainly apprehension, endurance, well to be able to profit of endurance, yes, apprehension, retentivity. Those are the main points, I would say, yes?" (P 64)
„Mental performance. Well, that A) I remember what I have taken up during my life and B) that I can build up from what I have to think and decide about every day." (P76)

The ability to take up information was associated with alertness and susceptibility to things happening in the environment. But not only the passive uptake of information but also the ability to interact with the environment was seen as vital:

„ Mental performance means the transfer of what one has learned, what one has been transferred genetically, what one has explored by oneself, actually that one can through hearing, saying, feeling all those criteria, that's what I call physical, mental performance." (P 77)

„ This is for me the ability to, at most, with the corresponding intelligence quotient, take up knowledge and the environment quickly, effective and comprehensive." (P 65)

Social and emotional intelligence

Another predominant theme (referred to by 22% of parents) which was identified from the interviews was the ability of social interaction and to deal with emotions. This was seen as more and more important not only for school achievement but also for every day's life:

„Beyond this I think about emotional and social performance, those are also aspects which come into play in school and which are in the meantime being more cared about as compared to maybe 10 years ago or so. Yes." (P86)

The ability to put oneself in somebody else's place, to read between the lines (empathy) or to manage social conflicts was also expressed as an important mental ability:

„ It is about, how shall I put it, about natural intelligence. That's for me the mental thing. Well, so that you can in life, yes, certain things or to read between the lines, also to see what is happening to me, not only to walk around. This is mental or being mentally high developed. Also when I speak with somebody, to notice what this person really means, not what he says." (P 61)
„Intelligence to make it brief, also actually empathy." (P 51)
"[…] to deal with problems, not matter what kind of, if this is, I don't know, human, interpersonal things or factual problems. That's what I would add on all to mental performance." (P97)

Dealing with own emotions, either the ability to process emotions or to manage specific situations such coping with challenges or problems where self-confidence plays a role:

„Yes, than also emotional things, how you feel about something and also, for instance, how long it takes to process those feelings and how you can deal with other persons. Maybe something like this. Yes." (P 93)
„[…] that they (…) when being confronted with problems or challenges as usual, that they can cope with this. Well, spur, and that they don't give up at one but have the courage. Yes." (P 70)

Other cognitive categories

A smaller number of German parents mentioned aspects of other cognitive function categories when being asked for their definition of mental performance e.g. speed of processing by 11% of parents (in the sense of reaction time to mental tasks and processing information), language abilities (receptive and expressive; 7% of parents), perception of environment in the sense of actively taking part in the environment and perceive stimuli of the environment (9%) and psychomotor abilities (2%).

4.4. Discussion

The research question that is relevant in this context is: "What do parents understand by the term mental performance when thinking of children aged 4-10?" The purpose of this study is to examine parental concepts of mental performance in three different European countries with an emphasis on the German parents' concept.

Few studies have examined people's lay views and implicit theories of intelligence in the sense of intelligent behaviours and attitudes but without detecting the range of different cognitive functions which would make it possible to relate these perceptions to research about nutritional effects on cognitive modalities (Giraudeau, Chasseigne, Apter, & Mullet, 2007; Lim, Plucker, & Im, 2002; Swami et al., 2008). In addition, questionnaires were used in those studies which already outlined aspects of intelligence and had to be rated – this way participants were already presented definitions of intelligence and no exploratory approach to detect peoples' understanding of intelligence was undertaken. More published research can be found in the area of estimation and self rating of intelligence by parents and children in different cultural contexts (Chamorro-Premuzic, Arteche, Furnham, & Trickot, 2009; Kirkcaldy, Noack, Furnham, & Siefen, 2007) while there is obviously, to the best of knowledge, an absence of published research on lay people's understanding and definition of the term mental performance in children.

Parents in the three countries most often used general expressions (44% – 60%) when describing their understanding of MP such as academic performance (28% UK) or mental development (29% ES). Words used such as academic performance, intelligence, thinking or intellectual development, seem to be equivalent to mental performance for the majority of parents. Definitions using the words "attention" and "concentration" were prevalent in England (42 %) and Germany (44 %) with the lowest number in Spain (2%). Many parents in Germany (44%) defined MP in terms of higher cognitive function (e.g. problem solving, reasoning, logical thinking); this number was lower in the other two countries (19% UK, 10% ES). Learning and memory abilities were also seen to represent mental performance in children aged 4-10. Interestingly, those categories were less important (33%) to German parents than executive functions (44%).

Interviews with German parents revealed that attention and concentration are seen as vital and underlying abilities to achieve good academic performance. In cognitive sciences, attention is indeed seen as a major cognitive function which develops first and which is

required for many other cognitive abilities such as learning, memory and higher order functions (Hughes & Bryan, 2003; J. Westenhoefer et al., 2004).

The combination of those abilities comprises the construct of intelligence and leads to functional outcomes such as school performance. Different modalities of attention and executive functioning can be measured using cognitive tests in order to detect nutritional influences (J. Westenhoefer et al., 2004) and many reviews have described the effects of foods or food components on attention (Bellisle et al., 1998; Dye & Blundell, 2002; Gibson & Green, 2002).

The term "concentration" was used by parents very often in line with "attention" – it remains unclear, how parents exactly define the term "concentration" and how this is distinguished from "attention" since there is no such classification in cognitive sciences. The term concentration can stand for various cognitive abilities such as sustained (focus) attention, behavioural control or mental endurance (Ellen Seiss, personal communication).

Interestingly, when parents are asked about their views on the relation of diet and mental outcomes, they mainly perceive food to have an effect on a child's attention and concentration level as well as on their mood and behaviour but not on memory and learning or any higher order cognitive function (see study 1 – chapter 3). In the present study, a remarkable number of parents refer to some kind of executive function when being asked for their definition of mental performance which shows that they do see these functions as being part of the outcome mental performance but obviously as not being affected by nutritional factors. German parents mention a broad range of different executive functions which reflects a differentiated understanding and observation of those more complex cognitive abilities. One explanation for this might lie in the fact, that the German parents were significantly older and more educated. Parents of higher age might have older children among which executive functions play a more important role in academic achievement and thus becoming more obvious to parents. A study by Ardila et al (2005) has found a correlation of children's' test scores in executive functioning with parental educational level (Ardila, Rosselli, Matute, & Guajardo, 2005). This might lead to the hypothesis that the higher a parents' education level, the more aware parents are about the importance of executive functions in children, the more likely parents will promote the development of executive functions in their children. This would mean that parents of higher educational level (which is correlated to socioeconomic status, SES) would most likely be reached by nutritional messages about benefits to higher order cognitive functions.

The results indicate that parents' understanding of mental performance in the three countries might be more differentiated than their perceptions of how diet affects different areas of cognitive functioning (see study 1 – chapter 3).

This has important implications for nutritional communication about the effects of diet on mental functioning in children. It shows that there is a gap between the expert model and parental concept of mental performance. Although parental understanding is differentiated and refers to different cognitive modalities, the level of differentiation and specify differs from the scientific field. Discrepancy between expert and lay concepts has already been identified by previous studies examining the concept of intelligence (Swami et al., 2008). This issue becomes relevant as soon as scientific findings about the effects of diet on cognitive functioning in children are to be communicated to consumers such as parents. In the specific case of mental claims on functional foods for example, appropriate wording is of crucial importance in order to ensure that the information is understood correctly (Williams, 2005) and that consumers can easily see where the food is supposed to contribute to their children's' mental performance and health. Lay interpretation of nutritional information has been shown to differ from expert opinion, particularly in relation to understanding "lay" keywords (Henderson, 2010). Consumers are interested in health claims but are sceptical about their reliability from manufacturers when there is no strong regulation, and previous studies have shown that consumers consider health claims as useful and that they prefer short claims rather than long and complex wording (Maubach, Hoek, & McCreanor, 2009; Williams, 2005). Although health claims have been shown to potentially improve the consumer's knowledge of diet-health relationships, understanding of functional foods as well as to support healthier food choices, current research indicates that a lot of the claims currently used are potentially misleading (Williams & Ghosh, 2008).

Regarding the obligatory scientific substantiation of health claims on those functional foods, scientific evidence and methodologies for testing on nutritional influences on mental state and performance were reviewed by the PASSCLAIM expert panel (ILSI-Europe, 2010; J. Westenhoefer et al., 2004). The authors suggest to advertisers to express claims in specific rather than in general terms in order to create clarity of meaning for the legislator and consumer which makes a more decisive evaluation of claims possible. Moreover, it is proposed that the wording of mental claims should be quantifiable and measurable to allow for scientific verification which will also lead to increased confidence in the claim (J. Westenhoefer et al., 2004).

Research in consumer understanding is important in order to deliver a basis for the formulation of those claims as well as for other stakeholders to know how precise nutritional information would have to be communicated to the consumer. The present study gives first insights into the level of differentiation and specify of parents' understanding of mental performance which can be used as a orientation for nutritional communication about the relation of nutrition on mental functioning in children.

Results of the present study suggest that effects of foods on general mental performance outcomes (e.g. intelligence or academic performance), attention and concentration as well as learning and memory, are most likely to encounter parents' awareness and understanding.

However, the methodological approach in the present paper calls for some caution when interpreting any differences between the three participating countries. Due to the fact that only in Germany the interviews were audio taped and thus could be transcribed word-by-word, the same level of detailed analysis could not be conducted in the two other countries.

This may have caused some bias since parents' answers might not have been captured in the same detail by taking notes manually in England and Spain. Because of the different languages the transcripts and notes had to be translated into English for international analysis. Even though there were standardised procedures to increase the objectivity and reliability, including checking the translations by a second researcher in each country, selection bias may have occurred, due to the qualitative nature of the data. However, the results are of course not exhaustive, but provide insights that could be further examined in larger, more representative samples. Further research would also need to investigate, to what extend parents see nutrition or foods affecting different cognitive functions and to compare those relations to the extent of parents' understanding of mental performance in children outside the food context.

4.5. Conclusions

The present exploratory and semi-quantitative study provides insight into the parental concepts of mental performance of a socio-demographic diverse group of parents. The study suggests that the reported definitions of mental performance might differ between countries and may be associated with socioeconomic status and cultural background. In summary, parents across the three participating countries predominantly express their understanding of mental performance using general terms which do not represent any specific cognitive category. Fewer parents understand mental performance by either attention and

concentration, learning & memory or executive functions which is consistent with the classification in cognitive sciences.

Since parents are the gatekeepers to what children eat and play a key role in the development of a child's eating behaviour, it is of basic interest to understand the consumers' definitions in order to formulate more targeted and sensitive communication about the relationship of foods and mental development and performance of children. Nutritional communication prerequires a detailed understanding of the consumer's definition in order to transliterate scientific findings about benefits of foods to a child's mental development and performance.

Moreover, understanding the concepts of parents in this area is likely to be important in supporting parents to promote foods and diet that might have a positive effect on the mental development and performance of their child. This provides an important field for further research with implications for public health initiatives that aim to improve children's diet via the family food environment. Further research on a national level will need to specifically address in more detail parental definitions of mental performance and examine with statistical power the possible association to SES in order to guide the formulation of nutritional information aimed for socioeconomically different target groups in each country. Results of this qualitative research to assess consumer understanding will provide input for the design and orientation of such a subsequent approach.

5. RATING OF INFLUENCING FACTORS ON MENTAL PERFORMANCE AND THE ROLE OF FOOD – a quantitative study using the card sorting technique

5.1. Background

Nutrition is one of many factors that may influence a child's cognitive development as well as genetic, socio-economic, environmental and behavioural influences (Associate Parliamentary & Health, 2008; Bryan et al., 2004). During infancy and early childhood the family is a key - environment for children to learn and develop food preferences and eating habits with implications for future mental health and wellbeing (R. Brown & Ogden, 2004). Young children do not choose what they eat, but their parents decide and prepare the food for them. In this context, it is important to find out to what extent parents consider food factors to influence their child's mental state and performance among other potential influencing factors.

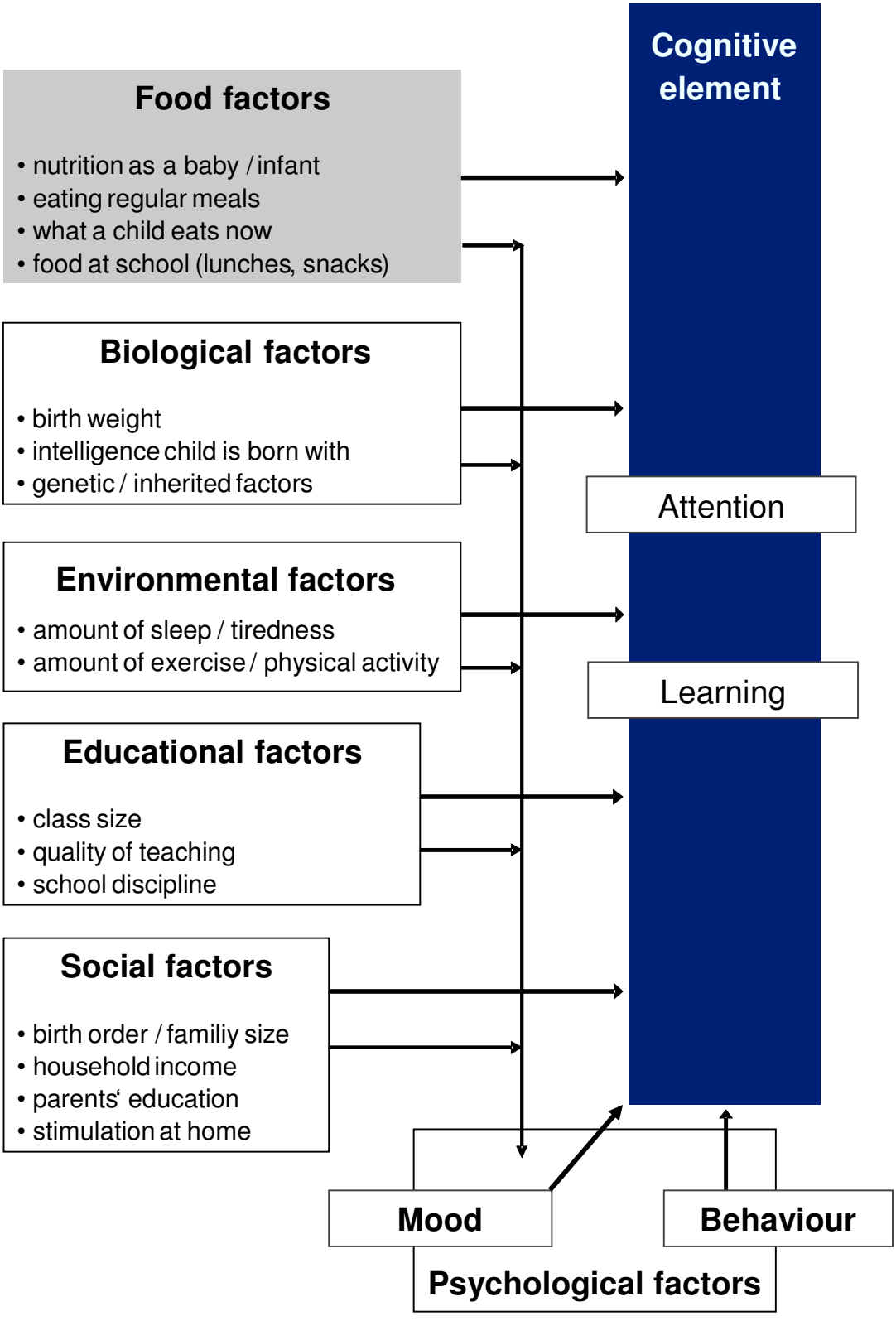
The aim of this study was to quantitatively examine how parents of children aged 4-10 years rate the role of food as an influencing factor on aspects of mental state and performance among other influencing factors.

5.1.1. Factors influencing a child's cognitive development, mental state and performance

Previous research has shown that there are a number of nutritional factors which can influence a child' mental outcomes such as: nutrition as a baby or infant, what a child eats now, regularity of meals and snacks as well as the food in school (lunches and snacks) (Bellisle, 2004; Benton, 2008a, 2008b; Benton & Jarvis, 2007; Benton et al., 2007; Florence et al., 2008; Taras, 2005a).

Besides nutritional factors, there are a variety of other factors which can have an effect on mental outcomes of children. For the present studies' purposes, 18 factors which were grouped into six categories have been determined: biological, psychological, sleep and physical activity, educational, social and food factors (figure 5).

Figure 5 Factors and factor groups which potentially influence a child's mental state and performance (e.g. Attention, Learning, Mood and Behaviour)



Biological factors

The transmission of genes which potentially influence intelligence is one way by which parents and the family background may impact on a child's cognitive outcomes. Although genetic and environmental factors strongly interact, research still tries to separate the contribution of each factor on intellectual attainment (Scott-Jones, 1984).

Low birth weight has been shown to be another biological factor which is associated to a child's mental outcomes. Low birth weight or premature birth is a health factor related to low levels of cognitive development – this association seems to be lessened in higher social environments. Low birth weight and other measures of perinatal status may be predictive of intellectual functioning in the first years of life (Associate Parliamentary & Health, 2008; S. M. Grantham-McGregor, Fernald, & Sethuraman, 1999; Scott-Jones, 1984). The lower the birth weight the greater the risk of brain disorders (Associate Parliamentary & Health, 2008).

Psychological, environmental and educational factors

Mood and behaviour have been shown to modulate cognitive functioning in children (Schmitt et al., 2005). Mood oftentimes is considered as a mediating state for improved physical or mental performance (J. Westenhoefer et al., 2004). Factors which have an effect on mood, thus indirectly have an influence on mental performance. The level of tiredness which correlates with the amount and quality of sleep, has been shown to be another factor which influences mental outcomes in a child (Taras & Potts-Datema, 2005; J. Westenhoefer et al., 2004) – this has been indicated also for the amount of exercise and physical activity (Taras, 2005b). As to educational factors, class size and the quality of teaching have been shown associated with behaviour and academic performance of elementary school aged children (Belsky et al., 2004) as well as discipline at school and teacher's managerial competences (Wilks, 1996).

Social factors

One of the family factors that affect children's cognitive development is the provision of an intellectual stimulating environment (Scott-Jones, 1984). A lack of stimulation at home is considered to have a negative impact on a child's cognitive development. On the other hand, overstimulation (especially too much background stimulation) may also have adverse effects.

Moreover, the size of the family (number of people in the home – density of people) was found to be predictive of a child's mental performance: the more people are living together

in a family, the more limited is the space available for a child. This makes it difficult for a child to avoid noise and background stimulation – a relation that has been shown to negatively influence a child's cognitive development and school achievement (Scott-Jones, 1984).

Moreover, a child's development seems to be influenced by family configuration as well through the combined level of intellectual functioning of family members (S. M. Grantham-McGregor et al., 1999; Scott-Jones, 1984). The older the family members, the higher the intellectual functioning which positively contributes to a child's intellectual development (increasing the total amount of intellectual stimulation for a child). According to this "confluence theory" the birth order of a child may be a predictor for cognitive performance – only children and last born children are of disadvantage according to this theory because they cannot play a teaching role for other family members which are younger (Scott-Jones, 1984). However, there is no consistent support for this theory since it is not possible to disentangle the effect of birth order / child spacing or family size from other confounding factors that influence cognitive development.

Parental education and socioeconomic status (SES) and appear to be good predictors of intelligence in the preschool years (Scott-Jones, 1984). Family socioeconomic status is seen to be strongly associated with intellectual attainment and SES appears to be a better predictor of a child's performance than other status variables (Bradley & Corwyn, 2002). SES may be a powerful predictor of academic achievement because of values, behaviours, attitudes and living conditions associated with families of various socioeconomic levels (S. M. Grantham-McGregor et al., 1999).

All above mentioned influencing factors show complex interactions making it difficult to try to isolate the role of each specific factor on mental status and performance in children.

5.2. Material and Methods

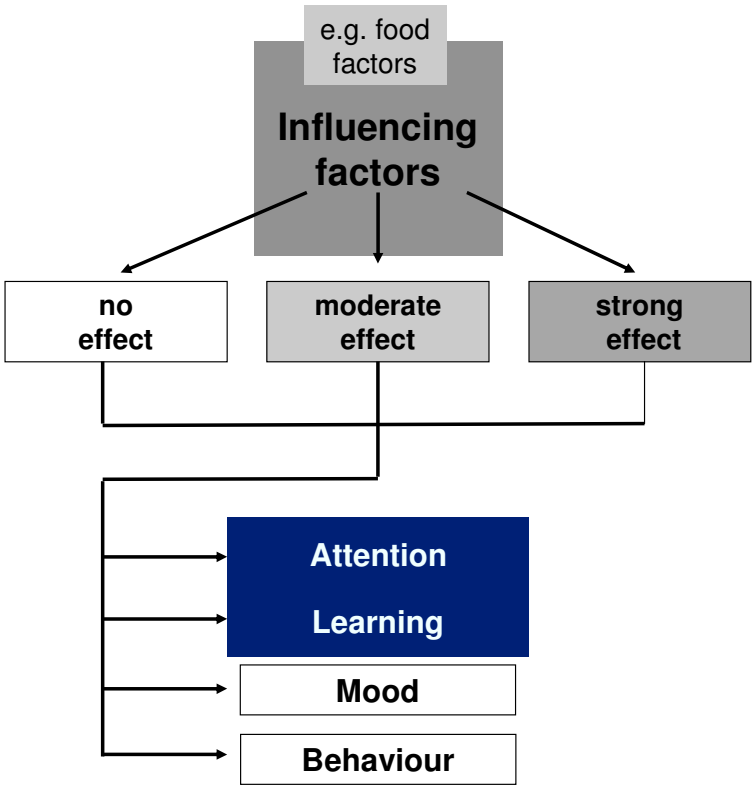
The recruitment of schools and participants was undertaken as outlined in chapter 2. Parents in Germany who took part in the present study also participated in the previous study on parents' concepts of mental performance (chapter 4).

5.2.1. Interview Schedule

Face-to-face interviews with parents were conducted and a card sorting interview schedule was used for the rating of factors by parents as described by Rugg et al (Rugg & McGeorge, 1997). The basic idea behind sorting techniques like the card sort is to ask respondents to sort things in groups. This approach allows for the rating of specific factors on defined categories in order to detect the importance of a specific factor for a specific category (here: to detect the importance of food factors on mental outcomes compared to other non-food factors). Furthermore, the method is easy to use, systematic and quick. Based on the results of the previously conducted interview study with parents (see chapter 3) and literature in this area, four elements of mental state and performance were selected for the present study: Attention, Learning, Mood and Behaviour.

All 18 influencing factors described in chapter 5.1.1 were presented on paper cards to parents; participants were asked to sort those cards for each of the four elements (attention, learning, mood and behaviour) into three groups according to how much of an effect they thought each factor had on each element i.e. no effect / moderate effect / strong effect (figure 6). The results were recorded on a grid and subsequently entered into SPSS. The full course of the sorting experiment is described in appendix III.

Figure 6 Graphical outline of the card sorting experiment



5.2.2. Data analysis

For quantitative analysis the statistics software SPSS 17.0 / 18.0 was used. Data were analysed using non-parametric tests for categorical data. Beyond descriptive statistics to identify the overall ranking of factor groups and specific factors, the Spearman Rank Correlation Test was applied to test on any statistical significant relationship between the main demographics of participants and ordinal responses to the factor vs. element ratings; as well as for detecting clusters of factors which were rated in correlation. The Friedman test was applied to detect statistical significant differences in the ratings of factors and factor groups on the different elements (attention, learning, mood, behaviour).

5.3. Results

The present study took place from January until February 2009. 47 interviews were conducted with parents. Two data sets had to be excluded from analysis due to incomplete grids (P55, P87). Thus, a total of 45 interviews were included in the analysis.

Table 8 Characteristics of participants in Germany

		Parents n=45	
		n	%
Age group (years of age)	under 30	1	2,2
	30-39	15	33,3
	over 40	29	64,4
Highest level of education completed	none	0	0
	Primary school	0	0
	secondary school age 15/16 (Hauptschulabschluss HS)	3	6,7
	secondary school age 16/17 (mittlere Reife und/oder HS + Lehre)	5	11,1
	college (alle Abschlüsse zwischen mittlere Reife + Lehre und Universitätsabschluss)	20	44,4
	university (Universitätsabschluss)	17	37,8
In paid employment	YES	38	84,4
	NO	7	15,6
Number of children	1	15	33,3
	2	22	48,9
	3	7	15,6
	4	1	2,2
National language as the first language	YES	35	77,8
	NO	10	22,2
Participant relationship to child(ren) at school	mother	40	88,9
	father	5	11,1
Responsible for choosing food served at home	YES	41	91,1
	NO	4	8,9

Highest ranked factors across all elements

As previously described, the ranking comprised three levels from 0 (no effect), 1 (moderate effect) to 2 (strong effect).

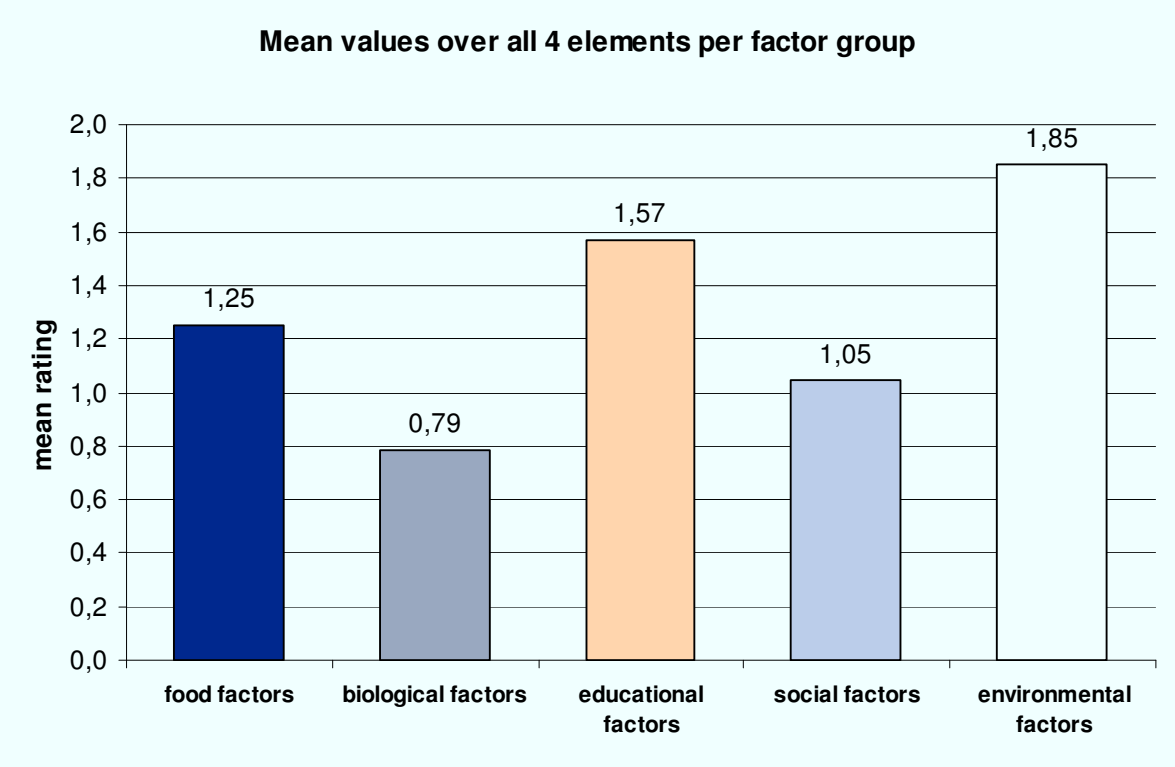
Parents rated the factor "amount of sleep / tiredness" as having the highest effect on all mental elements (Attention, Learning, Mood, Behaviour) with an mean value of 1,92. This factor was followed by the psychological factors "Mood" and "Behaviour" with a mean value of 1,85 and 1,83. The factor "amount of exercise / physical activity" and "stimulation at home" were rated on position four and five (rating of all factors see table 9). The biological factor "birth weight" received the lowest scoring for all elements.

Table 9 Ranking of each of the 18 factors across all mental elements

18 factors across all 4 elements	Mean
Amount of sleep / tiredness	1,9175
Mood	1,8500
Behaviour	1,8267
Amount of exercise / physical activity	1,7900
Stimulation at home	1,7175
Quality of teaching	1,6900
Eating regular meals	1,6200
School discipline	1,5475
Class size	1,4500
What a child eats now	1,2900
Food at school (lunches, snacks)	1,2900
Genetic /inherited factors	1,1725
Parents' education	1,0450
Intelligence child is born with	,9750
Birth order/ family size	,8050
Nutrition as a baby or infant	,7975
Household income	,6150
Birth weight	,2175

Analysing the ranking on a factor group level, environmental factors received the highest scores in ranking across all 4 elements (attention, learning, mood and behaviour) with a mean value of 1,85 – followed by educational factors (mean = 1,57) and the food factors as the third highest ranked group (mean = 1,25). Biological factors were ranked lowest with a mean of 0,79 (figure 7).

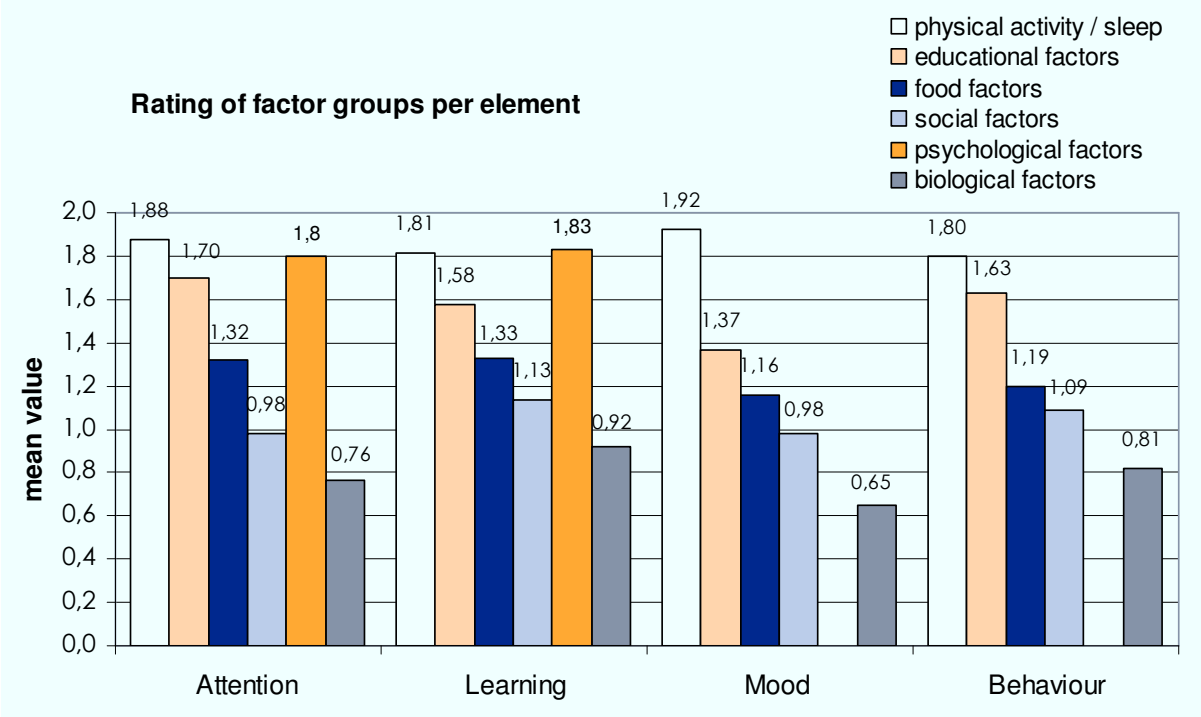
Figure 7 Ranking of each factor group across all elements



5.3.1. Factor ranking for the mental elements Attention, Learning, Mood and Behaviour

When looking at the rating of factor groups in each element, it shows that the environmental factors have the highest effect on the element mood (mean= 1,92) but with a significant difference to the rating for the 3 other elements (Friedman test p= 0,039). Educational factors were rated highest for the element attention (mean 1,70) showing also a significant difference in the distribution of the rating to the other elements (p=0,000). Food factors received the highest ranking for the element attention and learning (mean values 1,32; 1,33; detailed analysis of food factors see 5.3.2).

Figure 8 Rating of factor groups for each mental element



Correlation of the rating to socio-demographic factors

Analysing the rating of the factor groups per element regarding the main socio-demographic factors, the only significant correlation was found for the age group of parents correlating with the rating of biological (p=0,005), educational (p=0,033) and psychological factors (p=0,004) on the element “attention” (all positive correlation coefficients).

For the element “learning”, only the ranking of the psychological factors “mood” and “behaviour” significantly correlated with a positive correlation coefficient to the age group (p= 0,034) and the number of children (p= 0,009) of parents. No significant correlation was found for any of the main socio-demographic factors and the rating for the element “mood”. In contrast, the rating of the biological factors for the element behaviour showed dependency on the age group of parents (p=0,049; overview all correlations see table 10).

Table 10 significant correlations of the factor group rating per element to the main socio-demographic factors (age group, educational level and number of children), Spearman Rank Correlation Test

Element	Socio-demographic factor	Correlation to factor group	p	Correlation coefficient (Spearman)
Attention	Age group	biological	0,005	0,041
		educational	0,033	0,319
		psychological	0,004	0,418
Learning	Age group	psychological	0,034	0,318
	Number of children	psychological	0,009	0,386
Behaviour	Age group	biological	0,049	0,295

Ranking for the element "Attention"

Environmental factors were ranked with the highest mean score for attention (mean = 1,88), followed by the psychological factors (mean= 1,80) and the educational factor group (mean = 1,70). Food factors were rated with a mean of 1,32. Social factors received higher scoring than biological factors (mean 0,98 versus 0,76) (see figure 8).

Parents seem to perceive the factor "amount of sleep / tiredness" as having the most impact on a child's attention (mean=1,96). "Mood" was rated secondly important as an influencing factor (mean=1,82) equally followed by the "quality of teaching" and "amount of exercise / physical activity" (means=1,80; see table 11). Fifth most importantly ranked was the factor "behaviour". The factor "birth weight" was rated with the lowest value (0,29).

Table 11 Mean values of the rating of single factors for the element "Attention" (n=45)

Factor	Mean	Factor	Mean
Amount of sleep / tiredness	1,96	Food at school (lunches, snacks)	1,40
Mood	1,82	What a child eats now	1,31
Quality of teaching	1,80	Genetic /inherited factors	1,04
Amount of exercise / physical activity	1,80	Parents' education	1,00
Behaviour	1,78	Intelligence child is born with	,96
Stimulation at home	1,71	Nutrition as a baby or infant	,84
Eating regular meals	1,71	Birth order/ family size	,80
Class size	1,64	Household income	,40
School discipline	1,64	Birth weight	,29

The Spearman ranked correlation test resulted in a number of significant correlations between pairs of single factors which all showed positive correlation coefficients > 0,3. The factors "amount of sleep/ tiredness" and "amount of exercise /physical activity" were the only factors which were rated independently from all other factors (no significant correlations to other factors). Strong correlations (correlation coefficient >0,5) were found for the factor "class size" and "quality of teaching", "nutrition as a baby or infant" versus "parents' education", "family size / birth order" versus "parents' education" and "regularity of meals" versus "what a child eats now" (see table 12).

Table 12 Rating of factors on the element "Attention" - significant correlations between single factors (Spearman Rank Correlation Test)

Factor	Significant correlation to factor	p < 0,05	Correlation coefficient > 0,3
class size	quality of teaching	0,000	0,557
nutrition as a baby or infant	parents' education	0,000	0,541
family size / birth order	parents' education	0,000	0,506
regularity of meals	what a child eats now	0,000	0,503
genetics	intelligence born with	0,002	0,454
behaviour	mood	0,002	0,450
quality of teaching	stimulation at home	0,003	0,434
household income	parents' education	0,004	0,420
family size / birth order	nutrition as a baby or infant	0,005	0,408
behaviour	school discipline	0,009	0,385
genetics	mood	0,010	0,379
family size / birth order	what a child eats now	0,016	0,357
behaviour	genetics	0,017	0,353
household income	nutrition as a baby or infant	0,018	0,351
food at school	school discipline	0,024	0,336
intelligence born with	stimulation at home	0,027	0,330
birth weight	what a child eats now	0,029	0,325
birth weight	nutrition as a baby or infant	0,039	0,308
intelligence born with	quality of teaching	0,042	0,305
household income	intelligence born with	0,042	0,304
class size	intelligence born with	0,043	0,303
regularity of meals	school discipline	0,047	0,298

When looking at the three main demographic factors (age group, educational level and number of children), the only strong correlation (correlation coefficient >0,5) was found for "age group" and the rating of the factor "mood" as an influence on the element attention.

This means that the older the parent, the stronger he or she rated the influence of mood on attention (see table 13).

Table 13 Rating of factors on the element "Attention" - significant correlations to main socio-demographic factors (Spearman Rank Correlation Test)

Socio-demographic factor	Correlation to factor	p	Correlation coefficient (Spearman)
Number of children	Amount of exercise / physical activity	0,043	0,303
Age group	Behaviour	0,048	0,296
	Class size	0,045	0,300
	Genetic /inherited factors	0,020	0,347
	Mood	0,000	0,526
	Quality of teaching	0,040	0,308

Ranking for the element "Learning"

As well as for the element "Attention", the factor "amount of sleep/tiredness" was ranked as having the highest impact on learning (mean=1,89). The factor "stimulation at home was considered to be secondly important with a mean ranking of 1,87 followed by the psychological factors "behaviour" and "mood" (means 1,84 and 1,82). The factor "amount of exercise / physical activity" was ranked on position five with a mean value of 1,73.

Table 14 Mean values of the rating of single factors for the element "Learning" (n=45)

Factor	Mean	Factor	Mean
Amount of sleep / tiredness	1,89	Food at school (lunches, snacks)	1,47
Stimulation at home	1,87	What a child eats now	1,36
Behaviour	1,84	Parents' education	1,31
Mood	1,82	Intelligence child is born with	1,31
Amount of exercise / physical activity	1,73	Genetic /inherited factors	1,27
Quality of teaching	1,69	Nutrition as a baby or infant	,84
Eating regular meals	1,64	Birth order/ family size	,76
School discipline	1,56	Household income	,60
Class size	1,49	Birth weight	,18

Analysing for correlations between single factors concerning the rating for the element learning, only one strong correlation was found between the factors "genetics" and "intelligence child is born with" (correlation coefficient >0,5) (see table 15).

Table 15 Rating of factors on the element "Learning" - significant correlations between single factors (Spearman Rank Correlation Test)

Factor	Significant correlation to factor	p < 0,05	Correlation coefficient > 0,3
genetics	intelligence child is born with	0,000	0,556
food at school	school discipline	0,001	0,486
class size	quality of teaching	0,002	0,453*
class size	school discipline	0,003	0,439
amount of exercise / physical activity	mood	0,003	0,428
regularity of meals	food at school	0,004	0,421
regularity of meals	what a child eats now	0,014	0,366
food at school	nutrition as a baby or infant	0,016	0,356
mood	what a child eats now	0,019	0,347
nutrition as a baby or infant	family size / birth order	0,022	0,340
household income	parents' education	0,023	0,338
amount of exercise / physical activity	what a child eats now	0,024	0,337
food at school	what a child eats now	0,028	0,328
amount of exercise / physical activity	regularity of meals	0,035	0,316
birth weight	what a child eats now	0,037	0,312

Analysing for correlations between demographic factors and the rating of the element learning, there was no strong correlation found. The Spearman Rank Correlation Test showed week correlation (correlation coefficient >0,3 <0,5) between the number of children and the rating of the factor "mood" as well as between the educational level of a parent and the rating of the factor "household income" (see table 16).

Table 16 Rating for the element "Learning" - significant correlations to main demographic factors (Spearman Rank Correlation Test)

Socio-demographic factor	Correlation to factor	p	correlation coefficient (Spearman)
Number of children	Mood	0,025	0,334
Educational level	Household income	0,017	0,356

Ranking for the element "Mood"

The same as for the elements learning and behaviour, the factor "amount of sleep / tiredness" was rated with highest scores for the element "Mood" (mean value 1,98). The "amount of exercise / physical activity" was considered secondly important with a mean value of 1,87

closely followed by the factor "behaviour". The "quality of teaching" and "stimulation at home" were rated as fourth and fifth important influencing factors on mood (mean values 1,60 and 1,56) (see table 17).

Table 17 Mean values of the rating of single factors for the element "Mood" (n=45)

Factor	Mean	Factor	Mean
Amount of sleep / tiredness	1,98	Food at school (lunches, snacks)	1,13
Amount of exercise / physical activity	1,87	Genetic /inherited factors	1,09
Behaviour	1,86	Household income	,84
Quality of teaching	1,60	Parents' education	,80
Stimulation at home	1,56	Birth order/ family size	,73
Eating regular meals	1,53	Nutrition as a baby or infant	,67
School discipline	1,33	Intelligence child is born with	,67
What a child eats now	1,31	Birth weight	,20
Class size	1,18		

The strongest correlation between factors was found for "family size / birth order" and "household income" (correlation coefficient = 0,556). The factors "food at school" and "nutrition as a baby or infant" also strongly correlate. The stronger parents rated "food at school" as an influencing factor on mood, the higher "nutrition as a baby or infant" was rated. Three other factor pairs also strongly correlate: "family size / birth order" and "parents' education", "parents' education" and "school discipline" as well as "quality of teaching" and "stimulation at home" (see table 18).

Table 18 Rating of factors on the element "Mood" - significant correlations between single factors (Spearman Rank Correlation Test)

Factor	Significant correlation to factor	p < 0,05	Correlation coefficient > 0,3
family size / birth order	household income	0,000	0,556
food at school	nutrition as a baby or infant	0,000	0,542
family size / birth order	parents' education	0,000	0,534
parents education	school discipline	0,000	0,531
quality of teaching	stimulation at home	0,000	0,506
class size	quality of teaching	0,001	0,487
food at school	what a child eats now	0,001	0,482
household income	parents' education	0,001	0,479
regularity of meals	food at school	0,002	0,459

regularity of meals	what a child eats now	0,002	0,452
food at school	school discipline	0,002	0,450
nutrition as a baby or infant	what a child eats now	0,002	0,447
family size / birth order	school discipline	0,002	0,443
birth weight	school discipline	0,002	0,441
family size / birth order	stimulation at home	0,003	0,434
class size	school discipline	0,003	0,433
parents education	quality of teaching	0,004	0,419
regularity of meals	nutrition as a baby or infant	0,005	0,410
quality of teaching	school discipline	0,005	0,410
nutrition as a baby or infant	school discipline	0,005	0,409
class size	parents' education	0,006	0,402
class size	nutrition as a baby or infant	0,010	0,381
genetics	intelligence child is born with	0,012	0,373
class size	family size / birth order	0,012	0,370
birth weight	nutrition as a baby or infant	0,013	0,367
regularity of meals	school discipline	0,015	0,361
family size / birth order	intelligence child is born with	0,016	0,356
class size	stimulation at home	0,017	0,354
nutrition as a baby or infant	parents' education	0,019	0,348
school discipline	stimulation at home	0,027	0,330
birth weight	foode at school	0,029	0,325
birth weight	parents' education	0,030	0,324
household income	school discipline	0,040	0,308
household income	quality of teaching	0,041	0,306
regularity of meals	household income	0,043	0,303
amount of exercise / physical activity	regularity of meals	0,043	0,302
amount of exercise / physical activity	what a child eats now	0,044	0,302

No significant correlation was found between any of the demographic factors (age group, educational level and number of children) and the rating for the element mood.

Ranking for the element “Behaviour”

Parents rated the factor “mood” as having the strongest effect on a child’s behaviour (mean value=1,91). The factor “amount of sleep / tiredness” was rated secondly important with a mean value of 1,84 followed by the factor “amount of exercise / physical activity” (mean value= 1,76). “Stimulation at home” and “quality of teaching” were rated with mean values of 1,73 and 1,67 (see table 19).

Table 19 Mean values of the rating of single factors for the element "Behaviour" (n=45)

Factor	Mean	Factor	Mean
Mood	1,91	What a child eats now	1,18
Amount of sleep / tiredness	1,84	Food at school (lunches, snacks)	1,16
Amount of exercise / physical activity	1,76	Parents' education	1,07
Stimulation at home	1,73	Intelligence child is born with	,96
Quality of teaching	1,67	Birth order/ family size	,93
School discipline	1,66	Nutrition as a baby or infant	,84
Eating regular meals	1,60	Household income	,62
Class size	1,49	Birth weight	,20
Genetic /inherited factors	1,29		

Looking at the rated effect on the element behaviour, there were five strong correlations identified between factors – "nutrition as a baby or infant" and "what a child eats now" showing the strongest correlation with a correlation coefficient of 0,702 (see table 20). The stronger parents rated "nutrition as a baby or infant", the stronger they rated the effect of "what a child eats now" on a child's behaviour.

The other four factor pairs showing a strong correlation were "family size / birth order" and "parents' education", "food at school" and "what a child eats now", "household income" and "parents' education" as well as "regularity of meals" and "food at school".

Table 20 Rating of factors for the element "Behaviour" - significant correlations between single factors (Spearman Rank Correlation Test)

Factor	Significant correlation to factor	p < 0,05	Correlation coefficient > 0,3
nutrition as a baby or infant	what a child eats now	0,000	0,702
family size / birth order	parents' education	0,000	0,655
food at school	what a child eats now	0,000	0,557
household income	parents' education	0,000	0,553
regularity of meals	food at school	0,000	0,524
regularity of meals	what a child eats now	0,001	0,484
food at school	nutrition as a baby or infant	0,002	0,457
mood	stimulation at home	0,047	0,428
genetics	intelligence child is born with	0,005	0,410
household income	intelligence child is born with	0,005	0,410
genetics	quality of teaching	0,005	0,408
class size	quality of teaching	0,006	0,402
amount of exercise / physical activity	what a child eats now	0,007	0,394

household income	nutrition as a baby or infant	0,016	0,359
intelligence child is born with	parents' education	0,017	0,354
regularity of meals	nutrition as a baby or infant	0,018	0,352
amount of exercise / physical activity	amount of sleep	0,020	0,346
parents' education	stimulation at home	0,020	0,345
intelligence child is born with	stimulation at home	0,021	0,342
birth weight	what a child eats now	0,023	0,338
family size / birth order	household income	0,024	0,337
birth weight	food at school	0,032	0,320
amount of exercise / physical activity	regularity of meals	0,037	0,312
family size / birth order	intelligence child is born with	0,040	0,308
birth weight	genetics	0,046	0,299

The only correlation to demographic variables was found between the influencing factor “mood” on the element behaviour depending on the age group of the participant (p= 0,30; correlation coefficient 0,463).

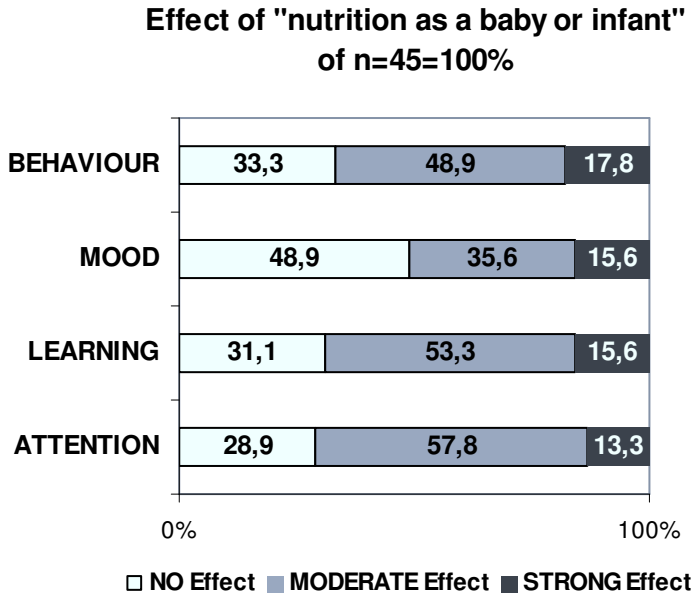
5.3.2. Ranking of the food factors

The rating of the four food factors (nutrition as a baby and infant, what a child eats now, eating regular meals and food at school) was analysed in more details across all four mental elements (attention, learning, mood and behaviour).

Factor "Nutrition as a baby or infant"

The majority of parents (> 68 %) rated the factor "nutrition as a baby or infant" as having a moderate or strong effect on learning and attention. This number was lowest for the element mood where 48,9% considered this factor to have no effect (see figure 9). The Friedman test which tests for significant differences in the distribution of the rating, revealed no significant difference (p= 0,168). This shows that the factor nutrition as a baby or infant was not rated significantly different for each of the four elements.

Figure 9 Percentage of parents rating the factor "nutrition as a baby or infant" with no, moderate or strong effect on each mental element

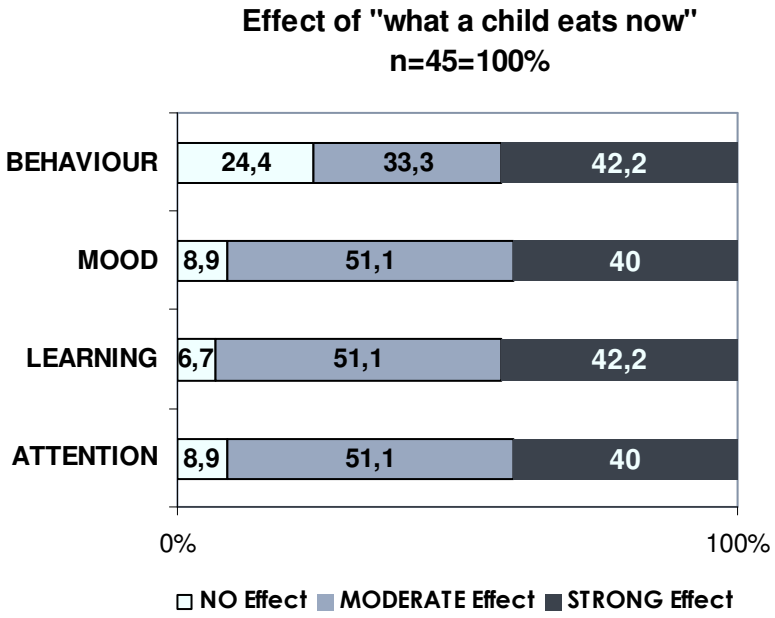


Factor "what a child eats now"

The factor "what a child eats now" was considered to have a moderate or strong effect on attention, learning and behaviour by the majority of parents (> 68 %). Noticeably, the number of parents rating this factor with a strong effect was higher than for the factor "nutrition as a baby or infant" (40 % vs. < 18 %). The proportion of parents believing that "what a child eats now" has no effect was about equally low for attention, learning and mood (< 9 %) while 24,4% were the opinion, that this factor has no effect on behaviour (see figure 10).

The Friedman test showed no statistically significant difference in the distribution of the rating of this factor accross all four elements (p=0,382). Thus, it can be concluded that parents rated this factor the same for all elements.

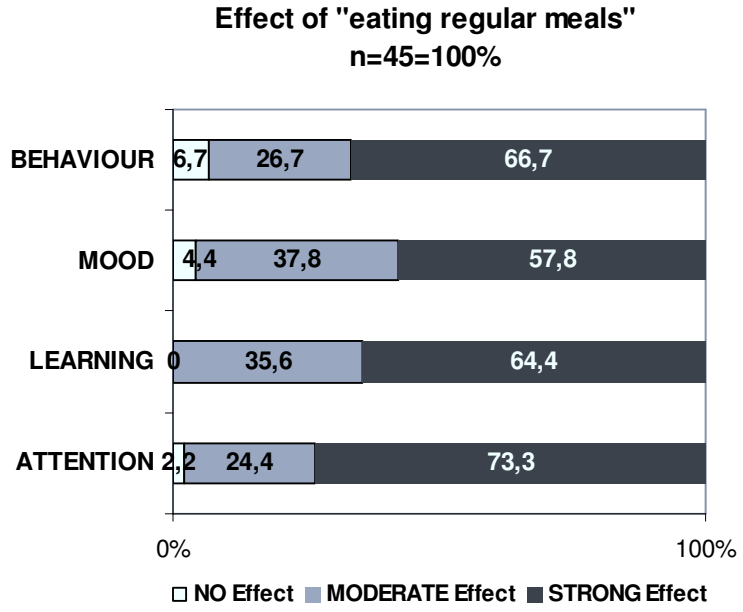
Figure 10 Percentage of parents rating the factor "what a child eats now" with no, moderate or strong effect on each mental element



Factor "eating regular meals"

Out of all food factors, the factor "eating regular meals" was considered to have the highest effect on all 4 elements. More than 93% of the parents believe that eating regular meals has a moderate or even strong effect on learning, attention, mood and behaviour (see figure 11). The Friedman test showed no significant difference in the distribution of the rating among those four elements (P=0,200).

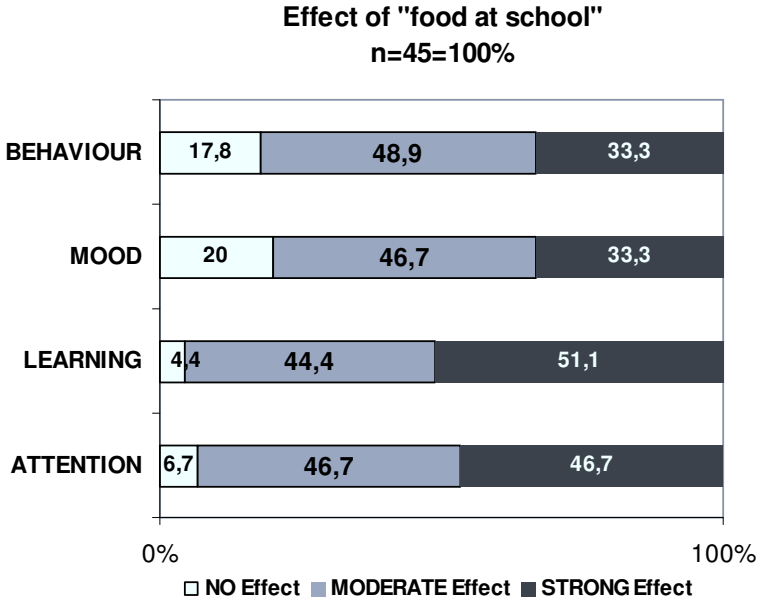
Figure 11 Percentage of parents rating the factor "eating regular meals" with no, moderate or strong effect on each mental element



Factor "food at school"

The fourth food factor included in the card sorting experiment was "food at school". It is obvious that parents distinguish between the effect on attention & learning on the one hand and mood & behaviour on the other hand. Food at school is believed to have more effect on attention and learning (< 94%) as on mood and behaviour (< 80%) (figure 12).

Figure 12 Percentage of parents rating the factor "food at school" with no, moderate or strong effect on each mental element



Testing for the distribution of the rating (Friedman test), it shows that there is a statistical significant difference between the rating of those two element pairs (attention & learning vs. mood & behaviour) with a p- value of 0,000. The Wilcoxon matched pairs test showed significant differences between the rating of those two element pairs attention & learning vs. mood & behaviour (see table 21). With p values > 0,05 no significant differences were found within those 2 element groups which means that the factor "food at school" was not rated differently for attention compared to learning (p= 0,366) and mood compared to behaviour (p=0,796) by parents.

Table 21 Significant differences between the rating of the two element groups (Attention & Learning, Mood & Behaviour); Wilcoxon matched pairs test for the factor "food at school"

	p value
attention vs behaviour	0,005
attention vs. mood	0,011
learning vs. behaviour	0,003
learning vs mood	0,004

Correlation of the food factor rating to main demographic factors

There was no significant correlation found between the rating of food factors on either of the mental elements and demographic factors (age group, educational level, number of children; test for Spearman Rank Correlation).

When testing for dependency of the food factor rating (exact test of Fisher) on those three demographic factors, there was no significant dependency found either (all p > 0,05).

5.4. Discussion

The results of the card sorting experiment show that parents consider nutritional factors to have an effect on attention and learning in children while environmental, psychological and educational factors are seen to have stronger effects. The rating of psychological factors was strongly correlated to the parent's age, either for attention (p=0,004) or learning (p= 0,034) which indicates that the older the parent, the higher the effects of mood and behaviour were rated on attention and learning.

The rating of factors on attention and learning showed the same tendencies: environmental factors such as amount of sleep/ level of tiredness, amount of exercise/physical activity as well as mood and behaviour were considered to have the strongest effects. A number of research articles have reported on the prevalence of suboptimal sleep in school-aged children and the association of quantity and quality of sleep with measures of cognitive ability and school performance (Taras & Potts-Datema, 2005), indicating the importance of sleep on academic performance in children. Experimental conditions of sleep deprivation and restriction appear to impair neuropsychological performance related to higher-level cognitive functions and attention. This is supported by observational studies which have found a disorder or lack of sleep in children to be detrimental to cognitive functions and outcomes such as memory, attention, or increased problematic behaviour (Taras & Potts-Datema, 2005). Thus, there is scientific evidence for parents and educators to assume that poor sleep might contribute to a child's difficulties in attention or learning.

Research has also shown that physical activity increases blood flow to the brain, improves general circulation as well as leading to increased levels of norepinephrine and endorphins – factors that may improve mood, reduce stress and induce a calming effect after exercise, which might perhaps result in improved achievement (Taras, 2005b). Findings of the present study show a high appreciation of this relation among parents. Since students spend most of their time at school, regular and daily physical activity would need to be promoted in schools, where despite some programmes, physical education has not been adequately implemented in school life yet (Brandt, Moss, Berg, & Wabitsch, 2010).

Regarding the rating of the food factors, nutrition as a baby or infant, which implies a long term effect of nutrition on later attention and learning abilities, is rated less important than nutritional factors of short term implication such as what a child eats now or regularity of meals. About one third of parents rate early nutrition as having no effect on attention or

learning (28,9%; 31,1%) while this number was significantly lower for the short term food factors what a child eats now (8,9-6,7%) and eating regular meals (0%; 2,2%).

Moreover, the factor regularity of meals is believed by most parents to have the strongest effect on attention (mean 1,71; 73% of parents rated strong effect) or learning (mean 1,64; 64,4 % of parents rated strong effect) compared to the other food factors. Interestingly, the rating of the factor nutrition as a baby or infant positively correlated to the rating of the factor parents' education for the element attention only (correlation coefficient 0,54). This shows that parents who think that early nutrition has an effect on attention also think that the level of parental education influences this mental ability.

However, none of the food factor ratings on attention and learning revealed a significant correlation to any of the tracked demographic factors of participants. The findings of the present study indicate that the current nutrition of a child is perceived to be more important for attention and learning than nutrition early in life. Taking into account the importance of early nutrition for cognitive outcomes later in life as shown by research in this field (Associate Parliamentary & Health, 2008; Morley, 1998), parental perceptions do not adequately reflect the potential long term effects of nutrition on mental abilities such as attention and learning. This is consistent with findings from a study by Gage et al 2010 which showed that first time mothers rate diet as a baby less important for later health outcomes than diet in childhood/adolescence or adulthood (Gage et al., 2011). Thus, improved knowledge of the potential future impact and underlying mechanisms of early nutritional factors on mental outcomes may help to increase the likelihood of parents to adopt mental performance promoting eating habits.

As to the mental outcomes mood and behaviour, the same rating profile of factor groups as for the outcomes attention and learning was detected. Environmental factors such as sleep and tiredness as well as physical activity were considered to have strongest effects on mood or behaviour (mean values 1,92 and 1,80). Consistent with the rating of the food factors on the elements attention and learning, the long term factor nutrition as a baby or infant was considered to have least effect on mood and behaviour (mean values 0,67 and 0,84) among all four food factors. The short term nutritional factors were considered to have a stronger influence on mood (mean value of 1,16) and behaviour (mean value of 1,19) while mean values were slightly lower compared to the elements attention and concentration.

Eating regular meals was believed by 93% of parents to have the strongest effect on all mental elements while fewer parents (68%) believed that what a child eats now influences those mental outcomes. As shown by research in the field, a regular and steady supply of

food ensures less fluctuation in blood sugar levels which has been observed to ensure mental state and performance during school day (Benton & Parker, 1998; Hoyland et al., 2008; Mahoney et al., 2005). In the context of every day school life, school meal programmes should thus be taking into account to supply food on a regular basis and to promote regular eating habits among children. Results of the study also show that nutritional communication to parents would have to emphasise the importance of having the right foods for their children's regular meals.

However, though rigorously conducted, findings of the present study have to be interpreted with caution. Since participants volunteered for the study, the sample may not be representative of the community of parents in terms of knowledge, awareness or other values as well as socio-demographics. The absence of correlation of the food factor ratings to demographic variables might be due to the selective nature of the sample. However, the results do not claim to reflect an exhaustive census, but they are useful for revealing meaningful perceptions within a well defined group of parents. Further research would need to aim for the inclusion of parents from various socioeconomic backgrounds to detect possible differences in perceptions correlated to socioeconomic status and to design target group specific nutritional communication and intervention programmes to improve mental state and performance in school aged children.

5.5. Conclusions

In summary, nutrition is believed to have an moderate influence on mental outcomes such as attention, learning, mood and behaviour by parents (mean value 1,25) while parents consider environmental, psychological and educational factors to be more relevant. However, parents perceive nutrition to have a greater influence on mental outcomes than social or biological factors. Findings of this study deliver evidence, that parents recognize the effects of nutrition on mental state and performance but do rate them as having a moderate effect only. Moreover, findings of this study show a lack of perception by parents regarding potential long term effects of early nutrition on mental outcomes.

Nutritional communication and intervention to promote mental state and performance in school aged children should thus consider highlighting the role of early nutrition on later mental outcomes in particular while trying to increase awareness of healthy eating habits and their implication for mental outcomes and academic achievement of young children.

6. SUMMARY (English)

The aim of the dissertation was to identify current attitudes, beliefs and perceptions of parents about the relationship between nutrition and mental performance in young children.

Exploratory interviews with parents detected a wide gap between perceived effects of diet on mental performance by parents and the spectrum of detected nutritional influences on different cognitive modalities in the scientific area. Positive relations are seen on a general level: a healthy balanced diet is associated with the feeling of wellbeing, mental fitness and performance from a mid and long term perspective. In contrast, parents perceive specific foods and nutrients as having rather negative and short term effects on mental outcomes such as attention, concentration, mood and behaviour. Nutrition communication and intervention would have to take into account this lack of perception when trying to transliterate scientific findings about the relation of nutrition and mental performance in children.

As to parents' understanding and perception of the term mental performance, findings of the present work suggest that the reported definitions of mental performance might differ between countries and may be associated with socioeconomic status and cultural background. Parents predominantly express their understanding of mental performance using general terms which do not represent any specific cognitive category. Fewer parents understand mental performance by either attention & concentration, learning & memory or executive functions which is consistent with the classification in cognitive sciences. Findings of the present work suggest that nutritional information about the effects of foods on general mental performance outcomes (e.g. intelligence or academic performance), attention and concentration as well as learning and memory, are most likely to encounter parents' awareness and understanding.

The present work also indicates that parents perceive nutrition to have a greater influence on mental state and performance than social or biological factors. However, parents consider environmental, psychological and educational factors to be more relevant. Findings of this work deliver evidence, that parents recognize the effects of nutrition on mental state and performance but do rate them as having a moderate effect only. Moreover, it has been shown that parents poorly perceive potential long term effects of early nutrition on mental outcomes.

Nutritional communication and intervention programmes to promote mental state and performance in school aged children should thus consider highlighting the role of early nutrition on later mental outcomes in particular while trying to increase awareness of healthy eating habits and their implication for mental outcomes and academic achievement of young children.

7. SUMMARY (German)

Ziel dieser Arbeit war es, aktuelle Sichtweisen und Überzeugungen von Eltern zu dem Zusammenhang von Ernährung und geistiger Leistungsfähigkeit bei Kindern im Alter von vier bis zehn Jahren zu erfassen.

Explorative Befragungen von Eltern ergaben eine weite Abweichung der wahrgenommenen Effekte von Ernährung auf geistige Leistungsfähigkeit im Vergleich zu wissenschaftlich untersuchten, potentiellen Einflüssen von Nahrung auf kognitive Funktionen. Positive Effekte von Nahrung auf den mentalen Zustand bei Kindern werden von Eltern hauptsächlich allgemein wahrgenommen. Eine gesunde, ausgewogene Ernährung wird dabei mit Wohlbefinden, geistiger Fitness und Leistung auf mittelfristige oder langfristige Sicht in Verbindung gebracht. Im Gegensatz dazu werden bestimmte Nahrungsmittel und Nährstoffe hauptsächlich mit negativen und kurzfristigen Einflüssen auf mentale Parameter wie Aufmerksamkeit, Konzentration, Stimmung und Verhalten wahrgenommen. Kommunikation und Umsetzung in Form von Interventionsprogrammen basierend auf neuen wissenschaftlichen Erkenntnissen in diesem Bereich sollte diesem Stand an vorherrschenden Überzeugungen entsprechend Rechnung tragen.

Ergebnisse der vorliegenden Arbeit zeigen zudem, dass der Begriff geistige Leistungsfähigkeit von Eltern in verschiedenen Ländern unterschiedlich definiert wird und ein möglicher Zusammenhang zu sozioökonomischen und kulturellen Faktoren besteht. Eltern verwenden bei der Definition von geistiger Leistungsfähigkeit größtenteils allgemeine Ausdrücke, die keiner spezifischen kognitiven Funktion entsprechen. Ein geringerer Teil der Eltern beschreibt geistige Leistungsfähigkeit bei Kindern als die Fähigkeit zur Aufmerksamkeit und Konzentration, Lernen und Gedächtnis oder exekutiven Funktionen - eine Differenzierung, die der wissenschaftlichen Klassifizierung kognitiver Modalitäten grundlegend entspricht. Ergebnisse dieser Arbeit geben Hinweis darauf, dass Informationen über die Auswirkungen von Ernährung auf allgemeine mentale Parameter (wie Intelligenz oder schulische Leistung), Aufmerksamkeit und Konzentration sowie Lernen und Gedächtnis, eine entsprechende Wahrnehmung und Aufnahme bei Eltern erreichen.

Die vorliegende Arbeit zeigt zudem, dass Eltern dem Faktor Ernährung einen größeren Einfluss auf mentalen Zustand und Leistung bei Kindern beimessen, als sozialen oder biologischen Faktoren. Allerdings wird der Einfluss von umweltbezogenen, psychologischen

und schulischen Faktoren höher bewertet. Darüber hinaus liefern Ergebnisse dieser Arbeit erste Belege, dass Eltern den langfristigen Einfluss von frühkindlicher Ernährung auf die geistige Leistungsfähigkeit als gering ansehen.

Ernährungsbezogene Kommunikation und Intervention sollte die Bedeutung frühkindlicher Ernährung, förderlicher Nahrungsmittel und gesunder Ernährungsweisen in den Vordergrund stellen um somit an der Schnittstelle zwischen Forschung und Praxistransfer in den Alltag zur Förderung von geistigem Wohlbefinden und mentaler Leistungsfähigkeit bei Kindern beizutragen.

REFERENCES

Alderman, H., Behrman, J. R., Lavy, V., & Menon, R. (1997). Child Nutrition, Child Health, and School Enrollment: A Longitudinal Analysis. *SSRN eLibrary*.

Ardila, A., Rosselli, W., Matute, E., & Guajardo, S. (2005). The influence of the parents' educational level on the development of executive functions. *Developmental Neuropsychology, 28*(1), 539-560.

Associate Parliamentary, F., & Health, F. (2008). *The Links Between Diet and Behaviour: The influence of nutrition on mental health*

Bellisle, F. (2004). Effects of diet on behaviour and cognition in children. *Br J Nutr, 92 Suppl 2*, S227-S232.

Bellisle, F., Blundell, J. E., Dye, L., Fantino, M., Fern, E., Fletcher, R. J., et al. (1998). Functional food science and behaviour and psychological functions. *Br J Nutr, 80 Suppl 1*, S173-S193.

Belsky, J., Booth-LaForce, C. L., Bradley, R., Brownell, C. A., Campbell, S. B., Clarke-Stewart, K. A., et al. (2004). Does class size in first grade relate to children's academic and social performance or observed classroom processes? *Developmental Psychology, 40*(5), 651-664.

Benton, D. (2008a). The influence of children's diet on their cognition and behavior. *Eur.J.Nutr., 47 Suppl 3*, 25-37.

Benton, D. (2008b). The influence of children's diet on their cognition and behavior. *European Journal of Nutrition, 47*, 25-37.

Benton, D., & Jarvis, M. (2007). The role of breakfast and a mid-morning snack on the ability of children to concentrate at school. *Physiol Behav, 90*(2-3), 382-385.

Benton, D., Maconie, A., & Williams, C. (2007). The influence of the glycaemic load of breakfast on the behaviour of children in school. *Physiology & Behavior, 92*(4), 717-724.

Benton, D., & Parker, P. Y. (1998). Breakfast, blood glucose, and cognition. *Am J Clin Nutr, 67*(4), 772S-778S.

Bhutta, Z. A., Black, R. E., Brown, K. H., Gardner, J. M., Gore, S., Hidayat, A., et al. (1999). Prevention of diarrhea and pneumonia by zinc supplementation in children in developing countries: pooled analysis of randomized controlled trials. Zinc Investigators' Collaborative Group. *J Pediatr, 135*(6), 689-697.

Birch, L. L., & Davison, K. K. (2001). Family environmental factors influencing the developing behavioral controls of food intake and childhood overweight. *Pediatr.Clin.North Am., 48*(4), 893-907.

Birch, L. L., & Fisher, J. O. (1998). Development of eating behaviors among children and adolescents. *Pediatrics, 101*(3 Pt 2), 539-549.

Bourre, J. M. (2006a). Effects of nutrients (in food) on the structure and function of the nervous system: update on dietary requirements for brain. Part 1: micronutrients. *J Nutr Health Aging, 10*(5), 377-385.

Bourre, J. M. (2006b). Effects of nutrients (in food) on the structure and function of the nervous system: update on dietary requirements for brain. Part 2 : macronutrients. *J Nutr Health Aging, 10*(5), 386-399.

Bradley, R. H., & Corwyn, R. F. (2002). Socioeconomic status and child development. *Annu.Rev.Psychol., 53*, 371-399.

Brandt, S., Moss, A., Berg, S., & Wabitsch, M. School-based obesity prevention. *Bundesgesundheitsblatt-Gesundheitsforschung-Gesundheitsschutz, 53*(2-3), 207-220.

Brandt, S., Moss, A., Berg, S., & Wabitsch, M. (2010). School-based obesity prevention. *Bundesgesundheitsblatt-Gesundheitsforschung-Gesundheitsschutz, 53*(2-3), 207-220.

Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative Research in Psychology, 3*(2), 77-101.

Brown, K. A., Ogden, J., Vogele, C., & Gibson, E. L. (2008). The role of parental control practices in explaining children's diet and BMI. *Appetite, 50*(2-3), 252-259.

Brown, K. H., Peerson, J. M., Rivera, J., & Allen, L. H. (2002). Effect of supplemental zinc on the growth and serum zinc concentrations of prepubertal children: a meta-analysis of randomized controlled trials. *Am J Clin Nutr, 75*(6), 1062-1071.

Brown KH, W. S., Peerson JM. (2001). The importance of zinc in human nutrition and estimation of the global prevalence of zinc deficiency. . *Food Nutr Bull., 22*(2), 113-125.

Brown, R., & Ogden, J. (2004). Children's eating attitudes and behaviour: a study of the modelling and control theories of parental influence. *Health Educ.Res., 19*(3), 261-271.

Bryan, J., Osendarp, S., Hughes, D., Calvaresi, E., Baghurst, K., & van Klinken, J. W. (2004). Nutrients for cognitive development in school-aged children. *Nutr.Rev., 62*(8), 295-306.

Campos, C. J. G., & Turato, E. R. (2009). Content Analysis in Studies Using the Clinical-Qualitative Method: Application and Perspectives. *Revista Latino-Americana De Enfermagem, 17*(2), 259-264.

Chamorro-Premuzic, T., Arteche, A., Furnham, A., & Trickot, N. (2009). Assessing pupils' intelligence through self, parental, and teacher estimates. *Educational Psychology, 29*(1), 83-97.

Coveney, J. (2005). A qualitative study exploring socio-economic differences in parental lay knowledge of food and health: implications for public health nutrition. *Public Health Nutr., 8*(3), 290-297.

Curtis, S., Gesler, W., Smith, G., & Washburn, S. (2000). Approaches to sampling and case selection in qualitative research: examples in the geography of health. *Social Science & Medicine, 50*(7-8), 1001-1014.

Delange, F. (2001). Iodine deficiency as a cause of brain damage. *Postgrad Med J, 77*(906), 217-220.

DGE-Stellungnahme: Vitaminversorgung in Deutschland (2005). DGE Info.

Dye, L., & Blundell, J. (2002). Functional foods: psychological and behavioural functions. *British Journal of Nutrition, 88*, S187-S211.

Ells, L. J., Hillier, F. C., Shucksmith, J., Crawley, H., Harbige, L., Shield, J., et al. (2008). A systematic review of the effect of dietary exposure that could be achieved through

normal dietary intake on learning and performance of school-aged children of relevance to UK schools. *British Journal of Nutrition, 100*(05), 927-936.

Fleith, M., & Clandinin, M. T. (2005). Dietary PUFA for preterm and term infants: review of clinical studies. *Crit Rev Food Sci Nutr, 45*(3), 205-229.

Florence, M. D., Asbridge, M., & Veugelers, P. J. (2008). Diet Quality and Academic Performance*. *Journal of School Health, 78*(4), 209-215.

Gage, H., Raats, M., Williams, P., Egan, B., Jakobik, V., Laitinen, K., et al. (2011). Developmental origins of health and disease: the views of first time mothers in five European countries on the importance of nutritional influences in the first year of life. *Am J Clin Nutr - in press*.

Gibson, E. L., & Green, M. W. (2002). Nutritional influences on cognitive function: mechanisms of susceptibility. *Nutrition Research Reviews, 15*(1), 169-206.

Giraudeau, C., Chasseigne, G., Apter, M. J., & Mullet, E. (2007). Adults' lay views about intelligence: A Reversal theory approach. *Personality and Individual Differences, 42*(1), 169-179.

Golan, M., & Crow, S. (2004). Parents are key players in the prevention and treatment of weight-related problems. *Nutr.Rev., 62*(1), 39-50.

Gomez-Pinilla, F. (2008). Brain foods: the effects of nutrients on brain function. *Nat Rev Neurosci, 9*(7), 568-578.

Graneheim, U. H., & Lundman, B. (2004). Qualitative content analysis in nursing research: concepts, procedures and measures to achieve trustworthiness. *Nurse Education Today, 24*(2), 105-112.

Grantham-McGregor, S. (2005). Can the provision of breakfast benefit school performance? *Food Nutr Bull, 26*(2 Suppl 2), S144-158.

Grantham-McGregor, S. M., Fernald, L., C. , & Sethuraman, K. (1999). Effects of health and nutrition on cognitive and behavioural development in children in the first three years of life. Part 1: Low birthweight, breastfeeding, and protein-energy malnutrition. *Food and Nutrition Bulletin, 20*.

Green, J., Karen, W., Emma, H., Small, R., Welch, N., Lisa, G., et al. (2007). Generating best evidence from qualitative research: the role of data analysis. *Australian and New Zealand Journal of Public Health, 31*(6), 545-550.

Hart, K. H., Herriot, A., Bishop, J. A., & Truby, H. (2003). Promoting healthy diet and exercise patterns amongst primary school children: a qualitative investigation of parental perspectives. *J Hum Nutr Diet, 16*(2), 89-96.

Henderson, J. (2010). Expert and lay knowledge: A sociological perspective. *Nutrition & Dietetics, 67*(1), 4-5.

Hesketh, K., Waters, E., Green, J., Salmon, L., & Williams, J. (2005). Healthy eating, activity and obesity prevention: a qualitative study of parent and child perceptions in Australia. *Health Promot Int, 20*(1), 19-26.

Hoyland, A., Lawton, C. L., & Dye, L. (2008). Acute effects of macronutrient manipulations on cognitive test performance in healthy young adults: A systematic research review. *Neuroscience & Biobehavioral Reviews, 32*(1), 72-85.

Hughes, D., & Bryan, J. (2003). The assessment of cognitive performance in children: considerations for detecting nutritional influences. *Nutr.Rev., 61*(12), 413-422.

ILSI-Europe. (2010). *Beyond PASSCLAIM - Guidance to substantiate health claims on foods*.

Isaacs, E., & Oates, J. (2008). Nutrition and cognition: assessing cognitive abilities in children and young people. *Eur.J.Nutr., 47 Suppl 3*, 4-24.

Kirkcaldy, B., Noack, P., Furnham, A., & Siefen, G. (2007). Parental estimates of their own and their children's intelligence. *European Psychologist, 12*(3), 173-180.

Koletzko, B., Agostoni, C., Carlson, S. E., Clandinin, T., Hornstra, G., Neuringer, M., et al. (2001). Long chain polyunsaturated fatty acids (LC-PUFA) and perinatal development. *Acta Paediatr, 90*(4), 460-464.

Leathwood, P. D., Richardson, D. P., Strater, P., Todd, P. M., & van Trijp, H. C. M. (2007). Consumer understanding of nutrition and health claims: sources of evidence. *British Journal of Nutrition, 98*(3), 474-484.

Lim, W., Plucker, J. A., & Im, K. (2002). We are more alike than we think we are Implicit theories of intelligence with a Korean sample. *Intelligence, 30*(2), 185-208.

Lopez-Dicastillo, O., Grande, G., & Callery, P. (2009). Parents' contrasting views on diet versus activity of children: implications for health promotion and obesity prevention. *Patient Educ Couns, 78*(1), 117-123.

Lozoff, B., & Georgieff, M. K. (2006). Iron Deficiency and Brain Development. *Seminars in Pediatric Neurology, 13*(3), 158-165.

Mahoney, C. R., Taylor, H. A., Kanarek, R. B., & Samuel, P. (2005). Effect of breakfast composition on cognitive processes in elementary school children. *Physiol Behav., 85*(5), 635-645.

Maubach, N., Hoek, J., & McCreanor, T. (2009). An exploration of parents' food purchasing behaviours. *Appetite, 53*(3).

Mendez, M. A., & Adair, L. S. (1999). Severity and timing of stunting in the first two years of life affect performance on cognitive tests in late childhood. *J Nutr, 129*(8), 1555-1562.

Miyake, A., Friedman, N. P., Emerson, M. J., Witzki, A. H., Howerter, A., & Wager, T. D. (2000). The unity and diversity of executive functions and their contributions to complex "frontal lobe" tasks: A latent variable analysis. *Cognitive Psychology, 41*(1), 49-100.

Morley, R. (1998). Nutrition and cognitive development. *Nutrition, 14*(10), 752-754.

Morse, J. M., Mitcham, C., Hupcey, J. E., & Tason, M. C. (1996). Criteria for concept evaluation. *Journal of Advanced Nursing, 24*(2), 385-390.

Muthayya, S., Thomas, T., Srinivasan, K., Rao, K., Kurpad, A. V., van Klinken, J. W., et al. (2007). Consumption of a mid-morning snack improves memory but not attention in school children. *Physiol Behav, 90*(1), 142-150.

Perez-Rodrigo, C., & Aranceta, J. (2001). School-based nutrition education: lessons learned and new perspectives. *Public Health Nutr., 4*(1A), 131-139.

Pollitt, E. (1995). Does breakfast make a difference in school? *J.Am.Diet.Assoc., 95*(10), 1134-1139.

Rampersaud, G. C., Pereira, M. A., Girard, B. L., Adams, J., & Metzl, J. D. (2005). Breakfast habits, nutritional status, body weight, and academic performance in children and adolescents. *J Am Diet Assoc, 105*(5), 743-760; quiz 761-742.

Rugg, G., & McGeorge, P. (1997). The sorting techniques: a tutorial paper on card sorts, picture sorts and item sorts. *Expert Systems, 14*.

Schmitt, J. A., Benton, D., & Kallus, K. W. (2005). General methodological considerations for the assessment of nutritional influences on human cognitive functions. *Eur.J.Nutr., 44*(8), 459-464.

Scott-Jones, D. (1984). Family Influences on Cognitive Development and School Achievement. *Review of Research in Education, 11,* 259-304.

Sherry, B., McDivitt, J., Birch, L. L., Cook, F. H., Sanders, S., Prish, J. L., et al. (2004). Attitudes, practices, and concerns about child feeding and child weight status among socioeconomically diverse white, Hispanic, and African-American mothers. *J.Am.Diet.Assoc., 104*(2), 215-221.

Swami, V., Furnham, A., Maakip, I., Ahmad, M. S., Naw, N. H. M., Voo, P. S. K., et al. (2008). Beliefs about the meaning and measurement of intelligence: A cross-cultural comparison of American, British and Malaysian undergraduates. *Applied Cognitive Psychology, 22*(2), 235-246.

Swinburn, B. A., Jolle, D., Kremer, P. J., Salbe, A. D., & Ravussin, E. (2006). Estimating the effects of energy imbalance on changes in body weight in children. *American Journal of Clinical Nutrition, 83*(4), 859-863.

Synnott, K., Bogue, J., Edwards, C. A., Scott, J. A., Higgins, S., Norin, E., et al. (2007). Parental perceptions of feeding practices in five European countries: an exploratory study. *European Journal of Clinical Nutrition, 61*(8), 946-956.

Szajewska, H., Horvath, A., & Koletzko, B. (2006). Effect of n-3 long-chain polyunsaturated fatty acid supplementation of women with low-risk pregnancies on pregnancy outcomes and growth measures at birth: a meta-analysis of randomized controlled trials. *Am J Clin Nutr, 83*(6), 1337-1344.

Taras, H. (2005a). Nutrition and student performance at school. *J Sch Health, 75*(6), 199-213.

Taras, H. (2005b). Physical activity and student performance at school. *Journal of School Health, 75*(6), 214-218.

Taras, H., & Potts-Datema, W. (2005). Sleep and student performance at school. *Journal of School Health, 75*(7), 248-254.

Taylor, R. M., Gibson, F., & Franck, L. S. (2008). A concept analysis of health-related quality of life in young people with chronic illness. *Journal of Clinical Nursing, 17*(14), 1823-1833.

THE-EUROPEAN-PARLIAMENT, & EUROPEAN-UNION, T.-C.-O.-T. (2007). REGULATION (EC) No 1924/2006 on nutrition and health claims made on foods, *Official Journal of the European Union*.

Thomas, D., Grant, S., & Aubuchon-Endsley, N. (2009). The Role of Iron in Neurocognitive Development. *Developmental Neuropsychology, 34*(2), 196-222.

van Trijp, H. C. M. (2009). Consumer understanding and nutritional communication: key issues in the context of the new EU legislation. *European Journal of Nutrition, 48*, S41-S48.

Van Vuuren, M., & Botes, A. (1999). [Concept analysis of reflective thinking]. *Curationis, 22*(3), 25-35.

Wesnes, K. A., Pincock, C., Richardson, D., Helm, G., & Hails, S. (2003). Breakfast reduces declines in attention and memory over the morning in schoolchildren. *Appetite, 41*(3), 329-331.

Westenhoefer, J., Bellisle, F., Blundell, J. E., de Vries, J., Edwards, D., Kallus, W., et al. (2004). PASSCLAIM 1â€"Mental state and performance. *European Journal of Nutrition, 43*(0), ii85-ii117.

Westenhoefer, J., Bellisle, F., Blundell, J. E., de Vries, J., Edwards, D., Kallus, W., et al. (2004). PASSCLAIM - Mental state and performance. *European Journal of Nutrition, 43*, 85-117.

White, M. D., & Marsh, E. E. (2006). Content analysis: A flexible methodology. *Library Trends, 55*(1), 22-45.

Wilks, R. (1996). Classroom management in primary schools: A review of the literature. *Behaviour Change, 13*(1), 20-32.

Williams, P. (2005). Consumer understanding and use of health claims for foods. *Nutrition Reviews, 63*(7), 256-264.

Williams, P., & Ghosh, D. (2008). Health claims and functional foods. *Nutrition & Dietetics, 65*, S89-S93.

Withall, J., Jago, R., & Cross, J. (2009). Families' and health professionals' perceptions of influences on diet, activity and obesity in a low-income community. *Health Place, 15*(4), 1078-1085.

APPENDIX

I. Appendix to chapter 3: Letter of Invitation, Confirmation, Consent Form and Questionnaire (German)

Forschung über Ernährung und Gesundheit bei Kindern –

Dr. von Haunersches Kinderspital

Teilnahme an Interviews im Rahmen eines EU-Projektes

Liebe Eltern,

Besonders durch zahlreiche Beiträge in den Medien und Projekte an Schulen in vergangener Zeit, ist das Thema Ernährung und Auswirkung auf die Gesundheit und das Wohlbefinden von Kindern zu einem großen Thema geworden.

Die Grundschule XX unterstützt uns Forscher der Universität München an der Dr. von Haunerschen Kinderklinik dabei herauszufinden, was Eltern über den Zusammenhang von Ernährung und Gesundheit von Kindern denken. Diese Arbeit ist Teil eines großen EU-Forschungsprojektes, das auch in den Ländern England, Spanien und Ungarn durchgeführt wird

Wir möchten Sie als Eltern dazu einladen, im Rahmen dieses Projektes an kurzen persönlichen Interviews mit einem unserer Forscher teilzunehmen. Die Interviews werden voraussichtlich im Zeitraum von Mitte Oktober – Dezember 2008 vor Ort in der Grundschule zu Terminen stattfinden, die für die Teilnehmer passend sind. Wir rechnen damit, dass ein Interview zwischen 15-20 Minuten dauern wird.

Wir hoffen sehr, dass wir unter Ihnen circa 20 Eltern für dieses Thema begeistern können, die ein Interview zu Ihren Ansichten und Überzeugungen über die Auswirkungen von Ernährung auf die Gesundheit bei Kindern geben möchten. Jeder Teilnehmer ist außerdem dazu eingeladen, an einer anschließenden Verlosung teilzunehmen. Der 1. Preis ist ein Gutschein im Wert von 50 Euro, der 2. und 3. Preis jeweils ein Gutschein über 25 Euro für die Einlösung bei Hugendubel oder Amazon.de!

Für Ihre Teilnahme wären wir Ihnen sehr dankbar! Wir möchten Sie daher bitten, bei Interesse an einem Interview den beiliegenden Fragebogen auszufüllen und diesen bis zum **XX** in der Schule Ihres Kindes abzugeben. Wir werden Sie anschließend kontaktieren um Ihnen weitere Information zukommen zu lassen und um einen passenden Termin für ein Interview vor Ort in Ihrer Schule zu vereinbaren. Falls Sie Fragen oder Anregungen haben rufen Sie uns einfach an oder schreiben Sie uns!

Vielen herzlichen Dank im Voraus für Ihre Unterstützung!

Mit freundlichen Grüßen

Brigitte Anton, Dipl. Biol. MBE – wissenschaftliche Mitarbeiterin
Dr. von Haunersches Kinderspital
Abteilung Stoffwechselkrankheiten und Ernährungsmedizin
Lindwurmstraße 4
80337 München
Tel: 089 / 5160 2816 Fax: 089 / 5160 4938
Email: Brigitte.Anton@med.uni-muenchen.de

Wichtiger Hinweis: Alle erhobenen Daten werden mit strengster Vertraulichkeit behandelt. Diese Studie wurde vom staatlichen Schulamt der Landeshauptstadt München und der Ethikkommission der Universität München genehmigt.

Dr. von Haunersches
Kinderspital

Forschung über Ernährung und Gesundheit bei Kindern

Teilnahme-Bestätigung

Liebe XX

Vielen Dank für Ihr Interesse an unserer Studie und Ihre Bereitschaft, ein Interview mit uns zu führen!

Das Interview wird in der Grundschule XX

am XX

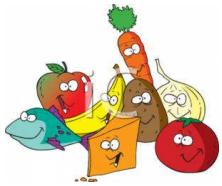
um XX

stattfinden. Bitte melden Sie sich im Sekretariat der Schule. Frau Brigitte Anton wird das Interview mit Ihnen führen.

Bitte lesen Sie die folgende Information sowie die beiliegende Einwilligungserklärung zur Studienteilnahme, bevor Sie zum Interviewtermin kommen. Wir möchten Sie bitten, diese Einwilligungserklärung zu Beginn des Interviews zu unterschreiben.

Falls Sie weitere Fragen zu der Studie oder den Interviews haben, beantworten wir diese gerne im Vorfeld wie auch persönlich vor Ort zu unserem Interview-Termin.

Informationen zu dieser Studie



Die Grundschule XX unterstützt Forscher der Universität München an der Haunerschen Kinderklinik dabei herauszufinden, was Eltern über die Auswirkung von Ernährung auf das Wohlbefinden von Kindern denken und welche Zusammenhänge hierbei gesehen werden. Diese Arbeit ist Teil eines großen EU-Forschungsprojektes, das auch in den Ländern England, Spanien und Ungarn durchgeführt wird. Die Ergebnisse dienen vor allem der Verfassung von öffentlichen Gesundheits-Richtlinien.

Die Teilnahme an der Studie ist freiwillig. Bei Einwilligung an einer Teilnahme führen Sie mit einem unserer Forscher ein persönliches Interview durch, in dem Sie zu Ihren Ansichten und Überzeugungen zum Thema Ernährung und Gesundheit bei Kindern befragt werden. Um eine anschließende Auswertung zu ermöglichen, wird das Interview auf Tonband aufgenommen.

Wir rechnen damit, dass das Interview zwischen 15 – 30 Minuten dauern wird. Sie können die Befragung jederzeit und ohne Angabe von Gründen abbrechen und aus der Studie ausscheiden. Jegliche Information und Daten werden mit strengster Vertraulichkeit behandelt und ausschließlich für diese Studie verwendet. *Die Daten werden vor der Auswertung irreversibel anonymisiert.* Weder Ihr Name noch der Name der teilnehmenden Grundschule wird in den aus dieser Studie resultierenden Berichten und Veröffentlichungen genannt werden.

Forschung über Ernährung und Gesundheit bei Kindern

- Einwilligungserklärung -

Hiermit erkläre ich mich einverstanden, an der Studie zum Thema Ernährung und Gesundheit bei Kindern teilzunehmen. Ich erkläre mich zudem bereit, im Rahmen dieser Studie mit einem Wissenschaftler des Dr. von Haunerschen Kinderspitals der Universität München ein Interview zu führen, welches auf Tonband aufgenommen wird.

Ich wurde vollständig über den Inhalt, Zweck, Örtlichkeit und Dauer der Studie und über meinen Beitrag informiert. Ich habe dieses Informationschreiben und diese Einwilligungserklärung gelesen und verstanden. Aufgetretene Fragen wurden mir verständlich und genügend beantwortet. Ich hatte ausreichend Zeit, mich für eine Teilnahme zu entscheiden.

Ich bin mit der Erhebung und Verwendung persönlicher Daten nach Maßgabe des Teilnehmerinformation einverstanden. Der Umgang mit den Daten erfolgt unter strengster Vertraulichkeit und unter Einhaltung des Datenschutz-gesetzes. Es werden weder teilnehmende Personen noch Schulen in den aus dieser Studie resultierenden Veröffentlichungen namentlich genannt.

Ich habe das Recht, meine freiwillige Mitwirkung jederzeit und ohne Angabe von Gründen zu beenden. *Die Tonbandaufnahmen meines Interviews und alle personenbezogenen Daten werden hiermit unwiderruflich gelöscht.*

Eine Kopie dieser Teilnehmerinformation und Einwilligungserklärung habe ich erhalten.

Name des Teilnehmers (in DRUCKBUCHSTABEN):

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Ort, Datum	Unterschrift des Teilnehmers
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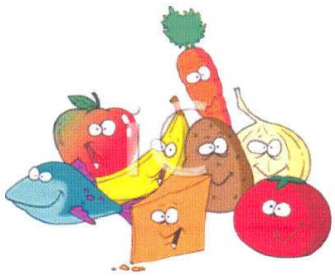
Ort, Datum	Unterschrift des Studienleiters



Forschung über Ernährung und Gesundheit bei Kindern

Antwortfragebogen für Eltern

Bitte die Felder in Druckbuchstaben ausfüllen!

Ja, ich möchte an einem Interview teilnehmen.

Ihr Name: _____

Ich bin Mutter / Vater / andere **(Zutreffendes bitte einkreisen)** eines Kindes, das hier zur Schule geht.

Ihre Kontaktadresse **(bitte vollständig angeben, damit wir einen Interviewtermin mit Ihnen vereinbaren können)**:

Telefonnummer _____ **(privat)** _____ **(Handy)**

Email Adresse_____

Post-Anschrift _____

Zu welcher Tageszeit / an welchen Wochentagen möchten Sie vor Ort in der Schule ein Interview geben?

Mögliche **Tageszeiten** bitte einkreisen: morgens, vormittags, mittags, nachmittags, abends

Mögliche **Wochentage** bitte einkreisen: Montag, Dienstag, Mittwoch, Donnerstag, Freitag

---

Bitte beantworten Sie uns folgende Fragen, die wir als Hintergrundinformation benötigen:

1. Wie viele eigene Kinder haben Sie? Wie alt sind diese?

_____ Mädchen, im Alter von _____ Jahren Schulklasse: _____

_____ Jungen, im Alter von _____ Jahren Schulklasse: _____

2. Ist Deutsch Ihre Muttersprache? Ja / Nein

3. Sind Sie hauptsächlich zuständig für den Einkauf und die Zubereitung des Essens Ihres(r) Kindes(r) zuhause?

Ja / Nein

4. Was ist Ihr Alter? Zutreffendes bitte einkreisen:

Unter 30 Jahren / zwischen 30 – 39 Jahren / über 40 Jahre

Bitte geben Sie diesen ausgefüllten Fragebogen **bis zum XX im Sekretariat der Grundschule** ab. Sie können uns den Fragebogen auch faxen oder per Post zurückschicken an:

Fax: 089 / 5160 4938
Dr. von Haunersches Kinderspital, Stoffwechsellabor, Brigitte Anton
Lindwurmstraße 4, 80337 München

Vielen Dank! Wir werden Sie persönlich kontaktieren um einen Interviewtermin zu vereinbaren!

II. Appendix to chapter 4 and 5:

Letter of Invitation, Confirmation and Consent Form (German)

Forschung zum Thema Gesundheit bei Kindern –

Teilnahme an Interviews im Rahmen eines EU-Projektes

Dr. von Haunersches Kinderspital

Liebe Eltern,

Besonders durch zahlreiche Beiträge in den Medien und Projekte an Schulen sind die unterschiedlichen Einflüsse auf die Gesundheit von Kindern, in letzter Zeit zu einem immer wichtigeren Gesprächsthema geworden.

Die Grundschule an der XX unterstützt uns Forscher der Universität München an der Dr. von Haunerschen Kinderklinik dabei herauszufinden, was Elternüber das Thema Gesundheit und geistige Leistungsfähigkeit von Kindern denken. Diese Arbeit ist Teil eines großen EU-Forschungsprojektes, das auch in den Ländern England, Spanien und Ungarn durchgeführt wird.

Wir möchten Sie als Eltern dazu einladen, im Rahmen dieses Projektes an kurzen persönlichen Interviews mit einem unserer Forscher teilzunehmen. Die Interviews werden voraussichtlich im Zeitraum Januar – Februar 2009 vor Ort in der Grundschule zu Terminen stattfinden, die für die Teilnehmer passend sind. Wir rechnen damit, dass ein Interview zwischen 15-20 Minuten dauern wird.

Wir hoffen sehr, dass wir unter Ihnen circa 20 Eltern begeistern können, die ein Interview zu Ihren Ansichten und Überzeugungen zum Thema Gesundheit und geistige Leistungsfähigkeit von Kindern geben möchten. Jeder Teilnehmer ist außerdem dazu eingeladen, an einer anschließenden Verlosung teilzunehmen. Der 1. Preis ist ein Gutschein im Wert von 50 Euro, der 2. und 3. Preis jeweils ein Gutschein über 25 Euro für die Einlösung bei Hugendubel oder Amazon.de!

Für Ihre Teilnahme wären wir Ihnen sehr dankbar! Wir möchten Sie daher bitten, **bei Interesse an einem Interview den beiliegenden Fragebogen auszufüllen und diesen bis zum XX im Sekretariat der Schule Ihres Kindes abzugeben.** Wir werden Sie anschließend kontaktieren um Ihnen weitere Information zukommen zu lassen und um mit Ihnen einen passenden Termin für ein Interview vor Ort in Ihrer Schule zu vereinbaren. Falls Sie Fragen oder Anregungen haben rufen Sie uns einfach an oder schreiben Sie uns.

Vielen herzlichen Dank im Voraus für Ihre Unterstützung!

Mit freundlichen Grüßen

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Forschung über Gesundheit bei Kindern

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Vielen Dank! Wir werden Sie persönlich kontaktieren um einen Interviewtermin zu vereinbaren!

Dr. von Haunersches
Kinderspital

Prof. Dr. Berthold Koletzko

Studienleitung:
Brigitte Anton
Dr.von Haunersches Kinderspital
Lindwurmstraße 4
80337 München

Tel: 089 / 5160 2816 Fax: 089 / 5160 4938
Email: Brigitte.Anton@med.uni-muenchen.de

Forschung über Gesundheit bei Kindern

Teilnahme-Bestätigung

Liebe XX

Vielen Dank für Ihr Interesse an unserer Studie und Ihre Bereitschaft, ein Interview mit uns zu führen!

Das Interview wird in der Grundschule XX

am XX

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stattfinden. Bitte melden Sie sich im Sekretariat der Schule. Frau Brigitte Anton wird das Interview mit Ihnen führen.

Bitte lesen Sie die folgende Information sowie die beiliegende Einwilligungserklärung zur Studienteilnahme, bevor Sie zum Interviewtermin kommen. Wir möchten Sie bitten, diese Einwilligungserklärung zu Beginn des Interviews zu unterschreiben.

Falls Sie weitere Fragen zu der Studie oder den Interviews haben, beantworten wir diese gerne im Vorfeld wie auch persönlich vor Ort zu unserem Interview-Termin.

Informationen zu dieser Studie

Die Grundschule an der XX unterstützt Forscher der Universität München an der Haunerschen Kinderklinik dabei herauszufinden, was Eltern über die Gesundheit und geistige Leistungsfähigkeit von Kindern denken. Diese Arbeit ist Teil eines großen EU-Forschungsprojektes, das auch in den Ländern England, Spanien und Ungarn durchgeführt wird. Die Ergebnisse dienen vor allem der Verfassung von öffentlichen Gesundheits-Richtlinien.

Die Teilnahme an der Studie ist freiwillig. Bei Einwilligung an einer Teilnahme führen Sie mit einem unserer Forscher ein persönliches Interview durch, in dem Sie zu Ihren Ansichten und Überzeugungen zum Thema Ernährung und Gesundheit bei Kindern befragt werden. Um eine anschließende Auswertung zu ermöglichen, wird das Interview auf Tonband aufgenommen.

Wir rechnen damit, dass das Interview zwischen 15 – 30 Minuten dauern wird. Sie können die Befragung jederzeit und ohne Angabe von Gründen abbrechen und aus der Studie ausscheiden. Jegliche Information und Daten werden mit strengster Vertraulichkeit behandelt und ausschließlich für diese Studie verwendet. *Die Daten werden vor der Auswertung irreversibel anonymisiert.* Weder Ihr Name noch der Name der teilnehmenden Grundschule wird in den aus dieser Studie resultierenden Berichten und Veröffentlichungen genannt werden.

Forschung über Gesundheit bei Kindern

- Einwilligungserklärung -

Hiermit erkläre ich mich einverstanden, an der Studie zum Thema Gesundheit und geistige Leistungsfähigkeit bei Kindern teilzunehmen. Ich erkläre mich zudem bereit, im Rahmen dieser Studie mit einem Wissenschaftler des Dr. von Haunerschen Kinderspitals der Universität München ein Interview zu führen, welches auf Tonband aufgenommen wird.

Ich wurde vollständig über den Inhalt, Zweck, Örtlichkeit und Dauer der Studie und über meinen Beitrag informiert. Ich habe dieses Informationschreiben und diese Einwilligungserklärung gelesen und verstanden. Aufgetretene Fragen wurden mir verständlich und genügend beantwortet. Ich hatte ausreichend Zeit, mich für eine Teilnahme zu entscheiden.

Ich bin mit der Erhebung und Verwendung persönlicher Daten nach Maßgabe des Teilnehmerinformation einverstanden. Der Umgang mit den Daten erfolgt unter strengster Vertraulichkeit und unter Einhaltung des Datenschutzgesetzes. Es werden weder teilnehmende Personen noch Schulen in den aus dieser Studie resultierenden Veröffentlichungen namentlich genannt.

Ich habe das Recht, meine freiwillige Mitwirkung jederzeit und ohne Angabe von Gründen zu beenden. *Die Tonbandaufnahmen meines Interviews und alle personenbezogenen Daten werden hiermit unwiderruflich gelöscht.*

Eine Kopie dieser Teilnehmerinformation und Einwilligungserklärung habe ich erhalten.

Name des Teilnehmers (in DRUCKBUCHSTABEN):

---	---
Ort, Datum	Unterschrift des Teilnehmers
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Ort, Datum	Unterschrift des Studienleiters

III. Appendix to chapter 5: Card sort Procedure and Data Grid (German)

Nutrimenthe- Ernährung und geistige Leistungsfähigkeit

Task 10.1 Interviewleitfaden Teil B – Karten-Sortierungsexperiment

In diesem Teil der Studie werden nur Eltern befragt (Soll n=50). Diese werden genauso wie in Teil A aus umliegenden Grundschulen rekrutiert. Auch diesmal fragen wir Hintergrundinformationen über die Eltern ab (Altersgruppe, Geschlecht, Beruf, Anzahl und Alter der Kinder, höchster Schulabschluss).

Der Interviewer stellt das Projekt vor, indem er…

- das allgemeine Ziel des Interviews erklärt,
- die vertrauliche Behandlung der Daten bestätigt und darauf hinweist, dass alles anonym bleibt,
- auf mögliche Fragen der Teilnehmer eingeht,
- die Einwilligungserklärung unterschreiben lässt.

1. Beginnen Sie das Interview mit folgender Frage:

> "Was verstehen Sie unter dem Begriff ***geistige Leistungsfähigkeit*** *wenn Sie an Kinder im Alter zwischen 4-10 Jahren* denken?"

Der Interviewer nimmt diesen Teil des Interviews mit dem Diktiergerät auf (alternativ können die Antworten handschriftlich im Detail auf dem Antwortbogen festgehalten werden)

Anmerkung: Es ist möglich, dass diese Frage den Eltern zunächst schwierig erscheinen mag, trotzdem sollte der Interviewer es vermeiden, hier die Antwort zu stützen!

2. Bitten Sie den Teilnehmer an Kinder im Alter zwischen 4 und 10 Jahren zu denken und Aspekte zu bewerten, die die folgenden vier Kategorien geistiger Leistungsfähigkeit beeinflussen können: **Aufmerksamkeit/ Lernen/ Stimmung/ Verhalten.**

3. Der Interviewer soll die Reihenfolge, in der die vier Kärtchen mit dem Aufdruck **Aufmerksamkeit/ Lernen/ Stimmung/ Verhalten** vorgelegt werden, variieren. (Auf jedem Kärtchen wird eine kurze Beschreibung des Begriffs gegeben) → Latin Square

4. Untenstehend sind 18 Einflussfaktoren aufgeführt (nach Kategorien geordnet), die den Teilnehmern zur Bewertung des jeweiligen Einflusses vorgelegt werden (siehe Tabelle unten). Diese Punkte wurden auf der Basis von Fachliteratur und Expertenmeinungen ausgewählt.

<table>
<tr><td>biologisch/ intrinsisch:
Geburtsgewicht
Angeborene Intelligenz
Genetische/ vererbte Faktoren</td><td rowspan="2">Umwelteinflüsse
Ernährung als Säugling und im Kleinkindalter
Aktuelle Ernährungsgewohnheiten
Regelmäßige Mahlzeiten
Schlafdauer/ Müdigkeit
Körperliche Bewegung</td></tr>
<tr><td>Bildungswesen
Klassengröße
Qualität des Unterrichts
Disziplin in der Schule
Essen in der Schule (Brotzeit, Mittagessen)</td></tr>
<tr><td>Soziale Faktoren
Geburtenfolge/ Familiengröße
Einkommen der Eltern
Bildungsstand der Eltern
Anregung/Förderung zuhause</td><td>Psychologische Faktoren:
Stimmung
Verhalten</td></tr>
</table>

Die Kartenstapel werden farbcodiert, so dass jede Kategorie **Aufmerksamkeit**/ **Lernen**/ **Stimmung**/ **Verhalten** eine eigene Farbe bekommt. Die möglichen Einflussfaktoren stehen jeweils auf einer eigenen Karte.

Jeder Stapel wird einzeln auf den Tisch gelegt, so dass die Teilnehmer alle Karten einer Farbe einordnen und in Beziehung zu den anderen Karten setzen können.

Die Teilnehmer werden gebeten, die Karten für jede Kategorie geistiger Leistungsfähigkeit in drei Gruppen zu ordnen, je nachdem wie stark ihrer Meinung nach der Einfluss auf die jeweilige Kategorie geistiger Leistungsfähigkeit ist. (Rating)

Formulierung zu Beginn des Sortierungsexperiments:

"Wir würden nun als erstes gerne erfahren, was Sie denken, welche Faktoren die Aufmerksamkeit eines Kindes beeinflussen. Ich zeige Ihnen jetzt einige Karten, auf denen verschiedene Faktoren stehen. Ich möchte Sie bitten, sich diese Karten anzuschauen und die Karten Ihrer Meinung nach zu sortieren. Bitte ordnen Sie jede Karte einer der 3 Gruppen zu, je nachdem was Sie denken, wie sehr der Einfluss des Faktors auf die Aufmerksamkeit ist."

> ***Gruppe 1:*** *Faktoren, die* ***Ihrer Meinung*** *nach* ***KEINEN EINFLUSS*** *auf die Aufmerksamkeit von Kindern haben.*
>
> ***Gruppe 2:*** *Faktoren, die* ***Ihrer Meinung*** *nach* ***ETWAS EINFLUSS*** *auf die Aufmerksamkeit von Kindern haben.*
>
> ***Gruppe 3****: Faktoren, die* ***Ihrer Meinung*** *nach* ***STARKEN EINFLUSS*** *auf die Aufmerksamkeit von Kindern haben.*

Sobald der Teilnehmer die Zuordnung beendet hat, sammelt der Interviewer die Kärtchen ein und trägt die Ergebnisse in die Tabelle ein.

Tabelle zur Datenerfassung (für den Interviewer) Interviewnummer .....

1. Was verstehen Sie unter dem Begriff ***geistige Leistungsfähigkeit*** wenn Sie an Kinder im Alter von 4-10 Jahren denken?

.....

.....

2. Sortierungs - Experiment

Code: 0 = kein Einfluss; 1= etwas Einfluss; 2= starker Einfluss

		AUFMERKSAMKEIT	LERNEN	STIMMUNG	VERHALTEN
	Rotation der Kategorien (I-IV); wobei I zuerst				
A	Geburtsgewicht				
B	Angeborene Intelligenz				
C	genetisch/ vererbt				
D	Klassengröße				
E	Qualität des Unterrichts				
F	Disziplin in der Schule				
G	Essen in der Schule				
H	Ernährung als Säugling und Kleinkind				
I	aktuelle Essgewohnheiten				
J	regelmäßige Mahlzeiten				
K	Schlafdauer/ Müdigkeit				
L	körperliche Bewegung				
M	Familiengröße/ Geburtenfolge				
N	Einkommen der Eltern				
O	Bildungsstand der Eltern				
P	Anregung / Förderung zu Hause				
Q	Stimmung			/	/
R	Verhalten			/	/

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Publications (status 04/2011)

Brands B, Györei E, López-Robles J, Gage H, Raats M, Decsi T, Campoy C, Koletzko B, Egan B: Effects of diet on children's mental state and performance - a qualitative study of perceptions, attitudes and beliefs of parents in four European countries. (manuscript finalised)

Brands B, Egan B, López-Robles J, Campoy C, Koletzko B, Raats M.: Concept maps of parents' understanding of mental performance - a qualitative study in three European countries. (in preparation)

Brands B, Koletzko, B.: Frühe Programmierung. in Reinehr T KM, van Teeffelen-Heithoff A, Widhalm K (Hrsg) (ed): Pädiatrische Ernährungsmedizin. Grundlagen und praktische Anwendung. Stuttgart: Schattauer, 2011.

Brands B, Koletzko, B.: Geburtshilfe. Metabolische Programmierung - Einfluss früher ernährungsbedingter Faktoren auf spätere Gesundheit und Krankheitsrisiko. Aktuell diskutiert Geburtsh Frauenheilk 2011;71:151-153.

Brands, B., Koletzko, B., & Demmelmair, H. (accepted). Early Life Programming of Obesity through Perinatal Nutrition. Eur J Gastroenterol Hepatol Review.

Koletzko, B., Brands, B., & Demmelmair, H. (accepted). The Early Nutrition Programming Project: Five years of successful multi-disciplinary collaborative research. Am J Clin Nutr.

Koletzko B, Schiess S, Brands B, Haile G, Demmelmair H, von Kries R, Grote V: Infant feeding practice and later obesity risk. Indications for early metabolic programming. Bundesgesundheitsblatt-Gesundheitsforschung-Gesundheitsschutz 2010;53:666-673.

Koletzko B, Grote V, Schiess S, Verwied-Jorky S, Brands B, Demmelmair H, von Kries R: Prevention of pediatric obesity through infant nutrition. Monatsschrift Kinderheilkunde 2010;158:553-+.