

Preface

Our interest in developmental psychology sparked our curiosity concerning non-parental childcare and its potential effects on children's development. This led us to the current research question of whether early and extensive time in day care is beneficial or detrimental in regards to Norwegian children's development. Data from the longitudinal Trondheim Early Secure Study (TESS) were contributed and analyzed with the help of Professor Lars Wichstrøm, Department of Psychology, Norwegian University of Science and Technology.

We would like to express our sincere gratitude to Professor Lars Wichstrøm for his excellent guidance and for allowing us to use data from the TESS. His dedication to his students and extensive knowledge about childhood development motivated and inspired our work. His timely advice, attention to details and methodological knowledge has been invaluable in the process of writing this paper.

For their unconditional love and support, we would like to thank our parents. We owe them everything in life. The past six years would not have been the same without your encouragement.

Last, but not least, we wish to express our gratefulness to Espen and Joar for bearing with us. A special thanks to Joar for his help in finalizing this paper.

Long-Term Effects of Extensive Day Care on Norwegian Children's Development

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Abstract

Early and extensive day care has become increasingly common in western countries. Studies investigating the potential short-term impact of such experiences on children's development have yielded mixed results, whereas long-term effects have been understudied. In this study we therefore examine the impact of early and extensive day care on children's emotional, behavioural, relational and cognitive functioning during preschool and the first three years of school. 878 children drawn from the longitudinal Trondheim Early Secure Study (TESS) participated in the current study. The sample was representative of Norwegian four, six and eight year-olds. Results showed apparent effects of early extensive childcare on several areas of children's life. When results were adjusted by controlling for selection factors and correction for number of variables, almost all of the effects disappeared. This indicates that the long-term effects of time spent in non-parental childcare on children's development are limited, at least up to age eight.

Keywords: day care, child development, longitudinal

Long-Term Effects of Extensive Day Care on Norwegian Children's Development

The use of day care among 1-2 year-olds has increased in most Western countries during recent years; in 2008, 43 % of children under the age of two attended childcare in the United States (UNICEF Innocenti research Center, 2008), the average in OECD countries was 33 %, up 20 % from year 2001 (OECD, 2009). Questions whether early and extensive day care affects children's development, positive or negative, is important to parents, policy makers and educators alike. The research attempting to answer these questions has mainly been driven by two theoretical perspectives; attachment theory and socialization theory. Attachment theory proposes that spending extensive time in non-maternal care at an early age, with long periods of separation, could have adverse effects on both development of secure attachments, emotion regulation and social behaviors (Belsky & Rovine, 1988). Socialization theory proposes that, on one hand, interaction with non-parental caregivers and peers may support cognitive-linguistic, academic, and socio-emotional development (Lamb, Hwang, Broberg, & Bookstein, 1988; Pianta, 1997), but on the other hand, that negative interactions could interfere with the development in these areas, and potentially lead to problematic behavior (Skalická, Belsky, Stenseng, & Wichstrøm, 2015a). Thus, a broad set of developmental outcomes has been investigated in the day care research literature; attachment to primary caregiver, social competence, behavior, language, school adjustment, cognitive function and others. Research on childcare experiences and associated developmental outcomes hardly organizes into any clear-cut domains. However, in the current study, four distinctive, but interrelated domains of developmental outcomes will be presented: the emotional, behavioral, relational and cognitive domain.

Despite decades of research, few firm conclusions can be drawn concerning the relationship between quantity of non-parental day care and child development, especially in a long-term perspective. Several possible methodological reasons for this will be outlined in the following. For instance, most of the childcare literature is based on observational data, and all non-experimental studies come with the challenge of selection bias (Singer, Fuller, Keiley, & Wolf, 1998). Day care experience may not be random, and failing to consider such selection bias may lead to misspecifying the effects of day care. Children's preconditions (e.g. family background and child characteristic), cultural and socio-political context can affect both use of day care and children's adjustment, thus confounding the results (Belsky, 2006). Hence, adjusting

for selection bias is important when seeking to investigate specific effects of time spent in day care on developmental outcomes.

Taking all this into consideration, the present study will address a range of methodological concerns when reporting from a long-term and multi-wave follow up of a large representative Norwegian sample of children with varying quantity of time in non-parental day care. More specifically, we seek to examine whether time spent in day care has any effects on developmental outcomes at age four, six and eight.

Childcare internationally

The use, organization, cost and quality of day care vary considerably between countries. Effects may therefore not necessarily generalize well across countries. Even so, out-of-home care has increasingly become the norm for more children, at lower ages and for more hours a day (UNICEF, 2008b). Of the world's 2-6 year-olds from economically advanced countries, 80 % are now in some form of non-parental childcare and the generation growing up today is the first who spends a relatively large part of their childhood in non-parental childcare arrangements. An increase in younger children (1-2 year-olds) attending childcare has been reported in several OECD countries (OECD, 2009). At the same time, 50 % of children under the age of one attended some form of non-parental childcare in the United States in 2008 (UNICEF, 2008c).

Childcare in Norway

By the end of 2014, very few children under the age of one attended day care in Norway (4%). At the same time, the great majority of one- to two-years olds attended day care (80%). In the age bracket three- to five-years olds almost all children (97%) experienced non-parental out-of-home childcare (Statistics Norway, 2015). The children from zero- to five-years-old, typically spent 35 to 40 hours or more per week in childcare following the initiation of care, continuing until they entered school the year they turn six (Statistics Norway, 2015).

Today, parents in Norway have one year parental leave, with 80-100% of full salary depending on the length of the leave (Ministry of Education, 2011). When the leave ends, children have the right to attend a day care facility. Further, state funds ensure a maximum monthly fee; which in 2014 was NOK 2,580 (\$314). Several aspects of the structural quality (i.e. child-to-staff ratios, teacher education and curriculum) of day care facilities are regulated by law (Ministry of Education, 2010). In center care, adult-to-child ratios cannot exceed 3:10 for children younger than three

and 3:19 for those older than the age of three. Teachers with necessary qualifications (e.g. three years tertiary education with a qualification in early childhood studies) must supervise caregivers weekly about pedagogical planning to ensure that activities facilitate learning in concordance with the curriculum (Ministry of Education, 2005). However, according to UN standards 50% of the staff should be tertiary educated with relevant qualifications (UNICEF, 2008), but in Norway only approximately 32% of caregivers had the required bachelor degree in preschool education or an equivalent professional training in the period from 2008-2010 (Statistics Norway, 2012). Despite challenges with childcare staff education level, structural quality is relatively high and homogenous (Winsvold & Gulbrandsen, 2009). According to UNICEF Norway meets or exceeds eight of 10 benchmarks (e.g. 1.0% of GDP is spent on early childhood services) for early childhood service regulations, standards and quality (UNICEF Innocenti research Center, 2008). In comparison Sweden meets or exceeds 10, whereas the United States only meets three.

In the following, a review of the childcare literature on early and extensive day care will be presented. Although much of the research conducted on childcare has been conducted in the United States, we draw particular attention to non-US studies when they provide information on the four developmental domains considered: emotional, behavioral, relational, and cognitive.

Emotional domain

As noted previously, attachment theory proposes that attachments may influence children's development of emotion regulation. Learning how to regulate emotional responses in an appropriate and adaptive way is considered an essential component of children's successful development (Denham et al., 2003). It is thought that children learn how to regulate emotions in interactions with available attachment-figures who is responsive to the child's internal states (Tronick, 1989). Research on this area is non-existing; no studies found investigated effects of time in day care on emotion regulation capacity.

Further, research in developmental psychopathology has linked difficulty in regulating negative emotions such as sadness and anger to emotional and behavioral problems (Cicchetti, Ackerman, & Izard, 1995; Eisenberg et al., 2001; Silk, Steinberg, & Morris, 2003). Effects of early and extensive time in day care on internalizing emotional problems like anxiety and depression are severely understudied. In fact, only one study was found (Schjølberg, Lekhal, Vartun, Helland, & Mathiesen, 2011).

Results from the large prospective MoBa study, including 12,875 children, indicated no associations between childcare initiation and emotional problems (anxiety and depression) at age five, controlling for socioeconomic status (SES), single-parent reared, siblings and biomedical risk (Schjølberg et al., 2011). It should be noted that this study only includes five questions concerning internalizing problems from the Child Behavior Checklist (CBCL), rated by both parents and teachers during preschool and toddlerhood years. Using only five questions to reveal whether or not the children experiences any emotional problems may be problematic; with a limited set of questions, it is possible that potential effects are left undetected.

In sum, there is, perhaps surprisingly, little research on effects of early and extensive time in day care on emotional outcomes. The present study seeks to investigate possible effects on this area of development further. First, in regards to emotion regulation by investigating in a large scale longitudinal study whilst controlling for selection factors, whether there are any effects of early and extensive time in day care on emotion regulation at age four, six and eight. To obtain information about emotion regulation capacity in different contexts, information from teachers and parents were included. Second, the present study seeks to investigate, like the MoBa-study, whether or not early and extensive time in day care has any effects on emotional problems. However, extending the research by including a long-term perspective with repeated measurements, and investigating whether any effects can be found beyond the age of five. To ensure a broad and thorough exploration of possible emotional problems, the present study includes all questions pertaining internalizing problems from the CBCL and TRF questionnaire, as well as interviewer-based ratings of symptoms of emotional disorders.

Behavioral domain

Attachment theory proposes that socio-emotional development depend upon secure attachment to primary caregivers, suggesting that disruption of this process by early and extensive day care may have possible adverse effects on children's emotional regulation and social behavior (Belsky, 1988). Thus, over the past two decades, early and extensive day care has repeatedly been found to correlate with and prospectively predict higher levels of externalizing problem behavior (Belsky, 2006; McCartney et al., 2010). An American review found quantity of day care the single most consistent and strongest predictor of externalizing problems (Jacob, 2009). The prediction has been palpable, although not robust, when implementing control for

selection factors (as noted by McCartney et al., 2010; Zachrisson, Dearing, Lekhal, & Toppelberg, 2013). Yet, this is an area of ongoing debate and inconsistency in findings.

A number of studies have reported quantity of day care predictive of more externalizing behavior (among others; McCartney et al., 2010; Melhuish, 2010; Yamauchi & Leigh, 2011). Most notably were the findings from the American NICHD Early Child Care Research Network (ECCRN), finding more hours spent in day care to predict higher caregiver and teacher rated externalizing problems when the children were 24 and 54 months, but not 36 (Belsky, 2006; NICHD Early Child Care Research Network, 2003, 2003a). Findings emerged after statistical control for a wide range of selection factors including repeated measures of child and family characteristics in addition to quality, across the first 4.5 years of life. Follow-up analyses found quantity of day care to predict higher teacher rated externalizing behavior up to age 12 (Belsky, Burchinal, Clarke-Stewart, McCartney, & Owen, 2007), and higher self-rated risk taking and impulsivity at age 15 (Vandell, Belsky, Burchinal, Steinberg, & Vandergrift, 2010).

Other studies report more hours in day care as having positive effects on behavior outcomes (Andersson, 1992; Borge, Rutter, Côte, & Tremblay, 2004; Côte et al., 2007), however, these effects are primarily seen for children at developmental risk before entering high quality day care (Solheim, 2013). Still, another study, implying the same statistical control for selection factors as the NICHD, found early non-parental care before the age of three to predict lower problem behavior scores in childhood and adolescence in a sample of 9,185 American children (Jaffe, Hulle, & Rogers, 2011). In contrast, some studies report no quantity effects of day care on behavior (Campbell, Lamb, & Hwang, 2000; McCartney, Scarr, Rocheleau, Phillips, & Abbott, 1997; Sylva, 2007).

In a Scandinavian context, research on the relationship between quantity of day care and behavior problems is still in its infancy. Except from a few small-scale studies reporting effects of early and extensive day care predictive of less externalizing behavior (Andersson, 1992; Campbell et al., 2000; Grupta & Simonsen, 2007) or more (Borge & Melhuish, 1995), more recent Scandinavian studies report near zero findings. Two recent large-scale longitudinal studies fail to reproduce similar findings as the NICHD. In a Norwegian study reporting from the same sample, as we will do herein, externalizing problems at 4.5 years were unrelated to time spent

in day care across the 4.5 first years of life. The results was evident after controlling for selection factors including type of care, as well as measurements of family and child characteristics (Solheim, Wichstrom, Belsky, & Berg-Nielsen, 2013).

Zachrisson et al. (2013) found similar lack of results after analyzing data from the large-scale Norwegian MoBa study including reports from 72,271 mothers. After conservative control for selection bias was implemented (e.g. sibling fixed effects), no association between hours in day care and maternal reported externalizing behavior at 18 and 36 months was found.

On the whole, the research literature on the area is vast and inconsistencies may arise from major differences in research methods and sociopolitical context across studies. Nevertheless, some systematic differences seemingly appear. Countries that offer unstandardized day care with varying quality, as the United States (UNICEF Innocenti research Center, 2008), report fairly consistent findings; more hours in day care predict adverse effects on externalizing behavior (for reviews see Belsky, 2006; Vandell et al., 2010). Studies conducted in countries offering homogenously high quality day care as Norway report zero findings (Solheim et al., 2013; Zachrisson et al., 2013).

In brief, the current study seeks to investigate if findings as reported by the NICHD ECCRN and others, will emerge in a Norwegian socio-political context. Emphasizing the importance of longitudinal follow-up studies in this area, sleeper effects of quantity of day care on behavior outcomes past the age of 4.5 years has been reported (Belsky et al., 2007; Vandell et al., 2010). Large-scale longitudinal studies investigating quantity effects past the age of 4.5 are however lacking in Scandinavia, thus, the current study seek to extend previous research by adding additional behavioral measures at age six and eight.

Relational domain

Attachment to primary caregivers. As previously noted, there has been a concern that early and extensive non-parental care could have adverse effects on the security of child-parent attachment. However, in a meta-analysis of 59 studies from four decades of research, results indicated no significant effect of non-parental childcare on the security of child-mother attachment (Erel, Oberman, & Yirmiya, 2000). The analysis revealed that, over time, there has been an increase in findings indicating that non-maternal care does not pose a risk in term of insecure infant-mother attachment. The latter finding may reflect the fact that much of the early

research on effects of time in non-parental care and attachment failed to take selection factors into consideration, and as noted, selection factors may confound the results. Later research has generally taken this into consideration, and control for selection factors is often included in the studies (e.g. NICHD Early Child Care Research Network, 1997; Sagi, Koren-Karie, Gini, Ziv, & Joels, 2002). Note that the above meta-analysis is dated back to year 2000. Not all research published after this concurs with its conclusion. In the Israeli Haifa Study (Sagi et al., 2002), including 758 children, found that center care in and of itself did increase the likelihood of infants developing insecure attachments to their mothers compared to their home-reared peers when 12-months old, whilst controlling for confounding variables associated with attachment security (marital relations).

More important, all research conducted measure attachment security when the child is 12-15 months old, thus any effect on attachment beyond that age is not addressed. Other areas of developmental research have been investigating the hypothesis of whether non-parental care and child outcomes could emerge when the child is older, often called “sleeper effects” (Vandell et al., 2010). This hypothesis has not yet been investigated in relation to early and extensive day care and attachment security; thus, it is possible that attachment security is affected by extensive time in day care, but that this becomes evident later in life, rather than in infancy.

In sum, although still debated, the main conclusion from five decades of research is that early and extensive time in day care does not have any main effects on attachment. However, effects of time spent in day care on attachment security beyond infancy have not been studied. Further, as the Israeli Haifa study shows (Sagi et al., 2002), not all recent research concludes with the notion that day care has no effects on attachment security. It has been hypothesized that such inconsistencies could stem from differences in socio-political context where studies are conducted. Thus, the present study seeks to build upon and extend this research in several ways. First, regarding attachment security beyond infancy, by including measures of attachment security when the child is four and six years old. Second, regarding socio-political context, by investigating if any effects of early and extensive day care and attachment security can be found in a Norwegian sample. And third, by controlling for selection factors associated with early and extensive time in day care.

Social competence. Recall that according to socialization theory, early and extensive day care experience could have both positive and negative effects on

children's development of social competence. In the research literature there are large inconsistencies in findings. Some studies have found that more time spent in non-parental childcare is associated with better social competence (Andersson, 1989, 1992; Campbell et al., 2000). The old and oft-cited studies by Andersson (1989, 1992), controlling for home background, child gender and intelligence, indicated that children enrolling day care before one year of age (but after six months) were rated by teachers as more socially competent at 13 years than children enrolling later. Focusing on extent of time in day care, rather than time at enrollment, results from Campbell et al. (2000), indicated that more days, but shorter sessions in care predicted more socially competent children, whereas extensive time in day care (many days *and* long hours) predicted less pro-social behavior. One important limitation regarding these studies should be mentioned; they include small study samples ($n= 128$ and 53). Thus the samples are less likely to be representative of the population in general, and the results are uncertain.

Contrary to these, other studies have found time in non-parental day care to be associated with lower social competence (Loeb, Bridges, Bassok, Fuller, & Rumberger, 2007; NICHD Early Child Care Research Network, 2003b; Vandell & Corasaniti, 1990). One study, including 235 children, found that compared to children in part-time day care, children participating in early and extensive care from infancy were rated as having poorer peer relationships, and more negative nominations from classmates, even when controlling for child and family variables (Vandell & Corasaniti, 1990). Similar results were reported by Loeb et al. (2007); starting center based childcare before the age of two had adverse effects on social development, and were particularly large for children who entered center-based care prior to the age of one. Findings from the NICHD Early Child Care Research indicated no association between hours in day care and social competence at 4.5 years of age. However, during follow-up, they did find that more time spent in day care predicted lower ratings of social competence from third grade (~ eight years) continuing into adolescence (NICHD Early Child Care Research Network, 2005; Vandell et al., 2010).

In contrast to studies finding effects, some studies have reported no effects of day care experiences on social competence (Lamb et al., 1988; Solheim et al., 2013; Zachrisson et al., 2013). Even when controlling for type of care, SES, family background and child covariates, these studies found that social competence were

irrespective of childcare experience (quality, quantity and type of care) measured across ages 1.5-4.5 years,

To summarize, the research literature on effects of early and extensive time in day care on social competence is, as noted, inconsistent. There are several possible explanations for this. All studies indicating positive or no effects of quantity of day care on social competence were conducted in Scandinavian countries (Norway and Sweden), whereas studies reporting negative effects were conducted in the United States. As noted previously, differences in socio-political context may yield differences in effects of day care experiences on development (Volling & Feagans, 1995). Also, it is important to note that the literature indicating positive effects on social competence are all uncertain because of small sample sizes. Another possibility is that the positive effect on social competence would not be evident in a larger, more representative study sample. In regards to the studies not finding any effects, none of these investigate effects of hours in day care on social competence beyond the age of 4.5. As seen in the NICHD studies, effects were only evident from the children were eight years old. Thus, it is possible that similar effects could emerge if one includes measures later in children's life. Besides the studies by Andersson (1989, 1992), Vandell et al. (2010) and NICHD Early Child Care Research Network (2005) there were not found any longitudinal studies with repeated measures, investigating effects of early and extensive day care on social competence.

Therefore, the current study seek to extend existing research by including a long-term perspective with repeated measures on a large Norwegian sample, controlling for selection factors, when investigating whether or not quantity of time in day care has any main effects on the development of social competence.

Relationship to secondary caregivers. The child-teacher relationship has been suggested to play an important role for young children and their adjustment to non-parental day care, school, and development in childhood (Pianta, Nimetz, & Bennet, 1997; Pianta & Steinberg, 1992). This theoretical reasoning has been supported by research showing positive effects on achievement, school adjustment and social competence (Birch & Ladd, 1997; Howes, Matheson, & Hamilton, 1994; O'Connor & McCartney, 2007; Pianta & Steinberg, 1992). Research on what affects the child-teacher relationship itself is scarce, and the only literature found on the subject concludes with the notion that sensitivity, individual or group, is important (Ahnert, Pinquart, & Lamb, 2006). Thus, the present study seek to extend research in

this area by examining whether or not early and extensive time in day care has any short or long-term effects on the child-teacher relationship.

Cognitive domain

As noted, socialization theory suggest that the day care experience may promote cognitive, linguistic and academic development (Lamb et al., 1988). On the other hand, negative interactions could have the opposite effect (Skalická et al., 2015a). In addition, attachment theory proposes that disruption of the attachment process by early and extensive day care may influence children's ability to regulate emotions. In fact, a broad body of evidence suggests that emotion regulation can impact cognition in different ways (Mikulincer, Shaver, & Pereg, 2003). The literature regarding amount of time spent in day care and possible effects on children's cognitive functioning, language comprehension, and academic performance shows inconsistency in findings.

Executive functions. Cognitive functioning is often measured by tests of language comprehension or academic performance in reading, math or language in the day care research literature. However, additional specific cognitive abilities have the potential to broaden the understanding of overall cognitive performance in relation to day care quantity. As found by the NICHD ECCRN, short-time memory at the start of kindergarten was predicted by amount of time spent in day care. Analysis included repeated measurement of quality of care, child and family characteristics for a control of selection bias (NICHD Early Child Care Research Network, 2005). Although suggestive, this indicates that amount of time spent in day care may correlate with specific cognitive abilities as executive functioning. Except from the NICHD ECCRN no large-scale longitudinal study has investigated day care quantity and cognitive outcomes as executive performance (memory, attention, motor skills, perception, emotion regulation, metacognition and behaviour regulation) in relation to day care quantity.

Language. The NICHD ECCRN has conducted the most comprehensive analyses found on the relationship between time spent in day care and language development. No associations between quantity of day care and language performance at age three or eight was found. Repeated measures of quality of care, family and child characteristics were included as control for selection factors (Belsky et al., 2007; NICHD Early Child Care Research Network, 2000b, 2003). However, the NICHD SECCYD found day care attending three-year-olds as having more advanced

language compared to children without attendance (NICHD Early Child Care Research Network, 2002b). This was supported by Loeb et al. (2007) finding day care enrollment between age two to three to predict pre-academic reading skills in preschool. In sum, day care attendance seems to predict more advanced language compared to no attendance. Even though NICHD found no relation between quantity of care and language development, Bradley and Vandell (2007) concluded in a review that evidence is too inconsistent to draw any clear cut conclusion whether quantity of day care has adverse, positive or no relation to language development.

Except from one Norwegian longitudinal study finding day care attendance at 1.5 and three years of age to predict a reduced risk of late talking (Lekhal, 2013), research on language development in relation to day care quantity is largely absent in Scandinavia.

Academic performance. Evidence from the last decades indicates that quantity of day care may be predictive of academic performance (Andersson, 1992; NICHD Early Child Care Research Network, 2007).

Some studies report negative effects of quantity of non-parental care on academic performance (Brooks-Gunn, Han, & Waldfogel, 2002; Erel et al., 2000; Vandell & Corasaniti, 1990). In example, Vandell and Corasaniti (1990) found extensive day care during infancy to predict lower grades in reading, math and language during primary grades (up to 3rd grade). Analyses included control for selection factors as socioeconomic status, family size, parental occupational status, marital status, childbirth order and child gender. However, conducted in the state of Texas, with minimal day care standard and much different childcare policy, generalizing these findings to a Scandinavian context is of little relevance. In addition, sample size was small, including only 236 children. Yet, evidence underscores beliefs about extensive non-parental care during the first year of life as detrimental to development (Belsky, 1988). Further, Loeb et al. (2007) found entering day care between the ages two to three, predictive of higher scores on reading and math after enrolment into kindergarten at ages five to six, compared to those starting earlier or later (Loeb et al., 2007). Analyses included control for selection factors: age, gender, birth weight, ethnicity, family structure, maternal employment, parental education, and socioeconomic status.

Except from some older longitudinal Scandinavian studies, including small sample sizes (Andersson, 1989, 1992; Broberg, Wessels, Lamb, & Hwang, 1997;

Sundell, 2000), no large-scale investigations including repeated measurements have been conducted in Scandinavia focusing on the relationship between hours spent in day care and academic performance. Nevertheless, a recent Norwegian study found that age of enrolment into day care predicted performance on standardized national test of language and math at age seven (Drange & Havnes, 2015). Controlling for selection factors as gender, age, ethnicity, number of siblings, economical status, parental education and employment, children enrolling into day care at 15 months performed significantly better on the math and language tests at seven than children enrolling at 19 months. Even though no quantity of time measure was obtained, evidence suggests quantity of day care may be predictive of academic performance, also in a Norwegian sample.

Academic performance and cognitive abilities is often synonym in the day care literature, and a vast body of literature have found cognitive abilities predictive of academic performance (Spinath, Spinath, Harlaar, & Plomin, 2006). Even so, cognitive ability explains less than half of the variance in academic achievement (Spinath et al., 2006), therefore it's worthwhile to investigate alternative explanatory factors that will add to the overall predictive power. Underlying the educational process is motivational factors, and motivation may positively influence overall academic achievement but also the development of more specific cognitive abilities (Nurmi & Aunola, 2005). Investigations regarding the relationship between day care quantity and self-rated task motivation are nonexistent in the day care literature. Thus it remains to investigate if time in day care has any effects on task motivation, rated by children themselves.

In short, the current investigation seeks to extend previous research in several ways. Firstly, by investigating if quantity effects could be found in relation to executive performance, subsequently adding to the overall understanding of the relationship between cognitive ability and day care quantity. Secondly, large-scale studies reporting effects of quantity are mostly American. The current study investigates if similar effects could be found in a Norwegian sociopolitical context. Thirdly, measurement of self-rated task motivation was included to complement more traditional measure of academic performance. Lastly, by adding to the literature where previous findings have been inconsistent or largely missing.

Method

Participants and Recruitment

Two birth cohorts (born in 2003 or 2004) of four-year-old children with their parents living in the city of Trondheim, Norway, were invited to participate in the Trondheim Early Secure Study (Wichstrøm, Belsky, & Berg –Nielsen, 2013; Wichstrøm et al., 2012). A letter of invitation together with the Strengths and Difficulties Questionnaire (SDQ; Goodman, 1997) was sent to their homes. The SDQ is a 31 item screening measure for psychiatric symptoms. The parents brought in the completed SDQ when attending their scheduled appointment for the ordinary community health checkup for four-year-olds. A flow-chart describing the recruitment procedure and participant flow is depicted in Figure 1. As can be seen, almost all of the children invited met at the clinic. The sample is therefore effectively a community sample. Parents with too insufficient proficiency in Norwegian to be interviewed were excluded. To increase statistical power, children with emotional and behavioral problems, were oversampled by employing the total difficulties score of the SDQ version 4-16 (Goodman, Ford, Simmons, Gatward, & Meltzer, 2000). SDQ-scores were divided into four strata (0-4, 5-8, 9-11, 12-40), and by means of a random number generator eligible families were drawn to participate in the study. The probability of being drawn increased according to the level of problems represented by the four SDQ strata (drawing probabilities: 0.37, 0.48, 0.70, and 0.89, respectively). At first assessment (T1; $M_{age} = 4.4$ years, $SD = .18$), the majority was attending state-sponsored day-care centers (95%). The second assessment (T2) took place when the children were six years old (1st grade; $M_{age} = 6.7$ years, $SD = .17$) and the third assessment (T3) commenced when the children were eight years old (3rd grade; $M_{age} = 8.3$ years, $SD = .24$). As might be expected in a university town, parents' educational level were generally high (6.7% had not finished high-school; 17.3% high-school graduates; 17.2% with some post high-school education; 58.3% college graduates), though comparable to the level in the general Norwegian population of parents of 4-year-olds (Wichstrøm et al., 2013).

Figure 1 portrays that not all consenting parents and children met for testing. However, the dropout rate after consenting at the well-child clinic (T1) did not differ according to the children's SDQ score, $t(1,250) = .28, p = .78$ or gender, $\chi^2 = 0.23, df = 1, p = .37$. Later attritions were however selective according to study variables. Children with higher teacher rated internalizing symptom score on the Achenbach

System of Empirically based Assessment (ASEBA) Teacher Report Form (TRF; OR = 1.025, 95% CI 1.00 to 1.05), higher teacher rated externalizing problem score (TRF; OR = 1.03, 95% CI 1.02 to 1.04), more ADHD symptoms (OR = 1.06, 95% CI 1.02 to 1.11), lower teacher rated scores on social competence (SSRS-T; OR = 0.97, 95% CI = .96 to .99), more conflicts with their teachers (STRS; OR = 1.04, CI 1.01-1.07), and higher score on teacher dependency (STRS; OR = 1.12, 95% CI 1.06 to 1.18) were more likely to drop out of the study between T1 and T2. Together, these variables explained between 3-4 % (according to the method used) of the variance in the drop out, indicating that drop out was only modestly skewed in a systematic manner (Cox & Snell $R^2 = 0.026$; Nagelkerke $R^2 = 0.042$). Children with more internalizing problems (teacher rated) (OR: 1.07 95% CI: 1.01 to 1.12), lower scores on language comprehension (WASI) (OR: .94 95% CI: .90 to .99) and children whose parents had lower educational level (OR: .85 95% CI: .78 to .94) were more likely to drop out between T2 and T3. Together, these variables explained between 4-7% (according to the method used) of the variance in the drop out, indicating that dropout was moderately skewed in a systematic manner (Cox & Snell $R^2 = .04$; Nagelkerke $R^2 = .07$).

The implied power of the present study will vary by the number of children followed up. However, at T3 the sample was as it lowest ($n = 699$), which resulted in a power of .83 to detect a standardized regression coefficient of .11 (determined by Gpower 3.1)

Procedure

The Regional Committee for Medical and Health Research Ethics approved research procedures. When the parents met for their child's regular health check up at the public health center they were informed about the study and provided informed written consent. Parents completed a structured diagnostic interview, followed by testing and observation at the University with their child, which took four hours on average. The retesting took place two (1st grade) and four years (3rd grade) later. Data on the children was also collected from day care providers, 1st and 3rd grade teachers through questionnaires. The teacher, who knew the child, was supposed to fill in the respective questionnaires. In Norway, pupils usually have one main teacher who follows her or his class from grades 1-3. Grades are not given in Norwegian elementary school, but the City of Trondheim conduct standardized tests. We

obtained and used such archival data from the city on the children's performance in Reading (1st and 3rd grades), Math (1st and 3rd grades), and English (3rd grade).

Measures

Early and Extensive Day care. The parents retrospectively reported the number of days and hours per week that the child was in childcare during four ages (6-12, 13-24, 25-36 and 37+ months). Using this information we calculated the total number of hours each child had spent in care from the onset of care until the University assessment. To ease interpretation of the results (regression coefficients), numbers of hours was represented per 1000 hours. Although accuracy of parental recollections of child care could not be directly established, prior research involving both prospective and retrospective reports of time spent in childcare have shown retrospective reports of extent of care to be reliable (Vandell & Corasaniti, 1990; Vandell & Powers, 1983).

Emotional outcomes. Two types of emotional outcomes were included, emotion regulation and symptoms of internalizing disorders.

Emotion Regulation was measured with the Emotion Regulation Checklist (ERC; Shields & Cicchetti, 1997). Parents and teachers completed the 24-item ERC at T2 and T3, using a 4-point scale (1= *almost always* to 4 = *never*). The rating yields scores on two subscales: Lability/Negativity and Emotion Regulation. The Lability/Negativity subscale consists of items representing a lack of flexibility, mood lability and dysregulated negative affect (e.g. "*Emotional reactions are inappropriate*"). The Emotion regulation subscale includes items describing situational appropriate affective displays, empathy, and emotional self-awareness (e.g. "*Has genuine/close relationships*"). The reliabilities of Lability/Negativity and Emotion Regulation, respectively, for parents were at both T2 and T3: $\alpha = .77$ and $.65$, and for teachers T2: $\alpha = .77$ and $.78$, and T3: $.80$ and $.78$.

Internalizing problems. Both teachers and parents provided ratings of internalizing problems by means of the Achenbach System of Empirically Based Assessment (ASEBA; Achenbach & Rescorla, 2000). The Child Behavior Checklist (CBCL) and Teacher's Report Form (TRF) were completed at T1, T2 and T3 by parents and teachers respectively. There are different versions available according to age; at T1 the 1.5-5 years versions were used, whereas the 6-18 years versions were used at T2 and T3. The CBCL 1.5-5 version includes 100 problem related items,

whereas the 6-18 years version and TRF includes 120 problem related items, which parents and teachers rate, using a 3-point scale (0= *not true* to 2= *very true/often true*). The total problem score gives the basis for two different problem scales; internalizing and externalizing problems. The reliabilities of internalizing problems for parents were T1: $\alpha = .83$, T2: $.75$ and T3: $.78$, and for teachers T1: $\alpha = .86$, T2: $.83$ and T3: $.83$.

Internalizing symptoms. Internalizing symptoms was assessed with the use of Preschool Age Psychiatric Assessment (PAPA; Egger et al., 2006) at T1 and T2, and the Child and Adolescent Psychiatric Assessment (CAPA; Angold & Costello, 2000) at T3. The CAPA is an interviewer-based semi-structured psychiatric interview for completion by children aged 9-17 and their parents. The PAPA is derived from the CAPA, and is also a semi-structured psychiatric interview for completion by parents of preschool aged children. Both collects data on the onset, duration, frequency, and intensity of symptoms of a wide range of psychiatric diagnoses relevant to children from both DSM-IV and ICD-10 (Angold & Costello, 2000). Interviewers ($n=7$) had at least a bachelor's degree in relevant disciplines, experience working with children and families, and trained by the team who developed the PAPA and the CAPA. Nine percent of the interview audio recordings were recoded using blinded raters. The inter-rater reliabilities for internalizing symptoms were: depression: ICC= $.91$ and anxiety: $.91$.

Behavioural outcomes. Similar to emotional outcomes, two measures were used for the behavioural outcomes: externalizing problems and symptoms of externalizing disorders.

Externalizing problems. Both teacher and parent rated measures of externalizing problems were included, by means of the TRF and CBCL respectively. The externalizing problems subscales consist of Attention Problems and Aggressive behaviour. The TRF had the following reliabilities at T1: Chronbachs's $\alpha = .95$, T2: $.93$; T3: $.93$, whereas the corresponding parent rated CBCL were T1: $\alpha = .89$, T2: $.86$; T3: $.85$.

Externalizing symptoms. Externalizing symptoms were assessed using PAPA at T1 and T2, and CAPA at T3. The ICC of the externalizing symptoms were for Attention Deficit Hyperactivity Disorder: $.97$, Oppositional Conduct Disorder: $.94$ and Conduct Disorder: $.89$.

Relational outcomes. Three types of relational outcomes were included; attachment to parents, social competence and child-teacher relationship.

Attachment. Attachment representations were measured using the Manchester Child Attachment Story Task (MCAST; Green, Stanley, Smith, & Goldwyn, 2000). The MCAST uses a structured doll plot methodology, where each child is presented with four distressing vignettes (e.g. getting lost at a shopping mall) to evoke specific attachment-related thoughts and behaviors. The child receives a primary and a secondary attachment strategy code for each vignette; secure (B), avoidant (A), ambivalent/resistant (C) or disorganized (D). Previous research has demonstrated that a continuous scale for each classification is both useful and an advantage when assessing children's attachment classifications (Futh, O'Connor, Matias, Green, & Scott, 2008; O'Connor, Bureau, McCartney, & Lyons-Ruth, 2011), and a continuous scale for each classification was therefore created. Primary categorization was coded as 1 (present) or 0 (absent), and each secondary classification as 0.5 (present) or 0 (absent). A classification scale was created as the mean of the primary and the secondary classifications. This enhances the statistical power and allows us to capture different degrees of the various attachment styles (O'Connor et al., 2011). Ten percent of the videos were recoded by raters blind to all information concerning the child and family. All coders had the equivalent of a bachelor's degree in relevant disciplines and were trained and licensed by Jonathan Green and his team. Intraclass Correlation Coefficient (ICC) was as follows: at T1; A-scale: .71, B-scale: .79, C-scale: .70 and D-scale: .73. At T2; A-scale: .72, B-scale: .86, C-scale: .52 and D-scale: .75.

Social competence. The Social Skills Questionnaire from the Social Skills Rating System (SSRS; Gresham & Elliott, 1990) were completed by both parents and day care providers/teachers at T1, T2 and T3. It consists of items describing child behaviour, rated on a 4-point scale (1= *never*, 2= *sometimes*, 3= *often*, and 4= *very often*). The SSRS parent report includes 39 items whereas the SSRS teacher report includes 30 items. The sum of all items gives a total score, with higher scores reflecting higher levels of perceived social skills. Parent ratings had the following reliabilities: T1: $\alpha = .89$, T2: .92; T3: .92, whereas the corresponding teacher ratings were T1: $\alpha = .92$, T2: .93; T3: .94.

Student-teacher relationship. The Student-Teacher Relationship Scale (STRS; Pianta & Steinberg, 1992) were completed by day care providers/teachers at T1, T2 and T3. The STRS is a self-report questionnaire for completion by teachers,

evaluating the quality of the child-teacher relationship. It consists of 28 items using a 5-point scale (1= *definitely does not apply* to 5= *definitely applies*). It evaluates the quality of the child-caregiver relationship in terms of three subscales: closeness, conflict and dependency. The closeness subscale measures the degree to which a teacher experiences affection, openness and warmth with a particular child (e.g. “*I share an affectionate, warm relationship with this child*”). The conflict subscale measures the level of disagreement in the interaction between the teacher and the particular child (e.g. “*This child and I always seem to be struggling with each other*”). Finally, the dependency subscale measures the teachers’ perception of clingy and possessive behavior from the child (e.g. “*This child reacts strongly to separation from me*”). STRS ratings had the following reliabilities; T1: $\alpha = .72$, T2: $.77$ and T3: $.77$.

Cognitive outcomes. To obtain data on cognitive functioning, measurement of executive functions, language comprehension and academic achievement and motivation were included.

Executive functions. Several measures were included to assess the children’s executive functions.

Behavior regulation, emotion regulation and metacognition. Measures of parent and teacher rated behavior regulation, emotion regulation and metacognition were obtained using The Behavior Rating Inventory of Executive Function questionnaire (BRIEF; Gioia, Isquith, Guy, & Kenworthy, 2000) for children aged 5-18, parents completed this at T2, whereas teachers at both T2 and T3. BRIEF consists of 86 items rated on a three-point scale (0 = “*Not true*”, 1 = “*somewhat or sometimes true*” and 2 = “*very true or often true*”). The reliability of parent rated Behavior regulation at T2; $\alpha = .90$. Parent rated Emotion regulation at T2; $\alpha = .90$. Parent rated Metacognition at T2; $\alpha = .94$. Reliabilities for teacher rated Behaviour regulation was at T2; $\alpha = .97$ and at T3 = $.96$. Teacher rated Emotion regulation at T2; $\alpha = .93$ and at T3= $.93$. Teacher rated Metacognition T2; $\alpha = .97$ and, T3= $.97$.

Working memory. Working memory was measured using backwards-number recall of the Wechsler Intelligence Test for Children 3rd edition (WISC-IV; Wechsler, 2003). The children were asked to orally recall, in the backward order, different sequences of digits (1-9) presented orally by the examiner (backward number recall; Wechsler, 2003). The backward number recalls was then used as a measure of working memory.

Attention. The Intra-Extra Dimensional Set Shifting (IED) subtest of the Cambridge Neuropsychological Test Battery (CANTAB; Robbins et al., 1994) was included to assess the children's ability to maintain attention on different stimuli within a relevant dimension (intradimensional shift, IDS) and then shift attention to a previously irrelevant dimension (extra-dimensional shift, EDS). The test is presented on a computer, whilst the child learns a specific rule to understand which of the stimuli presented is correct, based on computer feedback. In the current study we used outcomes on how many mistakes the child makes, adjusted for how many stages the child completed ("total errors adjusted") and "EDI errors" (total errors made in the intra dimensional stage of the task). A high score indicates a low set shifting ability; low scores indicate good set shifting ability. Some contend that measures of accuracy best reflect shifting (van der Ven, Kroesbergen, Boom, & Leseman, 2013). Both these outcomes reflects errors, hence accuracy.

Impulse control. Further, two subtests from a Developmental Neuropsychological Assessment (NEPSY; Korkman, Kirk, & Kemp, 1998) was included as a measure of inhibition; cats test and statue test. During the cats test, children are given a sheet of paper with pictures of different symbols, cats and other animals. The task is to, as quickly as possible, cross out all the cats, while not making any errors (crossing off symbols or other animals). The statue subtest is designed to assess motor persistence and inhibition. The child is asked to maintain a body position like a "statue" (eyes closed, no body movements or vocalizations), pretending to hold a flag for 75 seconds. At preset intervals, distractors are introduced (e.g. the examiner drops a pen), and at each such interval the child is rewarded with one point if he/she manages to maintain the body position, and no points if the distraction results in inappropriate responses (e.g. body movements or vocalizations).

Langue comprehension. Language comprehension was measured using Peabody Picture Vocabulary Test 3rd Edition (PPVT; Dunn & Dunn, 1997) at T1, and the vocabulary subtest from the Wechsler Abbreviated Scale of Intelligence (WASI; Weschler, 1999) at T2 and T3. PPVT is a measure of receptive vocabulary. It consists of 175 vocabulary items of generally increasing difficulty. In PPVT the child listens to the word uttered by the interviewer and then selects one of four pictures that best describes the words meaning (e.g. Fountain), whereas vocabulary subtest from WASI requires children to provide definitions of words uttered by the experimenter.

Teacher rated academic achievement. Teacher rated academic achievements in Reading, Writing, Math, Effort and Attention at T1 and T2 were included.

Self-rated task-values. Task-Value Scale for Children (TVS-C; Nurmi & Aunola, 2005) was administered to assess children's self-rated task-motivation (i.e. interest in or liking for a particular subject). The scale consists of 9 items rated on a five point scale (from 1/ picture of unhappy face = "I do not like it at all/I dislike doing those tasks" to 5/ picture of happy face = "I like it very much/I really enjoy doing those tasks"), and measure task-motivation in reading (3 items), writing (3 items) and math (3 items) separately (e.g. "How much do you like math?"; "How much do you like doing math-related tasks at school?"; "How much do you like doing math-related tasks at home?"). TVS-C was administered at T2 ($\alpha = .88$) and T3 ($\alpha = .89$).

Test results. We obtained and used archival data from the city of Trondheim on the participants' performance in Reading (T2 and T3), Math (T2 and T3), and English reading and listening (T3). The tests are designed nationally with the aim of identifying underperforming children. The Reading test from 1st grade to 3rd grade reflects the development of reading skills from language comprehension to learning letters, reading words to reading diverse types of text while understanding the coherence (Department of Education, 2011b). The Mathematics test maps the ability to among other, count, rank numbers, count forward and backwards, split numbers and solve textual assignments (Department of Education, 2011a). The English test maps the ability to recognize and understand English words and expressions orally and written. The test has two parts, one is listening and the other is a reading part (Department of Education, 2015). Tests scores are positively skewed to detect underperforming children.

Potential selection factors. Potential selection to early and extensive day care in the present sample has been closely examined and reported previously (Solheim, 2013). We therefore included the likely candidates identified in that study in our present investigation.

Socioeconomical status (SES). Three variables pertaining SES were coded; 1) The highest occupational level in the household, coded according to the International Classifications of Occupations (ILO, 1990), 2) gross annual family income were coded in 13 intervals of 75,000 NOK (USD 12,500), ranging from no income to an income of 900,000 NOK (USD 120,000) or higher, and 3) the educational level of

both the informant parent and the other parent, as measured in years, were coded.

Family climate. To assess family climate, a Norwegian translation of the McMaster Family Assessment Device (FAD; Epstein, Baldwin, & Bishop, 1983) were included. It consists of seven scales: Problem Solving (5 items), Communication (6 items), Roles (8 items), Affective Responsiveness (6 items), Affective Involvement (7 items), Behavior Control (9 items) and General Functioning (12 items). In the current study, only the General Functioning scale was used ($\alpha = .82$), which assess the overall health/pathology of the family, drawing items from all the above subscales. The FAD has demonstrated good psychometrics properties in terms of both internal consistency and validity (Epstein et al., 1983).

Alcohol problems. The current level of alcohol consumption by the parent meeting at the University at T1 was measured using the Alcohol Use Disorders Identification Test (AUDIT; Saunders, Aasland, Babor, De la Fuente, & Grant, 1993). The AUDIT is a 10-item screening instrument that is used to evaluate hazardous and harmful alcohol consumption, drinking behaviours and alcohol-related problems. The responses to each question are scored from 0 to 4, and the sum of the scores range from 0 to 40; a score above 8 indicates an alcohol problem.

Mental health problems. The informant parent provided information as to whether the child's biological parents had ever experienced psychological problems (i.e., not formal psychiatric diagnoses) ($yes=1, no=0$).

Ethnicity. The informant parent also provided information about the ethnicity of the biological parents ($Norwegian=0$ or $not\ Norwegian=1$).

Family status. The informant parent reported whether the biological parents lived together or was married at the time the child began day care ($yes=0, no=1$).

Siblings. The informant parent reported the number of siblings for each child in the study, including half- and stepsiblings (included when they had lived together for a longer period than one month).

Child characteristics. Child characteristics was reported by the interviewed parent at the University clinic, and included gender, age at the time of the assessment, gestation age (in weeks), prematurity status ($yes=1, no=2$), and birth weight. Low birth weight was defined as weights under 2,500 g ($low=1, not\ low=2$).

Results

Given that a stratified sample was used in this study, we conducted all analyses using weights that were proportional to the inverse of the probability of

selection of each subject. Robust confidence intervals were estimated using the Horvitz-Thompson estimator (Maiti, 2011).

Descriptive statistics for all study variables, means and standard deviations, are presented in Table 1. As can be seen, when the children were four years old, the mean number of hours spent in non-parental care was near 3,000. Parents have a tendency of higher ratings of internalizing and externalizing problems than the teachers, but there also seem to be a decrease in such problems, as reported by both parents and teachers, between T1 and T3. At T1 the ratings of social competence by teachers is higher than the parent ratings, but at T2 and T3 this tendency is reversed, and parents rate children higher on social competence than teachers. Also, as expected, because of the oversampling of children with problems, some of the standard deviations regarding problems, especially in the behavioural domain, were similar to or higher than the mean.

Table 2 shows descriptives and primary analyses of the association between hours in day care and covariates. First, the association between these potential selection factors and hours in day care were examined with linear regression. Variables significantly associated with day care were entered into a multiple regression, using backwards elimination according to LR ratio. By using this procedure we identified four selection variables predicting early and extensive day care; parent's education, gross income, siblings and age at assessment. Overall, the selection variables included in these analyses accounted for 8.9% of the total variance in initiation and extent of day care experiences, leaving most of the variance unexplained. The secondary analyses involved a general linear model, testing if child functioning at four, six and eight years varied as a function of childcare quantity (initiation of and extent of care). Table 3 shows the results of these analyses, first unadjusted and then adjusted for factors accounting for selection into early and extensive day care. Given the magnitude of variables included in the analyses, it is highly likely that some of the results would turn out significant on chance. False discovery rate correction for multiple comparisons (Benjamini & Hochberg, 1995) was therefore included *post hoc*. A description of the results from Table 3 and FDR corrected analyses is presented in the following.

Emotional Outcomes

Eight aspects of emotional outcomes (see Table 3) were considered. In the unadjusted analyses children spending more time in day care had less internalizing

problems (teacher rated), and fewer symptoms of both anxiety and depression at T1. When adjusted for selection factors the association with the internalizing problems (teacher rated) and fewer symptoms of major depression at T1 remained. Further the analysis revealed that more time spend in childcare was associated with higher levels of internalizing problems (parent rated) at both at T2 and T3. None of the results involving emotional outcomes remained significant after the FDR correction.

Behavioural Outcomes

As shown in Table 3, five measures of behavioural outcomes were considered. The unadjusted analyses indicated that children spending more time in day care had less externalizing problems (teacher rated) at T1 and T2. When adjusted for covariates these associations disappeared, and results revealed that children spending more time in day care had more symptoms of conduct disorder at T2. However this association was not significant after FDR adjustment.

Relational Outcomes

We considered nine aspects of relational outcomes (see Table 3). Unadjusted analyses revealed that children with early and extensive day care experience had higher teacher rated social competence at T1, rated as having a closer relationship with the teacher at T2, and rated lower on social competence by their parents at T3. When adjusting for covariates none of the associations remained.

Cognitive Outcomes

Shown in Table 3, 25 measures of cognitive outcomes were included. Unadjusted analyses showed associations between more hours in day care and higher scores on language comprehension (Peabody Picture Vocabulary Test) at T1, executive functions (working memory, IED set shifting - total errors adjusted, and IED set shifting - errors) at T2, language comprehension (WASI) at T2 and T3 and teacher rated performance in reading, writing and math and attention at T2 and T3. Further, more time spent in day care was associated with higher scores on standardized national tests in reading, both Norwegian and English, at T3.

In the adjusted analyses more hours in day care predicted higher scores on language comprehension at T1, executive functions – working memory at T2, test results English reading and math at T3, and self rated task values in writing and math at T2 and T3. After the FDR corrections only the association between more hours in day care and higher scores on working memory backwards-number recall at T2 (p

= .033, $r^2 = .026$) and the self-reported task values in math at T3 remained significant ($p = .033$, $r^2 = .025$).

In summary, the results show that several associations between extent of day care experiences can be found, but when controlling for selection factors and including FDR correction, only two of these remained; the association between early and extensive day care and higher scores on working memory at T2 (backwards-number recall), and more time in day care and higher self reported task values in math at T3.

Discussion

Early and extensive day care has become increasingly common in western countries (OECD, 2013; UNICEF Innocenti research Center, 2008), and theoretical perspectives propose that the day care experience may influence children's development for better or for worse. This possibility has generated considerable research over the last four decades reporting both advantages and disadvantages (Belsky, 2006). However, long-term effects have seldom been addressed, many potential outcomes have been neglected, and much of the early research did not adjust for potential selection factors into early and extensive day care – which may confound results. In addition, many of the studies reporting effects of early and extensive day care on child development were conducted in countries with varying structural day care quality, and it is not known whether such findings will emerge in countries with higher structural day care quality.

In the present study we therefore examined effects of early and extensive day care on developmental outcomes in four broad domains (emotional, relational, behavioral, and cognitive) in a community sample of Norwegian preschoolers followed from age four to eight. More specifically, the focus was on hours spent in day care from time of initiation, as a predictor of these developmental outcomes at age four, six and eight. By this, the present study seeks to build upon, and extend previous research in several ways. First, by examining if similar effects could be found in a representative Norwegian sample. Second, by including multiple informants and measurements (observations, interviews and questionnaires). Third by adjusting for selection factors. And fourth, by investigating potential long-term effect extending into the first three years of school. The main finding was that time spent in day care had, with a few exceptions, no effect on the developmental outcomes investigated. Time spent in day care had no predictive value on emotional, behavioral

or relational outcomes, but did however predict some positive outcomes in the cognitive domain.

Emotional outcomes

Regarding emotion regulation and emotional problems, attachment theory propose that extensive time in non-parental day care could interfere with the development of emotion regulation, and that difficulty with regulating emotions could lead to emotional problems (Cicchetti et al., 1995). Although few have examined potential emotional outcomes, results from the Norwegian MoBa study (Schjølberg et al., 2011) found no associations between childcare initiation and anxiety and depression at age five. Our results coincide with these, finding no association between time spent in day care and internalizing emotional problems at age four, six and eight. In addition, no effects of time in day care on emotion regulation were found. Thus, it is possible that time in non-parental care do not have the effects on emotional development one would expect as proposed by attachment theory. There could be several explanations for this. One possibility is that extent of time in day care, and thus separations from primary caregivers, does not have any effects on emotional development. However, it is well known that children are dependent on others who is responsive to the child's internal state in order to learn how to regulate emotions (Tronick, 1989), and thus promote a successful emotional development (Denham et al., 2003). Therefore, this explanation is highly unlikely. Another, more likely possibility is that the emotional development is not affected by separations from parents because staff in the day care facilities acts as a secondary attachment figures and fulfills the children's needs, thus hindering the possible negative effects such separations could have (Bowlby, 2007).

Behavioral outcomes

The NICHD ECCRN (Belsky, 2006; NICHD Early Child Care Research Network, 2003, 2003a) found time spent in day care to predict higher caregiver and teacher rated externalizing behavior at 24 and 54 months, with long-term effects evident at 12 and 15 years (Belsky et al., 2007; Vandell et al., 2010). Based on these findings we expected to find some association between quantity of day care and externalizing problems. No such associations were detected. Consistent with our findings, other Norwegian studies (Solheim et al., 2013; Zachrisson et al., 2013) have also failed to detect these associations.

Several possible reasons associated with sociopolitical context could explain this. First, several factors has been found to increase the probability of developing externalizing problems, as aggressive behavior, hereunder environments offering stress and chaos (Hinshaw, 2002; Zachrisson et al., 2013). Even though Norway does not meet all the current benchmarks in regards to UNICEF day care standards, the structural quality of day care in Norway is high and proximately homogenous (UNICEF Innocenti research Center, 2008). Government regulations regarding staff education, caregiver-child ratios and laws ensuring the educational framework (Ministry of Education and Research, 2006) may contribute to form a day care environment less promoting of such aggressive behaviors. Second, attachment theory proposes that early and extensive day care during infancy may influence children's socioemotional development (Belsky & Rovine, 1988). However, day care attendance before the age one is unusual in Norway, but more common in countries offering leave for a shorter period of time, as for example the United States or United Kingdom (UNICEF Innocenti research Center, 2008). Even though findings are inconclusive, studies reporting effects of day care quantity on externalizing behavior are often conducted in such countries (Belsky, 2006; Borge et al., 2004; Loeb et al., 2007). Taking this into consideration with recent similar findings (Solheim et al., 2013; Zachrisson et al., 2013) it is highly likely that quantity effects of Norwegian day care on behavior outcomes are in fact absent.

Relational outcomes

Attachment. As noted, attachment theory suggests that extensive time in day care could disrupt attachments to primary caregivers. However, the main finding from studies on attachment is that quantity of day care has no main effects on attachment security to parents (Erel et al., 2000; NICHD Early Child Care Research Network, 1997a, 2001). These results are supported by the present study as well. As noted, attachment beyond infancy is not investigated, and it was hypothesized that effects of extensive time in day care on attachment security could be evident at a later time in children's life. The results indicate that there are no long-term effects of extensive time in day care on attachment later in life either.

Social competence. Consistent with recent Scandinavian research (Lamb et al., 1988; Solheim et al., 2013; Zachrisson et al., 2013) no effects of time in day care on social competence age four were found. Remember that concerning long-term effects of time in day care on social competence, both positive (Andersson, 1989, 1992) and

negative (NICHD Early Child Care Research Network, 2005) effects have been found. In the present study, no long-term effects of time in day care were evident. Thus, it is possible that extent of time in non-parental childcare do not have any effect on development of social competence. As noted, large differences in socio-political context where studies are conducted could account for the differences in the results. As noted, socio-political context may account for some of the difference in the research literature on effects of time in day care on social competence. It is possible that both earlier enrollment in day care, and varying structural quality in the US (UNICEF Innocenti research Center, 2008), makes for day care experiences that negatively affects development of social competence. Such effects may not yield in a Norwegian sample, where children enroll in day care later, and structural quality is relatively high.

Relationship to secondary caregiver. Further, regarding the child-teacher relationship, which is severely understudies, no effects of early and extensive time in day care on the child-teacher relationship was found.

Cognitive outcomes

Previous research has suggested that time spent in day care may influence cognitive, linguistic and academic development (Lamb et al., 1988). In the present study we therefore included several measurements, assessing different aspects of cognitive performance to increase the possibility of detecting effects, if any were indeed present. These included both parent and teacher rated measures of executive functions as well as direct assessment of different aspects of executive functions (e.g. attention and working memory) and clinical assessment of language comprehension. In addition, test results on standardized national test as well as teacher rated academic achievement, and child rated task motivation were included.

Executive functions. Results after final analysis showed that quantity of day care predicted higher scores on working memory (backwards number recall from WASI) when the children were six years old. This is consistent with previous findings from the NICHD ECCRN (NICHD Early Child Care Research Network, 2005), reporting that quantity of day care predicted higher scores on working memory at start of kindergarten (age 5-6). The explained variance of quantity of day care on working memory backwards number recall was low, only 2.5 %. Although no definitive answer can be given we offer several explanations for this effect. First, if there actually exist an association between time in day care and executive functions

(working memory), this could reflect educational practices in day care that facilitates the development of executive functions. Since this effect was only observed at six, an explanation could be the fact that children enrolling early into day care have a head start on children enrolling later. Hence, these children are more exposed to factors of day care that may enhance cognitive development, which may reflect higher performance at age six, compared to those starting later. Executive functions are highly heritable (Blokland et al., 2011; Devlin, Daniels, & Roeder, 1997), thus when entering school and being offered a more similar environment during the first years of school, heritability will eventually explain more of the variation, leaving less room for earlier experiences. It is also possible that later-starting children will catch up with earlier starting children when exposed to a more executive enhancing environment, such as school. However, from both a heritability and catching-up explanation one would predict that effects of early day care would diminish or vanish after a while, which is consistent with our findings. Further, taking into consideration the fact that this effect emerged after adjustment for selection factors and FDR controlling, it is highly unlikely that a Type 2 error has occurred because of methodological shortcomings. Taking this into consideration, in addition to the previous findings from the NICHD ECCRN (NICHD Early Child Care Research Network, 2005), it is reasonable to think that day care quantity actually predicts higher scores on working memory tests at age six.

Language. The NICHD ECCRN found no association between hours in day care and language development (Belsky et al., 2007; NICHD Early Child Care Research Network, 2000b, 2003). In concordance, the current investigation found no quantity effects on language development. One possible explanation may be that age of enrollment, rather than time spent in day care, may influence language development. As was found by Loeb et al. (2007), day care enrollment between the ages 2-3 predicted higher pre academic reading skills in an American sample. Hence, it is likely that main effects of day care quantity on language development are in fact lacking.

Academic performance. Associations between more time spent in high quality day care and higher academic performances have been documented in the day care literature (NICHD Early Child Care Research Network, 2007). As mentioned previously, recent findings from a study including a Norwegian sample, showed age of enrolment to predict higher academic achievement at age seven. Children enrolling

at 15 months scored significantly higher on standardized national test of language (Norwegian) and math at age seven, compared to children enrolling day care at 19 months (Drange & Havnes, 2015). Our analysis included results on the same standardized national tests on math and language. In addition, we included both teacher rated academic performance and child rated task-values. Quantity of day care did not predict test results or teacher rated academic performance. Our results showed however, that time in day care predicted higher child rated task values of math at age eight. The explained variance by quantity of day care on child-rated preference of math was only 2.5 %. One possible explanation for the observed effect could be related to the educational framework offered in Norwegian day care. Under the Day care Act (Ministry of Education and Research, 2006), a regulatory framework with the intention of ensuring the purpose and content in day care is given. As part of this regulation, play with number, spaces and shapes are insured to help children develop mathematical skills. One may argue that introducing mathematical concepts through play and activities in day care enhances children's preference for math. Therefore, children enrolling early and spend longer hours in day care are more exposed to these activities compared to those enrolling later. This could explain the children's preference of math at age eight. Even so, this does not explain why the same effect was not observed at age six. However, following this line of interpretation, the observed effect could be a so called "sleeper effect" (Vandell et al., 2010) there is a possibility that the enhancing preference for math (provided by day care) yields only when more challenging mathematical tasks are offered in 3rd grade, as compared to easier tasks in 1st grade. Further, as can be seen in Table 3, there was an effect of time in day care on task values math when the children were six years old, but this effect disappeared after the FDR corrections. It is therefore possible that the effect actually is present at an earlier time, but that the FDR controlling has led to a Type 1 error. Again, in regards to both adjusting for selection factors and FDR correction, it is doubtful that the effect found was a Type 2 error because of methodological shortcomings.

Why is there lack of effects?

Before accepting the conclusion that there are no short- or long-term effects of early and extensive day care, except some cognitive outcomes, we will consider a range of potential pitfalls. These relate to several methodological issues and the specific sociopolitical context the present study was conducted in. All these

explanations relate to what is traditionally considered study limitations. Before continuing and addressing this question, reader should be reminded that the findings mentioned here are based on an observational study, and although the time-relationship between exposure and outcome is clear and a range of potential confounders are controlled for, the present design do not allow for a strong test of causal relations, or lack thereof.

Methodological explanations

Reliability. Zero-findings will result when reliabilities are absent or low. Results showed moderate to high reliabilities throughout the different measures. Thus, we cannot rule out the possibility of not being able to detect true effects of day care because of moderate reliabilities in some cases (i.e. MCAST, STRS and ERC). However, reliability problems cannot explain the complete lack of findings in the present study. Moreover, as opposed to many other studies, the present investigation was well powered to detect small effects; thus, the lack of power cannot serve as an important explanation for no effects being observed.

Confounding. We adjusted for selection effects that may have acted as confounders between the day care and child outcome relationships, by taking into account a wide range of potential confounders and adjusting for those who turned out to predict early and extensive day care. Because we had a continuous exposure measure, and not a dichotomize one (i.e. early versus late starters) more conservative controlling could not be implemented (i.e. propensity score matching) in the current study. Studies have found that covariate-adjusted regression estimates of childcare effects do not prove robust when more conservative controls for selection are employed (Jaffe et al., 2011; McCartney et al., 2010; Solheim, 2013; Zachrisson et al., 2013). This could have influenced the conclusions of this study had there been any effects, but since this study generally shows a lack of effects, this is not considered a limitation in the present study. As noted, related studies have demonstrated that alleged associations between day care and early child functioning tend to disappear when adjusted for selection into early and extensive day care (McCartney et al., 2010; Zachrisson et al., 2013). The present study demonstrates that this is true for longer-term effects as well; when controlling for potential selection factors, most of the initial associations between hours in day care and developmental outcomes in all of the five domains examined disappeared.

Multiplicity. Further, in relation to the Multiple Testing Problem, researchers must not overlook the statistical challenge when considering hundred or more confidence intervals simultaneously (Benjamini & Hochberg, 1995). Taking this into consideration, FDR corrections were included to ensure that rejections of null hypothesis findings were not falsely accepted, and to increase power (Benjamini & Hochberg, 1995; Shaffer, 1995). Thus, when an incremental procedure correcting for the number of test performed, only two of the 13 initially identified significant effects survived. One possibility for the inconsistency in effects identified in the research literature could therefore be the grounds of lack of correction of multiple tests. Several studies use longitudinal data that include measures of children in several domains (NICHD Early Child Care Research Network, 2003, 2005). Studies like these, often report several associations, both short-term and long-term, between time in center care and different developmental outcomes (e.g. better memory, more conflicts in relationships with teacher and mothers, poorer work habits and poorer social skills through third grade). However, it is seldom mentioned that multiple tests may constitute any problem in the interpretation of these findings. As the present study shows, several associations could be identified when adjusting only for selection factors, but when including FDR correction most of these disappeared. Based on this, lack of corrections for multiple tests may be another possibility for the inconsistency in findings. However, corrections for multiple test, like FDR corrections, despite of gaining statistical power, it should be mentioned that this is at the cost of increased probability of Type 1 errors (Shaffer, 1995) which means that it is a possibility that effects exists, but that they remain undetected or overlooked because of the corrections of number of variables. The FDR corrections may therefore have contributed to the lack of findings presented here. Hence, both the FDR corrections and controlling for selection factors may contribute to the lack of findings in the present study. However, as noted previously, the present investigation was well powered to detect even small effects, and it is not likely that this could explain the almost complete lack of findings.

External validity. Regarding representativeness, attrition rate was moderately selective in a systematic manner between 1st and 3rd grade; children showing internalizing problems (teacher rated), who had poorer language comprehension, and those with parents with lower educational level were more likely to drop out of the study. It is therefore possible that including all children could have yielded different

results. Research has shown that disadvantaged children (e.g. from families with low socio-economic status) profits the most of spending time in day care, independent of quality (Burchinal et al., 2000; Drange & Havnes, 2015; Lazar & Darlington, 1982; NICHD Early Child Care Research Network, 2005; Vandell et al., 2010). By including all children in the study, or by not using complete case analyses (e.g. multiple imputation or full information maximum likelihood estimation) it is conceivable that some positive effects of day care could have been detected, maybe especially in regards to academic and cognitive development. Further, the fact that children with more internalizing problems were more likely to drop out could have prevented us from finding negative effects on emotional outcomes of time in day care. The same is true in regards to language comprehension. Even so, it is likely that by including these children it would only have influenced the results to a very limited extent. It should be mentioned that selective attrition, especially when high, could potentially lead to a less representative sample, and thereby make generalization of findings more challenging (Jüni & Egger, 2005). However, the variables only explained between 4-7% of the variance in drop out, indicating that most of the variance in dropout was not systematic.

Multivariate normality. Further, skewness and kurtosis diagnostics on the variables included in the study was not conducted, and may therefore be a limitation. Skewness in variables could influence the representativeness of the sample. This is however, not considered a major limitation. Due to our large sample, we were less vulnerable than others to the effects of not conducting this analysis, and the transformations that might result from it (Cox, 2010).

Sociopolitical context. A substantial amount of the previous presented literature on day care and developmental outcomes has been conducted in countries with a different socio-political context than the present study, such as the United States. Such differences (e.g. parental leave policies and child care regulations) between countries may be a likely determinant of the discrepancies observed (van Ijzendoorn & Tavecchio, 2003). This can be illustrated by the meaning of ‘early’ day care across different nations. In Norway, a very small percentage of children attend day care before their first birthday (Statistics Norway, 2015), but in the United States it is common to initiate non-parental care well before that time (UNICEF Innocenti research Center, 2008). Also, day care quality in terms of standardized day care and government regulation differs dramatically across nations; From Scandinavian

countries with almost universal coverage and overall high quality day care (Andersson, 1992; Lamb et al., 1988; Solheim et al., 2013) to the United States with varying quality and little governmental regulation (Love et al., 2003; Vandell & Corasaniti, 1990). With differences like these, children's day care experiences will vary across nations with different sociopolitical context, which could lead to different effects of childcare detected in different studies. If in fact, differences in socio-political contexts make for different day care experiences and therefore different effects on development, generalizations of results across nations could be challenging. However, inconsistency in studies conducted within Scandinavia with a much more similar socio-political context exists (Andersson, 1989, 1992; Borge & Melhuish, 1995; Campbell et al., 2000; Gupta & Simonsen, 2007; Solheim, 2013; Zachrisson et al., 2013). Thus, differences between countries may account for some, but not all, of the inconsistency in the results across studies.

Not considering quality. As noted previously, no measure of day care quality was included, and potential effects of quality could not be included in the analysis. Even though government regulation ensure high levels of structural day care quality in Norway, it is possible that variations in process quality (e.g. quality of caregiver-child interactions) moderate children's day care experience. If measures of quality had been included in the study, and controlled for, we would be able to separate effects of quantity from effects of quality. Thus, we cannot rule out day care quality as a possible moderator of the effects of early and extensive day care. Even if one accepts that there are no overall effects of early and extensive day care in Norway that does not imply that some children may not profit from day care while others suffers from it, as has been indicated from a large body of studies from other parts of the world (Belsky, 2006). Furthermore, even in the context of no effects of day care in Norway, organizational differences in day care, e.g. differences in group sizes or traditional regular groups versus less fixed child groups may have long term effects on children, as indicated by other results from TESS study (Skalická et al., 2015a; Skalická, Belsky, Stenseng, & Wichstrøm, 2015b).

Conclusion

Previous Norwegian research has documented no effect of early and extensive day care on selective areas of children's development during the preschool years (Solheim et al., 2013; Zachrisson et al., 2013). Here we replicate and extend these

findings showing that amount of time spent in day care have no overall effects on children's development at age four, six or eight. However, quantity of day care did predict two specific cognitive outcomes: higher test scores on working memory at age six, and higher child rated preference of math at eight. Thus, most of the positive and negative consequences of early and extensive day care, which were evident in some of the previous international research, were not detected in the current study. Yet, finding does not indicate that childcare is beneficial for child development; there was a lack of both positive and negative effects of early and extensive day care in the present study. The implication of this study is that so far there is little evidence warranting concern for how most children are affected by early and extensive time in non-parental day care in Norway. It remains to be determined if the effect of quantity in day care seen in this study remains past the age of eight, or if any effects emerge at a later time in the children's life — so called sleeper-effects.

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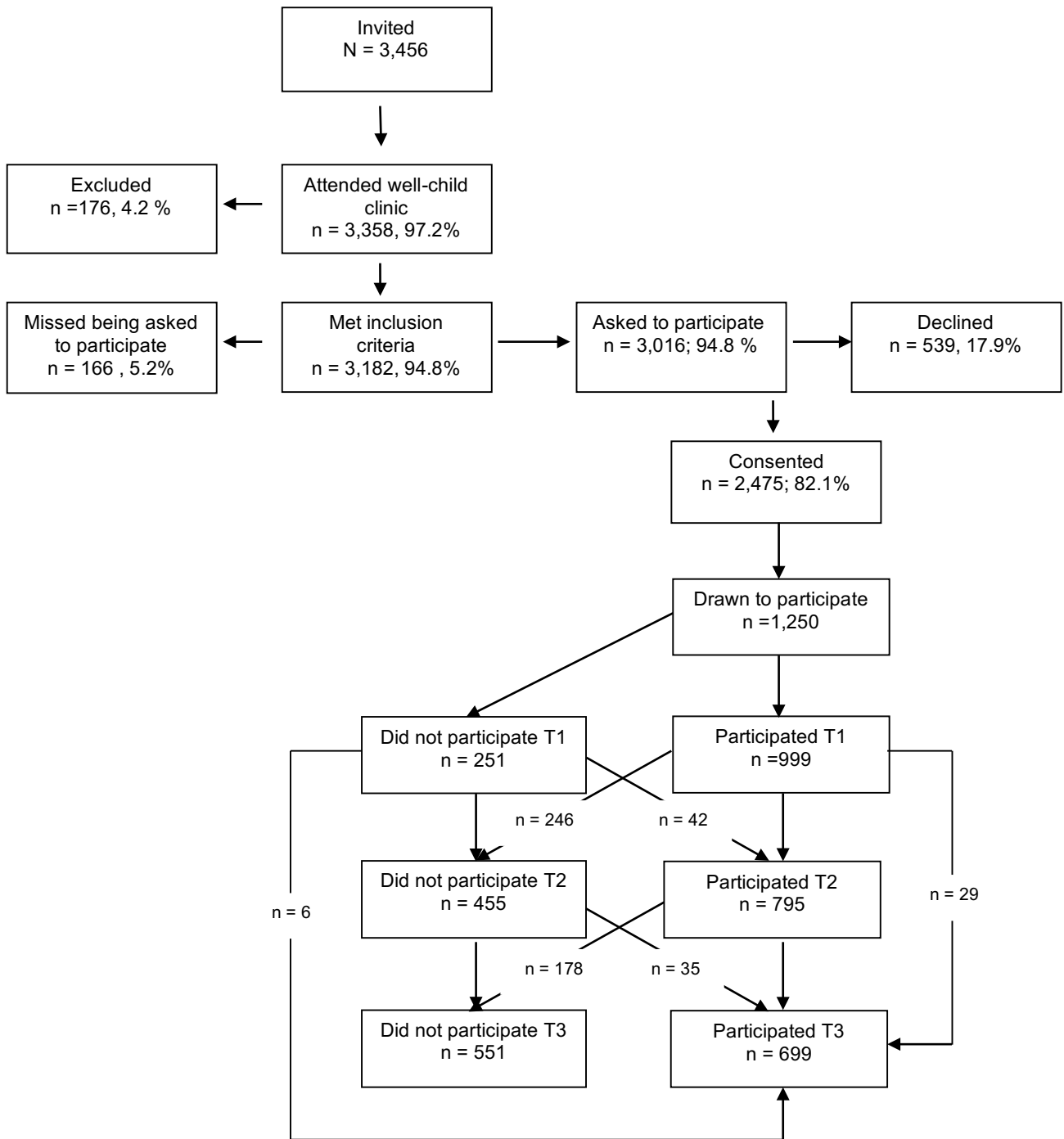


Figure 1. Recruitment and participant flow from T1 to T3.

Table 1

Deskriptives of Study Variables

Study Variables	4 years		1 st grade		3 rd grade	
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
Hours in day care	2.94	.98				
Emotional domain						
Emotion regulation: Lability/negativity – P rated	NA		1.61	.24	1.57	.23
Emotion regulation: Emotion regulation – P rated	NA		3.44	.27	3.50	.28
Emotion regulation: Lability/negativity – T rated	NA		1.43	.25	1.36	.27
Emotion regulation: Emotion regulation – T rated	NA		3.35	.36	3.41	.37
Internalizing problems – T rated	4.21	3.59	2.34	3.04	2.11	2.77
Internalizing problems – P rated	4.69	3.12	3.08	2.91	2.56	2.74
Number of symptoms of anxiety disorders	.85	.85	.83	1.07	.92	1.03
Number of symptoms of depressive disorders	.86	1.04	.98	1.32	.99	1.37
Behavioral domain						
Externalizing problems – T rated	6.04	6.26	2.60	3.92	2.20	4.12
Externalizing problems – P rated	6.29	3.83	3.46	3.04	2.77	2.82
Number of symptoms of oppositional defiant disorder	.74	.82	1.00	1.01	.79	1.00

Study Variables	4 years		1 st grade		3 rd grade	
	M	SD	M	SD	M	SD
Number of symptoms of oppositional conduct disorder	.33	.44	.23	.39	.31	.50
Number of symptoms of attention-deficit/hyperactivity disorder	1.22	1.23	1.43	1.74	1.26	1.89
Relational domain						
Insecure – avoidant attachment score (A)	.21	.17	.17	.18	NA	
Secure attachment score (B)	.51	.25	.67	.26	NA	
Insecure – ambivalent attachment score (C)	.08	.11	.07	.12	NA	
Disorganized attachment score (D)	.19	.17	.08	.13	NA	
Social competence – T rated	57.42	9.85	57.62	11.53	60.86	12.20
Social competence – P rated	49.65	6.73	73.03	11.29	75.56	11.74
Student-teacher relationship: Closeness	39.27	3.54	38.45	4.16	38.61	4.49
Student-teacher relationship: Conflict	17.59	3.19	17.82	3.70	17.52	3.71
Student-teacher relationship: Dependency	7.82	1.81	7.35	2.02	7.12	2.01
Cognitive domain						
Executive functions: Behavior regulation – T rated	NA		24.14	6.08	23.14	5.33
Executive functions: Emotion regulation – T rated	NA		20.89	3.08	20.72	3.24
Executive functions: Meta cognition – T rated	NA		54.85	10.71	54.73	11.47
Executive functions: Behavior regulation– P rated	NA		25.11	4.41	NA	
Executive functions: Emotion regulation–P rated	NA		22.25	3.81	NA	

Study Variables	4 years		1 st grade		3 rd grade	
	M	SD	M	SD	M	SD
Executive functions: Meta cognition– P rated	NA		61.98	8.99	NA	
Executive functions: Working memory (BNR)	NA		3.91	1.61	8.50	1.30
Executive functions: IED Set Shifting (TEA)	NA		53.96	23.28	46.57	22.86
Executive functions: IED Set Shifting – errors	NA		19.74	8.86	18.32	9.38
Executive functions: Impulse control (NEPSY cats)	NA		19.04	1.39	19.45	1.21
Executive functions: Impulse control (NEPSY statue)			.82	.22	.28	.02
Language comprehension: PPVT	65.58	14.62	NA		NA	
Language comprehension: WASI	NA		16.67	4.51	27.33	5.94
Reading performance – T rated	NA		3.31	.78	3.39	.93
Writing performance – T rated	NA		3.23	.75	3.26	.83
Math performance – T rated	NA		3.34	.67	3.38	.83
Effort – T rated	NA		4.51	1.14	4.56	1.31
Attention – T rated	NA		4.73	1.06	4.79	1.21
Task values: Reading – C rated	NA		2.21	1.05	2.01	.94
Task values: Math – C rated	NA		2.14	1.06	2.02	1.06
Task values: Writing – C rated	NA		2.12	1.06	2.17	1.01
Test results: Reading skills	NA		97.14	9.36	53.55	13.54

Test results: Math	NA	42.17	7.04	66.38	12.66
Test results: English listening	NA	NA		20.64	3.11
Test results: English reading	NA	NA		23.11	3.18

Note. T= teacher, P= parent, C= child, BNR= Backwards Number Recall, TEA = total errors adjusted, IED = Intra-Extra Dimensional Set Shifting, NEPSY= A Developmental Neuropsychological Assessment, PPVT= Peabody Picture Vocabulary Test, WASI= Wechsler Abbreviated Scale of Intelligence

Table 2

Association between number of hours in day care and covariates

Study Variables	Mean (SD)	Unadj. B (p-value) (95% CI)	Adj. B (p-value) (95% CI)
Parental occupation (1-6)	4.46 (.77)	249.87 (<.0001) (183.80; 315.95)	69.39 (.16) (-27.17; 165.96)
Gross family income (0-13)	10.04 (2.29)	78.42 (<.0001) (56.42; 100.43)	73.78 (<.0001) (34.08; 113.48)
Index parent's education (1-11)	7.12 (1.67)	135.83 (<.0001) (107.27; 164.40)	78.24 (.001) (32.73; 123.76)
Other parent's education (1-11)	6.92 (2.06)	96.23 (<.0001) (68.35; 124.11)	15.17 (.42) (-22.05; 52.39)
Family climate	1.64 (.33)	-133.42 (.09) (-287.90; 21.03)	-84.12 (.38) (-273.68; 105.44)
Parent's alcohol problems	4.18 (2.02)	18.02 (.15) (-6.78; 42.83)	-2.53 (.88) (-35.87; 30.81)

Study Variables	Mean (SD)	Unadj. B (p-value) (95% CI)	Adj. B (p-value) (95% CI)
Parental hospitalization for mental health problems (1=ever present)	.05 (.18)	99.37 (.58) (-450.60; 251.85)	36.80 (.85) (-408.06; 334.46)
Ethnicity (0=Non-Norwegian)	1.92 (.32)	135.37 (.04) (2.77; 267.97)	8.32 (.90) (-122.69; 139.34)
Parents living together (1= parents not living together)	.11 (.22)	-177.13 (.05) (-357.49; 3.22)	92.84 (.60) (-258.75; 444.42)
Number of siblings	1.33 (.76)	-75.75 (.03) (-143.98; -7.53)	-55.40 (.26) (-151.46; 40.68)
Gender of child (1=male)	1.50 (.39)	-15.55 (.81) (-142.74; 111.64)	24.91 (.75) (-126.61; 176.43)
Age at clinic deduced from age at DC (months)	54.79 (2.99)	42.73 (<.0001) (42.73; 61.38)	24.99 (.02) (3.25; 46.73)
Gestation age (weeks)	39.40 (1.66)	11.94 (.41) (-16.75; 40.63)	-6.80 (.81) (-61.34; 47.75)

Study Variables	Mean (SD)	Unadj. B (p-value) (95% CI)	Adj. B (p-value) (95% CI)
Preterm (1=premature)	.04 (.16)	98.77 (.54) (-216.17; 413.71)	295.02 (.37) (-352.40; 942.43)
Birth weight (1=low)	.04 (.15)	-297.20 (.04) (-586.55; 7.86)	-257.69 (.27) (-711.22; 195.85)

Note. CI= confidence intervall, DC= day care,

Table 3

Numbers of hours in day care predicting outcomes with and without adjusting for covariates

Study variables	4 years		1 st grade		3 rd grade	
	<i>Unadj. B</i> <i>(95% CI)</i>	<i>Adj. B</i> <i>(95% CI)</i>	<i>Unadj. B</i> <i>(95% CI)</i>	<i>Adj. B</i> <i>(95% CI)</i>	<i>Unadj. B</i> <i>(95% CI)</i>	<i>Adj. B</i> <i>(95% CI)</i>
Emotional domain						
Emotion regulation: Lability/negativity – P rated	NA		-.01 (-.32; .00)	-.01 (-.03; .02)	-.01(-.03; .02)	.00 (-.02; .03)
Emotion regulation: Emotion regulation – P rated	NA		.01 (-.02; .03)	.00 (-.02; .02)	-.00 (-.03; .02)	-.01 (-.04; .02)
Emotion regulation: Lability/negativity – T rated	NA		1.82 (-.02; .02)	.00 (-.02; .03)	-.01 (-.03; .02)	.00 (-.03; .03)
Emotion regulation: Emotion regulation – T rated	NA		.20 (-.01; .05)	-.01 (-.04; .02)	.02 (-.02; .05)	.00 (-.04; .04)
Internalizing problems – T rated	-.50 (-.76; -.24)	-.32 (-.62; -.03)	.10 (-.09; .28)	.18 (-.04; .40)	-.10 (-.40; .20)	.03 (-.34; .39)
Internalizing problems – P rated	.04 (-.16; .24)	.19 (-.04; .43)	.18 (-.27; .40)	.35 (.10; .59)	.19 (-.01; .40)	.29 (.04; .54)
Number of symptoms of anxiety disorders	-.06 (-.13; -.00)	-.04 (-.12; .04)	-.05 (-.12; .01)	-.02 (-.10; .05)	-.05 (-.13; .03)	-.02 (-.13; .08)
Number of symptoms of depressive disorders	-.06 (-.09; -.02)	-.05 (-.09; .00)	-.03 (-.09; .02)	-.04 (-.10; .03)	.01 (-.04; .05)	.04 (-.02; .09)
Behavioral domain						
Externalizing problems – T rated	-.83 (-1.34; -.33)	-.52 (-1.05; .01)	-.33 (-.64; -.03)	-.05 (-.40; .30)	-.31 (-.77; .15)	-.14 (-.70; .42)
Externalizing problems – P rated	-.17 (-.43; .09)	.01 (-.30; .32)	-.09 (-.30; .13)	.05 (-.20; .30)	.07 (-.14; .29)	.16 (-.10; .43)

Study variables	4 years		1 st grade		3 rd grade	
	<i>Unadj. B</i> (95% CI)	<i>Adj. B</i> (95% CI)	<i>Unadj. B</i> (95% CI)	<i>Adj. B</i> (95% CI)	<i>Unadj. B</i> (95% CI)	<i>Adj. B</i> (95% CI)
Number of symptoms of ODD	-.03 (-.09; .30)	.01 (-.06; .08)	-.02 (-.10; .05)	.04 (-.05; .12)	-.04 (-.12; .03)	-.02 (-.12; .09)
Number of symptoms of CD	-.30 (-.06; .00)	.00 (-.04; .04)	.01 (-.01; .04)	.04 (.00; .07)	.00 (-.03; .03)	.02 (-.03; .06)
Number of symptoms of ADHD	-.06 (-.15; .03)	-.00 (-.12; .11)	.01 (-.12; .14)	.07 (-.09; .23)	-.09 (-.25; .06)	-.07 (-.26; .12)
Relational domain						
Insecure – avoidant attachment score (A)	.00 (-.01; .01)	.00 (-.01; .02)	-.01 (-.03; .00)	-.01 (-.03; .01)	NA	
Secure attachment score (B)	.00 (-.01; .02)	.00 (-.02; .02)	.02 (-.01; .04)	.02 (-.01; .04)	NA	
Insecure – ambivalent attachment score (C)	.00 (-.01; .01)	.00 (-.01; .01)	-.00 (-.01; .01)	-.00 (-.01; .01)	NA	
Disorganized attachment score (D)	-.00 (-.02; .01)	-.01 (-.02; .01)	-.00 (-.01; .01)	-.00 (-.02; .01)	NA	
Social competence – T rated	1.16 (.50; 1.82)	.57 (-.15; 1.29)	.74 (-.07; 1.55)	-.37 (-1.27; .52)	.90 (-.08; 1.88)	.02 (-1.13; 1.17)
Social competence – P rated	-.19 (-.59; .21)	-.23 (-.72; .20)	.11 (-.70; .92)	-.10 (-1.11; .92)	-1.00 (-1.98; -.01)	-.85 (-1.99; .30)
Student-teacher relationship: Closeness	.21 (-.03; .45)	.12 (-.17; .42)	.44 (.16; .72)	.19 (-.12; .49)	.20 (-.17; .54)	.14 (-.26; .55)
Student-teacher relationship: Conflict	.09 (-.15; .33)	.24 (-.06; .53)	.05 (-.20; .30)	.28 (-.06; .61)	-.31 (-.67; .04)	-.27 (-.72; .18)
Student-teacher relationship: Dependency	.00 (-1.12; .13)	.11 (-.04; .25)	0.01 (-.14; .15)	.09 (-.10; .27)	-.10 (-.26; .07)	-.04 (-.25; .16)

Study variables	4 years		1 st grade		3 rd grade	
	<i>Unadj. B</i> (95% CI)	<i>Adj. B</i> (95% CI)	<i>Unadj. B</i> (95% CI)	<i>Adj. B</i> (95% CI)	<i>Unadj. B</i> (95% CI)	<i>Adj. B</i> (95% CI)
Cognitive domain						
Executive functions: Behavior regulation – T rated	NA		-.38 (-.82; .06)	-.15 (-.67; .38)	-.36 (-.84; .12)	-.13 (-.69; .44)
Executive functions: Emotion regulation – T rated	NA		-.03 (-.28; .21)	.02 (-.31; .35)	-.10 (-.44; .24)	.01 (-.42; .43)
Executive functions: Meta cognition – T rated	NA		-.31 (-1.08; .45)	.39 (-.53; 1.30)	-.90 (-1.91; .13)	-.08 (-1.28; 1.12)
Executive functions: Behavior regulation– P rated	NA		-.07 (-.40; .25)	-.05 (-.42; .32)	NA	
Executive functions: Emotion regulation– P rated	NA		-.05 (-.33; .23)	.05 (-.28; .38)	NA	
Executive functions: Meta cognition– P rated	NA		.32 (-.35; .99)	.67 (-.11; 1.45)	NA	
Executive functions: Working memory (BNR)	NA		.24 (.13; .35)	.21 (.07; .35)	.08 (-.03; .18)	.04 (-.09; .16)
Executive functions: IED Set shifting (TEA)	NA		-1.47 (-2.76; -.17)	-.52 (-2.11; 1.06)	-.77 (-2.64; 1.11)	-.03 (-2.05; 1.99)
Executive functions: IED Set shifting – errors	NA		-.75 (-1.33; -.16)	-.62 (-1.33; .09)	.32 (-.34; .98)	.64 (-.13; 1.42)
Executive functions: Impulse control (NEPSY cats)	NA		.06 (-.05; .16)	.03 (-.11; .17)	.03 (-.04; .09)	-.00 (-.08; .07)
Executive functions: Impulse control (NEPSY statue)	NA		0.01 (-.00; .03)	.01 (-.01; .03)	.00 (-.00; .00)	.00 (-.00; .01)
Language comprehension: PPVT	2.62 (1.52; 3.72)	1.48 (.21; 2.76)	NA		NA	
Language comprehension: WASI	NA		.54 (.24; .85)	.35 (-.02; .71)	.64 (.18; 1.10)	.21 (-.31; .73)

Study variables	4 years		1 st grade		3 rd grade	
	<i>Unadj. B</i> (95% CI)	<i>Adj. B</i> (95% CI)	<i>Unadj. B</i> (95% CI)	<i>Adj. B</i> (95% CI)	<i>Unadj. B</i> (95% CI)	<i>Adj. B</i> (95% CI)
Reading performance – T rated	NA		.06 (.01; .11)	.02 (-.04; .08)	.10 (.03; .16)	.02 (-.06; .09)
Writing performance – T rated	NA		.80 (.03; .13)	.03 (-.03; .09)	.10 (.04; .16)	.03 (-.03; .10)
Math performance – T rated	NA		.06 (.01; .10)	-.01 (-.06; .05)	.09 (.03; .15)	.01 (-.06; .08)
Effort – T rated	NA		.05 (-.04; .13)	-.05 (-.15; .04)	.07 (-.02; .16)	.01 (-.09; .11)
Attention – T rated	NA		.10 (.30; .18)	-.00 (-.09; .08)	.12 (.03; .21)	.05 (-.05; .15)
Task values: Reading – C rated	NA		.04 (-.03; .11)	.04 (-.05; .11)	.01 (-.06; .09)	.07 (-.01; .16)
Task values: Math – C rated	NA		.30 (-.05; .09)	.09 (.00; .17)	.05 (-.03; .13)	.14 (.05; .22)
Task values: Writing – C rated	NA		.05 (-.01; .12)	.08 (.00; .16)	.07 (-.01; .14)	.10 (.01; .18)
Test results: Reading skills	NA		.31 (-.57; 1.12)	.01 (-.92; .93)	1.19 (.29; 2.10)	.23 (-.82; 1.27)
Test results: Math	NA		.55 (-.24; 1.33)	-.18 (-1.00; .65)	-.20 (-1.21; .813)	-1.31(-2.52;-.11)
Test results: English listening	NA		NA		.20 (-.10; .50)	.08 (-.25; .41)
Test results: English reading	NA		NA		.48 (.20; .76)	.37 (.03; .72)

Note. T= teacher, P= parent, C= child, BNR= Backwards Number Recall, TEA = total errors adjusted, IED = Intra-Extra Dimensional Set Shifting, NEPSY= A Developmental Neuropsychological Assessment, PPVT= Peabody Picture Vocabulary Test, WASI= Wechsler Abbreviated Scale of Intelligence