

A Randomized Control Trial of an Internet-based Intervention (Mamma Mia): The Effects on Self-reported Attachment in Norwegian Mothers.

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IV

Abstract

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Background: 60 000 women in Norway give birth each year. Out of these 10-15% suffer from perinatal depression. A large body of research has shown the significant impact of mothers' mental health on mother-child-attachment. Children's temperamental style also contribute to the quality of the attachment. Attachment is proven to be an important factor in both mother and child development and health, with lifelong repercussions. In this paper I investigate whether a Norwegian web-based intervention (Mamma Mia) targeted at perinatal women's mental health, increases mothers' perceived attachment towards their babies. The main hypothesis is that women in the intervention group will have healthier attachment scores compared to controls. It is further examined whether the development of attachment over time in the two groups is affected by the initial scores of postnatal attachment, and whether attachment development is moderated by initial reports of postnatal child temperament and mothers' depressive symptoms.

Methods: All current data are based on data from the Norwegian Mamma Mia-study, where 609 perinatal women were included. A RCT-study was conducted, comparing the effects of Mamma Mia on attachment between an intervention and a control group at four measuring points after giving birth. Attachment was measured by a short version of the Parental Stress Index. The data was analyzed using independent samples *t*-test and mixed design ANOVA.

Results: Results showed a consistent tendency of healthier attachment-scores in the intervention group, but the differences between groups were not statistically significant. Initial reports of both postnatal attachment, child temperament and mothers' depressive symptoms were significantly related to attachment development over time, but with no difference between the intervention and control groups.

Conclusion: The consistency of healthier scores on attachment in the Mamma Mia- group, suggests an effect of the intervention on attachment which may be of clinical relevance, if not statistically significant.

Preface

Writing this thesis has been what I imagine the perinatal phase to be – an emotional roller-coaster. For the most part I have been excited and proud to create something new, but there has also been plenty of sleepless nights where I wondered why in the world I did this voluntarily. Looking back, I picture the developmental process, from the birth of the idea till the paper's first steps, followed by ups and downs in its youth, and finally its send-off into the world. It is wonderous and a little frightening at the same time.

On many occasions I wished for a Mamma Mia-intervention for graduating students like me, to prevent mental breakdowns, motivate and offer support. Even though I had no such intervention, I had plenty of support. First of all, I want to thank my supervisors Silje Marie Haga and Pål Ulleberg for their advice, knowledge, patience and encouragement. I am super grateful towards Silje for the enthusiasm she showed when I first contacted her and for allowing me to process the data she has worked so hard for. I am also so grateful for the statistical guidance by Pål, enabling me to present such extensive results. Even the differences between them has made me stronger in trusting myself to make the final decisions. In addition, I want to thank my fellow students for long days in the study-hall where we could share joys and frustrations. At last I want to thank my friends, family, and loved one, for believing in me even when I did not and for providing a safe haven to gather strength. Thank you all for making me feel like I was not alone.

To me, attachment theory is one of the most meaningful frameworks for understanding human development and functioning, and preventive family-work the most meaningful way to use my abilities as a psychologist. I have been lucky to find a project that allowed me to combine the two and I am proud to contribute to the evaluation of a possible future health-promoting program.

Happy Reading!

Taran Eik

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Introduction

Background

In Norway, about 60 000 women give birth every year (Statistisk sentralbyrå [SSB], 2018), of which most are eager to give their baby the best possible start in life and are therefore motivated to facilitate optimal conditions for development. In other words, perinatal women seek out information and readily absorb knowledge and advice that may benefit themselves and their baby. Perinatal women go through many changes, including bodily, psychosocial and emotional changes, and they can be a source of growth and development, but also vulnerability and stress. Up to 10-15% experience perinatal depressive symptoms (Gavin et al., 2005; Banti et al., 2011) such as sad mood, loss of joy in previously joyful activities, difficulties with concentration, and social isolation. The consequences of perinatal depressive symptoms can be serious for the mother, her child and family. Indeed, perinatal depression may influence child development in several ways (Dennis & Ross, 2006), for example a mother's interaction with her baby (Bonari, Bennett, Einarson, & Koren, 2004; Field, T., 2010), which in turn may influence the child's cognitive, and socioemotional development (Goodman, Brogan, Lynch, & Shielding, 1993), as well as the infant's attachment style (Herring & Kaslow, 2002). Possible effects of parents' health and relational skills on child development has been illustrated by other studies as well. Propper and Moore (2006) talks about how parents affective style and behavioral strategies can affect infant's emotional expression, through facilitating biological processes like heartrate and the organization of the neural networks in the brain. Another example is Carleton and Padolsky (2012) who illustrate, through Wilhelm Reich's theory of attachment and neurophysiological research, how the mother-infant bond is crucial for development of self-regulation, starting already during pregnancy.

These examples illustrate how the relational bond between the baby and the caregiver shapes and lays the groundwork for physical, emotional, cognitive, and social development. This bond, typically referred to as *attachment*, is highly influenced by parental health and care giver-abilities and is the basis for how we interact with others both in child- and adulthood. This underscores the importance of strengthening perinatal women's health, promoting the growth of healthy attachment bonds, and secure both mother well-being and infant development from the very beginning. As women in this stage of life is set for change to understand and accommodate their baby's needs, it is an excellent opportunity for

intervention. Many interventions target early mother-child interaction, striving to enhance attachment. Most of these involve face-to-face guidance by health-professionals, but arguments have been made for the benefits of internet-based interventions as an alternative, offering advantages like anonymity and easy access to mention a couple. The internet is the preferred source of information for perinatal women (Osma, Barrera, & Ramphos, 2016), suggesting that an internet-based intervention would make sense with this population

Purpose

In this article I will outline a Norwegian internet-based intervention program, named Mamma Mia, and evaluate the program's effect on self-reported attachment. The overarching aim of Mamma Mia is to promote subjective well-being and prevent depressive symptoms among perinatal women. The study is a Randomized Controlled Trial (RCT) comparing the intervention with reference to a control group that received perinatal usual care. First a theoretical framework of attachment is presented. Research supporting the importance of early attachment is offered. Subsequently, a review of previous attachment-interventions follows, and argumentation supporting internet-based interventions is made. Before revealing the results and following discussion, Mamma Mia and methods is elaborated.

Attachment Theory

Attachment theory can be defined as

a theory that (a) postulates an evolutionarily advantageous need, especially in primates, to form close emotional bonds with significant others: specifically, a need for the young to maintain close proximity to and form bonds with their caregivers; and (b) characterizes the different types of relationships between human infants and caregivers. These relationships have been shown to affect the individual's later emotional development and emotional stability. (American Psychological Association [APA], 2007).

This definition points out how people, from the very beginning, are dependent on close relationships with others, mainly caretakers, to survive. It also points out that these relationships are dyadically unique and have lifelong effects on emotional and social development. The theory has become one of the most influential in developmental

psychology and is the result of the combined efforts of John Bowlby, and Mary Ainsworth (Bretherton, 1992).

Two of the main components in attachment theory are *inner working models* and *sensitive caregiving* (Bowlby, 1983; Ainsworth, Blehar, Waters, & Wall, 1978). Inner working models develop through frequent interaction with caregivers and guide our later understanding of the world, including the self and social relationships (Herring & Kaslow, 2002). The theoretical concept of relatively enduring working models is a way of explaining how our first experiences with others can affect us all the way into adulthood. This duration and stability of attachment has been demonstrated by a longitudinal study (Waters, Merrick, Treboux, Crowell, & Albersheim, 2000), and is further supported by biogenetical research showing that mother-infant interaction creates fundamental neurological circuits in the brain (Schore, 2005; Propper & Moore, 2006). Sensitive caregiving is a term for a series of behaviors typically described in parents with securely attached children (De Wolff & Ijzendoorn, 1997; Herring & Kaslow, 2002). Sensitive mothers are described as predictable, available, responsive, and adaptive to their children's signals (Tetzchner, 2013; Fearon, Bakermans-Kranenburg, van Ijzendoorn, Lapsley, & Roisman, 2010), resulting in children who cry less, explore more, are more emotionally stable, and have better harmony with others, including their mothers (Crockenberg, 1981; Bretherton, 1992; Tetzchner, 2013). Such sensitivity helps creating healthy inner working models, and these children often have less social and emotional difficulties both in childhood and later (Herring & Kaslow, 2002; Tetzchner, 2013).

Plenty of research seems to affirm the theoretical framework of attachment. For example, Belsky and Fearon's (2002) findings showed that the most competent 3-yearolds were the ones who had experienced sensitive mothering, and thereby secure attachment, during the first months and years of life. In addition, many studies have shown how sensitive caregiving and secure attachment typically is related to good mental health and developmental outcomes, such as affect-regulation, conscience, language and cognitive functioning, mentalization, and self-regulation (Schore, 2001; Schore, 2005; Laible & Thompson, 2000; Baumwell, Tamis-LeMonda, & Bornstein, 1997; Camoirano, 2017; Powell, Frankel, Umemura, & Hazen, 2017). Secure attachment appears to be a protective factor in mental health (Oliviera & Costa, 2009). Conversely, less sensitive parenting more often results in insecure attachment (Herring & Kaslow, 2002; Tetzchner, 2013). Less securely attached children often have behavior problems characterized by avoidance, ambivalence, dependence,

fearfulness, anger, and rigidity (Tetzchner, 2013; Fearon et al., 2010; Cherry, 2017). These qualities are more often related to developmental and relational dysfunction. Oliviera and Costa (2009) write about how mental health is inversely correlated with insecure aspects of attachment like ambivalence and dependence, while Szalai, Czeglédi, Vargha and Grezsa (2017) elaborate how dysfunctional attachment can contribute to abnormal personality functioning and vulnerability to psychopathological symptoms like: stress-sensitivity, anxiety, negative emotions, depression, and negative global self-esteem, as well as lower body satisfaction in adolescents. These findings suggest that less sensitive parenting can lead to insecure attachment styles, which may leave children vulnerable to a variety of psychological difficulties.

Most of this research have been done in children and has been well documented and established. Recently though, Rennebohm, Seebeck & Thoburn (2017), in line with attachment theory, stated that *adult* working models are reflections of early caregiving experiences, and they view these models as relatively stable over time. Several studies show how securely attached adults tend to be more satisfied in their relationships, highlighting how early attachment lay the groundwork for relational functioning throughout life (Hazan & Shaver, 1987; Feeney & Noller, 1990; Givertz, Waszidlo, Segrin, & Knutson; Chung 2014), and underlining the significance of relational experiences in the first years. Other studies have found that insecure attachment is related to perinatal depression (Ikeda, Hayashi, & Kamibeppu, 2014; Santona et al., 2015).

To further demonstrate the repercussions attachment can have, recent studies have shown that parent attachment is related to child attachment. Powell et al. (2017) proposes that parents own attachment orientation may affect how they respond to their children. Specifically, they relate this to eating, showing how anxiously attached parents use feeding practices that affect children's self-regulation in eating, possibly increasing the risk of obesity. Crittenden, Robson, Tooby, and Fleming (2017) studied attachment-relations in 5-6-yearolds, to complement the findings of related mother-infant-attachment. Crittenden et al. illustrated that mother's attachment strategies relates to their preschool-aged children's strategies. It also seemed as the mother's strategies were related to *their* own father's strategies, illustrating the way attachment bonds can have an effect across generations.

Perinatal Depression, Temperament, and the Transactional Model

Evidently sensitive parenting and secure attachment are protective factors of mental health and development, with possible repercussions lasting a lifetime. Several factors contribute to caregivers' capacity to be sensitive. Parents' own attachment experiences, life stresses, relationship satisfaction, physical and mental illness, are all factors affecting the quality of caregiving. No matter the quality, children has no other choice than to adapt to the caregiver. Øvreeide and Hafstad (2016) describe how the caregiver-child-relationship, even in a transactional process, is skewed when it comes to dependency and ability to take responsibility for oneself and one's actions. This skewedness of power is of natural necessity as the child is incapable of caring for itself but requires that caregivers possess the capability to put the child's interests above their own. Most parents are in fact capable of appropriate caring for their child. Even so, the mentioned contributing factors challenge caregivers' sensitivity. As mentioned, 10-15% of the Norwegian perinatal population experience perinatal depression. Perinatal depression has been found to predict less sensitive caregiving (Santona et al., 2015). Being sensitive demands grate flexibility and the ability to adapt to the continuity of change that is child development. For many people struggling with depressive symptoms, it is difficult to perform such flexibility. Depressive symptoms can affect caregivers' ability to interpret and mentalize around children's temperamental cues, or behavioral signals, proven to be important in parent-infant-attachment (Zeegers, Colonnese, Stams, & Meins, 2017; Camoirano, 2017; Quitmann, Kriston, Romer, & Ramsauer, 2011). By interfering with the quality of mother-child interactions (Field, T., 2010) perinatal depression constitutes a risk-factor (Carr, 2016) in attachment development and by extension, the health of both mother and child.

It is important though to emphasize that attachment development is not solely dependent on the behaviors of the mother or primary caregiver. Children form attachment-bonds to different people in different stages of their lives, which is both affected by and contributing to the alterations of early working models. Also, all children are born with individual differences in behavior patterns, known as *temperament*. Both genetics and the uterine environment during pregnancy form a basis for initial self-regulation, affecting how infants react to sounds, light and touch, their tolerance for stress, and their ability to take in and respond to caregiver's efforts (Olafsen, 2016). Temperament as such, can be described as the child's own contribution to its environment and development (Smith, 2016; Crockenberg, 1981). Parents and infants use each other's signals to guide their behaviors, learning from and

adapting to each other, in what is called a mutual *transactional process* (Sameroff, 1975; Smith, 2016). As such, the emerging quality of attachment can be more dependent on matching behaviors than what behaviors are right and wrong. This matching is also known as “goodness of fit” (Olafsen, 2016). It is, for instance, easier to exhibit sensitivity towards a child when signals are clear, and response is quick and happy, compared to children who seem to cry for no reason and takes long to respond (Pederson et al., 1990). Olafsen (2016) presents studies showing some connections between difficult temperament and later developmental problems. At the same time, demanding signals, like heavy crying, could be a protective strategy for the infant, especially if caregivers fail to detect milder signals.

The concepts of perinatal depression and temperament illustrate that both child and caregiver characteristics affect the transactional process, which is the foundation of the attachment bond between them. As the first months of a child’s life is where this foundation is formed, it is important to initiate interventions at an early stage of parenthood, e.g. the perinatal phase. Such early interventions enable us to prevent dysfunctional development and promote good health. Parents have greater abilities to change and affect both their own and their child’s behavior and, as mentioned in the introduction, are usually motivated to facilitate child-beneficial changes. This makes perinatal women natural subjects for interventions targeting attachment.

Attachment Interventions

Attachment is a theoretical concept that refers to the *relational process* that occurs between a child and its caregiver. As outlined above, the attachment-bond is the result of our experiences with each other and is therefore indirectly affected by the things we do to or with each other. To affect attachment then, arguable one has to direct interventions towards the actual behaviors involved in a caregiver-child-interaction. Indeed, this has been the strategy of several interventions aiming to strengthen attachment.

Wright and Edginton (2016) recently did a review and a meta-analysis on various interventions targeting dysfunctional attachment, in clinical practices. 30 studies were included in the review. Inclusion criteria were interventions aimed at primary caregiver-child-attachment as outcome, where caregivers of children with, or at risk of, severe attachment problems were the population of interest. The mean age of the child population had to be under 13 years old. Only RCT-studies were included. 21 of the 30 reviewed studies were included in a meta-analysis. All interventions aimed to promote healthy attachment, and the

main goal of Wright and Edginton's paper was to provide an overview of the effectiveness of these interventions.

Overall, the interventions resulted in statistically significant improvement in secure attachment and reduction in dysfunctional attachment, though there were variability between studies. Although all the interventions in this review had many of the same components, including face-to-face meetings with deliverers, home visits, video-feedback, psychoeducation, and observational skills, a few things separated the non-effective from the effective ones. Based on my own observations, the interventions showing healthy changes in attachment typically seemed more focused on affecting the parent-child-interaction. Especially they focused on enhancing skills typically related to sensitive parenting, like how to read, understand, respond, and adapt to, the child's signals. Studies *not* showing a significant change in attachment often had interventions with more focus on the mothers' feelings and experiences, rather than the dyad, compared to the significant ones. These studies also had greater variability in intervention-deliverers levels of experience, while effective interventions mostly included mental health professionals. It is interesting that studies targeting populations with higher rates of pathology, had fewer non-significant results. A possible explanation is that high-pathology populations might have a greater potential and need for the interventions, therefore obtaining greater effects.

Internet-based Interventions

Despite variabilities among interventions, attachment *is* changeable for the better, according to Wright and Edginton's review (2016). It seems that one of the most important aspects in doing so, is by supporting mothers' skills in sensitive parenting and focusing on the mother-child-interaction rather than the mother alone. Preferably a mental health professional should deliver the intervention, as opposed to someone less experienced. All the interventions included in the review applied a face-to-face approach. This approach enables close/direct psychoeducation and follow-up but are not without limits. Interventions require longitudinal designs. They vary in comprehensiveness but demands a substantial amount of time and resources either way (Erbe, Eichert, Riper, Ebert, 2017). There are often many sessions over months, even years, that require attendance of both professionals and caregivers. This involves a lot of traveling and investment for both parts. Especially caregivers, having their lives transformed by the new family member, might be overwhelmed by the time-consumption. In addition, many parents fear a sense of stigma if they need to see a therapist.

The face-to-face approach offers little anonymity and might intensify feelings of stigma and prevent participants from completing sessions. In addition, there are monetary consequences related to travelling and payment of health-professionals. Indeed, at the end of their review Wright and Edginton (2016) urge researchers to find cost-effective solutions.

Missing from the attachment literature, is a readily accessible, easy to use, low cost, - intervention. A solution for this could be *internet-based* interventions. Internet-based interventions offer solutions to many of the disadvantages with face-to-face interventions (Donker, Cuijpers, Stanley, & Danaher, 2015; Erbe et al., 2017). They enable parents to receive guidance within the comforts of the home, at a time suitable to their own schedule and energy-level. With the internet being continuously elaborated all over the world, it's easy to access, as well as cost effective, and can be administered over long distances, compared to face-to-face-initiatives. In addition, the internet offers anonymity and protection from stigma linked to health issues, like perinatal depression, hindering women in obtaining help. What is more, internet is the preferred source of information for perinatal women (Osama et al., 2016). The fact that Milgrom and Gemmill's (2013) study in just four weeks of open recruitment had over 1400 applicants to their internet-trial, targeting postnatal women struggling with depressive symptoms, can be interpreted as a clear sign that perinatal women are in high demand of online treatment.

There is a large body of research suggesting that internet-interventions work and that outcomes of these treatments for common mental disorders, are similar to face-to-face interventions (Andersson & Titov, 2014; Barak, Hen, Boniel-Nissim, & Shapira, 2008; Erbe et al., 2017). Additionally, a recent meta-study (Sander, Rausch, & Baumeister, 2016) show promising use of internet-based interventions on mental health, as a preventive tool. Such interventions have been developed for the perinatal phase as well. One study showed preliminary positive results in internet-interventions targeted at improving mental health at this stage (Ashford, Olander, & Ayers, 2016). Another proposed that web-based therapy may play a role in improving maternal mood (Lee, Denison, Hor, & Reynolds, 2016). Others have shown similar affects (Donker et al., 2015). These are optimistic findings, suggesting that internet-based interventions can be both preventive of mental health issues, like depressive symptoms, and promotive of well-being perinatally. In combination with outlined research in the present article, internet-based interventions targeting the perinatal phase could be beneficial for attachment- and child development as well, through their support of the mother.

Mamma Mia

Mamma Mia is such a perinatal-focused internet-based intervention. Tailored for Norwegian women, Mamma Mia provides an innovative self-help supplement in the perinatal phase. Norway has a well extended, not too expensive, public internet access across the country, making it ideal for internet-based interventions. As well as possessing the general benefits of internet-interventions, MM targets perinatal women in general, making it a universal-preventive program. A report compiled by the Norwegian Public Health Institute (Folkehelseinstituttet [FHI], 2011), concerning evidence-based recommendations for health-preventive measures, endorse universal interventions, including internet-based interventions. The report concludes that such interventions can be both preventive and symptom-reducing at a populational level. By branching out to all members of the target population, in this case perinatal women, one has the possibility to reach more people in need which otherwise might not get help.

Content Development of Mamma Mia

Mamma Mia (MM) was developed by the Center for Child and Adolescent Mental Health, Eastern and Southern Norway (RBUP). The intervention has three main purposes: promoting good mental health, particularly well-being, in the perinatal phase; prevention of perinatal depression; and supporting women in the process of becoming a mother (for a complete description of the intervention, see Drozd, Haga, Brendryen, & Slinning, 2015). While directly targeting the women, MM indirectly affects their infants as well, making the intervention beneficial for both mother and child. The program is an unguided, universal intervention that includes themes believed to have an impact on mental health during and after pregnancy. Examples of included themes as depression-symptoms, subjective well-being, relationship satisfaction, parental self-efficacy/stress, attachment, social support, child characteristics such as temperament and sleeping pattern, expectations, and stressful life events. These themes were selected based on theory of determinants for perinatal mental health, as well as research, and feedback from Norwegian perinatal women (Haga, 2011). Health determinants are individual or environmental risk- and protective factors, contributing to or reducing, illness, and are emphasized in deciding what variables to target when interventions are developed (FHI, 2011). In developing MM, health determinants were collected through a needs assessment. A needs assessment is the first step of Intervention Mapping, which MM is based on. Intervention Mapping (IM) is a step-by-step procedure on

how to develop interventions, where the goal is to help planners create an intervention that is theory- and evidence-based (Bartholomew, Parcel & Kok 1998; Bartholomew, Parcel, Kok, Gottlieb & Fernández, 2011). There are 6 steps to IM, overviewed in Appendix 1. According to Bartholomew et al. (2011), IM has been successfully applied in health promoting programs across many settings.

MM consists of three phases in an overall period of 11,5 months. MM is delivered to the intervention group through a total of 44 online sessions covering several perinatal specific themes. The first phase starts in the second trimester, stretching from gestational week (GW) 22-25, till GW 37, consisting of 11 online sessions. The second phase, the most intensive phase, begins when the infant is 2-3 weeks old and lasts for 6 weeks, with three sessions a week. Finally, the third phase lasts for about 18 weeks, with 10 sessions spread across them. Following a step-by-step principle, the women are guided through the program, having to complete each session to access the next. This is done to gradually prepare women for the psychological aspects of motherhood and ensure that relevant information has been reviewed, as well as create continuity throughout the program. Each session is designed to take approximately 10 minutes to complete. A feasibility-study of MM was conducted in 2012, showing good user-acceptance and satisfaction (Haga, Drozd, Brendryen, & Slinning, 2013)

Mamma Mia and Attachment

For the purpose of this paper the most important aspects of MM are its effects on attachment. MM tries to build healthy attachment-relations by targeting the interaction between mother and child, particularly through supporting the mother. The intervention attempts this by increasing mothers' knowledge and understanding of their child, especially the importance of early interactions on developmental outcomes. These abilities are taught in line with the psychoeducative principles of the Newborn Behavioral Observation (NBO) and Circle of Security (COS) procedures. Both NBO and COS are interactional techniques developed to strengthen the child-caregiver-bond, by helping caregivers understand their baby's unique signals. NBO has its primary focus on the first 3 months after birth. It's a strength-based system, rather than targeting pathology, and the principle is that early experiences drive development and later function. NBO helps parents see their newborn as a person, describing and demonstrating infant individual capacities and vulnerabilities, so parents can appreciate and adapt to their baby's unique needs (Nugent, 2015). Studies have shown that NBO can increase parental knowledge, understanding, and self-efficacy, parent-infant engagement, and

even reduce perinatal depressive symptoms (Nugent, 2015; Nugent, Bartlett, Von Ende, & Valim, 2017). In a recent study (Nugent et al., 2017), the authors demonstrate how NBO seems useful in enhancing both infant and mother sensitivity, promoting positive mother-infant relations.

COS is closely related to attachment principles, helping parents understand the importance of and connections between their child's and their own attachment experiences (Torsteinson, Brandtzæg & Powell, 2016). COS emphasize both general and specific understanding of children's emotional and relational needs and can serve as a tool in all stages of childhood. To demonstrate children's needs for both support and autonomy in development, a graphical model is used (Appendix 2). The model visualizes the dualistic role of the parent as both a secure base and safe haven, meaning that children need parents support in exploring the environment as well as a reassurance of comfort and protection when overwhelmed. The model illustrates how parents help children accept, organize, and expand their experiences, calling the need for sensitivity. It is implied that parents are the ones facilitating relational change. COS also promote empathy towards infants' behavior within the parents, explaining typical outcomes when children's needs are not met. COS invites parents to observe their own behavior and its impact on attachment.

Both NBO and COS were originally designed to guide helpers in helping parents, through psychoeducation, observations, and feedback, in a face-to-face fashion. As MM is an internet-based self-help program, mostly the psychoeducational principles are used, but illustrating videos and exercises are also included in an attempt to promote mastery.

Aim of the Study

This paper's main goal is to examine whether MM influences mothers perceived attachment towards their babies. This is important because early attachment experiences influence general development and relational functioning throughout the lifespan. Secure attachment is a protective factor of mental health for both mother and child, a bond that is co-created through the parent's ability to be sensitive, and the child's temperament. Targeting caregiver-child interaction through the mother, MM hopefully will increase positive interactions and affect attachment for the better. The main hypothesis is that the level of attachment will differ between treatment and control group, with "better" scores for women who received MM. Second, I investigate whether the effect of Mamma Mia changes over time.

It might be that women who struggle more with perceived attachment, difficult child temperament and depressive symptoms at the beginning of parenthood, have greater potential for improvement, getting better usage of MM. In order to investigate this, three supplementary analyses are included. In the third question I examine if the impact of Mamma Mia on attachment is affected by initially reported levels of postnatal attachment. At last I examine whether the impact of Mamma Mia on attachment is moderated by the level of depressive symptoms and child temperament reported at 6 weeks postpartum. Research questions are summarized and specified in Table 1.

Table 1.

Summary of the Specific Research Questions.

Research questions
1. Examine whether women who complete Mamma Mia differ in attachment compared to women in the control group.
2. Examine whether the effect of Mamma Mia on attachment change over time.
3. Examine if the level of reported attachment at 6 weeks postpartum affects attachment development over time differently in the two groups
4. Examine possible moderating effects of reported child temperament at 6 weeks postpartum on development of attachment over time, comparing groups.
5. Examine possible moderating effects of reported depressive symptoms at 6 weeks postpartum on development of attachment over time, comparing groups.

Methods

Sample Collection Procedure

Recruiting began in December 2013 and the data collection was completed in spring of 2016. Participants were recruited via ultrasounds in Norwegian hospitals, well-baby clinics, and through the internet, social media, magazines, and pamphlets. Target population was all pregnant women in Norway. Two exclusion criteria were applied: women had to be 18 years or older and be able to read and understand Norwegian well. Interested participants were referred to a web-site with further information. Here participants had to confirm that they had

read the information and submit the informed consent. Then participants reported demographical data, such as age, socioeconomic status, education, marital status and estimated due date. Based on the estimated due date, it was calculated when participants were between gestational week (GW) 22-25, or baseline, receiving the initial questionnaire.

1590 women submitted the informed consent. Out of these, 1342 completed the baseline questionnaire and were in turn randomized into two groups – control and intervention. The control group received treatment as usual (TAU) and the intervention group received MM in addition to TAU. Randomization resulted in 664 participants in the control group and 678 in the intervention group. In the present study, the total sample size is 609, 339 in the control group and 270 in the intervention group. The reason for this reduction in sample size is that attachment is measured at several points in time. Only participants who completed all measurements of postnatal attachment were included in the analyses. The main benefit of excluding non-completers was to examine effects over a year, which enabled one to detect patterns of perceived attachment over time.

All assessments were done through internet-based surveys and all the participants, both control and intervention, completed the same questionnaires at the same six measuring points. The first measure (T0) was done at baseline (GW 22-25). T1, the first follow-up, was done in GW 37, while follow-up T2, T3, T4 and T5 were measured 6 weeks, 3 months, 6 months, and 12 months postpartum, respectively. This means that there were two measures conducted during pregnancy, and four measures conducted after birth. Variables assessed during pregnancy included depressive symptoms, subjective well-being, relationship satisfaction, breastfeeding self-efficacy, prenatal attachment, social support, expectations, stressful life event, and demographical data. Variables assessed after birth included depressive symptoms, subjective well-being, relationship satisfaction, breastfeeding self-efficacy, attachment, social support, parental stress, stressful life events, maternal self-efficacy, child temperament, and the child's sleeping pattern. Notice that parental stress, maternal efficacy, child temperament and child sleeping pattern, has been *added*, while expectations and demographical data has been *removed*, from pre- till post-birth assessments.

Measurement Instruments

To answer the research questions, measures of pre- and postnatal attachment, depressive symptoms, and child temperament were used. Postnatal attachment was the main outcome variable of interest.

Pre- and Postnatal Attachment

Prenatal attachment was measured by *The Prenatal Attachment Inventory* (PAI; Muller & Mercer, 1993). PAI was developed to emphasize affiliation in prenatal attachment, rather than merely behaviors. With PAI, women self-report on 21 items, scored on a 4-point scale where 4=almost always, 3=often, 2=sometimes, 1=almost never. As such, the maximum and minimum scores are 84 and 21, respectively. Higher scores indicate greater prenatal attachment as reported by the mothers. Muller and Mercer (1993) reported PAI as a valid and reliable measure of prenatal attachment. In the present study, the reliability estimated by Cronbach's Alpha was .901 at baseline.

Postnatal attachment was measured by a short version of the subscales in *The Parenting Stress Index* (PSI; Doll, 1989). The PSI assesses the degree of stress parents experience caring for their child. It was developed to help identify dysfunctional parent-child relationships, potentially harmful to child emotional development. In this short version, PSI was scored on the 3 following items: "How easy is it for you to understand what your child wants and needs?", "It takes a long time for parents to develop close, strong feelings towards their children", and "I expected having stronger warmer feelings towards my child than I do, and that worries me" (my translation). The first item was scored on a 5-point scale, from usually I do not understand the problem (5) to very easy (1). The two following items were scored on a 5-point scale from strongly disagree (5) to strongly agree (1). 15 was the maximum and 3 was the minimum score. Higher scores indicate higher dysfunction. Dysfunction can come from two sources: the parent does not feel emotional closeness to the child, or the parent has a real or perceived inability to understand and meet the child's needs. Indirectly one can say that lower scores indicate better parenting sensitivity, or healthier attachment. In her review of the PSI, Doll (1989) reported reliability at .95 from the PSI manual. Good validity was also reported. In this study, Cronbach's Alpha varied between .664 and .564 from T2-T5. This is slightly lower than .70, which is the minimum norm for good reliability. Yet, it is difficult to achieve high scores of reliability with only three items. As such, reliability scores around the .60-range were perceived to be acceptable in this case.

Comparison of pre- and postnatal attachment was done separately. As correlations between PAI and PSI were relatively small and negative (Table 3.) conversion to Z-scores, or a single attachment-scale, was considered meaningless. As postnatal attachment has several measures over time and involves more direct interaction between the mother and the infant, focus was put on the PSI as the main outcome variable of attachment. Statistical analyses

involved all measuring points (T2-T5), and 6 weeks postpartum (pp.) is considered the “baseline” of postnatal attachment. PAI was merely used as grounds for comparison of attachment, thus only baseline scores (T0) of the PAI were included in the statistical analyses.

Child Temperament

Child temperament, or emotional reactivity, was measured by the 9-item fussy-difficult subscale of *The Infant Characteristic Questionnaire* (ICQ; Bates, Freeland & Lounsbury, 1979). The origin of ICQ was the need for a valid way to measure child temperament, for the purpose of longitudinal studies of difficult infants. Research at the time hypothesized difficult child temperament to elevate the risk for later behavior problems. It also suggested parent ratings to be useful in identifying temperamental differences in children. As such, the ICQ, through parents’ reports, was developed to help identify children with difficult temperament. The ICQ enables the possibility of preventive actions through its detection-qualities. The total number of items in the ICQ is 24, distributed over four subscales. Particularly the fussy-difficult subscale, applied in MM, have been found to have adequate reliability over time (Bates, Freeland & Lounsbury, 1979). In this study, Cronbach’s Alpha was estimated to be .805 at 6 weeks pp. Item-ratings are done on a seven-point Likert scale, from totally disagree (1) to totally agree (7). With the fussy-difficult scale consisting of 9 items, lowest possible score is 9, while highest possible score is 63. Higher scores indicate more difficult child temperament. Only the scores at 6 weeks pp. was included in the statistical analyses. 6 weeks pp. was the baseline for child temperament, as well as postnatal attachment. The scores were used to investigate moderating effects of initially reported temperament on the development of attachment over time.

Depressive Symptoms

Symptoms of perinatal depression were measured by *The Edinburgh Postnatal Depression Scale* (EPDS; Cox, Holden & Sagovsky, 1987). EPDS was developed in reaction to the fact that well established depression scales were limited in its accuracy of detecting perinatal depression. It was hypothesized that ordinary complications of childbearing and childbirth, such as physical pain and fatigue, are understood as depressions symptoms in older scales, detecting many false positives among perinatal women. The EPDS is a self-report instrument, estimating PPD-symptoms during the last 7 days. It consists of 10 items scored on a 1-4 scale. In this dataset though, answers were coded 0-3, making the minimum score 0 and the

maximum score 30. Higher scores indicate greater risk for depression. Cox, Holden and Sagovsky, reported satisfactory validity and split-half reliability. In the present study, Cronbach's Alpha was estimated to be .844 at 6 weeks pp. EPDS-scores measured at 6 weeks pp. was included in the statistical analyses to see whether depressive symptoms reported at initial postnatal attachment, moderate development of attachment over time.

Statistical Analysis

The statistical analyses were executed using IBM-SPSS version 25. A correlation analysis was executed to investigate the relationship between instruments. An independent samples *t*-test was applied to examine differences in mean scores at the same measuring points, between the Mamma Mia- and the control group. Analysis of variance, more specifically a mixed design ANOVA, was applied to examine the development of attachment in the two groups over time, making it a combined between groups- and repeated measures design. This kind of analysis enables one to examine several effects at the same time. For this study, that includes:

- *Time*: whether the average scores on attachment changes over time in general. No separation between intervention and control groups is made here.
- *Time x intervention*: whether there is a difference in development of attachment between the intervention and control groups over time.
- *Time x initial attachment x intervention*: whether the development of attachment over time is moderated by initial attachment, and possible differences between groups. One investigates if development is different for mothers reporting low, moderate, or high scores of attachment dysfunction at 6 weeks postpartum, and whether mothers reporting high scores especially benefit from the intervention.
- *Time x temperament x intervention*: whether development of attachment over time is moderated by child temperament, and possible differences between groups. One investigates if development is different for mothers reporting low, moderate, or high scores of child temperament at 6 weeks postpartum, and whether mothers reporting high scores especially benefit from the intervention.

- *Time x depression x intervention*: whether development of attachment over time is moderated by mothers' depression symptoms, and possible differences between groups. One investigates if development is different for mothers reporting low, moderate, or high scores of depressive symptoms at 6 weeks postpartum, and whether mothers reporting high scores especially benefit from the intervention.

To trust the significance test of the mixed design ANOVA-analyses, some assumptions must be met. The most important is the premise of sphericity. This means that the variance in changes in scores from time 1 till time 2, must be the same as changes from time 2 till time 3, and so on. This premise was not met in the analyses presented in the results below but was easily corrected by the use of Greenhouse-Geisser correction. The reported significance values are therefore based on the Greenhouse-Geisser correction (Field, A., 2013).

I used the total mean scores, subtracting or adding the standard deviation (SD), to calculate low, moderate and high scores of postnatal attachment, child temperament and depression symptoms at 6 weeks pp. Low scores ranged from minimum score – mean minus SD, for each instrument. High scores ranged from mean plus SD – maximum score, for each instrument. Moderate scores fell in between (mean minus SD – mean plus SD). See Appendix 3 for concrete calculations. Low/moderate/high-distributions within the groups are displayed in the results-section (Table 6). In this study, the purpose of separating scores into categories, was to illustrate the initial distribution of higher and lower scores within the groups at postnatal attachment baseline, and whether this affected attachment development over time. This does not necessarily mean that high scores indicate clinical levels. Neither the 3-item PSI or 9-item ICQ has any standardized cut-off scores to separate low, moderate, and high reports. The EPDS have some suggestions. Matthey, Henshaw and Elliott (2006) recommend a cut-off score of 13 or higher to detect depression in postnatal English-speaking women. At the same time the authors recommend careful use of this cut-off with non-English-speaking women. Based on this, and the fact that MM does not set out to detect clinical groups, the described method was applied. The mean +/- SD is also a way of avoiding too few or too many in the high- and low-groups.

When investigating the relationships between instruments (Table 3), correlations were considered weak at .10-.29, moderate at .30-.49, and strong at .50-1.00 (Cohen, 1977; Field, A., 2013, p. 267).

Results

Demographical Distribution

Table 2 shows the demographical distributions of age, number of children, education level, and relationship status within the two groups. There were no significant difference between groups in age, number of children, level of education, or relationship status. On average women in both groups were around 31 years of age and over 60% of the women were first time mothers. In both groups, the main portion of women had higher education, with around 90% having completed 1 year or more in university or college. When it comes to relationship status, most women were in a relationship. Only 3-4% of the women were raising their child alone.

Table 2.

Demographical distributions within each group.

Demographics	Mamma Mia			Control Group			<i>p</i> -value
	<i>N</i>	Mean/%	<i>SD</i>	<i>N</i>	Mean/%	<i>SD</i>	
<i>Age</i>	270	30.96	4.64	339	31.41	4.34	.221 ^a
<i>Number of children</i>							
First time mothers	179	66.3%		208	61.4%		
Previous children	91	33.7%		131	38.6%		.574 ^b
<i>Level of Education</i>							
Primary school	3	1.1 %		2	0.6%		
High school	23	8.5 %		39	11.5%		
1-3 years uni/college	85	31.5 %		94	27.7%		
4-5 years uni/college	79	29.3%		108	31.9%		
>5 years uni/college	80	29.6%		96	28.3%		.566 ^b
<i>Relationship status</i>							
Married	121	44.8%		131	38.6%		
Cohabitant/partner	139	51.5%		195	57.5%		
Single	10	3.7%		13	3.8%		.303 ^b

Note: *p*-value is significant at the 0.05 level. ^a Based on *t*-test; ^b Based on Chi-square

Instrument Correlations

A correlational analysis (Table 3) was conducted to examine the relationship between the different measurement instruments and the relationship between the same measures over time. Because there were only trivial differences in correlations between the intervention and control groups, correlations based upon the total sample is presented.

Table 3.

Correlational matrix between measurement instruments based on the total sample

	Mean	SD	1	2	3	4	5	6	7
<i>1: PAI</i>									
Baseline	53.32	11.1	1						
<i>2: PSI</i>									
6 uker pp.	5.65	1.99	-.251**	1					
<i>3: PSI</i>									
3 mnd pp.	5.20	1.81	-.285**	.717**	1				
<i>4: PSI</i>									
6 mnd pp.	4.99	1.67	-.267**	.653**	.747**	1			
<i>5: PSI</i>									
12 mnd pp.	4.83	1.71	-.276**	.648**	.707**	.741**	1		
<i>6: ICQ</i>									
6 uker pp.	25.74	8.39	-.145**	.375**	.407**	.352**	.344**	1	
<i>7: EPDS</i>									
6 uker pp.	5.41	4.16	-.057	.427**	.393**	.296**	.349**	.363**	1

Note: **. Correlation is significant at the 0.01 level (2-tailed). $N=609$. PAI=Prenatal Attachment Inventory; PSI=Parenting Stress Index; ICQ=Infant Characteristic Questionnaire; EPDS=Edinburgh Postnatal Depression Scale

PAI at baseline was negatively corelated with every measure of the PSI which means that high PAI-scores and low PSI-scores co-occurred. Written out it means that when good prenatal attachment was reported, reports of attachment dysfunction went down. All correlations were relatively low, suggesting a weak relationship between the pre- and postnatal instruments. Statistically, this means that they do not tap the same phenomena, in this case attachment. The matrix shows that the same is true when it comes to PAI-correlations and the other instruments as well.

PSI had high positive correlations with itself on every measuring point, indicating it is stable over time. ICQ at 6 weeks pp. was positively correlated with all measures of the PSI, meaning that attachment dysfunction increase as child temperament gets more difficult and vice versa. Correlations were moderate to high, indicating a relatively strong association between reported attachment and child temperament. EPDS at 6 weeks pp. was positively correlated with all measures of the PSI, meaning that there is a connection between higher reports of depression symptoms and reports of higher attachment dysfunction. The relationship between EPDS at 6 weeks pp. and all PSI measures was moderate, indicating that higher depressive symptoms and attachment dysfunction is somewhat related to each other. The ICQ and EPDS at 6 weeks pp. were also moderately correlated, indicating that high or low reports of child temperament and depressive symptoms follow each other.

Baseline Attachment

To ensure comparability of attachment between the intervention and controls, the baseline levels of attachment within the groups, as measured by the PAI, was established. There was no statistically significant difference in prenatal attachment between intervention and control group at baseline (Table 4). This means that there was no systematic difference in attachment between groups before giving birth. Mean PAI-scores were 53.38 and 53.28, for MM and control respectively. As 6 weeks after birth is the baseline for postnatal attachment, one might also notice that there was no statistically significant difference between mean PSI-scores either, with mean scores of 5.52 and 5.74 for MM and controls respectively (Table 4.). These results show minimal difference in mean scores between the groups for baseline attachment, making them a secure basis for comparison.

Effects of Mamma Mia on Attachment

Table 4. shows descriptive distributions within the groups at the chosen measuring points in time for the attachment-instruments, and whether the difference in mean scores between intervention and control is statistically significant or not.

Table 4.

Descriptive distributions of PAI and PSI, comparing mean scores.

Measures	Mamma Mia			Control Group			<i>p</i> -value
	<i>N</i>	Mean	<i>SD</i>	<i>N</i>	Mean	<i>SD</i>	
<i>Prenatal Attachment (PAI)</i>							
Baseline, GW 22-25	270	53.38	11,35	339	53.28	10.88	.920 ^a
<i>Postnatal Attachment (PSI)</i>							
6 weeks pp.	270	5.52	1.99	339	5.74	1.99	.174 ^a
3 months pp.	270	5.11	1.73	339	5.27	1.86	.277 ^a
6 months pp.	270	4.93	1.59	339	5.04	1.74	.399 ^a
12 months pp.	270	4.79	1.75	339	4.86	1.68	.603 ^a

Note: *p*-value is significant at the 0.05 level. ^aBased on *t*-test. PAI=Prenatal Attachment Inventory; PSI=Parenting Stress Index

Overall, dysfunctional attachment decreased with time. Both groups showed generally low mean PSI-scores (min = 3, max = 15), and both had a steady decrease in mean scores from T2-T5. There is a consistent finding of the MM-group having lower mean PSI-scores than the control group. This group difference was, however, not statistically significant at any measuring point.

A mixed design ANOVA (Table 5) showed a statistically significant relationship between attachment development and time (“Time”), but no statistically significant difference between the two groups and attachment development over time (“Time x Intervention”). Group-comparison of attachment development over time is illustrated in Figure 1.

Table 5.

Mixed design ANOVA for the development of attachment over time.

	<i>df</i>	<i>F</i>	<i>p</i> -value
Time	3, 1821	74.9	<. 001
Time x Intervention	3, 1821	0.618	.590

Note: *p*-value is significant at the 0.05 level.

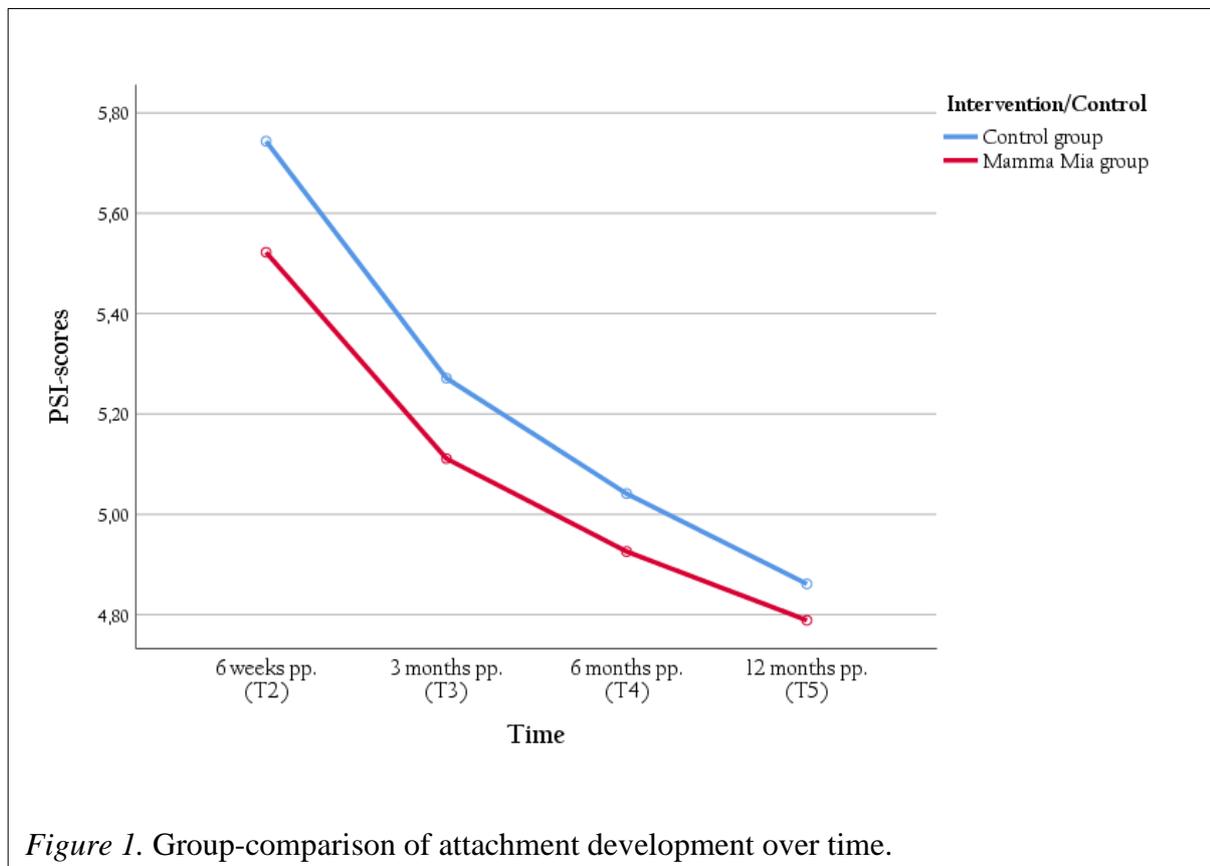


Figure 1 shows that there was a consistent difference in attachment between groups, with the intervention group scoring consistently lower. It also shows that the groups' slopes were the same over time, with a continuing decrease in PSI-scores. The attachment development over time was not different to a statistically significant degree.

Distribution of initial attachment, child temperament, and mothers' depressive symptoms at 6 weeks postpartum

Table 6 displays the number and percentages of intervention- and control-subjects who fell into the low, moderate, and high categories calculated in Appendix 3, for each measurement instrument at 6 weeks pp. These will be referred to as initial scores for each instrument.

Table 6.

Distribution of initial cores for each instrument within the two groups.

Initial scores	Mamma Mia		Control Group	
	<i>N</i>	%	<i>N</i>	%
<i>PSI</i>				
Low	106	39.3	112	33.0
Moderate	134	49.6	194	57.2
High	30	11.1	33	9.70
<i>ICQ</i>				
Low	38	14.1	47	13.9
Moderate	191	70.7	230	67.8
High	41	15.2	61	18.0
<i>EPDS</i>				
Low	80	29.6	77	22.7
Moderate	160	59.3	201	59.3
High	30	11.1	61	18.0

Note: PSI=Parenting Stress Index; ICQ=Infant Characteristic Questionnaire; EPDS=Edinburgh Postnatal Depression Scale

In general, there were few women who fell into the high-categories indicating greater difficulties. In the MM-group, around 11% reported high attachment dysfunction and depressive symptoms, while about 15% reported difficult child temperament. For the control group the attachment-reports were the same as for the intervention, but there were somewhat higher percentages (18%) falling into the high-categories of child temperament and depressive symptoms.

Effects of Initial Postnatal Attachment on Attachment Over Time

A mixed design ANOVA (Table 7) showed a statistically significant relationship between attachment development over time and reports of high, moderate, or low PSI-scores 6 weeks pp. (“Time x Initial attachment”). This means that the initial reported level of attachment affects the development of attachment over time, or where you end up with respect to attachment at 12 months postpartum. The table also shows that there was no statistically significant difference between the MM-group and the control group in terms of the effect of

initial level of attachment on the development of attachment scores over time (“Time x Initial attachment x Intervention”). Figure 2. illustrates the development of attachment over time in the MM-group, based on initial reports of attachment at 6 weeks pp. The MM-display only was chosen because attachment development was similar with respect to the intervention. The same consideration was made in displaying Figure 3 and 4 as well.

Table 7.

Mixed Design ANOVA. Significance level for attachment development over time and T2-PSI.

	<i>df</i>	<i>F</i>	<i>p</i> -value
Time	3, 1809	139.43	<. 001
Time x Intervention	3, 1809	1.67	.173
Time x Initial attachment	6, 1809	54.66	<. 001
Time x Initial attachment x Intervention	6, 1809	.994	.427

Note: *p*-value is significant at the 0.05 level.

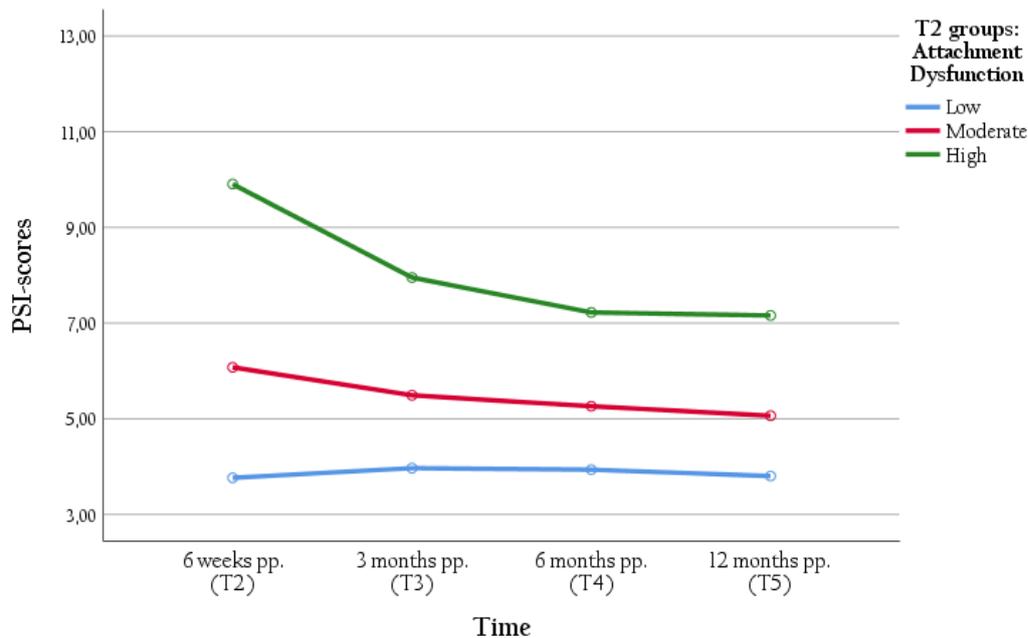


Figure 2. Attachment development over time as a function of PSI-scores at 6 weeks pp.

The initial attachment groups stayed the same in relation to each other over time. Initially high on attachment dysfunction had the highest level of PSI-scores on all four measurements in time. Those reporting the highest PSI-scores at 6 weeks pp. have a steeper decrease in attachment dysfunction over time, especially from 6 weeks pp.-3 months pp., compared to those reporting moderate and low PSI-scores at 6 weeks pp.

Moderating Effect of Child Temperament at 6 Weeks Postpartum

A mixed design ANOVA (Table 8) showed a statistically significant relationship between reported level of child temperament 6 weeks pp. and attachment development over time (“Time x Initial temperament”). This means that the initial reports of high, moderate, or low ICQ-scores affect the development of attachment over time, or where you end up with respect to attachment at 12 months postpartum. The development of attachment over time for the high/moderate/low-groups at 6 weeks pp. was not statistically different due to the intervention (“Time x Initial temperament x Intervention”). When the initial level of child temperament was controlled for, attachment development over time alone was no longer significant (“Time”). Figure 3. illustrates the development of attachment over time in the MM-group, based on initial reports of child temperament at 6 weeks pp.

Table 8.

Mixed Design ANOVA. Significance level for attachment development over time and ICQ.

	<i>df</i>	<i>F</i>	<i>p</i> -value
Time	3, 1812	1.96	.123
Time x Intervention	3, 1812	1.113	.340
Time x Initial temperament	3, 1812	4.80	.003
Time x Initial temperament x Intervention	3, 1812	0.88	.444

Note: p-value is significant at the 0.05 level.

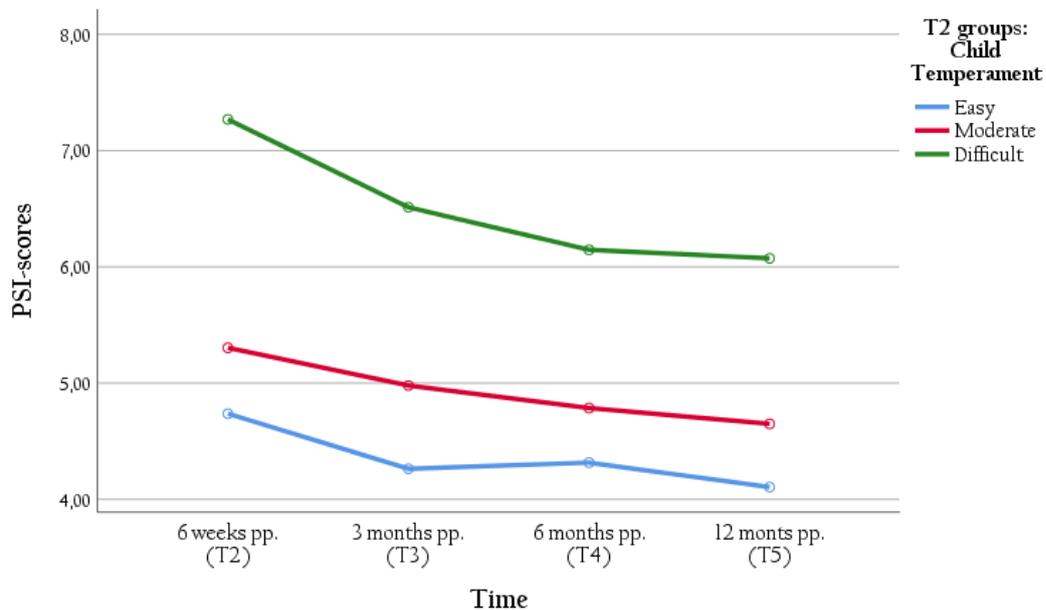


Figure 3. Attachment development over time as a function of ICQ-scores at 6 weeks pp.

The initial temperament groups stayed the same in relation to each other over time. Initially high on reported child temperament had the highest level of PSI-scores on all four measurements in time. Women who reported their children to have difficult temperament at 6 weeks pp., had a steeper decrease in attachment over time than those of initial moderate and easy temperamental children, especially from 6 weeks pp.-3 months pp.

Moderating Effects of Depressive Symptoms at 6 Weeks Postpartum

A mixed design ANOVA (Table 9) showed a statistically significant relationship between mother's reported level of depression symptoms 6 weeks pp. and attachment development over time ("Time x Initial depression"). This means that the reports of high, moderate, or low EPDS-scores affect the development of attachment over time. Attachment development over time in the high/moderate/low-groups, did not vary as a function of the intervention (Time x Initial depression x Intervention). Figure 4 illustrates the development of attachment over time in the MM-group, based on reports of depressive symptoms at 6 weeks pp.

Table 9.

Mixed Design ANOVA. Significance level for attachment development over time and EPDS.

	<i>df</i>	<i>F</i>	<i>p</i> -value
Time	3, 1815	9.66	<. 001
Time x Intervention	3, 1815	0.112	.944
Time x Initial depression	3, 1815	13.25	<. 001
Time x Initial depression x Intervention	3, 1815	0.56	.631

Note: *p*-value is significant at the 0.05 level.

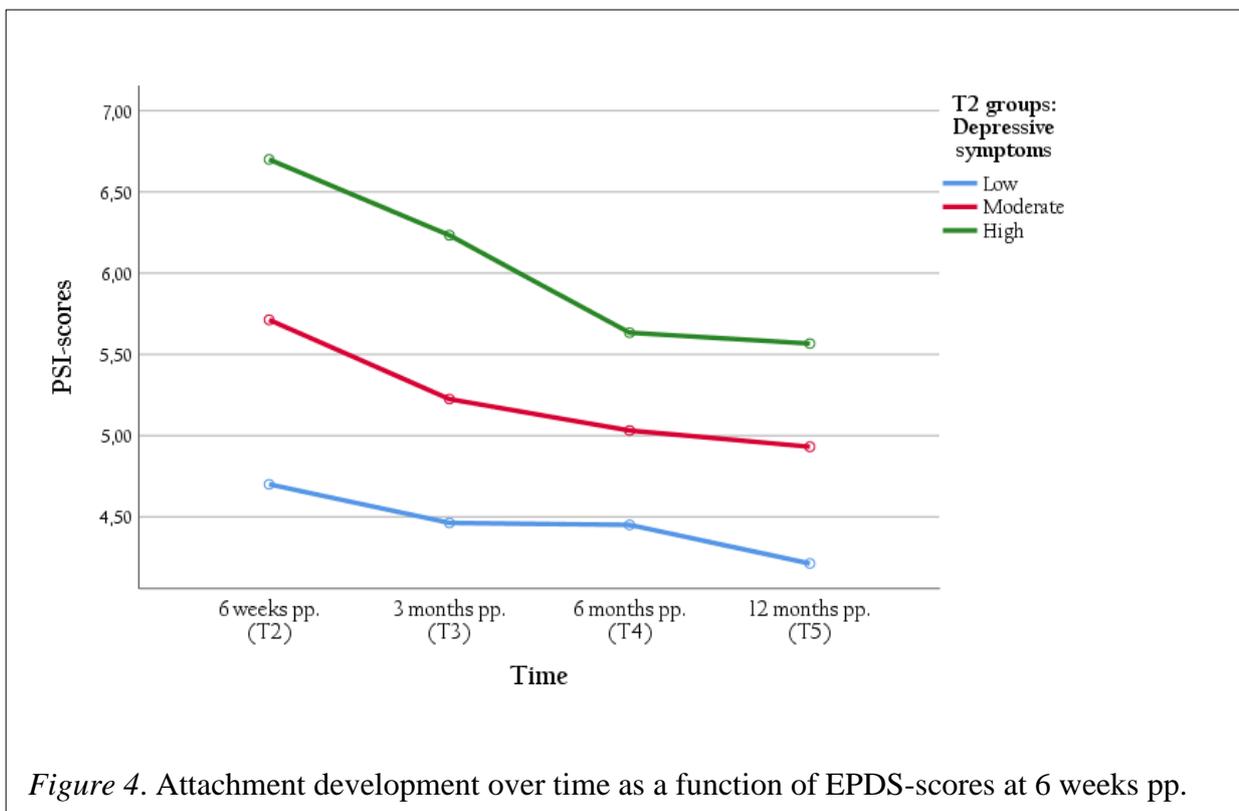


Figure 4. Attachment development over time as a function of EPDS-scores at 6 weeks pp.

The initial groups based upon depressive symptoms stayed the same in relation to each other over time. Initially high on depressive symptoms had the highest level of PSI-scores on all four measurements in time. Women reporting the highest depression symptoms at 6 weeks pp., had a steeper decrease in attachment over time than those reporting moderate and low scores, especially from 3 months pp.-6 months pp.

Discussion

I hypothesized that women who completed MM would show healthier attachment scores, or lower attachment dysfunction, than women in the control group. The results show that there is a consistent difference between the intervention and the control group when it comes to attachment development, where the MM-group have slightly lower PSI-scores, indicating healthier attachment, on every measuring point. This difference however, is not statistically significant.

The relatively strong relationships between instruments, except PAI, (Table 3) indicate that postnatal attachment, perinatal depression, and temperament affect each other, like suggested by the research elaborated in this paper. The development of attachment over time was significantly related to all three variables, meaning that whether you start out with high, moderate, or low scores affect where you end up with respect to attachment. All initial high/moderate/low-groups stayed the same in regard to each other, but the initial high-groups had a steeper decrease in attachment development over time, especially during the first months. This means that mothers who early on have higher attachment dysfunction, depressive symptoms, and temperamental children, experience more change in attachment for the better, than other women. The reason why attachment development over time no longer was statistically significant when the initial level of child temperament was controlled for (“Time”, Table 8), is probably because the change in attachment over time partly can be explained by the changes in the temperamental groups, particularly the high-group.

As for the group comparison, the effects of reported initial attachment, child temperament and depression symptoms at 6 weeks postpartum, was not statistically significant different between the intervention and control groups. Statistically, this means that there is no extra benefit for the high-scoring women to receive MM in order to achieve greater change in attachment development, even though the intervention group had consistently healthier scores.

In sum, it seems that there is a slight difference due to the Mamma Mia intervention on attachment. This difference does not reach statistical significance, but as the difference shown is consistently lower for the MM-group, it seems that the intervention must have had some effect.

Statistical versus Clinical Significance

As this is an effect-study, one must consider *how* one measures effect in interpreting these results. Obviously, the statistical significance is the main effect-measure in this study. Importantly though, a discussion around the clinical interpretations of statistical significance has occurred in the research community (Page, 2014; Connelly, 2014; LeFort, 1993). In clinical decision-making health professionals are required to guide their practice along evidence-based research, based on statistical significance. Statistical probability often "...do not provide clinical insight into important variables such as treatment effect size, magnitude of change, or direction of the outcome" (Page, 2014, p. 728). Said in another way; it does not reflect the actual changes. While *statistical* significance tells us how likely it is that findings are up to chance, *clinical* significance says something about the implications of findings for the people involved (Thompson, 2017). The practical impact of MM could still be meaningful to people even though the findings were not statistically significant. Clinically a slight improvement in attachment could mean a significant relief for both mother and child. One can imagine that mothers who understand their child's signals just a little more often, and feel just somewhat more connected to their child, will experience more joy interacting with her child, more parental self-efficacy, and more well-being as a mother. Such experiences lead to more positive interactions, strengthening mothers' mental health and in turn the child development.

In this paper, an important aspect of attachment is children's different temperament, and with this their different innate threshold for stress. In the *stress-vulnerability model* (Zubin & Spring, 1977) this threshold represents a person's genetic predisposition for tolerating different stressors, or their vulnerability when facing challenging experiences. While significant stress is a well-recognized factor in development of psychological issues, not everyone who experience such stress develop problems (Ingram & Luxton, 2005). This is where vulnerability comes in. As we are all born with different vulnerability, different people will react different to the same stressor. For example, some people do not care about a brake-up, while others are upset and struggles for months. The point in reference to attachment and clinical significance, is that some children are more vulnerable to developmental problems when mothers struggle with sensitivity, and that these children could get a tremendous help by the slightest improvement in mothers' behavior. Even though Mamma Mia did not reach a statistically significant effect on attachment, the consistent pattern of less dysfunction might have a clinically significant effect on attachment and the mother-infant-relationship. This clinical effect could be important, especially for those most vulnerable to relational stress.

Universal Interventions and the Prevention Paradox

Another aspect to consider is the fact that it is difficult to achieve statistically significant results when interventions are universal, rather than targeting clinical groups. We encounter what is called the *prevention paradox* (Rose, 1981; Health Knowledge, 2007). The prevention paradox states that when one uses a mass-strategy (e.g. universal interventions) in preventing illness, as opposed to high-risk-strategies (e.g. targeting clinical groups), the benefits are usually small for the individual but might be of great value on a societal level. Rose (1981) uses the example of men and coronary heart disease. If an intervention were to encourage average men to modify their diet to reduce the level of cholesterol-intake, only 1 in 50 could expect to avoid a heart attack. This means that 49 out of 50 would eat differently every day for years, without much effect. Such proportions are the norm when preventing in larger communities, including a universal-preventive intervention like Mamma Mia. Therefore, one might expect low scores and no large-scale effect, making the benefits seem small, as in the effects of Mamma Mia on attachment.

High-risk populations often have larger, more statistically visible, effects as they have greater need, potential and motivation for change by the immediate danger. That does not change the fact that there usually are few high-risk individuals in the overall population. In this study, few participants reported high attachment difficulties in the first place with only 10% or so (Table 6) falling into the high PSI-groups at 6 weeks pp., indicating few people in actual or immediate need. Yet there are often several cases of illness in a lower-risk population, which might never be detected by high-risk interventions. The low-risk population is larger and have the potential of producing more cases of illness, cases that are difficult to anticipate. Mass-interventions have a greater chance of reaching those cases, and perhaps prevent these and others from entering the high-risk population later on. The goal for mass-interventions like Mamma Mia then, is to reach the few amongst many, to benefit the community at large. It might not change much for most individuals, but the consequences can be immense for the ones it does. This was also the conclusion in the health-preventing FHI-rapport (2011).

Meaning of High Scores

Extending the topic of high and low scores, one must discuss the current meaning of high scores in this study. As mentioned in the methods-section, the calculated high scores of each instrument does not necessarily indicate clinical levels. It simply indicates that those subjects

had the highest scores in this study. The separation into low, moderate, and high scores was done to examine whether those who reported most difficulties to begin with, including possible clinical cases, had greater attachment-benefits from the intervention.

Even though there were no statistically benefit from the intervention, the steeper decrease in attachment over the first months in the high-groups indicate that mothers who report more difficult attachment, child temperament and depressive symptoms 6 weeks after birth experience grater positive attachment changes over the first months. This finding supports the already established point that populations with higher dysfunction usually show greater effects. This finding is important for another reason as well. As demonstrated by research previously elaborated in this paper, the first months of a child's life is one of the most important periods of their development. The fact that the steepest attachment-change for the better occurs at that time could mean a great deal for child development. If we combine this with the points made regarding clinical significance and the fact that the MM-group showed consistently healthier attachment-scores, clinically, this could mean that the women who report high initial dysfunctions have greater attachment-benefits in the intervention-group, and thereby a healthier developmental basis for their children, compared to control.

Demographical Considerations

When it comes to demographical data a point must be made about the high frequency of highly educated and non-single subjects in this dataset. With 90% having higher education the dataset might not reflect the actual distribution of the population. In the total Norwegian female population 20 years or older, about 35% have education beyond high-school level (SSB, 2017). If you leave out women who are 40 years or older, the frequency increase to about 50%. Higher levels of education are associated with better health outcomes (Ross & Wu, 1995), including attachment. So is social support, especially for women (Harandi, Taghinasab, & Nayeri, 2017). It is natural to think that women who are alone might struggle more with attachment than those who have the support of a partner, as the demands to her as a caregiver is doubled. The general high levels of education and women in couples might hide the potential effects of the intervention as the total perinatal community probably are less protected by such high levels of social support and education.

Possible Effects in the Control Group

An additional way of explaining the minimal statistical effects of MM on attachment, is the possibility of learning effects in the control group. Even though only one of the groups receive the intervention, both groups fill out the research questionnaires. The questions alone might inspire awareness, reflection, and self-educating around subjects like attachment and parenting, possibly affecting the control group as well. If so, this process might affect parents' answers at follow-up, slimming the gap between MM-subjects and controls, hiding the effects of the intervention.

The somewhat higher percentages falling into the high-categories of child temperament and depressive symptoms in the control group (Table 6) might hide the effects of the intervention as well. I have already discussed the fact that high-risk groups often show greater statistical effects and the results show greater decrease in attachment-scores over time in the high-groups. The somewhat higher percentage being categorized as difficult-temperament-group and high-depression-group within the control group, means that the control group have a bigger grater potential for change to begin with, making it more difficult to find an effect of the Mamma Mia intervention.

Strengths and Limitations

A possible reason why MM did not show a significant effect on postnatal attachment, might be the use of a short version of the PSI. As the short version in this study contains only 3 items, it is possible that those items do not reflect attachment to a sufficient degree. Even though reliability was considered acceptable, it is noteworthy that it did not reach the acceptable norm of .70. This means that the results could be affected by measuring errors making it is difficult to detect actual effects. As such, this short version of the PSI is a limited instrument for measuring attachment. Yet, the consistent difference between intervention and control group (Figure 1), as well as the high correlations between the measuring points in time (Table 3), suggest that the PSI measure something stable and might be a good predictor of attachment, despite few items.

Another limitation to discuss in that manner, is the degree to which the PSI actually measures attachment. The PSI is a measure of parental stress, and not an attachment-instrument specifically. As mentioned in the PSI-description, it is developed to identify dysfunctional parent-child-pairs, but the focus on parental experiences more than the dyad, might weaken the PSI as an attachment-measure. Observations made from Wright and

Edginton's review (2016) of previous attachment-interventions, support this notion. The observation was that the non-significant interventions had more focus on the mother alone, compared to the significant interventions which had a more interactional-centered approach. The mother-centered approach might put MM in the non-significant intervention cluster, when it comes to attachment. It seems that a parent-focus alone is not enough. Perhaps interventions designed to enhance attachment in addition needs to be more explicitly directed at child emotionality and behavior, affecting the transactional process from both aspects. With that said, MM was developed to support and strengthen mothers, not targeting attachment and child development per se, making a parent-focus obvious. Research connecting mothers' health to attachment-outcomes further supports the interventions emphasis on mothers.

Wangberg, Bergmo, and Johnsen (2008) report that low adherence is as common problem with internet-based interventions. In the current study, the MM-population was more than halved, from 678 till 270 subjects, when only those who had completed all PSI-measures were included. This underscores the adherence problem. Fewer subjects could compromise the generalizability of the results. It is a disadvantage of this exclusion criterion that one risks selective dropout, as many subjects might be left out. Despite this, the remaining population is quite large, and potential selective dropout-problems would probably be the same in both the intervention and the control group. The benefit of including those who completed all PSI-measures, is that one gets to examine the effects over a whole year, rather than a shorter period. Over a year it is easier to detect changes over time, allowing one to find patterns and longitudinal effects. Attachment for example, is a developing process dependent on adjustment and learning from both mother and child which might take some time to stabilize. In this study, attachment development showed a pattern of steepest decrease in dysfunction the first months, before the curve levels. Such a pattern would not be visible with only one measure or two. Additionally, the use of the mixed design ANOVA requires a score on all measures.

Low adherence to internet-based interventions might occur because of lonesome reflection and handling of thoughts and feelings, which could lead to emotional distress (Erbe et al., 2017; Andersson & Titov, 2014). It is important to underscore that MM is not meant as a stand-alone intervention, or as a treatment per se. MM was developed as a supplement to perinatal TAU, including face-to-face follow-up by health professionals, to support mothers and prevent illness. Wangberg et al. (2008) offer some solutions to increase adherence, for example automated follow-up via e-mail.

At last it is worth mentioning that the graphs illustrating findings enhance the difference between groups, making them look further apart than they are. When scores are generally low, this is necessary to be able to demonstrate the differences that is but might provide a misleading picture.

Further Research

As social support for the mother is an indirect factor to the mother-child interaction, its inclusions as a moderating factor for attachment was considered beyond the scope of this paper. Yet, other research should investigate the connection between social support, attachment, and MM to fully understand the effects of the intervention. Indeed, there are findings stating that social support is an important aspect of attachment-development. One study (Crockenberg, 1981) found that social support was a strong predictor of secure attachment, even more so than maternal responsiveness, or sensitivity. Its importance was also evident in Haga's (2011) interview study where social support was spontaneously mentioned by all women as crucial for their well-being as a mother, and also was connected to mothers' reports of depression symptoms. In addition, studies (Dennis & Ross, 2006; Gjerdingen, Frogberg, & Fontaine, 1991) show that emotional and practical support from a partner is an essential form of social support, so a study comparing differences in attachment between MM and controls based on reported marital status and relationship satisfaction, could shed further light onto MM's effect on attachment.

One way of testing potential learning effects in the control group would be through a Solomon four-group design (Bordens & Abbott, 2011). The present RCT-study is a two-group design, where both groups receive pre- and post-tests, and one receive the intervention. The Solomon four-group design would include these two groups as they are. In addition, it would include two more groups where both receive the posttests, one receives the intervention, but neither would receive the pretest. As this study include several measuring points, it would mean that the first and second group would be tested at all points, while the third and fourth group would not be tested at baseline. It would look something like this:

Table 10.

Example of the Solomon four-group design and MM.

	Baseline (T0) Pretest	T1-T5 Posttest
<i>Group 1</i>		
MM	X	X
<i>Group 2</i>		
Control	X	X
<i>Group 3</i>		
Control, Intervention and Posttest		X
<i>Group 4</i>		
Control, Posttest		X

One could also play with the number of pre- and posttests, due to the many measuring points. For example, if all measures (T0-T4) was considered pretests and only T5 was considered a posttest, or something in between. This enables a way of determining whether the questionnaires affect the control group or not and would be an interesting method if the intervention were to be remodified and retested.

As both child temperament and depressive symptoms are important factors contributing to mother-child interaction patterns and according to this study have a connection with attachment development over time, at least when dysfunction is high, separate studies need to investigate MM and its effects on temperament and depressive symptoms. In that context one could also check if there is a significant difference between the high temperament and depression groups of MM and control, possibly hiding effects of the intervention. Since early attachment has lifelong repercussions, studies conducting follow-ups of the longitudinal effects of MM in both adolescence and adulthood, should be done as well, enabling one to evaluate the actual preventing effects over time. Additional research should be conducted to examine adherence factors of MM, for example, whether women who failed to complete all sessions had worse baseline scores on attachment, child temperament and depressive symptoms.

Ethical Considerations

The current paper is based on data from an external research project. Ethical considerations of the development and data-collection in the Mamma Mia-study must be treated separately from the information presented here. The original trial was approved by the Regional Ethics Committee, Norway, South East (project number: 2012/1716). Nevertheless, the themes, results and discussion addressed in this study is based on personal data from the project. The data is addressed in general terms and presented at group-level, hiding individual differences, but might be experienced as personal or strange to those who participated. Depression symptoms as a risk-factor in child development is a continuous issue throughout the paper and might be difficult to read for those who identify with such symptoms. An attempt to nuance the impact of mothers' health on attachment is made by the notions of child temperament, the transactional model, the principle of goodness of fit, the stress-vulnerability model, and the impact of social support in the perinatal phase.

Conclusion

As an internet-based intervention that target several aspects of perinatal mothers' health, there are many advantages to Mamma Mia. The program seeks to strengthen mothers' well-being and parenting skills through information and education, including principles of sensitive parenting. In line with attachment theory and related research, sensitive parenting is essential for children to develop healthy inner working models to guide their social interaction and understanding of the world. Results showed that child temperament and depressive symptoms, particularly when more dysfunctional, also is related to development of attachment. Surprisingly though, MM did not have a statistically significant impact on attachment. It might be that MM affects attachment, but that this effect was hidden because of the limitations of the PSI as an attachment measurement instrument. It is also possible that attachment was not properly targeted as the focus of the MM is on the mother and not the mother-child interaction per se. There are also limitations to what effects one can expect with a universal-preventive intervention. Despite this, a clear pattern was in fact detected. The consistency of healthier attachment-scores in the intervention group suggest an effect of Mamma Mia on attachment which can be of clinical significance, if not statistically significant.

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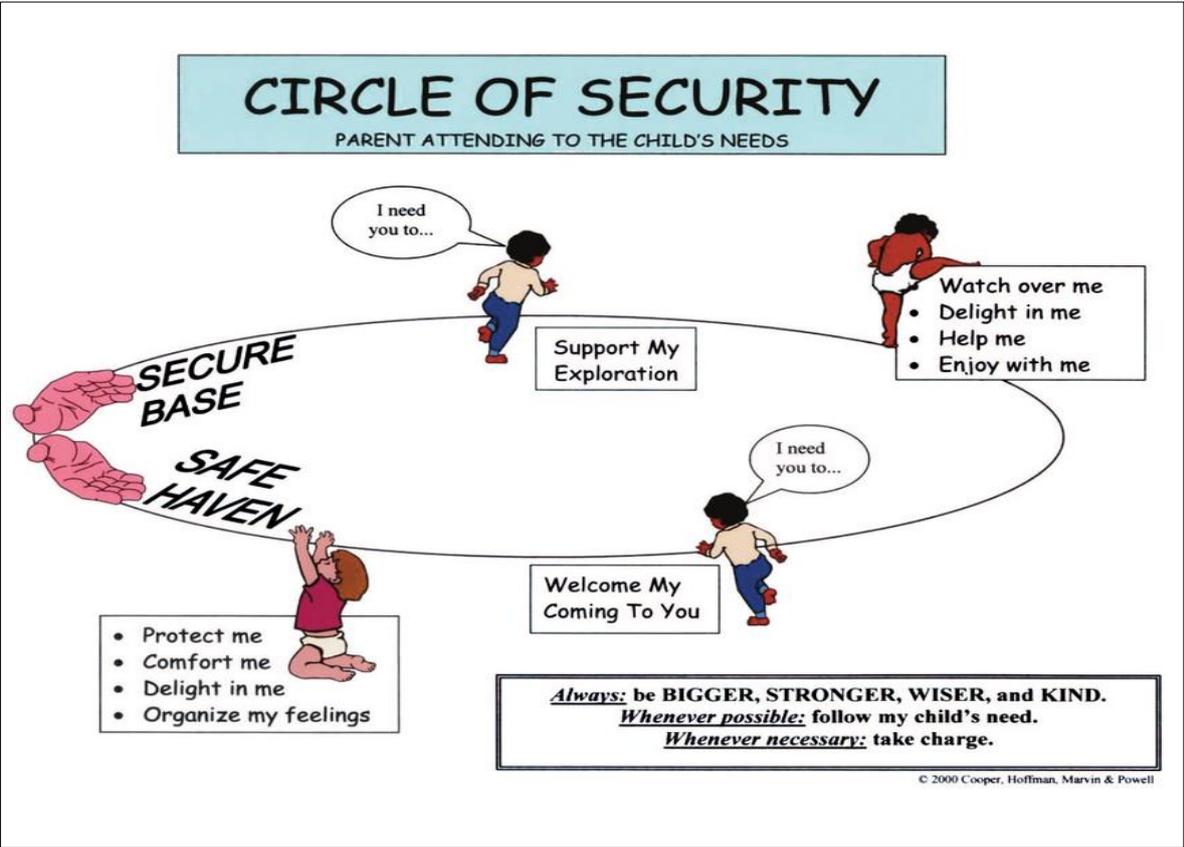
Appendix

Appendix 1. The 6 Steps of Intervention Mapping

	Step 1 Needs assessment	<ul style="list-style-type: none"> • Establish a participatory planning group • Conduct the needs assessment • Assess community capacity • Specify program goals for health and quality of life
	Step 2 Matrices	<ul style="list-style-type: none"> • State outcomes for behavior and environmental change • State performance objectives • Select important and changeable determinants • Create a matrix of change objectives
	Step 3 Theory- based intervention methods and practical applications	<ul style="list-style-type: none"> • Generate program ideas with the planning group • Identify theoretical methods • Choose program methods • Select or design practical applications • Ensure that applications address change objectives.
	Step 4 Intervention program	<ul style="list-style-type: none"> • Consult intended participants and implementers • Create program themes, scope, sequence, and material list • Prepare design documents • Review available program material • Draft program material and protocols • Pretest program materials and protocols • Produce materials and protocols
	Step 5 Adoption and implementation	<ul style="list-style-type: none"> • Identify potential adopters and implementers • Reevaluate the planning group • State program use outcomes and performance objectives • Specify determinants for adoption and implementation • Create a matrix of change objectives • Select methods and practical applications • Design intervention for adoption and implementation
	Step 6 Evaluation plan	<ul style="list-style-type: none"> • Review the program logic model • Write effect evaluation questions • Write evaluation questions for changes in the determinants • Write process evaluation questions • Develop indicators and measures • Specify evaluation design

Retrieved from: Geense, W. W., van Gaal, B., Knoll, J. L., Cornelissen, E., Schoonhoven, L., & Kok, G. (2016). Online Support Program for Parents of Children With a Chronic Kidney Disease Using Intervention Mapping: A Development and Evaluation Protocol. *JMIR Research Protocol*, 5(1), 1-12. doi:10.2196/resprot.4837

Appendix 2. The Circle of Security Illustrative Model.



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Appendix 3.

Calculations of low, moderate, and high scores for each instrument

	Mean	SD	Min	Max	Low (min – x-SD)	Moderate (x-SD – x+SD)	High (x+SD – max)
PSI	5.65	1.99	3	15	3 – 3.66	3.66 – 7.64	7.64 – 15
ICQ	25.74	8.39	9	63	9 – 17.36	17.36 – 34.14	34.14 – 63
EPDS	5.41	4.16	0	30	0 – 1.25	1.25 – 9.57	9.57 – 30

Note: N=609. PSI=Parenting Stress Index; ICQ=Infant Characteristic Questionnaire;

EPDS=Edinburgh Postnatal Depression Scale