

ACCEPTED VERSION

Angela Gialamas, Alyssa C. P. Sawyer, Murthy N. Mittinty, Stephen R. Zubrick, Michael G. Sawyer, and John Lynch

Quality of childcare influences children's attentiveness and emotional regulation at school entry

Journal of Pediatrics, 2014; 165(4):813-819.e3

Copyright, Elsevier Inc. All rights reserved.

This manuscript version is made available under the CC-BY-NC-ND 4.0 license

<http://creativecommons.org/licenses/by-nc-nd/4.0/>

Final publication at <http://dx.doi.org/10.1016/j.jpeds.2014.06.011>

PERMISSIONS

<http://www.elsevier.com/about/company-information/policies/sharing#acceptedmanuscript>

[Accepted manuscript](#)

Authors can share their accepted manuscript:

[...]

After the embargo period

- via non-commercial hosting platforms such as their institutional repository
- via commercial sites with which Elsevier has an agreement

In all cases accepted manuscripts should:

- link to the formal publication via its DOI
- bear a CC-BY-NC-ND license – this is easy to do, [click here](#) to find out how
- if aggregated with other manuscripts, for example in a repository or other site, be shared in alignment with our [hosting policy](#)
- not be added to or enhanced in any way to appear more like, or to substitute for, the published journal article

Embargo

<i>ISSN</i>	<i>Journal Name</i>	<i>Embargo Period (months)</i>
1097- 6833	Journal of Pediatrics	12

1 June, 2016

<http://hdl.handle.net/2440/89672>

Quality of childcare influences children's attentiveness and emotional regulation at school entry

Angela Gialamas¹, Grad Cert Public Health, Alyssa C P Sawyer¹, PhD, Murthy N Mittinty¹, PhD, Stephen R Zubrick², PhD, Michael G Sawyer^{3,4}, MBBS, John Lynch^{1,5}, PhD

Affiliations: ¹School of Population Health, University of Adelaide, Adelaide, Australia; ²The University of Western Australia, Telethon Institute for Child Health Research, Perth, Australia; ³Research and Evaluation Unit, Women's and Children's Health Network, Adelaide, Australia; ⁴Discipline of Paediatrics, University of Adelaide, Adelaide, Australia; ⁵School of Social and Community Medicine, University of Bristol, United Kingdom

Address Correspondence to: Angela Gialamas, School of Population Health, MDP DX 650 550, L7, 178 North Terrace, University of Adelaide, South Australia 5005, Phone: 61 8 83130962, Fax: 61 8 8313 6885 email: angela.gialamas@adelaide.edu.au

Short title: Childcare quality and self-regulation

Abbreviations: ARIA = Accessibility and Remoteness Index of Australia, β = beta coefficient, CI = Confidence Interval, LSAC = Longitudinal Study of Australian Children, SD = Standard Deviation

Keywords: child care; child behavior; early childhood

Funding source: AG is supported by a Faculty of Health Sciences, University of Adelaide postgraduate award and a Healthy Development Adelaide and Channel 7 Children's

Research Foundation supplementary scholarship award. JL is supported by an Australia Fellowship from the National Health and Medical Research Council of Australia (570120). ACPS and MNM are also supported by funds from the Australia Fellowship awarded to JL. The researchers are independent of the funding bodies.

Financial disclosure: The authors have no financial relationships relevant to this article to disclose.

Conflict of interest: The authors have no conflict of interest to declare.

Contributors' Statement:

Angela Gialamas: Ms Gialamas had the original idea for the study, led the conceptualization of the child care quality measures, undertook the statistical analyses, drafted the initial manuscript, and approved the final manuscript as submitted.

Alyssa C.P. Sawyer: Dr Sawyer contributed to the conceptualization of the self-regulation measures, reviewed and revised the manuscript and approved the final manuscript as submitted.

Murthy N. Mittinty: Dr Mittinty provided statistical advice, contributed to the conceptualization of the child care quality measures, reviewed and revised the manuscript and approved the final manuscript as submitted.

Stephen R. Zubrick: Prof Zubrick contributed to the conceptualization of the child care quality measures, reviewed and revised the manuscript and approved the final manuscript as submitted.

Michael G. Sawyer: Prof Sawyer contributed to the conceptualization of the child care quality and self-regulation measures, reviewed and revised the manuscript and approved the final manuscript as submitted.

John Lynch: Prof Lynch had the original idea for the study, contributed to the conceptualization of the child care quality and self-regulation measures, reviewed and revised the manuscript and approved the final manuscript as submitted.

ACKNOWLEDGEMENTS

This paper used confidentialised unit record files from LSAC. The LSAC project is conducted in partnership between the Commonwealth Department of Families, Community Services and Indigenous Affairs (FaHCSIA), the Australian Institute of Family Studies (AIFS) and the Australian Bureau of Statistics (ABS). The findings and views in this paper are those of the authors and should not be attributed to FaHCSIA, AIFS or ABS.

Abstract

Objective: To examine the association between domain-specific qualities of formal childcare at 2-3 years and children's task attentiveness and emotional regulation at 4-5 and 6-7 years.

Study design: We used data from the Longitudinal Study of Australian Children (n=1038). Three domain-specific aspects of childcare quality were assessed: (i) provider and program characteristics of care (ii) activities in childcare and (iii) carer-child relationship. Two self-regulatory abilities were considered: (i) task attentiveness and (ii) emotional regulation. Associations between domain-specific qualities of childcare and self-regulation were investigated in linear regression analyses adjusted for confounding, with imputation for missing data.

Results: There was no association between any provider or program characteristics of care and children's task attentiveness and emotional regulation. The quality of activities in childcare were only associated with higher levels of emotional regulation at 4-5 years ($\beta=0.24$ 95% CI 0.03, 0.44) and 6-7 years ($\beta=0.26$, 95% CI 0.04, 0.48). Higher quality carer-child relationships were associated with higher levels of task attentiveness ($\beta=0.20$, 95% CI 0.05, 0.36) and emotional regulation at 4-5 years ($\beta=0.19$, 95% CI 0.04, 0.34) that persisted to 6-7 years ($\beta=0.26$ 95% CI 0.10, 0.42) ($\beta=0.31$ 95% CI 0.16, 0.47).

Conclusion: Among children using formal childcare, those who experienced higher quality relationships were better able to regulate their attention and emotions as they started school. Higher emotional regulation was also observed for children engaged in more activities in childcare. Beneficial effects were stable over time.

INTRODUCTION

High quality care and education has been identified as one of the most effective ways to develop children's cognitive and socio-emotional capabilities.^{1,2} Early childhood interventions designed for at-risk children, such as Early Head Start, provide evidence that quality non-parental childcare is associated with improved cognitive and socio-emotional outcomes.^{3,4} However, the effect of domain-specific aspects of childcare quality on children's ability to attend to and persist with tasks, and regulate their emotions as they start school has not been widely investigated.

There are many skills that children need as they start school, including the ability to attend to and persist with tasks, and regulate their emotions. In this paper we conceptualize these skills as dimensions underlying 'self-regulation'. Children who display high levels of self-regulatory behaviour are considered better ready to be engaged in school^{5,6} making it a valuable skill for early school success. The first five years of life is a significant period for the development of self-regulation⁷ and is influenced by the relationships and interactions shared with important adults in a child's life.⁵ The family home and non-parental childcare environments are the key care-giving settings in early life where learning how to relate to others and regulating emotions and behaviours takes place.

In 2008, an estimated 28% of Australian children aged 0-3 years spent time in non-parental care. The prevalence was even higher in America with approximately 40% of children in childcare.⁸ In many high income countries, childcare policy for children younger than three years has primarily focused on supporting the labour force participation of mothers with only recent policy consideration given to the effect the quality of this care may have on children's later health and well-being. With significant numbers of children aged 0-3 years attending formal childcare, the relationships formed and the interactions shared with non-parental carers (childcare providers) may be important influences on children's developing capacity to self-regulate. Childcare offers many challenges for children

including following directions from non-parental carers who may have different rules, routines and expectations from parents, and fewer opportunities for one-to-one interactions.⁹

¹⁰ Consistent, positive interactions with familiar carers, particularly in the first three years of life, have been shown to generate secure attachment that influences children's self-regulation abilities.^{10, 11} However, little is known about the effect of the quality of the carer-child relationship, quality of activities and provider and program characteristics of formal childcare on children's self-regulatory abilities. The aim of this study was to examine the association between domain-specific aspects of childcare quality at 2-3 years and children's task attentiveness and emotional regulation at 4-5 and 6-7 years.

METHODS

Study Design and Sample

This study used data from the birth cohort of the Longitudinal Study of Australian Children (LSAC), a nationally representative cohort study which commenced in 2004.¹² Detailed study design and sampling framework has been described elsewhere.¹³ Briefly, the sampling framework used two-stage clustered sampling. The first stage selected Australian postcodes and the second, sampled children within postcodes.¹³ Postcodes were randomly selected and stratified by state/territory and urban/rural status to ensure a nationally representative sample. The Medicare database, which provides medical and hospital coverage for all Australian permanent residents was then used to randomly select infants born March 2003-February 2004 within each stratum. At baseline, 5107 infants aged 0-1 years were recruited into the study and were reassessed at 2-3 years (n=4606), 4-5 years (n=4386) and 6-7 years of age (n=4242). The study was approved by the Australian Institute of Family Studies Ethics Committee.

For the present study, the sample included children aged 2-3 years attending centre-based or family day care (carers paid to deliver care in their home for small groups of children) (Figure 1). Data were obtained from face-to-face interviews and questionnaires

with the child's primary caregiver (97% mothers) and questionnaires from childcare providers. At the parent interview, the primary caregiver identified whether in the past month the study child was 'looked after at regular times during the week by anyone other than the parent living in the home'. If the child spent eight or more hours per week in non-parental care, a questionnaire was posted to the main non-parental carer. There were 1859 children aged 2-3 years in childcare for greater or equal to eight hours per week and whose primary caregiver consented for a questionnaire to be posted to the study child's non-parental carer. A total of 1282 questionnaires were returned (69% response rate).

Domain-specific qualities of childcare

Details of the childcare quality measures have been reported elsewhere.¹⁴ In brief, LSAC utilized non-parental carers' reports to obtain information about the nature of childcare provided to children participating in the study. Two types of questionnaires were developed by the LSAC consortium: a centre-based questionnaire and a home-based questionnaire sent to family day carers. Three domains of childcare quality were developed *a priori* on the basis of a conceptual framework that considered Australian childcare standards, aspects of quality captured by direct observational methods and previous research on key components of quality. The three domains represented: (1) provider and program characteristics of care (n=5), (2) activities in childcare (n=11) and the (3) carer-child relationship using the closeness and conflict scales from the short version of the Student Teacher Relationship Scale¹⁵ (n=15 items) (Table 1; online). To explore our *a priori* conceptualization of the 31 indicators representing childcare quality, exploratory factor analysis of the correlation matrix using a maximum likelihood extraction method with oblique rotation was conducted. The analysis generated two factors: one factor describing the carer-child relationship and a second factor describing activities in childcare. The number of factors identified was based on Eigenvalues >1.50, detecting a break-point in the

scree plot and interpretability. Indicators were considered to load on a factor if they had an absolute correlation of ≥ 0.47 with that factor.¹⁶

Of the 11 indicators describing the quality of activities in childcare, four indicators had factor loadings ≥ 0.47 . The four indicators included: (1) singing, telling stories and reading books, (2) participating in active outdoor play, (3) pretend play and (4) teaching good health practices. Of the 15 indicators describing the quality of the carer-child relationship, eight indicators had factor loadings ≥ 0.47 . The eight indicators included: (1) sharing an affectionate, warm relationship, (2) in tune with child's feelings, (3) child values relationship, (4) spontaneously shares information, (5) openly shares feelings and experiences, (6) child's feelings towards me can be unpredictable (reverse-scored), (7) child drains my energy (reverse-scored) and (8) this child and I struggle with each other (reverse-scored). Indicators used to assess provider/program characteristics (carers' highest educational qualification, professional development, work experience, working towards a qualification that would expand their skills and knowledge in childcare and number of children in the group) did not significantly load onto any factor. However, the individual indicators were retained for later regression analyses because of *a priori* theoretical evidence¹⁷ and it is an aspect of childcare quality that regulatory agencies and governments use to define quality.

We created two factor-based domains that summed the four unstandardized scores for the quality of activities in childcare domain and the eight unstandardized scores for the quality of the carer-child relationship domain. The quality of activities in childcare domain score could range from 4-8, with a maximum score of 8 indicating that the child participated in all four activities 'very much/quite a lot'. A higher score was considered to reflect higher quality care. The quality of activities in childcare score was negatively skewed (mean score 7.1; median 8; interquartile range, 7-8) with 54.8% of all participants achieving the maximum score of 8.

The domain score for the quality of the carer-child relationship could range from 8-16, with a maximum score indicating that all relationship indicators ‘applied somewhat/definitely applied’ with the exception for reverse-scored indicators (child’s feelings can be unpredictable, child drains my energy, child and I always seem to be struggling with each other) where ‘definitely does not apply/not really/ neutral/not sure’ indicated a more positive relationship. A higher score was considered to reflect higher quality childcare. The quality of the carer-child relationship score was negatively skewed (mean score 14.9; median 16; interquartile range, 15-16) with 55.2% of all participants achieving the maximum score of 16.

Self-Regulation: Task Attentiveness and Emotional Regulation

We measured two self-regulatory behaviours, ‘task attentiveness’ and ‘emotional regulation’ using parent-rated questionnaires¹⁸⁻²⁰ at 4-5 and 6-7 years (Table 2; online). In order to assess the construct validity of items selected at each assessment to represent task attentiveness and emotional regulation, exploratory factor analyses of the correlation matrix using maximum likelihood extraction methods with oblique rotation were conducted. At each of the time-points a two factor structure was observed, labelled task attentiveness and emotional regulation. Five items that loaded above .40 were summed to create a ‘task attentiveness’ factor and five items that loaded above .50 were summed to create an ‘emotional regulation’ factor with high scores representing better regulation skills (Table 3; online). Examples of emotional regulation items were ‘often loses temper’ and for task attentiveness ‘sees tasks through to the end, has good attention span’.

For task attentiveness internal consistency, as measured by Cronbach’s alpha, was .79 at 4-5 years, and .78 at 6-7 years. For emotional regulation internal consistency was .71 at 4-5 years, and .72 at 6-7 years. The mean task attentiveness score for the sample was 17.4 (SD 3.8; range of scores 5-27) for children aged 4-5years and 17.9 (SD 4.03; range of scores 5-27) for children aged 6-7 years. The mean emotional regulation score for the sample was

19.6 (SD 3.8; range of scores 5-27) for children aged 4-5 years and 20.5 (SD 3.97; range of scores 7-27) for children aged 6-7 years.

Confounders

An extensive range of confounding factors was identified *a priori*, using a directed acyclic graph²¹, as being theoretically or shown in previous research to be associated with both childcare quality and children's self-regulation. Covariates were measured at baseline at the parent interview (0-1 years) with the exception of variables representing the home environment and time spent in any non-parental childcare that were measured when children were 2-3 years of age. Covariates included; hours per week spent in childcare, the primary caregivers, education, employment, annual household income, indicators of economic hardship over the last year, geographic remoteness using the Accessibility and Remoteness Index of Australia (ARIA)²², whether the child lived in a two parent household, number of siblings, child age, sex and birth weight, parental concern about the child's learning and development, number of children's books in the home, time spent reading to the child, whether the child undertook regular, special or extra cost activities in the last six months and the primary caregivers age, psychological distress using the Kessler 6 score²³, and self-reported level of warmth towards their child.

Analysis

Multiple linear regression analysis was used to examine the association between factor-based domains of childcare quality (activities in childcare, carer-child relationship) and individual provider/program characteristics of care at 2-3 years of age and children's task attentiveness and emotional regulation at ages 4-5 and 6-7 years.

Missing Data

Of the 1859 children aged 2-3 in formal childcare for eight or more hours per week and whose primary care giver consented to contact the main non-parental carer, 1282 questionnaires were returned and were eligible to be included in the analysis. Multiple

imputation by chained equations was used to address the possibility of bias due to missing values.²⁴ The imputation was conducted for the full sample, however data were analysed only for children who had observed task attentiveness and emotional regulation scores (n=1038).²⁵ The imputation model included all 31 indicators of childcare quality, all 18 covariates, type of non-parental childcare and scores for self-regulation outcomes. Imputed datasets were generated under the missing at random assumption that uses observed variables in the dataset to predict missingness and estimate parameters.²⁶ Twenty imputed datasets were generated and the results of the imputed analyses were combined using Rubin's rules.²⁷ Results using the complete-case data were not substantively different from the imputed analysis. However, we report the imputed results as they are subject to fewer assumptions than a complete-case analysis that assumes the data is missing completely at random. All analyses were conducted using Stata version 12.1 (Stata Corp, College Station, TX, USA).

RESULTS

Table 4 describes the characteristics of the study participants. Of the 1038 children spending eight or more hours per week in childcare, 847 (81%) spent time in centre-based care and 191 (18%) spent time in family day care. The mean number of hours per week in childcare was 24.0 hours (SD: 11.9; interquartile range: 15-31). The majority of children lived in a two parent household (92.5% vs 7.5%) had a primary caregiver with less than a bachelor degree (59.4% vs 40.6%) and an annual household income between \$41,549-77,999 (41.4%).

Table 5 presents the associations between provider and program characteristics of childcare, including the carers' highest educational qualification, professional development, work experience, working towards a qualification that would expand their skills and knowledge in childcare and number of children in the group and children's task attentiveness and emotional regulation at ages 4-5 and 6-7 years. There was no evidence to suggest that

provider or program characteristics of childcare were associated with children's later task attentiveness and emotional regulation.

Table 6 presents the association between the quality of activities in childcare and children's task attentiveness and emotional regulation at ages 4-5 and 6-7 years. The quality of activities in childcare at 2-3 years was associated with higher emotional regulation both before and after adjustment. More specifically, after adjustment for covariates, the quality of activities was associated with a .23 (95% CI .00, .42) and .26 (95% CI .04, .47) point increase in emotional regulation at 4-5 years and 6-7 years respectively. Adjustment for covariates and the quality of the carer-child relationship attenuated the association between the quality of activities in childcare and children's emotional regulation at ages 4-5 and 6-7 years; however the effect remained. There was no association between the quality of activities in childcare and task attentiveness at 4-5 and 6-7 years.

Table 6 also presents the associations between the quality of the carer-child relationship for children's task attentiveness and emotional regulation at ages 4-5 and 6-7 years. In unadjusted and adjusted analyses, ratings of a higher quality carer-child relationship at 2-3 years were associated with higher levels of task attentiveness at 4-5 years ($\beta=.20$ 95% CI .05, .36) and 6-7 years ($\beta=.26$ 95% CI .10, .42) and higher emotional regulation at ages 4-5 years ($\beta=.19$ 95% CI .04, .34) and 6-7 years ($\beta=.27$ 95% CI .24, .30). The benefit of a higher quality carer-child relationship for children's task attentiveness and emotional regulation at ages 4-5 and 6-7 years remained unaltered even after adjusting for covariates and the quality of activities in childcare. Coefficients for covariates are available in Tables 7-9 online.

DISCUSSION

After taking into account a wide range of confounders, carer ratings of a higher quality relationship in childcare - that is care characterized by warmth and predictability remained associated with greater task attentiveness and emotional regulation in the early

years of schooling. The quality of activities in childcare including children spending more time with carers singing, telling stories and reading books was associated with higher levels of emotional regulation but not task attentiveness. The beneficial effects persisted from ages 4-5 to 6-7 years. In contrast, provider and program characteristics of care were not associated with children's self-regulation.

Our results are consistent with findings from Sylva et al who found that high quality pre-school at age three was associated with higher levels of self-regulation at 11 years.²⁸ This previous study used the Early Childhood Environment Rating Scale-Revised that comprised 43 items across a number of childcare quality domains. Our analyses focusing on specific domains of childcare quality extend those of Sylva et al as they highlight the particular importance of higher quality relationships in formal childcare contributing to young children's task attentiveness and emotional regulation as they start school.

There is substantial evidence that the relationships children share with important adults in their early life affect their later development. Most of this evidence has highlighted the importance of the parent-infant relationship in fostering the developing socio-emotional and self-regulation capacities of the child.^{29,30} However, it makes sense that relationships and interactions shared with non-parental carers such as childcare providers may also contribute to children's later functioning. For example, a United States study of centre-based childcare showed that children whose carers rated their relationship with the child as closer (e.g. sharing a warm relationship), had lower problem behaviours through second-grade.³¹ This finding along with ours supports past research and theory that emphasizes the importance of positive relationships and interactions for children's healthy development.^{11,32}

There is inconsistent evidence regarding the importance of provider characteristics including educational qualifications and program features such as number of children in a group in predicting socio-emotional skills. The results from this study suggest that provider

and program characteristics of care – at least in the Australian childcare setting do not strongly influence children’s development. This may be because carer characteristics such as educational qualifications support skills that influence carer behaviour that then go on to influence children’s development.

Our findings should be interpreted within the context of the study limitations. First, a limitation of our study was the domains of childcare quality were based on carer self-reports which may have resulted in an overestimation of childcare quality. Direct observation is frequently used to assess the quality of childcare; however a problem with using direct observation is that it requires substantial time and resources which is not practical for large-scale studies investigating diverse aspects of child health and development. Encouragingly, recent research revealed a high level of agreement between carer-report and direct observation of child care quality.³³ Secondly, we used parent report measures to assess children’s self-regulation which are likely subject to measurement error. However, we were interested in examining children’s ability to regulate attention, emotion and behaviour in their everyday lives rather than their capacity to regulate as measured by objective assessments of children’s regulatory capabilities.³⁴

CONCLUSIONS

Our study adds to the literature by demonstrating a relatively small but enduring effect of the quality of the carer-child relationship and activities in formal childcare on children’s task attentiveness and emotional regulation as they start school. There is increasing policy focus to improve the quality of childcare to facilitate children’s learning and development before they commence school. Randomized controlled trials of high quality childcare have provided evidence of developmental benefits. However, there are important limitations of these trials as they targeted disadvantaged populations and had multi-faceted interventions that combined high quality childcare with other interventions (e.g. home visiting) thereby making inferences about the specific components of childcare

impossible. Trials investigating the developmental effect of childcare for children in the general population younger than three are lacking. With increasing focus from parents, clinicians and governments on the potential contribution childcare can have on children's development our study may have important implications for interventions and practice, as targeting the quality of the carer-child relationship and activities in formal childcare to support children's self-regulatory abilities may also have implications for school readiness and later academic achievement.

REFERENCES

- [1] United Nations General Assembly. Status of the convention on the rights of the child. Report of the Secretary-General. 65th session edn ed: United Nations; 2010.
- [2] Committee on Early Childhood Adoption and Dependent Care. Quality Early Education and Child Care From Birth to Kindergarten. *Pediatrics*. 2005;115:187-91.
- [3] Love JM, Kisker EE, Ross C, Raikes H, Constantine J, Boller K, et al. The Effectiveness of Early Head Start for 3-Year-Old Children and Their Parents: Lessons for Policy and Programs. *Developmental Psychology*. 2005;41:885-901.
- [4] Reynolds AJ, Temple JA, Ou SR, Arteaga IA, White BAB. School-Based Early Childhood Education and Age-28 Well-Being: Effects by Timing, Dosage and Subgroups. *Science*. 2011;333:360-4.
- [5] Shonkoff JP, Phillips DA. *From Neurons to Neighborhoods: The Science of Early Childhood Development*. Washington DC: The National Academies Press; 2000.
- [6] Eisenberg N, Valiente C, Eggum ND. Self-Regulation and School Readiness. *Early Education & Development*. 2010;21:681-98.
- [7] Kochanska G, Coy KC, Murray KT. The Development of Self-Regulation in the First Four Years of Life. *Child Development*. 2001;72:1091-111.
- [8] UNICEF. *The child care transition, Innocenti Report Card 8*. Florence: UNICEF Innocenti Research Centre; 2008.
- [9] Datler W, Ereky-Stevens K, Hover-Reisner N, Malmberg LE. Toddlers' transition to out-of-home day care: Settling into a new care environment. *Infant Behavior and Development*. 2012;35:439-51.
- [10] Schore AN. Attachment, Affect Regulation, and the Developing Right Brain: Linking Developmental Neuroscience to Pediatrics. *Pediatrics in Review*. 2005;26:204-17.

- [11] Schore AN. Effects of a secure attachment relationship on right brain development, affect regulation and infant mental health. *Infant Mental Health Journal*. 2001;22:7-66.
- [12] Nicholson JM, Sanson A. A new longitudinal study of the health and wellbeing of Australian children: how will it help? *Medical Journal of Australia*. 2003;178:282-4.
- [13] Soloff C, Lawrence D, Johnstone R. Sample Design, LSAC Technical Paper No.1. Australian Institute of Family Studies; 2005.
- [14] Gialamas A, Mittinty MN, Sawyer MG, Zubrick SR, Lynch J. Child care quality and children's cognitive and socio-emotional development: an Australian longitudinal study *Early Child Development and Care*. 2013;DOI: 10.1080/03004430.2013.847835:1-21.
- [15] Pianta R. Student-Teacher Relationship Scale. Odessa, FL: Psychological Assessment Resources; 2001.
- [16] Pett MA, Lackey NR, Sullivan JJ. Making Sense of Factor Analysis: the use of factor analysis for instrument development in health care research. Thousand Oaks, California: Sage Publications Inc.; 2003.
- [17] Burchinal M, Cryer D, Clifford RM, Howes C. Caregiver Training and Classroom Quality in Child Care Centers. *Applied Developmental Science*. 2002;6:2-11.
- [18] Goodman R. Psychometric Properties of the Strengths and Difficulties Questionnaire. *Journal of the American Academy of Child and Adolescent Psychiatry*. 2001;40:1337-45.
- [19] Sanson A, Smart DF, Prior M, Oberklaid F, Pedlow R. The Structure of Temperament From Age 3 to 7 Years: Age, Sex, and Sociodemographic Influences. *Merrill-Palmer Quarterly*. 1994;40:233-52.
- [20] Fullard W, McDevitt SC, Carey WB. Assessing Temperament in One-to Three-Year-Old Children. *Journal of Pediatric Psychology*. 1984;9:205-17.
- [21] Greenland S, Pearl J, Robins JM. Causal Diagrams for Epidemiologic Research. *Epidemiology*. 1999;10:37-48.

- [22] Australian Bureau of Statistics. ASGC Remoteness Classification: Purpose and Use (Census Paper No. 03/01). Australian Government; 2003.
- [23] Kessler RC, Andrews G, Colpe LJ, Hiripi E, Mroczek DK, Normand SL, et al. Short screening scales to monitor population prevalences and trends in non-specific psychological distress. *Psychological Medicine*. 2002;32:959-76.
- [24] Royston P. Multiple imputation of missing values. *The Stata Journal*. 2004;4:227-41.
- [25] von Hippel PT. Regression with Missing Ys: An Improved Strategy for Analyzing Multiply Imputed Data. *Sociological Methodology*. 2007;37:83-117.
- [26] Rubin DB. Inference and missing data. *Biometrika*. 1976;63:581-92.
- [27] Little R, Rubin D. Bayes and multiple imputation. *Statistical analysis with missing data*. Second ed. Hoboken, NJ: John Wiley & Sons; 2002.
- [28] Sylva K, Melhuish E, Sammons P, Siraj-Blatchford I, Taggart B. Pre-school quality and educational outcomes at age 11: Low quality has little benefit. *Journal of Early Childhood Research*. 2011;9:109-24.
- [29] Thompson RA. The legacy of early attachments. *Child Development*. 2000;71:145-52.
- [30] Stein A, Malmberg LE, Leach P, Barnes J, Sylva K, FCCCTeam. The influence of different forms of early childcare on children's emotional and behavioural development at school entry. *Child: Care, Health and Development*. 2012;39:676-87.
- [31] Peisner-Feinberg ES, Burchinal M, Clifford RM, Culkin ML, Howes C, Kagan SL, et al. The Relation of Preschool Child-Care Quality to Children's Cognitive and Social Developmental Trajectories through Second Grade. *Child Development*. 2001;72:1534-53.
- [32] Bowlby J. The making and breaking of affectional bonds. Aetiology and psychopathology in the light of attachment theory. An expanded version of the Fiftieth Maudsley Lecture, delivered before the Royal College of Psychiatrists, 19 November 1976. *The British Journal of Psychiatry*. 1977;130:201-10.

[33] Holloway SD, Kagan SL, Fuller B, Tsou L, Carroll J. Assessing child-care quality with a telephone interview. *Early Childhood Research Quarterly*. 2001;16:165-89.

[34] Toplak ME, West RF, Stanovich KE. Practitioner Review: Do performance-based measures and ratings of executive function assess the same construct? *Journal of Child Psychology and Psychiatry*. 2013;54:131-43.

FIGURE

Figure 1: Data flow of recruitment into LSAC and identification of children in formal childcare at 2-3 years and their task attentiveness and emotional regulation at 4-5 and 6-7 years

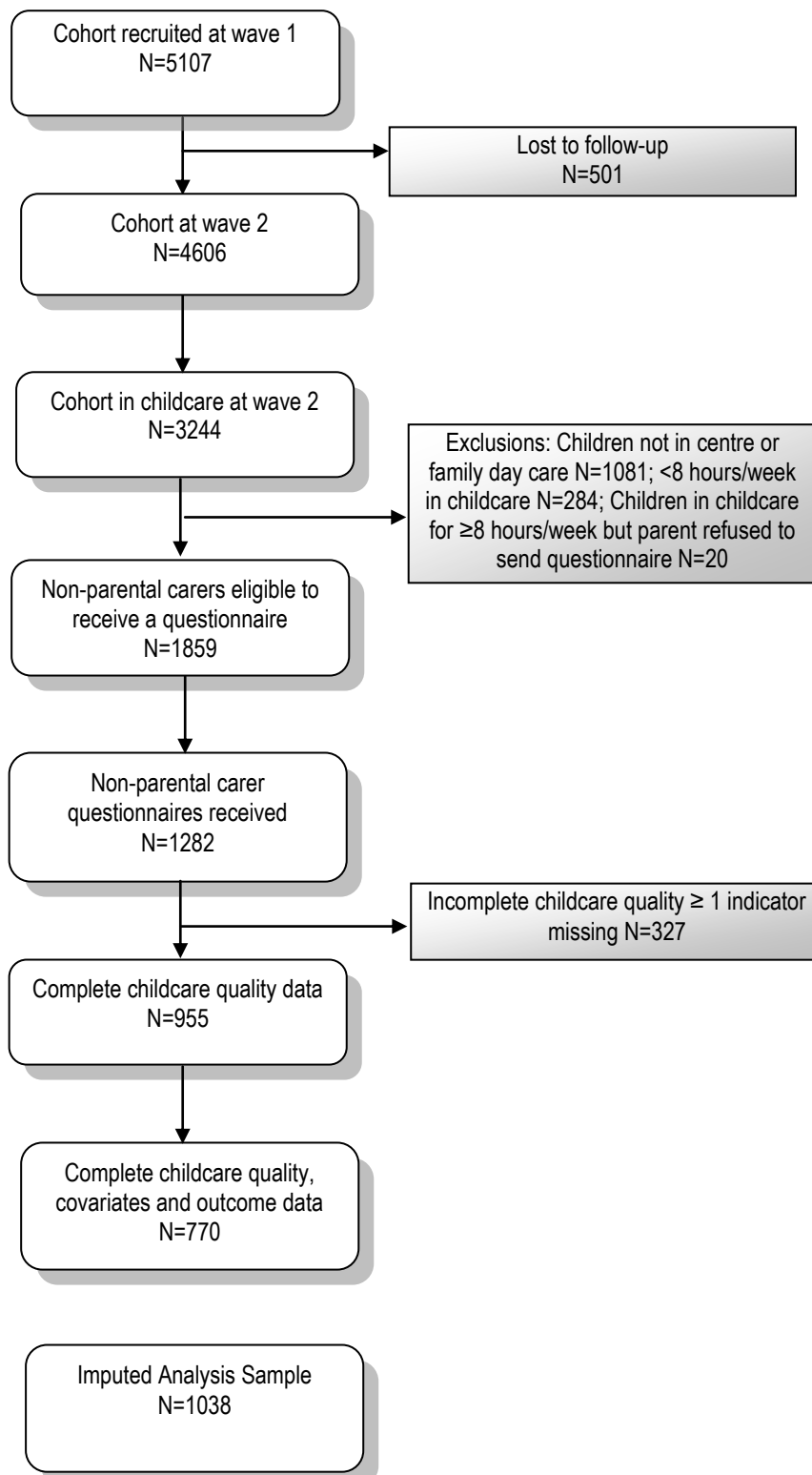


Table 1 online: A priori domains and indicators of childcare quality selected from LSAC centre and home-based non-parental carer questionnaires (n=31 indicators)

Domain	Indicator	Response Category
Provider and program characteristics (n=5)	What is the highest educational qualification you have completed?	1= \leq secondary education 2= advanced diploma/certificate 3= \geq bachelor degree
	Are you currently studying for a qualification that will expand your skills and knowledge in childcare or early childhood education?	1=No 2=Yes
	In the last 12 months, what is your best estimate of your hours spent on professional development activities?	1= \leq 6hours 2=7 to12 hours 3=13 to18 hours 4=19 to 24 hours 5= \geq 25 hours
	Counting this year, for how many years have you worked for 10 hours or more per week in childcare settings, early education programs or school settings?	1= \leq 8 years 2= \geq 9 years
	How many children, including the study child, are usually present in the same room?	1= \geq 21 children 2= 11-20 children 3=6-10 children 4= \leq 5 children

Domain	Indicator	Response Category
Quality of activities in child care (n=11)	How much of your usual daily work with the children is described by the following:	
	Sitting and playing with children (puzzles, blocks, construction, drawing, etc)	1= Not At All/Somewhat 2 =Quite a lot/Very much
	Singing, telling stories, reading books	1= Not At All/Somewhat 2 =Quite a lot/Very much
	Managing problem behaviour	1= Quite a lot/Very much 2 = Not At All/Somewhat
	Giving individual attention in routine care (helping child with feeding, toileting etc.)	1= Not At All/Somewhat 2 =Quite a lot/Very much
	Organising space, equipment or toys, food and drink	1= Not At All/Somewhat 2 =Quite a lot/Very much
	Teaching good health practices (hand washing, healthy eating, etc.)	1= Not At All/Somewhat 2 =Quite a lot/Very much
	Taking part in children's active outdoor play (ball play, running, etc.)	1= Not At All/Somewhat 2 =Quite a lot/Very much
	Watching or supervising child or children's play	1= Not At All/Somewhat 2 =Quite a lot/Very much
	Taking part in pretend play	1= Not At All/Somewhat 2 =Quite a lot/Very much
	On average, how many minutes per day does someone read books or sing songs to the children	1= ≤1 hour 2= >1 hour
	On average how much time was spent watching TV, videos, DVDs'	1= Daily 2= Less often 3= Never

Domain	Indicator	Response Category
Quality carer-child relationship (n=15)	Please indicate the nature of your relationship with the study child:	
	I share an affectionate, warm relationship with this child	1= Definitely doesn't apply /Not really/Neutral/Not sure 2=Applies somewhat / Definitely applies
	This child and I always seem to be struggling with each other	1=Applies somewhat/Definitely applies/Neutral/Not sure 2= Definitely doesn't apply/Not really
	If upset, this child will seek comfort from me	1= Definitely doesn't apply /Not really/Neutral/Not sure 2=Applies somewhat/Definitely applies
	This child is uncomfortable with physical affection or touch from me	1=Applies somewhat/Definitely applies/Neutral/Not sure 2= Definitely doesn't apply/Not really
	This child values his/her relationship with me	1= Definitely doesn't apply /Not really/Neutral/Not sure 2=Applies somewhat / Definitely applies
	When I praise this child, he/she beams with pride	1= Definitely doesn't apply /Not really/Neutral/Not sure 2=Applies somewhat /Definitely applies

Domain	Indicator	Response Category
	This child spontaneously shares information about himself/herself	1= Definitely doesn't apply /Not really/Neutral/Not sure 2=Applies somewhat / Definitely applies
	This child easily becomes angry with me	1=Applies somewhat/ Definitely applies/Neutral/Not sure 2= Definitely doesn't apply/Not really
	It is easy to be in tune with what this child is feeling	1= Definitely doesn't apply /Not really/Neutral/Not sure 2=Applies somewhat / Definitely applies
	This child remains angry or resistant after being disciplined	1=Applies somewhat/ Definitely applies/Neutral/Not sure 2= Definitely doesn't apply/Not really
	Dealing with this child drains my energy	1=Applies somewhat/Definitely applies/Neutral/Not sure 2= Definitely doesn't apply/Not really
	When this child is in a bad mood, I know we're in for a long and difficult day	1=Applies somewhat/Definitely applies/Neutral/Not sure 2= Definitely doesn't apply/Not really

Domain	Indicator	Response Category
	<p>This child's feelings towards me can be unpredictable or can change suddenly</p> <p>This child is manipulative with me</p> <p>This child openly shares his/her feelings and experiences with me</p>	<p>1=Applies somewhat/ Definitely applies/Neutral/Not sure</p> <p>2= Definitely doesn't apply/Not really</p> <p>1=Applies somewhat/Definitely applies/Neutral/Not sure</p> <p>2= Definitely doesn't apply/Not really</p> <p>1= Definitely doesn't apply /Not really/Neutral/Not sure</p> <p>2=Applies somewhat / Definitely applies</p>

Development of Self-regulation Measures: Task Attentiveness and Emotional Regulation

In order to assess children's self-regulatory skills, including their ability to attend and persist, and to regulate emotional reactivity, the second author, a child psychologist with clinical training, reviewed all items and questionnaires used in the LSAC questionnaires. This was done examining the questionnaires for items or scales which asked about children's ability to regulate their attention, emotion and behaviour. Fourteen items were identified from measures at 4-5 years and 6-7 years (6 items from the Strengths and Difficulties Questionnaire, 8 items from the Short Temperament Scale for Children). Items selected are shown in Table 2. These items were then reviewed independently by an expert panel, one of whom is a child psychiatrist and others who are experts in child development, to assess their face validity. In order to assess the construct validity of items selected at each assessment to represent task attentiveness and emotional regulation, exploratory factor analyses of the correlation matrix using maximum likelihood extraction methods with oblique rotation were conducted. At each of the time-points a two factor structure was observed, labelled task attentiveness and emotional regulation.

Table 2 online: A priori items selected from the Strength and Difficulties Questionnaire and Short Temperament Scale for Children to represent self-regulation at ages 4-5 and 6-7 years

<i>Strengths and Difficulties Questionnaire</i>
<ol style="list-style-type: none"> 1. Is restless, overactive, cannot stay still for long 2. Is constantly fidgeting or squirming 3. Is easily distracted, concentration wanders 4. Thinks things out before acting 5. Sees tasks through to the end, has good attention span 6. Often loses temper
<i>Short Temperament Scale for Children</i>
<ol style="list-style-type: none"> 7. When this child starts a project such as a puzzle or model, he/she works on it without stopping until it is completed, even if it takes a long time 8. This child likes to complete one task or activity before going onto the next 9. This child stays with an activity (e.g. puzzle, construction, reading) for a long time 10. When a toy or game is difficult, this child quickly turns to another activity 11. If this child wants a toy or sweet while shopping, he/she will easily accept something else instead 12. When this child is angry about something, it is difficult to sidetrack him/her 13. When shopping together, if I do not buy what this child wants (e.g. sweets, clothing), he/she cries and yells 14. If this child is upset, it is hard to comfort him/her

Table 3 online: List of items identified from exploratory factor analysis to represent task attentiveness and emotional regulation at ages 4-5 and 6-7 years

<i>Task attentiveness</i>
<ol style="list-style-type: none"> 1. When this child starts a project such as a puzzle or model, he/she works on it without stopping until it is completed, even if it takes a long time 2. This child likes to complete one task or activity before going onto the next 3. This child stays with an activity (e.g. puzzle, construction, reading) for a long time 4. When a toy or game is difficult, this child quickly turns to another activity 5. Sees tasks through to the end, has good attention span
<i>Emotional regulation</i>
<ol style="list-style-type: none"> 1. If this child wants a toy or sweet while shopping, he/she will easily accept something else instead 2. When this child is angry about something, it is difficult to sidetrack him/her 3. When shopping together, if I do not buy what this child wants (e.g. sweets, clothing), he/she cries and yells 4. If this child is upset, it is hard to comfort him/her 5. Often loses temper

Table 4: Summary Characteristics of Study Participants

	Complete Case	Imputed
	Sample ^a	Sample ^b
	(n=770)	(n=1038)
Age at wave 3 (months), mean (SD)	57.7 (2.7)	57.6 (2.7)
Age at wave 4 (months), mean (SD)	82.1 (3.4)	82.0 (3.5)
Sex, n (%)		
Female	363 (47.1)	485 (46.7)
Male	407 (52.9)	553 (53.3)
Do you have concerns about your child's development, learning and behaviour, n (%)		
No	724 (94.0)	973 (93.7)
Yes a little/Don't know	46 (6.0)	65 (6.3)
Birth weight		
<=2500 grams	32 (4.2)	45 (4.3)
>=2501 grams	738 (95.8)	993 (95.7)
Primary caregiver age, mean (SD)	32.1 (4.8)	31.9 (4.9)
Primary caregiver Kessler 6 score, mean (SD)	4.41 (0.5)	4.41 (0.5)
Primary caregiver warmth, mean (SD)	4.52 (0.3)	4.52 (0.3)
Two parent household, n (%)		
Yes	713 (92.6)	960 (92.5)
No	57 (7.4)	78 (7.5)

Number of siblings, n (%)		
0	324 (42.1)	421 (40.6)
1	315 (40.9)	437 (42.1)
≥ 2	131 (17.0)	180 (17.3)
Primary caregiver education, n (%)		
Less bachelor degree	437 (56.8)	617 (59.4)
Bachelor degree or higher	333 (43.3)	421 (40.6)
Primary caregiver work status, n (%)		
Full-time employment	124 (16.1)	169 (16.3)
Part-time employment	306 (39.7)	408 (39.3)
Not working	340 (44.2)	461 (44.4)
Household income, n (%)		
≤ \$41,548	160 (20.8)	236 (22.7)
\$41,549 – \$77,999	328 (42.6)	430 (41.4)
≥ \$78,000	282 (36.6)	372 (35.8)
Significant economic hardship, n (%)		
No significant hardship	452 (58.7)	595 (57.3)
Some significant hardship	318 (41.3)	443 (42.7)
ARIA, n (%)		
Highly accessible	436 (56.6)	575 (55.4)
Other	334 (43.4)	463 (44.6)

Number of children's books, n (%)		
≤ 20 books	70 (9.1)	107 (10.3)
≥ 21 books	700 (90.9)	931 (89.7)
How many minutes child usually read to, n (%)		
≤ 20 minutes	686 (89.1)	924 (89.0)
≥ 21 minutes	84 (10.9)	114 (11.0)
Child taken part in any special activities, n (%)		
No	374 (48.6)	541 (52.1)
Yes	396 (51.4)	497 (47.9)
Quality of activities in childcare, mean (SD)	7.1 (1.1)	7.1 (1.1)
Quality carer-child relationship, mean (SD)	14.9 (1.5)	14.9 (1.5)
Main type of childcare, n (%)		
Centre care	669 (86.8)	847 (81.6)
Family day care	101 (13.2)	191 (18.4)
Total hours per week in childcare, mean (SD)	24.0 (11.8)	24.0 (11.9)
Provider highest educational qualification		
≤ secondary education	71 (9.2)	117 (11.3)
Advanced diploma/certificate	555 (72.1)	729 (70.2)
≥ Bachelor degree	144 (18.7)	192 (18.5)
Hours spent on professional development		
≤ 6 hours	169 (21.9)	229 (22.1)
7-12 hours	139 (18.1)	194 (18.7)
13-18 hours	135 (17.5)	179 (17.2)
19-24 hours	120 (15.6)	142 (13.7)

>25 hours	207 (26.9)	294 (28.3)
Studying for a qualification that will expand skills/knowledge in child care or early childhood		
No	551 (71.6)	749 (72.2)
Yes	219 (28.4)	289 (27.8)
Years worked \geq 10 hours/week in child care settings, early education programs or school		
\leq 8 years	404 (52.5)	545 (52.5)
\geq 9 years	366 (47.5)	493 (47.5)
Number children, present in the same room		
\geq 21 children	112 (14.5)	138 (13.3)
11-20 children	442 (57.4)	561 (54.1)
6-10 children	131 (17.0)	174 (16.7)
\leq 5 children	85 (11.0)	165 (15.9)
Task attentiveness age 4-5, mean (SD)	17.4 (3.8)	17.4 (3.8)
Task attentiveness age 6-7, mean (SD)	17.9 (4.0)	17.9 (4.0)
Emotional regulation age 4-5, mean (SD)	19.7 (3.9)	19.6 (3.8)
Emotional regulation age 6-7, mean (SD)	20.6 (3.9)	20.5 (3.9)

^a Complete case sample includes respondents with complete data on the outcome, exposure and covariates. ^b Imputed sample includes data imputed on child exposure and covariates

Table 5: Provider and program characteristics of formal childcare and task attentiveness and emotional regulation scores at ages 4-5 and 6-7 years using the imputed sample (n=1038)

	Task attentiveness			Task attentiveness			Emotional Regulation			Emotional Regulation		
	4-5 years			6-7 years			4-5 years			6-7 years		
	β^*	95%CI	P**	β^*	95%CI	P**	β^*	95%CI	P**	β^*	95%CI	P**
Highest educational qualification												
≤ secondary education (r)												
Advanced diploma/certificate	-.51	-1.28, .25	0.19	-.82	-1.62, -.01	0.05	-.40	-1.17, .35	0.29	.04	-.74, .83	0.91
≥Bachelor degree	-.50	-1.41, .39	0.27	-.61	-1.55, .33	0.20	-.28	-1.17, .60	0.53	.45	-.47, 1.38	0.34
In last 12 months, hours spent on professional development activities												
≤ 6 hours (r)												
7-12 hours	.41	-.34, 1.17	0.28	.74	-.04, 1.52	0.06	.49	-.24, 1.24	0.19	.72	-.05, 1.51	0.07
13-18 hours	.48	-.28, 1.26	0.21	.39	-.41, 1.20	0.33	.50	-.26, 1.27	0.19	.34	-.46, 1.15	0.39
19-24 hours	.33	-.48, 1.15	0.42	.52	-.34, 1.38	0.23	.58	-.22, 1.40	0.15	.77	-.07, 1.62	0.07
≥25 hours	.09	-.58, .78	0.77	.21	-.50, .92	0.55	.33	-.34, 1.00	0.33	.31	-.38, 1.02	0.37

	Task attentiveness			Task attentiveness			Emotional Regulation			Emotional Regulation		
	4-5 years			6-7 years			4-5 years			6-7 years		
	β^*	95%CI	P**	β^*	95%CI	P**	β^*	95%CI	P**	β^*	95%CI	P**
Studying for a qualification that will expand skills/knowledge in child care												
No (r)												
Yes	-.01	-.55, .52	0.95	.14	-.42, .71	0.61	.24	-.27, .77	0.35	.18	-.36, .73	0.51
Years worked for ≥ 10 hours/week in child care, early education programs												
≤ 8 years (r)												
≥ 9 years	.12	-.35, .60	0.61	-.28	-.78, .21	0.25	.12	-.35, .59	0.61	-.07	-.57, .41	0.75
Number children in the same room												
≥ 21 children (r)												
11-20 children	-.10	-.83, .61	0.76	.04	-.71, .79	0.91	-.34	-1.06, .36	0.33	-.11	-.85, .62	0.76
6-10 children	-.52	-1.40, .35	0.24	-.02	-.93, .89	0.96	-.42	-1.28, .43	0.33	-.36	-1.26, .53	0.43
≤ 5 children	-.03	-.92, .86	0.94	.12	-.79, 1.05	0.78	.08	-.80, .97	0.85	.03	-.87, .95	0.93

*Regression Coefficient; ** P-value

Table 6: Quality of activities and quality of carer-child relationships in formal childcare at 2-3 years of age and children's task attentiveness and emotional regulation scores at ages 4-5 and 6-7 years using the imputed sample (n=1038)

	Task attentiveness			Task attentiveness			Emotional Regulation			Emotional Regulation		
	4-5 years			6-7 years			4-5 years			6-7 years		
	β^*	95% CI	P ^{**}	β^*	95% CI	P ^{**}	β^*	95% CI	P ^{**}	β^*	95% CI	P ^{**}
Quality of activities	.03	-.17, .25	0.71	.02	-.19, .24	0.82	.28	.08, .49	0.007	.30	.08, .51	0.007
Quality of activities + covariates ^a	-.00	-.22, .20	0.94	-.02	-.24, .19	0.80	.23	.02, .44	0.02	.26	.04, .47	0.01
Quality of activities + covariates ^a + quality of carer-child relationship	-.04	-.25, .17	0.70	-.06	-.29, .15	0.54	.21	.00, .42	0.04	.21	-.00, .43	0.05
Quality of carer-child relationship	.28	.13, .43	<0.001	.31	.16, .47	<0.001	.24	.09, .39	<0.001	.39	.23, .54	<0.001
Quality of carer-child relationship + covariates ^a	.20	.05, .36	0.009	.26	.10, .42	<0.001	.19	.04, .34	0.01	.27	.24, .30	<0.001
Quality of carer-child relationship + covariates ^a + quality of activities	.21	.05, .36	0.008	.26	.10, .42	<0.001	.17	.02, .32	0.02	.29	.13, .45	<0.001

*Regression Coefficient; ** P value

^a Adjusted for total time spent in child care (hours/week), child age, sex, birth weight, parental concern about child's learning and development, primary caregiver education, primary caregiver work status, household income, economic hardship, ARIA, two parent household, number of siblings, primary caregivers age, Kessler 6 score and self-reported level of warmth towards the child, number of children's books, minutes child usually read to and special or extra cost activities

Table 7 online only: Quality of activities in formal childcare at 2-3 years of age and children's task attentiveness and emotional regulation scores at 4-5 and 6-7 years using the imputed sample (n=1038)

	Task attentiveness			Task attentiveness			Emotional Regulation			Emotional Regulation		
	4-5 years			6-7 years			4-5 years			6-7 years		
	β^*	95%CI	P**	β^*	95%CI	P**	β^*	95%CI	P**	β^*	95%CI	P**
UNADJUSTED MODEL												
Quality of activities in childcare	.03	-.17, .25	0.71	.02	-.19, .24	0.82	.28	.08, .49	0.007	.30	.08, .51	0.007
ADJUSTED MODEL												
Quality of activities in childcare	-.00	-.22, .20	0.94	-.02	-.24, .19	0.80	.23	.02, .44	0.02	.26	.04, .47	0.01
Total hours/week in child care	-.01	-.03, .00	0.09	-.01	-.03, .00	0.16	-.00	-.02, .01	0.59	.00	-.02, .02	0.94
Age	.04	-.04, .13	0.28	-.00	-.07, .06	0.93	.03	-.04, .12	0.38	.02	-.04, .09	0.40
Sex												
Male (r)												
Female	.85	.38, 1.32	<0.001	.66	.17, 1.16	0.008	.54	.08, 1.01	0.02	.82	.33, 1.30	0.001

	Task attentiveness			Task attentiveness			Emotional Regulation			Emotional Regulation		
	4-5 years			6-7 years			4-5 years			6-7 years		
	β^*	95%CI	P**	β^*	95%CI	P**	β^*	95%CI	P**	β^*	95%CI	P**
Concerns about your child's development, learning and behaviour? Yes a little/Don't know (r)												
No	.50	-.46, 1.47	0.30	1.04	.02, 2.05	0.04	1.09	.14, 2.05	0.02	.74	-.23, 1.73	0.13
Birth weight >=2501 grams (r)												
<=2500 grams	-.03	-1.20, 1.13	0.95	.32	-.89, 1.55	0.60	.44	-.70, 1.58	0.44	.68	-.50, 1.87	0.25
Primary caregiver education < Bachelor degree (r)												
Bachelor degree or higher	.21	-.30, .73	0.40	.26	-.27, .80	0.34	-.07	-.58, .42	0.76	.18	-.34, .71	0.48
Significant economic hardship No significant hardship (r)												
Some significant hardship	-.20	-.72, .30	0.42	.04	-.49, .58	0.86	-.22	-.73, .28	0.37	-.23	-.76, .29	0.38

	Task attentiveness			Task attentiveness			Emotional Regulation			Emotional Regulation		
	4-5 years			6-7 years			4-5 years			6-7 years		
	β^*	95%CI	P**	β^*	95%CI	P**	β^*	95%CI	P**	β^*	95%CI	P**
Primary caregiver work status												
Full-time employment (r)												
Part-time employment	.34	-.37, 1.07	0.34	.36	-.38, 1.12	0.34	.04	-.66, .75	0.90	-.34	-1.08, .38	0.35
Not working	.11	-.62, .86	0.75	.12	-.64, .90	0.74	.42	-.30, 1.15	0.25	-.23	-.99, .52	0.54
Household income												
\leq \$41,548 (r)												
\$41,549 – \$77,999	.36	-.36, 1.09	0.33	-.32	-1.06, .42	0.40	-.08	-.79, .62	0.81	.13	-.59, .86	0.72
\geq \$78,000	.90	.07, 1.74	0.03	.39	-.45, 1.25	0.36	.29	-.52, 1.10	0.48	.34	-.49, 1.17	0.42
ARIA												
Highly accessible (r)												
Other	.20	-.28, .69	0.41	.02	-.48, .53	0.92	.27	-.20, .75	0.26	.43	-.06, .93	0.08
Two parent household												
No (r)												
Yes	-.43	-1.49, .62	0.41	.45	-.64, 1.55	0.41	.76	-.27, 1.80	0.14	.70	-.36, 1.78	0.19

	Task attentiveness			Task attentiveness			Emotional Regulation			Emotional Regulation		
	4-5 years			6-7 years			4-5 years			6-7 years		
	β^*	95%CI	P**	β^*	95%CI	P**	β^*	95%CI	P**	β^*	95%CI	P**
Number of siblings												
0 (r)												
1	-.21	-.74, .31	0.43	.16	-.38, .72	0.55	-.68	-1.20, -.16	0.01	-.61	-1.15, -.07	0.02
≥ 2	.13	-.59, .86	0.71	.80	.04, 1.56	0.03	-.17	-.89, .53	0.62	-.14	-.88, .59	0.69
Primary caregiver age	.02	-.03, .07	0.40	.03	-.02, .08	0.23	.02	-.02, .08	0.28	.02	-.03, .07	0.43
Primary caregiver Kessler 6	.68	.22, 1.13	0.003	.59	.12, 1.06	0.01	.74	.30, 1.18	0.001	.95	.49, 1.14	<0.001
Primary caregiver warmth	-.06	-.67, .54	0.83	-.15	-.79, .48	0.62	.84	.24, 1.44	0.006	.50	-.11, 1.12	0.11
Number of children's books												
≤ 20 books (r)												
≥ 21 books	.33	-.45, 1.13	0.40	-.17	-1.00, .65	0.67	.49	-.28, 1.27	0.21	.21	-.59, 1.02	0.59
How many minutes child usually read to at a sitting												
≤ 20 minutes (r)												
≥ 21 minutes	.76	-.00, 1.52	0.05	1.10	.30, 1.90	0.007	-.00	-.75, .74	0.98	.40	-.36, 1.18	0.30

	Task attentiveness			Task attentiveness			Emotional Regulation			Emotional Regulation		
	4-5 years			6-7 years			4-5 years			6-7 years		
	β^*	95%CI	P**	β^*	95%CI	P**	β^*	95%CI	P**	β^*	95%CI	P**
Child regularly taken part in any special or extra cost activities												
No (r)												
Yes	-0.03	-.52, .45	0.87	-.18	-.69, .32	0.48	.25	-.22, .73	0.30	.15	-.34, .65	0.53

* Regression Coefficient; ** P value; ARIA = Accessibility and Remoteness Index of Australia

Table 8 online only: Quality of the carer-child relationship in formal childcare at 2-3 years of age and children's task attentiveness and emotional regulation scores at 4-5 and 6-7 years using the imputed sample (n=1038)

	Task attentiveness			Task attentiveness			Emotional Regulation			Emotional Regulation		
	4-5 years			6-7 years			4-5 years			6-7 years		
	β^*	95%CI	P**	β^*	95%CI	P**	β^*	95%CI	P**	β^*	95%CI	P**
UNADJUSTED MODEL												
Quality carer-child relationship	.28	.13, .43	<0.001	.31	.16, .47	<0.001	.24	.09, .39	<0.001	.39	.23, .54	<0.001
ADJUSTED MODEL												
Quality carer-child relationship	.20	.05, .36	0.009	.26	.10, .42	<0.001	.19	.04, .34	0.01	.27	.24, .30	<0.001
Total hours/week in child care	-.01	-.03, .00	0.07	-.01	-.03, .00	0.11	-.00	-.02, .01	0.54	.00	-.00, .00	0.47
Age	.04	-.04, .13	0.33	-.00	-.07, .06	0.87	.02	-.05, .11	0.52	.03	.01, .04	<0.001
Sex												
Male (r)												
Female	.78	.30, 1.25	<0.001	.57	.07, 1.06	0.02	.48	.01, .94	0.04	.74	.64, .83	<0.001

	Task attentiveness			Task attentiveness			Emotional Regulation			Emotional Regulation		
	4-5 years			6-7 years			4-5 years			6-7 years		
	β^*	95%CI	P**	β^*	95%CI	P**	β^*	95%CI	P**	β^*	95%CI	P**
Concerns about your child's development, learning and behaviour?												
Yes a little/Don't know (r)												
No	.40	-.56, 1.37	0.41	.91	-.09, 1.92	0.07	1.00	.04, 1.96	0.03	.44	.24, .63	<0.001
Birth weight												
>=2501 grams (r)												
<=2500 grams	-.07	-1.23, 1.09	0.90	.28	-.93, 1.50	0.64	.35	-.79, 1.49	0.54	.64	.42, .86	<0.001
Primary caregiver education												
< Bachelor degree (r)												
Bachelor degree or higher	.19	-.31, .71	0.45	.23	-.29, .77	0.38	-.14	-.64, .36	0.58	.01	-.08, .12	0.72
Primary caregiver work status												
Full-time employment (r)												
Part-time employment	.34	-.37, 1.06	0.34	.36	-.38, 1.11	0.34	.04	-.66, .75	0.90	-.30	-.45, -.16	<0.001
Not working	.15	-.58, .89	0.68	.17	-.59, .94	0.65	.48	-.24, 1.20	0.19	-.28	-.42, -.13	<0.001

	Task attentiveness			Task attentiveness			Emotional Regulation			Emotional Regulation		
	4-5 years			6-7 years			4-5 years			6-7 years		
	β^*	95%CI	P**	β^*	95%CI	P**	β^*	95%CI	P**	β^*	95%CI	P**
Household income												
\leq \$41,548 (r)												
\$41,549 – \$77,999	.30	-.41, 1.03	0.40	-.38	-1.13, .35	0.30	-.12	-.83, .58	0.72	.28	.14, .41	<0.001
\geq \$78,000	.83	.00, 1.66	0.04	.30	-.54, 1.15	0.48	.25	-.55, 1.06	0.53	.30	.14, .45	<0.001
Significant economic hardship												
No significant hardship (r)												
Some significant hardship	-.19	-.71, .31	0.45	.06	-.47, .59	0.81	-.26	-.77, .24	0.30	-.32	-.42, -.22	<0.001
ARIA												
Highly accessible (r)												
Other	.19	-.29, 0.68	0.44	.01	-.49, .51	0.96	.24	-.23, .72	0.32	.25	.16, .35	<0.001
Two parent household												
No (r)												
Yes	-.46	-1.51, .59	0.39	0.42	-.66, 1.52	0.44	.71	-.32, 1.74	0.17	.54	.35, .74	<0.001

	Task attentiveness			Task attentiveness			Emotional Regulation			Emotional Regulation		
	4-5 years			6-7 years			4-5 years			6-7 years		
	β^*	95%CI	P**	β^*	95%CI	P**	β^*	95%CI	P**	β^*	95%CI	P**
Number of siblings												
0 (r)												
1	-.23	-.76, .29	0.38	.14	-.41, .69	0.61	-.69	-1.21, -.17	0.009	-.53	-.63, -.42	<0.001
≥ 2	.14	-.58, .86	0.70	.81	.06, 1.57	0.03	-.16	-.87, .54	0.65	-.09	-.24, .04	0.16
Primary caregiver age	.02	-.03, .07	0.41	.03	-.02, .08	0.24	.03	-.01, .08	0.22	.01	.00, .02	0.01
Primary caregiver Kessler 6	.63	.17, 1.08	0.006	.53	.06, 1.00	0.02	.70	.26, 1.14	0.002	.88	.79, .96	<0.001
Primary caregiver warmth	-.03	-.64, .57	0.91	-.11	-.75, .51	0.71	.91	.31, 1.51	0.003	.56	.44, .68	<0.001
Number of children's books												
≤ 20 books (r)												
≥ 21 books	.33	-.45, 1.13	0.40	-.17	-1.00, .65	0.67	.47	-.30, 1.24	0.23	-.02	-.16, .12	0.76
How many minutes child usually read to at a sitting												
≤ 20 minutes (r)												
≥ 21 minutes	.77	.01, 1.52	0.04	1.11	.32, 1.90	0.006	.05	-.68, .80	0.88	.52	.36, .67	<0.001

	Task attentiveness			Task attentiveness			Emotional Regulation			Emotional Regulation		
	4-5 years			6-7 years			4-5 years			6-7 years		
	β^*	95%CI	P**	β^*	95%CI	P**	β^*	95%CI	P**	β^*	95%CI	P**
Has child regularly taken part in any special or extra cost activities												
No (r)												
Yes	-0.03	-.52, .45	0.87	-.18	-.69, .32	0.48	.25	-.22, .73	0.29	.15	.05, .25	0.002

* Regression Coefficient; ** P value; ARIA = Accessibility and Remoteness Index of Australia

Table 9 online only: Quality of activities in formal childcare at 2-3 years of age and children’s task attentiveness and emotional regulation scores at 4-5 and 6-7 years, adjusted for covariates and quality of relationships using the imputed sample (n=1038)

	Task attentiveness			Task attentiveness			Emotional Regulation			Emotional Regulation		
	4-5 years			6-7 years			4-5 years			6-7 years		
	β^*	95%CI	P**	β^*	95%CI	P**	β^*	95%CI	P**	β^*	95%CI	P**
Quality of activities in childcare	-.04	-.25, .17	0.70	-.06	-.29, .15	0.54	.21	.00, .42	0.04	.21	-.00, .43	0.05
Quality of carer-child relationship	.21	.05, .36	0.008	.26	.10, .42	<0.001	.17	.02, .32	0.02	.29	.13, .45	<0.001
Total hours/week in child care	-.01	-.03, .00	0.07	-.01	-.03, .00	0.12	-.00	-.02, .01	0.52	-.00	-.02, .01	0.92
Age	.04	-.04, .13	0.34	-.00	-.07, .06	0.84	.03	-.05, .11	0.45	.02	-.04, .09	0.48
Sex												
Male (r)												
Female	.77	.30, 1.25	<0.001	.57	.07, 1.06	0.02	.48	.01, .95	0.04	.71	.23, 1.19	0.004
Concerns about your child’s development, learning and behaviour?												
Yes a little/Don’t know (r)												
No	.40	-.57, 1.37	0.41	.91	-.10, 1.92	0.07	1.01	.05, 1.96	0.03	.60	-.37, 1.59	0.22

	Task attentiveness			Task attentiveness			Emotional Regulation			Emotional Regulation		
	4-5 years			6-7 years			4-5 years			6-7 years		
	β^*	95%CI	P**	β^*	95%CI	P**	β^*	95%CI	P**	β^*	95%CI	P**
Birth weight												
>=2501 grams (r)												
<=2500 grams	-.08	-1.24, 1.08	0.89	.26	-.94, 1.48	0.66	.40	-.73, 1.54	0.48	.62	-.55, 1.80	0.29
Primary caregiver education												
< Bachelor degree (r)												
Bachelor degree or higher	.19	-.37, .70	0.47	.22	-.31, .76	0.40	-.10	-.61, .40	0.69	.14	-.37, .67	0.57
Primary caregiver work status												
Full-time employment (r)												
Part-time employment	.34	-.37, 1.06	0.34	.36	-.38, 1.11	0.33	.04	-.66, .74	0.90	-.34	-1.08, .38	0.34
Not working	.15	-.58, .90	0.67	.18	-.59, .95	0.64	.45	-.26, 1.18	0.21	-.17	-.92, .57	0.64
Household income												
≤ \$41,548 (r)												
\$41,549 – \$77,999	.30	-.41, 1.03	0.40	-.38	-1.13, .35	0.30	-.12	-.83, .58	0.72	.05	-.66, .78	0.87
≥ \$78,000	.83	.00, 1.67	0.04	.31	-.54, 1.16	0.47	.23	-.27, 1.04	0.57	.24	-.58, 1.07	0.56

	Task attentiveness			Task attentiveness			Emotional Regulation			Emotional Regulation		
	4-5 years			6-7 years			4-5 years			6-7 years		
	β^*	95%CI	P**	β^*	95%CI	P**	β^*	95%CI	P**	β^*	95%CI	P**
Significant economic hardship												
No significant hardship (r)												
Some significant hardship	-.20	-.72, .31	0.43	.05	-.48, .58	0.85	-.22	-.73, .28	0.38	-.23	-.75, .29	0.38
ARIA												
Highly accessible (r)												
Other	.18	-.30, .68	0.45	.00	-.50, .51	0.98	.26	-.21, .74	0.28	.41	-.08, .90	0.10
Two parent household												
No (r)												
Yes	-.46	-1.52, .58	0.38	.42	-.67, 1.51	0.45	.73	-.29, 1.77	0.16	.66	-.40, 1.73	0.22
Number of siblings												
0 (r)												
1	-.23	-.76, .29	0.38	.14	-.41, .69	0.61	-.70	-1.22, -.17	0.009	-.64	-1.17, -.10	0.02
≥ 2	.14	-.58, .86	0.69	.81	.06, 1.57	0.03	-.17	-.88, .54	0.63	-.13	-.87, .59	0.71

	Task attentiveness			Task attentiveness			Emotional Regulation			Emotional Regulation		
	4-5 years			6-7 years			4-5 years			6-7 years		
	β^*	95%CI	P**	β^*	95%CI	P**	β^*	95%CI	P**	β^*	95%CI	P**
Primary caregiver age	.02	-.03, .07	0.39	.03	-.02, .08	0.22	.02	-.02, .08	0.27	.02	-.03, .07	0.42
Primary caregiver Kessler 6	.63	.17, 1.08	0.006	.53	.06, 1.00	0.02	.70	.26, 1.14	0.002	.88	.42, 1.35	<0.001
Primary caregiver warmth	-.02	-.63, .58	0.93	-.10	-.74, .53	0.74	.87	.27, 1.47	0.004	.56	-.05, 1.17	0.07
Number of children's books												
≤ 20 books (r)												
≥ 21 books	.33	-.45, 1.12	0.40	-.18	-1.00, .64	0.66	.49	-.28, 1.27	0.21	.21	-.58, 1.01	0.60
How many minutes child usually read to at a sitting												
≤ 20 minutes (r)												
≥ 21 minutes	.77	.01, 1.54	0.04	1.12	.33, 1.92	0.005	.00	-.73, .75	0.98	.43	-.33, 1.20	0.26
Has child regularly taken part in any special or extra cost activities												
No (r)												
Yes	-.03	-.52, .45	0.88	-.18	-.69, .32	0.48	.25	-.22, .73	0.30	.16	-.33, 1.20	0.26

* Regression Coefficient; ** P value; ARIA = Accessibility and Remoteness Index of Australia