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What the baby needs

Must-haves for a good life

INAUGURAL SPEECH BY PROF. DR. CAROLINA DE WEERTH

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Radboud Universiteit



INAUGURAL SPEECH

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The period in the womb as well as the first postnatal years are extremely important 'sensitive' periods for development. What happens then will even partly dictate how happy and healthy the child will be, and even how he will age and grow old. By paying close attention to the needs of the baby, we can consolidate a developmental pathway to a good, healthy life. Prof. dr. Carolina de Weerth takes the baby's perspective to talk about how cultural, personal, and political decisions may stand in the way of fulfilling the baby's needs. She argues that it is essential to provide adequate education and support of parents during pregnancy and the child's early years. Investing in the baby is investing in society as a whole.

Carolina de Weerth studied Biology at the Universidad Nacional del Sur, Bahía Blanca, Argentina, and later ethology at Utrecht University, the Netherlands. She obtained her PhD in Developmental Psychology at Groningen University on a longitudinal study on infant behavior. Afterwards, she worked for 5 years as a postdoc researcher on psychosocial pregnancy stress at the Department of Child and Youth Psychiatry of the UMC Utrecht. She has been working at Radboud University since 2004. On April 1st, 2014, she was appointed personal full professor of Psychobiology of Early Development at the Department of Developmental Psychology.

WHAT THE BABY NEEDS

MUST-HAVES FOR A GOOD LIFE

What the baby needs

Must-haves for a good life

Inaugural speech delivered at the acceptance of the post of Professor of Psychobiology of Early Development at the Radboud University Faculty of Social Sciences, on Friday 24 April 2015

by prof. dr. Carolina de Weerth

Opmaak en productie: Radboud Universiteit, Facilitair Bedrijf, Print en Druk
Fotografie omslag: Bert Beelen

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Mijnheer de rector magnificus, dames en heren,

Goedemiddag en welkom. Omdat mijn ouders helemaal uit Argentinië zijn gekomen voor mijn oratie, zal ik nu doorgaan in het Engels.

Last year I became a professor. It was never my ambition or dream to become a professor, and I actually found the idea quite frightening. Just to show you what I mean I'll share two of my worst professor nightmares with you.

My first professor nightmare was becoming a symbol of wisdom: people would think I knew a lot. I'd have to say smart things, and yet I feel I know so little! And I'm not being falsely modest: I am in the middle of my learning process, and know just a tiny little bit of all there is to know about development. Not long after being appointed professor, a kind friend of mine gave me a book as a birthday present: '100 Words With Which You Sound Intelligent'. As you can imagine, the book didn't help much to boost my self-esteem!

My second professor nightmare was that somehow I was becoming a professor in the wrong discipline! I'm a biologist. My research integrates biology with psychology, and many other fields of research. But within this combination of research disciplines, I mostly do fundamental, basic research. I never wanted to be in the position of telling people what to do with their babies! Especially when human beings are so complex, when so much is still not known, when there are so many exceptions to the rules, when nothing is clearly black or white, and so on and so on. This speech today seemed to be my first step to doom. But, it turned out to be easier than I thought. My research has provided me with ideas that I'd like to share with you, things I feel deeply and passionately about. I hope that, in the next 45 minutes, I'll be able to transfer some of my enthusiasm to you.

And this is the right moment for a disclaimer: I won't talk about all the things a baby needs to have a good life. Also, I won't offer you any extremely intelligent and incredibly complicated ideas. The goal of my talk is to offer you exciting novel insights from our research of these last years, but also to remind you of facts that you all know but that are often given less importance than they deserve. The goal is to inspire you to reflect on how our lives begin in our Western society, and on whether this is really what the baby needs.

I'll divide my talk in four parts: the prenatal needs, the needs in the first year, why these needs are important, and how to fulfill them.

THE PRENATAL NEEDS

I'll start with the baby's prenatal needs. I'll refer to the baby as a 'he' just for practical reasons. A baby's life starts with a 9-month journey in the womb. His development is the result of a constant interaction between genes and environment. In the mother's womb, the baby already shows complex movements and behavioral states. A fetus may touch his head or grasp his foot, he may be awake or asleep, and may even be having dreams during sleep! He can hear and taste, open his eyes, and respond to bright lights flashed on the mother's belly. Learning also starts in the womb. The fetus will learn to swallow, to recognize his mother's voice, to distinguish unfamiliar music from music he's heard before. The fetus's behavior and learning will promote his physical development including the development of his brain.

If prenatal development is so rich and important, then it is not surprising to hear that the state of the mother will greatly influence the baby's development in the womb. Factors such as the mother's health, nutrition, and toxic substances and drugs will naturally affect the baby, but the mother's psychological state during pregnancy will also affect the baby! Severe stress of the mother during pregnancy, such as losing a close family member, has negative effects on the child's development into adulthood (Hohwü et al., 2014; Virk et al., 2014).

But what about 'normal' stress and anxiety in healthy pregnant mothers who don't go through traumatic events? For example, worries about whether the baby is healthy or not, or problems with the partner or at work? Studies have shown that a mother's stress and anxiety during pregnancy are related to all kinds of less desirable outcomes in the baby and later child. These include cognitive and motor delays, behavioral problems, and abnormalities in the stress system (de Weerth et al., 2005; Räikkönen et al., 2011; Beijers et al., 2014; Zijlmans et al., 2015b).

In our own psychobiological studies, we have shown that 'normal' prenatal stress may be related to even more aspects of the child's development, aspects that hadn't been studied earlier (de Weerth et al., 2003; Gutteling et al., 2004, 2005a, 2005b, 2006, 2007; Tollenaar et al., 2011). I'll give three examples of these innovative studies: one about infant health, one about how the baby gets used to being separated from the mother, and one about the intestinal microbiota.

Prenatal maternal stress and infant health

The first example is from our BIBO study. This intensive prospective study started 9 years ago with healthy pregnant mothers, has produced 17 scientific papers (e.g. Jansen et al., 2010a, 2010b; Tollenaar et al., 2010; Beijers et al., 2011a, 2011b), and is still ongoing today.

In this first example study, we asked pregnant mothers how much stress they had. We also measured the stress hormone cortisol in the mother's saliva. Cortisol is necessary to cope with stressful situations, but can have negative effects on the body if

the levels are high for a long time. In the baby's first year, we interviewed the mothers every month, asking them about their infants' health symptoms. We found that babies of mothers with higher prenatal stress had more general, skin, and respiratory illnesses, and received more antibiotics (Beijers et al., 2010). So the babies had worse health in their first year! Now we are investigating if these children still show worse health when they are in school.

Prenatal maternal stress and infant habituation to maternal separations

In the second example, we looked at how 9-month-old infants got used to being separated from their mother and taken care of by a babysitter (de Weerth et al., 2013a). We did three separations in 3 weeks and were able to see that, in general, infants adapt by crying less and showing lower levels of the stress hormone cortisol. But what about infants of mothers who had more stress during pregnancy? They did not show this adaptation: although, in general, those infants cried less during the separations, their cortisol did not decrease. This finding is extremely interesting in the light of how our infants adapt (or not!) to childcare arrangements. Some infants may be showing few signs of distress, such as crying, but may still have heightened stress hormones. In the future, we will go on studying how infants get used to childcare, as not getting used to these types of challenges may produce chronic stress, which is bad for growth and health.

A big question that arises from these findings is that, if a mother's prenatal psychological stress indeed affects the baby, then there has to be a way how the mother's worries affect the baby. To date we do not know exactly how maternal stress can affect the baby. Most probably stress hormones and the immune system are involved (Beijers et al., 2014).

But also, altered health behaviors in the mother, such as abnormalities in eating, sleeping, and exercise patterns, may be involved, and we are investigating these at the moment. Also, we are looking into the possibilities of using physical exercise as a way of decreasing levels of maternal stress and anxiety, and improving sleep. Exercise is known to have positive effects on health and well-being, but also to decrease depressive symptoms (Cooney et al., 2013), so it may also help alleviate a mother's stress during pregnancy.

Prenatal maternal stress and infant intestinal microbiota

Another way in which a mother's prenatal stress may affect the baby is through the intestinal microbiota (Beijers et al., 2014), and my third example will be about this pathway.

But first things first: what is the intestinal microbiota? Popularly known as intestinal flora, we now know that there are no real plants in our intestines, but that the microbiota is mostly bacteria. Incredibly, there are 10 times more microorganisms in

our intestines than the total number of human body cells (Qin et al., 2010). You could say that we are more microbe than person! And these bugs are to be cherished, as they are important for the development of our immune system and for the maturation of our gastrointestinal tract, and they synthesize vitamins and digest important otherwise indigestible foods for us (Adlerberth and Wold, 2009; Sekirov et al., 2010).

Interestingly, the bacteria in our intestines may even have other important roles, such as in the development of our stress system and even our behavior! Scientists have brought up mice in sterile environments, without any bacteria. These mice are called 'germ-free' mice and, by comparing them to normal mice, we can see how having bacteria in the intestines influences behavior (Sudo et al., 2004; Gareau et al., 2011; Heijtz et al., 2011). Germ-free mice have abnormal stress systems, poorer memory, and are less afraid to walk around in the open (not a good thing if you are a mouse, as you can be easily eaten up). And the most fascinating thing is that you can reverse these effects by putting bacteria in the germ-free mice's intestines. However, this can only be done during a sensitive window in early life. If you do it later in development: it is too late. This tells us that having bacteria in the intestines in early life is important for normal development.

But of course this was found in mouse models. What about human infants? Infants are born with virtually sterile intestines. They normally receive their first bacteria from the mother and, within minutes, the colonization of their intestines begins (Adlerberth and Wold, 2009; Koenig et al 2011; de Weerth et al., 2013b). A well-balanced colonization is important for a healthy development. And this brings us back to maternal prenatal stress: in monkeys, stressed pregnant mothers had babies with less desirable bacteria in their intestines. Could this be similar in humans? The answer is yes!

In a very first human study, we found that maternal prenatal stress strongly and persistently predicted the infants' microbiota composition (Zijlmans et al., 2015a). Mothers with the highest stress had infants with more 'bad' bacteria groups and fewer 'good' bacteria, and even with more gastrointestinal symptoms and allergic reactions.

Moreover, if the findings in the mouse model translate in any way to humans, starting life with a balanced intestinal microbiota may even be important for a normal development of behavior! In an earlier study, we already found that babies who cry excessively also show abnormal intestinal bacteria very early in life, before the excessive crying has developed (de Weerth et al., 2013b, 2013c). Our next step will be to find out whether the children's bacteria are related to their behavior and development at school age. We also want to know how babies acquire the 'wrong' bacteria by looking at the period around birth. In the new 'BINGO' study, we are investigating if a mother who is stressed in pregnancy has different intestinal bacteria and breast milk, as both affect the baby's bacteria.

A final important point about the intestinal microbiota is that it can be influenced in a relatively easy way by giving probiotics, essentially ‘good’ bacteria. This makes it even more interesting to study! In the future, probiotics may be a relatively simple way of positively influencing our development, health, behavior, and even emotions! In non-pregnant adults, probiotics have been found to decrease depression and anxiety and improve mood (Messaoudi et al., 2011; Steenbergen et al., 2015). So at the moment we are setting up studies to find out if probiotics can decrease maternal prenatal stress and anxiety, and also if probiotics can prevent excessive crying and boost health in infants.

Summary of prenatal needs

Let’s summarize what we’ve seen up until now. Maternal psychological stress and anxiety during pregnancy, even in healthy, normal populations, is associated with many different less desirable outcomes in the baby: ranging from developmental delays, behavioral problems, and, as we saw in the examples from our own studies, poorer health, not adapting to challenging situations, and abnormal bacteria in the intestines. Hence, what the baby needs during the period in the womb is a mother who is healthy, both physically and psychologically, without high levels of stress.

THE NEEDS IN THE FIRST YEAR

Up until now I’ve been mostly talking about prenatal factors that are associated with development. Let’s move on now to early life, to the first year after birth. Again, I’ll give three examples: one about premature babies, one about co-sleeping and breastfeeding, and one about childcare.

Care for premature babies

I’ll start out with a story about premature babies, a story that will help understand several of the points I’ll make afterwards.

Premature babies used to be cared for in ‘open bay’ neonatal intensive care units. Nowadays, more and more hospitals are transferring babies to ‘family rooms’. This provides parents with privacy and a bed, so that they can be with their infant. Parental presence and touch is extremely necessary for the baby’s development. Worldwide, parents are encouraged to spend hours in skin-to-skin contact or ‘kangarooing’ with their premature infants, as this leads to better growth and health (Ludington-Hoe et al., 2008; Moore et al., 2012). And some studies have indeed shown positive effects of family rooms on premature babies (Lester et al., 2014). So far so good.

However, a recent study in the US showed that family rooms had negative effects on infant brain development (Pineda et al., 2014). How can this be? The babies were mostly alone in the family rooms, virtually isolated from human contact. The key question is why weren’t the parents with their infants in these comfortable rooms?

Well, in the US there is no national law mandating paid time off for new parents (International Labour Office, 2014). This means parents often cannot afford to be with their premature infant! So policy and economics are depriving babies of the contact and touch needed for a healthy development. I think that implementing family rooms without having paid parental leaves is a perfect example of how we do not take the infant's needs into account, while we have known for a very long time what the infant needs.

Co-sleeping and breastfeeding

The example I just presented was on how caregiving can affect very vulnerable, premature infants. But what about healthy, full-term infants? Higher quality of parental behavior, in the form of well-attuned, warm, responsive, sensitive interactions between parents and infants, is related to better development of the child (e.g. Smekens et al., 2007). But how about caregiving factors such as where the baby sleeps, whether he is breast- or bottle-fed, and whether he goes to childcare or not? Do these everyday parental choices affect development in normal babies in ways we still don't know? In the BIBO study, we found that they might!

For example, whether a young baby sleeps alone or in the same room as the parents is related to how the infant reacts to stressful situations. Infants who sleep alone react with higher cortisol when they are taken out of a bath, which produces cold and discomfort, and also when they are separated from their mother (Tollenaar et al., 2012). Also, young infants who receive more breastfeeding show a quicker cortisol recovery from a maternal separation than those that receive less breastfeeding (Beijers et al., 2013). Parental caregiving may therefore influence the infant's stress system, perhaps even influencing how easily he adapts to everyday stressful situations.

Our findings fit in nicely with the World Health Organization (WHO) recommendation to feed the baby exclusively with breast milk for 6 months, and then continuing breastfeeding combined with solids for up to 2 years of age or beyond (recently reaffirmed by the American Academy of Pediatrics, 2012). Also, UNICEF UK recommends having the baby sleep in his own cot next to the parent's bed and so does the Dutch government: 6 months of co-sleeping in the parents' room (April, 2015; retrieved from <http://www.unicef.org.uk/BabyFriendly/Resources/Resources-for-parents/Caring-for-your-baby-at-night/>, and from <https://www.ncj.nl/programma-s-producten/preventie-wiegedood/adviezen-veilig-slapen?wiegedoodnl=1>).

Childcare

The final example is related to childcare in the first year of life. In an earlier study, we found that infants starting childcare at 3 months had higher cortisol levels in childcare than at home (Albers et al., in press). This could be showing the baby's stress reactions to the challenges of childcare. In the BIBO study, we also found that, for infants who

attended childcare, spending more hours in non-parental care was related to more respiratory and general illnesses, and having more concurrent arrangements (e.g. grandparents, babysitter) was related to more skin illnesses (Beijers et al., 2011b). At the moment we're investigating whether this means that these children will develop a generally poorer health.

But given that babies have higher cortisol and more illnesses in childcare, shouldn't we postpone childcare until the baby is at least 12 months old? Center-based childcare by itself may be just too overwhelming for young babies!

Summary of needs in the first year

Summarizing, what these examples tell us is that early caregiving choices may have unexpected effects on the infant's development. The results do not prove causality, but they do point to the importance of studying early-life caregiving in more detail. Also, these results were found in a highly educated population without economic problems. Protecting babies by co-sleeping and breastfeeding may be even more important when parents have lower education and socio-economic hardships.

WHY ARE THESE NEEDS OF THE BABY IMPORTANT?

We have now looked at several important factors that the baby needs early in life. What we haven't looked at in detail is why the baby needs these things early in life? One could argue that babies are resilient and that, while abuse and neglect will naturally affect them, more subtle pregnancy and early-life factors will not affect them in any large way.

One thing has become very clear in these past years of research, and that is that our time in the womb, as well our first postnatal years, can have a major impact on our later well-being. This phenomenon is called developmental programming, because the effects on development can be long lasting or even permanent (Gluckman and Hanson, 2004; Seckl, 2008). For example, whether a child will become obese is to a large extent already programmed in the womb and the first year of life, through interactions between genes and the environment (Gillman and Ludwig, 2013).

Because of the worldwide epidemic of diseases such as diabetes and obesity, the phenomenon of early programming is receiving a lot of attention and scientific effort. However, most of it is about physical-health outcomes. There is yet much to be done in studying how early programming affects behavior and psychological well-being. And this is an area in which psychobiological research such as ours is much needed. According to the WHO, the global burden of mental disorders in adulthood, such as depression and anxiety, is increasing. Much is to be gained if early interventions can prevent their development.

Are these views on developmental programming deterministic? Do they mean that, once we are programmed, we can only sit around and await our fate? No! Early life

may be a period of risk for developing future diseases, but it should also be seen as a great period of opportunity. In early life there is plasticity and it is easier to influence development, as our body and physiological systems are prepared to be programmed. Plasticity is gradually replaced by rigidity, which makes it more and more difficult to produce change. Think, for example, how difficult it is to reverse obesity in adulthood.

HOW CAN WE FULFILL THE BABY'S NEEDS?

We've now reached the last part of my talk: how can we fulfill the baby's needs, putting him on the road to a good life. The picture that I have drawn of what the baby needs early in life is one of non-stressed parents who offer intensive caregiving: plenty of high-quality interactions and touch, co-sleeping and exclusive breastfeeding for 6 months, and preferably no childcare in the first year. These relatively simple caregiving factors may make a fundamental difference in the baby's future development. But are parents aware of this? And do they have the options for doing it?

The reasons behind parental choices are complex, but in the Netherlands many caregiving decisions will be guided by short parental leaves after the baby is born: mothers have 10–12 weeks' paid leave and fathers only 2 days' paid leave. Imagine the typical Dutch mother who is preparing to go back to work when her baby is 10 weeks or so. Will she be breastfeeding her baby every couple of hours during the day as well as at night? Most probably she will be trying to get her baby into a feeding routine of 4-hourly feeds, and especially, to sleep through the night. Often, she will also be switching from breastfeeding to bottle feeding. We know this because only around 58% of mothers give any breastfeeding at all at 3 months after delivery, and only 39% exclusively breastfeed their infant until 6 months as the WHO recommends (Peeters et al., 2015). There are many reasons why Dutch mothers don't breastfeed more, including lack of sufficient information, support, and successful role models, and not only due to having to go back to work. However, in countries with more extended maternal and parental leaves, such as in Scandinavia and Hungary, breastfeeding rates are much higher. I've expanded on breastfeeding as an example of reasons behind parental choices, but the same holds for other choices, such as where the baby sleeps and who takes care of the baby when the parents are working. The pressures behind such decisions may often be large and not always dictated by what the baby needs.

What can we do to give babies what they need for a good life, both in the womb as in their first year? Many initiatives already exist and I don't pretend to know them all. However, I think there are four major areas where there is room for improvement, and I will talk about each of them separately. These suggestions are meant to break down barriers that can prevent parents from giving babies what they need. They are not intended as ways of putting pressure on parents to bring up baby in certain ways, or of judging parents who decide to do things differently. Human life is complex, and parents face many factors that will influence their caregiving decisions.

1. **Set up a routine pregnancy screening system for heightened stress, anxiety, and depressive symptoms in primary care, as well as a system for psychological support**

The taboo that psychologists are only for people with mental illnesses needs to be broken. Psychologists specialized in prenatal and perinatal problems should be easily accessible from within the routine prenatal care to talk in prenatal classes, to talk with mothers with worries and stress, and to offer women advice, interventions, and treatment where necessary. Psychologists should work closely with midwives and gynecologists, to offer the pregnant woman the best physical and mental support throughout pregnancy, delivery, and the neonatal period.

2. **Inform and teach parents-to-be**

Teach parents-to-be to see the world from the baby's perspective, to understand the baby's needs, and to make their decisions on caregiving based on the baby's needs, and do this already during pregnancy.

A worrying recent development is that being pregnant and having a baby has become something glamorous and cool. The Internet is full of cool celebrity daddies and mommies. Babies are even seen as the perfect costly accessory, and even models carry babies on the catwalk! Pictures of beautiful people carrying around happy babies and coping with parenthood seemingly effortlessly are great, but do they give a realistic picture of what having a baby is like? No, they don't!

Parents-to-be need realistic information on both the positive and less positive aspects of parenting a baby. Parents need to be made aware of the responsibility of taking care of a young life, and of the major investment of time and energy that it requires. I know this is an unpopular thing to say as both women and men want to pursue careers, but it is something that should be said. Early infancy is a sensitive period. High parental investment in this period sets a stable base for a good life. Once passed, the opportunity will not come again.

3. **Implement a paid 12-month postnatal parental leave for at least one parent**

The government should take responsibility for its role in providing the right conditions for parents to be able to take care of the baby's needs. A longer parental leave will help create the right conditions for parents to take care of the baby together. For example, mothers could take the first 6 months of the leave, and from 6 to 12 months the mother and father can both divide their time between caring for the baby and working.

Twelve months may sound expensive, but a 2008 report by UNICEF concluded that it is too costly and difficult to have the numbers of highly trained staff needed to care for the babies of under 1 year of age. Because research also shows that

childcare can be a risk for young infants, for example because of lack of stimulation or too much stress, UNICEF concludes that it is best for infants to be cared for by one of the parents in the first 12 months (UNICEF, 2008).

At around a year of age, babies should be introduced to high-quality childcare. Unfortunately, as Riksen-Walraven and colleagues showed in a national report in 2012, in the Netherlands only 12% of the observed childcare groups show good enough quality of care (Fukkink et al., 2013). This means that there is still much room for improvement in order to provide infants with the high quality of care that they need in their transition from the home to childcare.

4. **Support parents actively throughout the infant's first year of life**

Long parental leaves may have a negative side effect, namely that parents become isolated from social contacts and spend too much time alone with the baby. Catering for a baby's needs must not be synonymous to being cooped up in an apartment with a whiny baby and a washing machine! Young parents enjoy and benefit from contacts with other young parents, as shown by the recent success of Mama Café's. Support from peers and professionals may be especially beneficial for vulnerable parents, such as the large group of parents with postnatal depression or with babies who cry for hours each day.

Expensive improvements?

But aren't these suggestions for improvement terribly expensive? No! The economic costs of early-life investment are more than amply covered by the person's low psychological and physical health costs later in life. Prominent economists, such as Nobel Prize winner James Heckman, have been advocating for years the importance of a developmental approach and early interventions for child and adult health. Heckman has used economic models to show that the earlier the investment, the greater the return on each dollar invested (Heckman, 2008; Figure 1). Some studies have even found rates of up to 8 dollars return for each dollar invested in early life programs (UNICEF, 2008)!

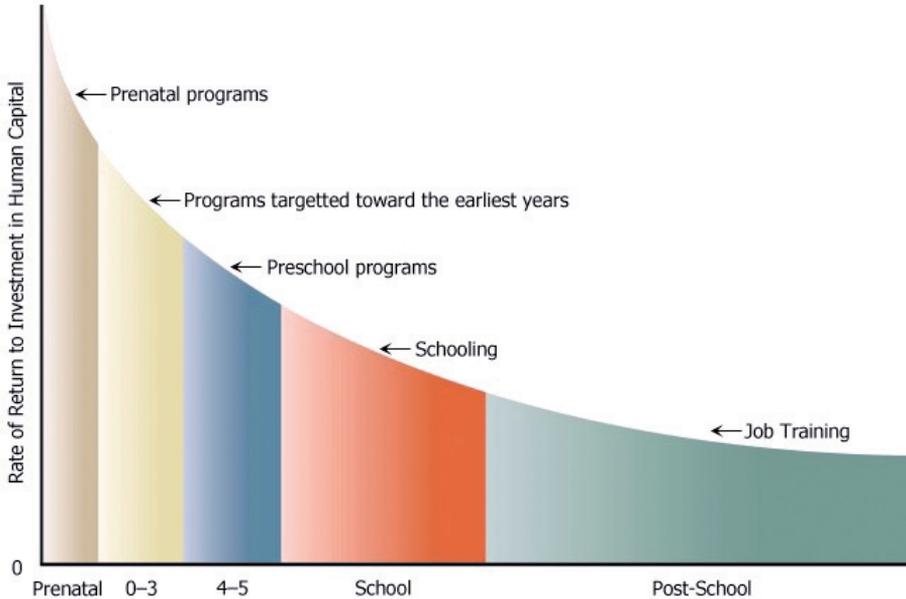


Figure 1. Return to a Unit Dollar Invested at Different Ages from the Perspective of the Beginning of Life, Assuming One Dollar Initially Invested at Each Age (adapted from Heckman, 2008).

So, by investing in early life, we actually save money and our economy grows. Is our country following this advice? No, sadly not, as can be seen in the gross domestic product percentage that is invested in childcare and early education. UNICEF recommends at least 1%; Sweden and Finland invest 1.3% and Denmark 1.7%, while the Netherlands invests only 0.6% (UNICEF, 2008).

And what about research money? At the moment, the European Commission is investing large amounts of money in projects on healthy aging. This is of course to be commended, but at the same time perhaps a short-sighted strategy. If we want to ensure healthy aging for Europe, we must invest in research and interventions in pregnancy and infancy.

CONCLUSION

To end this talk, I would like to come back to the beginning, to the importance of a good start in life. Throughout this talk we've looked at several basic needs of the baby that are must-haves for a good life. We've also looked at why the baby needs them and at how we can work towards giving the baby what he needs: through investing in multidisciplinary research on early life, screening for stress and anxiety in pregnancy, informing and educating parents, a 12-month paid parental leave, supporting parents

better during pregnancy and the first year, and setting up better interventions for pregnancy and early life. In sum, it takes small beginnings to make great things.

This is the end of the scientific part of my talk.

ACKNOWLEDGEMENTS

Now is the time for acknowledgements, for thanking people without whom I would not be here today. I'd like to thank the college van bestuur of the Radboud University, the dean of the Faculty of Social Sciences, Daniël Wigboldus, the director of the Behavioural Science Institute, Toon Cillessen, and the director of the Psychology Teaching Institute, Ruud Meulenbroek, for making my Full Professorship possible.

Additionally, I'd like to thank all the Bachelor, Master, and PhD students with whom I've worked, as well as all the participants, especially mothers and babies, that made my research possible. Without all of them: no research! I'm especially glad that two of the four mothers from my PhD study are here today, together with their now 22-year-old 'babies'.

My career path from student to professor was a bit unorthodox. I started out working as a biologist at the Universidad Nacional del Sur, in Bahía Blanca, Argentina, where there were few opportunities and resources for doing research. So I owe most of my research training and experience to the people I've worked with since coming to the Netherlands. I wrote my first paper when I was a student at Utrecht University, together with Hans Voerman, with whom I spent 5 months observing chimpanzees. For me it was a dream come true! And I was very happy that we were able to publish our observations in the prestigious journal *De Harpij*. We even had a discussion about who should be first author. I lost. Needless to say I have a little bit of mixed feelings about my first paper.

After my period with the chimpanzees, I was able to work and collaborate with Akko Kalma from Utrecht University. Akko introduced me to evolutionary psychology research, and taught me how to write a real scientific paper. He was a good teacher for me and an inspiring scientist, and I'm very happy to have started out with him. With Jan Buitelaar I worked for almost 6 years as a postdoc at the UMC Utrecht. I admire him for his capacity to switch effortlessly from one topic to another, quickly understanding the essence of a problem. He is amazingly efficient, and I am glad to have been able to work with him. These last years, I have been lucky to collaborate with Willem de Vos from Wageningen University, who I admire for his energy and his passion for the intestinal microbiota. He is untiringly supportive and enthusiastic about our collaborative work, and it is always a pleasure to talk research with him! My promotor and scientific 'father' was Paul van Geert from the University of Groningen. Paul introduced me to developmental psychology. Besides being an inspiration because of his never-ending enthusiasm for research, warmth and good humor, he actually

played a superman role, saving me and my PhD project from doom. I am eternally grateful for his support and trust! Finally, Marianne Riksen-Walraven was my colleague and scientific ‘mother’ for 10 years before she retired last year. To her I owe the most: from creating a job for me in Nijmegen, to untiringly supporting my growth throughout the years, and even to this very toga I am wearing! As a scientist, I admire her critical mind, inquisitive nature, and deep enjoyment of doing research. As a person, she is kind, warm, funny, and encouraging, and has a profound knowledge of the human nature. Altogether, this has made working with her thoroughly enjoyable and instructive.

I am also thankful to all my collaborators, as well as to my colleagues throughout the different departments and institutes of the Radboud University. They make going to work each day pleasurable instead of tedious. My colleagues from Developmental Psychology are especially important to me, as, with them, I share the daily uplifts and hassles of our work. Even though we are all very busy, there’s always room for a chat, a good laugh, and helping each other out. To Toon Cillessen, the head of our department, I am thankful for giving me complete freedom to investigate whatever my heart desired, even when it meant dirtying the name of our group with bacteria and poop! Finally, my own lab group, the Developmental Psychobiology group, with its Master and PhD students, and colleague Roseriet Beijers, is something I’m very proud of. Our weekly discussions are interesting and energizing, and I couldn’t have asked for a more hardworking and collaborative group.

On a personal level, I also want to thank several people. First of all my parents. They knew what the baby needed when I was born! And they also followed all the doctor’s health advice, even when that meant putting me to sunbathe nude on the balcony.

My parents both studied mathematics at the University of Buenos Aires, in a time when studying at university was certainly not the thing to do for women, and mathematics was not a good career choice for men. But they both followed their hearts and became professors. They always encouraged my brothers and me in every possible way to pursue our interests, based on intrinsic motivation and not on finances or prestige. They’ve always been an inspiration and an example for me, and I am thankful for all their support throughout my life. And I’m very happy that they are here today: *gracias Papi y Mami!*

I also want to especially mention my tante Corrie, my father’s cousin, standing here with my husband Luis. When Luis and I naively arrived in the Netherlands 26 years ago with a dream of doing a PhD and no money, it was Corrie who welcomed us warmly and opened her house to us. And we didn’t even know her before coming! She was our ‘inburgeringscursus’, Dutch teacher, and emotional support all in one, and without her it would have been very difficult for us to settle so smoothly into our new lives here. We still miss her hearty laugh!

And then my husband Luis. We've been together for more than 30 years, and Luis still keeps surprising me. I've never known a more rational, original, creative, and authentic person! And I've never known someone who is so deeply passionate about his research work, but couldn't care less about position and power. Luis knows loads about most topics and loves a good discussion. I'm sure many Jehovah's witnesses will gladly testify to this. If they are lucky enough to find Luis at home, they're sure to get a good discussion. And they even come back again! I'm also thankful for Luis' capacity for discussion: I always tell him my research ideas, as he is extremely sharp and critical in a constructive way. And I'm happy that he is willing to discuss my research, even though for him it is totally clear that babies are not half as fascinating as mushrooms! He is also a dedicated and loving partner and father, and without all his support for me, we would never have managed as a family. Muchas gracias Luis!

And then my own babies: through them I was able to learn all about babies, to experience first-hand what being a mother means. Although I'm sure I failed miserably at giving them all they needed as babies, they themselves did give me everything I needed as a mother, by being special and incredible persons, each in his or her own way. ¡Micaela, Florencia y Joaquín, estoy muy agradecida de tenerlos en mi vida y estoy muy orgullosa de ustedes!

Finally, many, many friends and family, both in the Netherlands as in many other places in the world have also been very important for me in reaching this point in my career. Thank you all for all the nice moments we've spent hiking, walking, playing badminton, talking, and eating together over the years. Let's hope we'll spend many more special moments in the future!

Thank you all for being here today and for your attention.

Ik heb gezegd

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