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RESEARCH ARTICLE



Socioeconomic differences in looking behavior in habituation tasks in the first two years of life

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ABSTRACT


Studies on the emergence of effects of socioeconomic inequality typically report that socioeconomic background is positively associated with early cognitive abilities. However, studies on looking behaviour in habituation tasks rarely investigate this association, although such tasks are standard in measuring cognitive abilities in infants. The current study aimed to explore the emergence and magnitude of the effects of socioeconomic background, as one aspect of socioeconomic inequality, on cognitive abilities in the first two years of life, using a dataset from a large-scale German cohort study. We modelled looking behaviour using growth curve modelling and found no significant effects at 7 months. However, we found positive effects of socioeconomic background on the initial looking time (intercept) and overall looking time at 17 months, but not on the looking decrement (slope). The results are discussed regarding the specificities of the data, as the habituation task was administered in a household setting.

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Social inequality refers to systematic differences in access to resources, opportunities, and privileges among groups of individuals within a society (Neckerman & Torche, 2007). It can manifest in various forms for different groups, resulting in economic, educational, or socio-cultural disparity (e.g., E. A. Smith et al., 2011). Infant research is relevant in understanding the mechanisms behind the emergence of social inequality because early life

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experiences lay the foundation for cognitive, emotional, and social development. Infants growing up in environments characterized by, for example, socioeconomic disadvantages may face limitations in terms of access to stimulating educational materials, quality of early childcare, and enriching social interactions (Bradley & Corwyn, 2002). However, infant research often struggles with selective samples (Bornstein et al., 2013; Oakes, 2017), and large-scale studies featuring observational measurements of early cognitive abilities have been rare (Hachul et al., 2019). Although visual habituation tasks have become a standard in infant research in the last decades (Colombo et al., 2020), there are few systematic investigations on how socioeconomic resources might be associated with interindividual differences in looking behaviour. Therefore, the current study used a German large-scale dataset to examine the emergence of socioeconomic differences in looking behaviour in a habituation task in the first two years of life.

Socioeconomic differences in cognitive development

Social inequality is tied to the concept of social stratification, namely having a broadly recognized hierarchical structure linked to access to resources (Neckerman & Torche, 2007). Social stratification works intergenerational: Children's access to such resources is, among other factors, associated with the socioeconomic status (SES) of their parents (Bradley & Corwyn, 2002). Socioeconomic differences can therefore be situated within the broader framework of social inequality. Considering the decades-long, interdisciplinary findings on how socioeconomic differences negatively impact cognitive abilities (e.g., Skopek & Passaretta, 2021; Weinert & Ebert, 2024), it is relevant to have a closer look at what aspects are affected and when SES-related effects emerge. Research with behavioural (e.g., Halle et al., 2009) and neurophysiological paradigms (Hurt & Betancourt, 2016) suggests that socioeconomic differences in early cognitive development emerge in the first year of life. While these effects are small, there is evidence that effect sizes may increase in the following years (Mollborn et al., 2014). Amongst others, the first two years of life have been shown to be relevant for emerging associations between SES and, for example, basic aspects of cognitive functioning, such as recognition memory (Hackman & Farah, 2009) and visual attention (Clearfield & Jedd, 2013). However, habituation tasks, which are considered a standard for assessing cognitive abilities in infants (Colombo et al., 2020) and are more predictive of later intellectual functioning than early

(sensorimotor) developmental tests (Kavšek, 2004), have seldom been used to investigate the emergence of socioeconomic differences.

Evidence from habituation tasks

In habituation tasks, a sequence of either identical or similar stimuli is presented to infants or toddlers. This marks the habituation phase, which is usually followed by a dishabituation phase with a novel (out-of-category) stimulus that is presented either concurrently with the familiar (or a new similar in-category) stimulus or on its own. Attention decrement in the habituation phase and attention recovery or preference for the out-of-category stimulus in the dishabituation phase are interpreted to reflect mental processes such as information processing, stimulus encoding, and recognition memory (Colombo et al., 2020). Such tasks have been used for decades to predict, for example, later language skills and intelligence (Fennell, 2012; Kavšek, 2004). However, the findings on socioeconomic differences have been inconclusive.

Early studies on attention decrement, as an indicator of information processing, found positive associations between SES (e.g., parental education and occupation) with looking behaviour at 3–4 months (e.g., McCall, 1972). Infants from higher socioeconomic backgrounds showed a stronger attention decrement, namely a faster decrease in looking behaviour during the habituation phase (McCall, 1972). However, subsequent investigations failed to provide clear evidence for such an association. Mayes and Bornstein (1995), for example, found no significant effect of maternal education on looking behaviour at 3 months. L. Smith et al. (2002) found that, while parental education was not associated with looking behaviour at 7 months, there was a small, positive correlation at 13 months ($r = .20, p < .05$), suggesting that toddlers from higher socioeconomic backgrounds looked shorter at the stimulus material. The authors interpreted the finding as a cumulative effect of socioeconomic background on cognitive development, indicating the emergence of interindividual differences in cognitive development due to socioeconomic resources in the second year of life. However, the study focused on preterm infants, which is why the effects are not generalizable (Kavšek & Bornstein, 2010). In addition, these empirical findings are drawn from small laboratory studies, which might have affected sample selectivity (Bornstein et al., 2013; Oakes, 2017).

The current study

Overall, few studies provide a thorough examination of SES-related differences in looking behaviour in habituation tasks based on a sufficiently large and heterogeneous sample. Therefore, the current study used large-scale data from a representatively drawn German cohort study to investigate the effects of SES on the performance in a habituation task administered at 7 months and 17 months of age. Overall, we were interested in the emergence and size of interindividual differences related to family background factors. In accordance with other studies (e.g., Hurt & Betancourt, 2016), we expected a significant association between infants' looking behaviour and parental SES at 17 months. However, this association should be considerably smaller or even non-existent at 7 months (Mollborn et al., 2014). More specifically, we expected that infants from higher socioeconomic backgrounds show shorter looking times during the habituation phase and a stronger recovery of attention (i.e., longer looking times) during the dishabituation phase, indicating advanced cognitive abilities (Colombo et al., 2020). It should be noted that there are previous analyses of this dataset that found no such effects (Attig & Weinert, 2018; Weinert et al., 2017). However, we argue that a closer look at the data is warranted because these analyses did not include all available habituation data. In addition, the current study used growth curve modelling (see below) to analyse the looking behaviour more precisely as well as a broader spectrum of SES components.

Method

Sample

The study used data from the representatively drawn Newborn Cohort of the German National Educational Panel Study (NEPS SC1; Blossfeld & Roßbach, 2019). NEPS SC1 started with a sample of $N = 3,481$ participants (i.e., 7-month-old infants as target persons) at the first survey wave; $n = 3,129$ parents gave informed consent to the habituation tasks, with $n = 2,945$ infants finishing the tasks. Video recordings with reported technical errors, multiple or severe infant-related disturbances, or parental interferences were dropped ($n = 464$), resulting in a final sample of $n = 2,481$ infants (51.39% male; 17.45% migration background) at the first survey wave. At the second survey wave (toddlers on average 17 months old), by

design only half of the sample respondents were asked to participate in the habituation tasks; resulting in $n = 1,484$ parents who gave informed consent to the habituation tasks, and $n = 1,315$ toddlers finishing the tasks. Video recordings with reported technical errors, multiple or severe toddler-related disturbances, or parental interferences were dropped ($n = 97$), resulting in a final sample of $n = 1,218$ toddlers (50.04% male; 15.16% migration background) at the second survey wave. Overall, there was data from $n = 983$ cases for both survey waves. As we used secondary data, no additional ethical approval was required. For further information on NEPS SC1, see Attig et al. (2023).

Assessment of looking behavior in the habituation task

The habituation task was administered in the homes of the families by trained interviewers. Both at 7 months and 17 months, NEPS SC1 included a categorical habituation task featuring the same stimulus material and task administration. The categorical stimulus material was deemed useful for facilitating visual attention in both age groups (Fennell, 2012). A fixed-trial procedure was used to ensure standardization in the large-scale assessment at infants' homes (Weinert et al., 2016). The habituation phase featured nine individual trials with categorical cartoon bugs, accompanied by a short three-note jingle; the dishabituation phase featured two individual trials with a deviant cartoon bug each (see Figure S1). Each trial was shown for 10 seconds, the only exception was the trials of the dishabituation phase at the first survey wave, which were shown for 15 seconds but truncated to 10 seconds in the official data release. Consequently, the presentation time was 177 seconds at the first survey wave and 157 seconds at the second. In both survey waves, other habituation tasks were also administered that focused on different developmental domains. The looking times were recorded, and coding was done offline and event-based, which means that for every single frame, the coders had to rate the looking behaviour as either on or off target (30 frames per second) using the software Mangold INTERACT. Interrater reliability was tested on a randomized subsample of 10% of all videos ($\kappa = .92$ for each survey wave). The current study used the accumulated looking time at the stimulus material, which could range from 0–10-seconds per trial. For further information on the habituation tasks, see Seitz et al. (2023).

In contrast to discrete measures of attention decrement and recovery, we used growth curve modelling to estimate the looking times during the habituation and dishabituation phases (see below). It should be noted that this approach is only possible due to the large sample size and the fixed-trial design, which is why there are few examples of comparable studies (see Young & Hunter, 2015). However, we regard this approach useful as it allows for disentangling the initial looking behaviour from attention decrement during the habituation phase with less measurement error than traditional measures, such as the dichotomous habituation criterion (for a recent discussion, see Byers-Heinlein et al., 2022).

Socioeconomic background

The current study defined parental SES with the following components: Parental occupation, parental education, and household income. Regarding parental occupation, we used the highest International Socio-Economic Index of Occupational Status (HISEI) in the household (Ganzeboom et al., 1992). We also included indicators of education of both the survey respondent, usually the mother, and their partners. We chose overall years of formal education, as it is more internationally comparable than specific qualifications, and we treated the variable continuously. For household income, we used the standard OECD approach of calculating a household-size adjusted score that weighs people below and above the age of 14 differentially (i.e., equivalized household income; OECD, 2013). For all components of socioeconomic background, we used data from the first survey wave.

Control variables

In all models, preterm birth status, age, and biological sex of the child as reported by the parents were used as control variables. For analysing the looking behaviour at 17 months, we also included age at the second survey wave as a control variable. Finally, household language was used as a dichotomous indicator of language exposure in the families (i.e., mostly German vs. mostly another language in the first year of life).

Table 1. Descriptive overview of socioeconomic and control variables.

	<i>N</i>	<i>M</i>	<i>SD</i>	Min	Max	Missing
HISEI	2,430	62.34	19.93	12.01	88.96	2.06%
Maternal education (years)	2,447	14.81	2.53	9	18	1.37%
Partner education (years)	2,286	14.86	2.59	9	18	7.86%
Household income (€)	2,414	1,684.01	820.30	120	10,208.33	2.70%
Age infant (first survey wave)	2,477	6.96	0.70	5.77	11.93	0.16%
Sex infant	2,481	51.39% male (0% missing)				
Household language	2,476	87.34% primarily German (0.20% missing)				
Preterm birth status	2,481	7.90% children born preterm (0% missing)				

Age, sex, and preterm birth status used as control variables; age reported in months.

Data analysis

We used latent growth curve modelling to estimate interindividual variability in intraindividual looking patterns. Intercept and slope were treated as latent variables in a linear growth model, predicted by the manifest looking times for all nine trials of the habituation phase. Intercept and slope were allowed to correlate with each other as initial looking and looking decrement are likely to be associated with each other. We included the first dishabituation trial as an additional endogenous variable, predicted by the intercept and slope of the previous habituation phase. We report two models that test the association between SES, intercept, slope, and the dishabituation trial. The first model examines this association at 7 months (Model A), while the second model examines this association at 17 months (Model B). In the latter model, the looking behaviour in the habituation task at 7 months is controlled for (latent factors) to address effects on changes of individual differences. For the models, non-dichotomous variables were standardized, and household income was log-transformed to account for outliers. Missing values for independent and control variables are mostly low (Table 1) and were treated using full information maximum likelihood (FIML; Lee & Shi, 2021). All calculations were performed using STATA 17.0 (StataCorp LLC, 2021).

Results

Table 1 provides descriptive information on socioeconomic and control variables for the first survey wave that was used in the analyses. A descriptive overview of these variables for the subsample at the second survey wave can be found in the supplement (Table 2-S). Descriptive information on the looking behaviour during the habituation task is also provided in the supplement (Table 1, -S). It should be noted that the looking behaviour does not suggest a clear pattern of

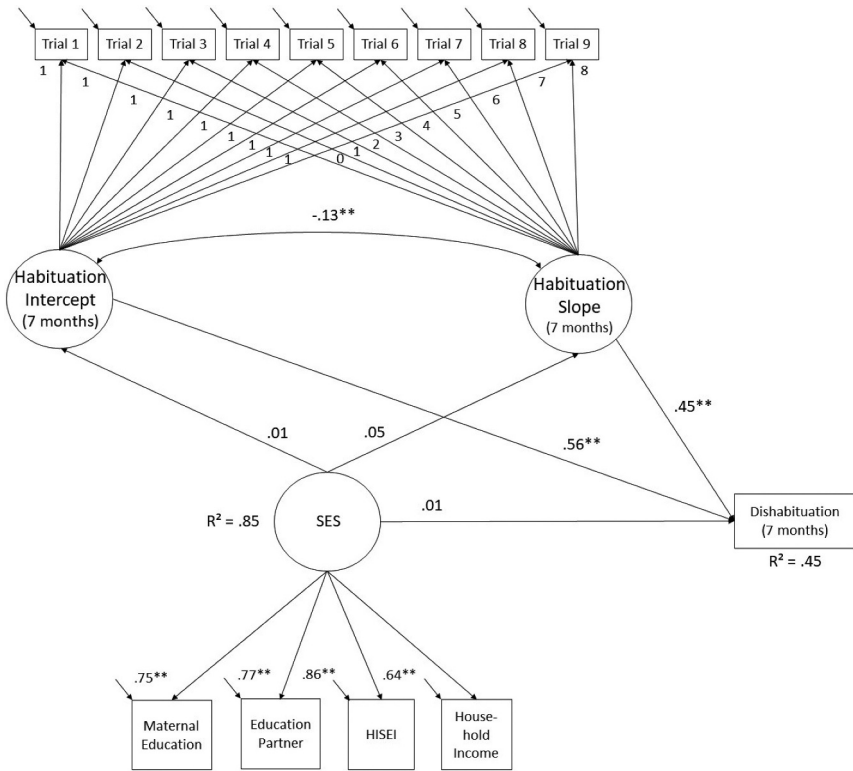


Figure 1. Model A: growth curve model predicting looking behavior at 7 months. $n = 2481$ (FIML); $\chi^2(119) = 482.32$; CFI = .975; TLI = .969; RMSEA = .035 [.032 – .038]; SRMR = .033; $*p < .05$, $**p < .01$. Control variables: Age, sex, preterm birth status, and household language.

habituation on average because it remained rather high across trials (see Supplement: Information on Habituation and Dishabituation and Discussion).

In Model A, we tested the association between looking behaviour in the habituation task and SES at 7 months (Figure 1). The latent intercept and slope factors were negatively associated with each other, indicating that infants with comparatively longer looking behaviour at the start of the habituation phase showed less attention decrement in the following trials. Both the intercept and slope were positively associated with the looking behaviour during the dishabituation trial, indicating that infants with longer initial looking behaviour and those with a higher attention decrement showed longer looking during the dishabituation phase. SES was not significantly associated with any of these indicators. Regarding the

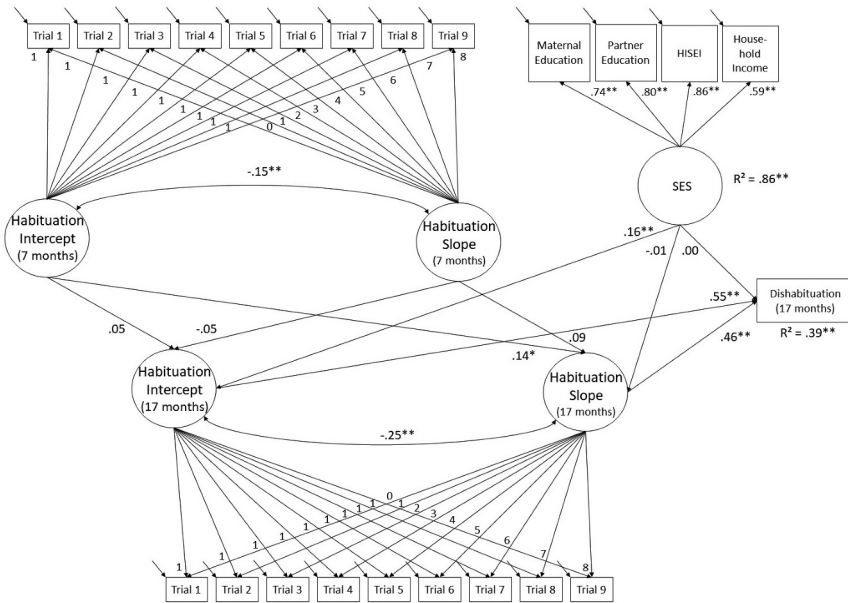


Figure 2. Model B: growth curve model predicting looking behavior at 17 months. $N = 1218$ (FIML); $\chi^2(322) = 577.98$; CFI = .971; TLI = .967; RMSEA = .026 [.022 – .029]; SRMR = .037; $*p < .05$, $**p < .01$. Control variables: Age, sex, preterm birth status, and household language.

control variables, preterm infants had a shorter initial looking time ($\beta = -.09$, $p < .01$) and higher attention decrement ($\beta = .10$, $p < .01$). In Model B, we tested the association between toddlers' looking behaviour in the habituation task and their socioeconomic background at 17 months (Figure 2). Again, the latent intercept and slope factors were negatively associated with each other and positively associated with the looking time during the dishabituation trial. SES was only significantly associated with the intercept at 17 months (for a robustness check testing indirect effects, see Figure 2, -5). We additionally controlled for toddlers' looking behaviour at the first survey wave to address the effects of the changes in individual differences. The magnitude and direction of the effect were similar for the model with and without the looking time indicators of the first survey wave (see Figure 3-5). Regarding the control variables, girls showed a longer looking time during the dishabituation trial ($\beta = .05$, $p = .03$). Overall, the model fit was good. In a further robustness check, we used a manifest indicator of total looking time to estimate the association with SES. Both when excluding or including the dishabituation trial (both models: β

= .14, $p < .01$), there was a significant positive association between overall looking behaviour and SES.

Discussion

To the knowledge of the authors, the current study is one of few large-scale investigations of SES-related effects on early cognitive abilities in infants and toddlers. We aimed to investigate the emergence of SES-related differences in looking behaviour in a habituation task. As expected, such effects emerged during the first two years of life. Still, structural aspects of the socioeconomic background were not systematically associated with interindividual differences in the initial looking time and looking decrement during the habituation phase (i.e., information processing), and looking time during the dishabituation phase (i.e., attention recovery) at 7 months. At 17 months, we found a small significant effect on the initial looking behaviour but not on attention decrement or the looking behaviour during the dishabituation trial. This suggests that our approach allowed for a more fine-grained analysis when compared to a previous study that found no such effect (Attig & Weinert, 2018). The size of the effect is comparable to previous research on preterm toddlers (L. Smith et al., 2002). Because we controlled for looking behaviour at 7 months (i.e., the same task), we argue that the findings pinpoint the emergence of SES-related differences in this indicator of cognitive development between 7 and 17 months. Overall, this supports the idea of a cumulative influence of socioeconomic background on early cognitive development (Mollborn et al., 2014). Note that looking behaviour was overall high across trials and longer (initial) looking times were associated with comparatively higher SES as well as with a lower attention decrement across trials as indicated by the significant negative correlation and higher looking times to the new out-of-category material in the dishabituation phase. This means that children with higher initial looking times showed less habituation and more sustained attention to the stimulus material across trials. This pattern of results holds for both assessment waves.

Theoretical implications

Prolonged looking behaviour in habituation tasks is typically associated with poorer cognitive abilities (Colombo et al., 2020; Kavšek, 2004). In

contrast to some empirical findings, our results showed that toddlers from higher socioeconomic backgrounds looked initially (as well as overall) longer at the stimulus material. Regarding cognitive models of infant habituation (for an overview, see Kavšek, 2013), this suggests that processes of self-regulation, such as sustained attention and inhibition, could play a considerable role in how children react to the stimulus material in habituation tasks presented in a more distraction-rich surrounding compared to a laboratory setting. However, the current findings indicate that only the initial (and overall) looking behaviour (but not the slope) was significantly associated with socioeconomic background, which could argue against this interpretation, highlighting the importance of focused attention at the beginning of the task. Yet, SES-related differences in the slope might show up when increasing the number of trials.

Concerning the documented SES-effect at the age of 17 months but not at the age of 7 months, this still could mean that other aspects of cognitive development might be associated with SES differences even earlier. There may be interindividual differences, for example, in infants' social cognition. Social cognition in infancy includes aspects of interpreting the behaviours, intentions, and emotions of others (see Baillargeon et al., 2014; Geraci & Surian, 2023). Furthermore, SES-related differences in parental behaviour (e.g., Attig & Weinert, 2020) could impact what infants and toddlers may learn from interactive situations with their parents and how they learn to regulate their attention in such situations (e.g., joint attention and imitation; Baillargeon et al., 2014). Thus, while the present analyses and study design focus on domain-general basic skills, social cognition and domain-specific skills could show other and earlier associations to parental SES that might contribute to the emergence of SES-effects.

Limitations and future directions

While the current research benefitted from the large-scale design of NEPS SC1, there are also considerable drawbacks. Alongside the habituation task examined in the present analyses, other habituation tasks were administered at the first two survey waves (Seitz et al., 2023). There could be sequence effects because of the different positions within the task sequence of each survey wave, possibly influencing children's attentional skills. In addition, the habituation task was administered in an unstandardized setting, namely in the children's homes. Although the

experimental setup was the same for all children and the coders of the videos flagged critical cases, the situation was not identical for all children. Overall, the documentation suggests that the fixed design was necessary for upholding standardization in households (Hachul et al., 2019).

Regarding the current investigation of children's socioeconomic background, we chose a latent approach that comprises various components typically associated with access to material and cultural resources. However, it has frequently been argued that different components of parental SES might influence child development in specific ways (Duncan et al., 2015). While parental education might be associated with parenting practices, economic resources may impact more basic aspects of the home environment (Bradley & Corwyn, 2002). Future research could analyse these components differentially to pinpoint specific mechanisms relevant to the cognitive development of young children. This should be important for potential interventions that focus on what kind of mediators or moderators could mitigate the emerging effects of socioeconomic differences (e.g., parental stress or investments; Conger & Donnellan, 2007).

Conclusion

The main result of the present study was that while we found no SES-related effect in basic cognitive abilities assessed with a habituation task at 7 months, we found such an effect at 17 months. Against our expectations, toddlers from higher socioeconomic backgrounds initially looked longer at the stimulus material. Furthermore, infants and toddlers with longer initial looking times tended to show higher visual attention across trials. The SES effect was small, but it may be cumulative, so it should be noteworthy and relevant to many studies that rely on behavioural assessments of children's visual attention, especially when interpreting findings from small and potentially selective samples.

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Disclosure statement

No potential conflict of interest was reported by the author(s).

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Data availability statement

This paper uses data from the National Educational Panel Study (NEPS): Starting Cohort Newborns, doi:10.5157/NEPS:SC1:8.0.0. From 2008 to 2013, NEPS data was collected as part of the Framework Program for the Promotion of Empirical Educational Research funded by the German Federal Ministry of Education and Research (BMBF). As of 2014, NEPS has been carried out by the Leibniz Institute for Educational Trajectories (LifBi, Bamberg) in cooperation with a nationwide network. Data of the word-learning task was also collected by the NEPS but coded under a different grant (ViVA project) and will be added in future scientific use files. The data and the analytic code are available on reasonable request to the authors. The study material can be found in the official documentation of NEPS SC1. Supplemental material is available at https://osf.io/6u3wb/?view_only=ae3a23d860fd468fa6c913cfd0e8517.

Contribution roles taxonomy statement:

Maximilian Seitz (Conceptualization, Data curation, Methodology, Writing – Original draft preparation); Dave Möwisch (Conceptualization, Writing – Review & Editing); Manja Attig (Conceptualization, Writing – Review & Editing); Markus Vogelbacher (Conceptualization, Writing – Review & Editing); Sabine Weinert (Funding acquisition, Conceptualization, Writing – Review & Editing, Supervision).

References

- Attig, M., Vogelbacher, M., & Weinert, S. (2023). Education from the crib on: The potential of the newborn cohort of the German national educational panel study. *Journal of Open Psychology Data*, 11(13), 1–18. <https://doi.org/10.5334/jopd.81>
- Attig, M., & Weinert, S. (2018). Soziale Disparitäten im Kontext von Mutter-Kind-Interaktionen und frühen Entwicklungsmaßen von Kindern [Social disparities in

- mother-child-interactions and early developmental measures in children]. *Frühe Bildung*, 7(1), 22–31. <https://doi.org/10.1026/2191-9186/a000356>
- Attig, M., & Weinert, S. (2020). What impacts early language skills? Effects of social disparities and different process characteristics of the home learning environment in the first 2 years. *Frontiers in Psychology*, 11, 557751. <https://doi.org/10.3389/fpsyg.2020.557751>
- Baillargeon, R., Setoh, P., Sloane, S., Jin, K., & Bian, L. (2014). Infant social cognition: Psychological and sociomoral reasoning. In M. S. Gazzaniga & G. R. Mangun (Eds.), *The cognitive neurosciences* (pp. 5–14). MIT Press. <https://doi.org/10.7551/mitpress/9504.003.0005>
- Blossfeld, H.-P., & Roßbach, H.-G. (2019). *Education as a lifelong process: The German National Educational Panel Study (NEPS)*. Springer VS. <https://doi.org/10.1007/978-3-658-23162-0>
- Bornstein, M. H., Jager, J., & Putnick, D. L. (2013). Sampling in developmental science: Situations, shortcomings, solutions, and standards. *Developmental Review*, 33(4), 357–370. <https://doi.org/10.1016/j.dr.2013.08.003>
- Bradley, R. H., & Corwyn, R. F. (2002). Socioeconomic status and child development. *Annual Review of Psychology*, 53(1), 371–399. <https://doi.org/10.1146/annurev.psych.53.100901.135233>
- Byers-Heinlein, K., Bergmann, C., & Savalei, V. (2022). Six solutions for more reliable infant research. *Infant and Child Development*, 31(5), e2296. <https://doi.org/10.1002/icd.2296>
- Clearfield, M. W., & Jedd, K. E. (2013). The effects of socio-economic status on infant attention. *Infant and Child Development*, 22(1), 53–67. <https://doi.org/10.1002/icd.1770>
- Colombo, J., Mitchell, D. W., & Zieber, N. (2020). Visual habituation and response to novelty in infancy. In J. B. Benson (Ed.), *Encyclopedia of infant and early childhood development* (pp. 428–434). Elsevier. <https://doi.org/10.1016/B978-0-12-809324-5.21819-1>
- Conger, R. D., & Donnellan, M. B. (2007). An interactionist perspective on the socio-economic context of human development. *Annual Review of Psychology*, 58(1), 175–199. <https://doi.org/10.1146/annurev.psych.58.110405.085551>
- Duncan, G. J., Magnuson, K., & Votruba-Drzal, E. (2015). Children and socioeconomic status. In M. H. Bornstein, T. Leventhal, & R. M. Lerner (Eds.), *Handbook of child psychology and developmental science. Volume 4: Ecological settings and processes* (pp. 534–573). John Wiley & Sons. <https://doi.org/10.1002/9781118963418.childpsy414>
- Fennell, C. T. (2012). Habituation procedures. In E. Hoff (Ed.), *Research methods in child language: A practical guide* (pp. 3–16). Wiley-Blackwell.
- Ganzeboom, H. B. G., De Graaf, P. M., & Treiman, D. J. (1992). A standard international socio-economic index of occupational status. *Social Science Research*, 21(1), 1–56. [https://doi.org/10.1016/0049-089X\(92\)90017-B](https://doi.org/10.1016/0049-089X(92)90017-B)
- Geraci, A., & Surian, L. (2023). Intention-based evaluations of distributive actions by 4-month-olds. *Infant Behavior and Development*, 70, 101797. <https://doi.org/10.1016/j.infbeh.2022.101797>

- Hachul, C., Attig, M., Lorenz, J., Weinert, S., Schneider, T., & Roßbach, H.-G. (2019). From birth to early child care: The newborn cohort study of the national educational panel study. In H.-P. Blossfeld & H.-G. Roßbach (Eds.), *Education as a lifelong process: The German National Educational Panel Study (NEPS)* (pp. 195–214). Springer VS. https://doi.org/10.1007/978-3-658-23162-0_11
- Hackman, D. A., & Farah, M. J. (2009). Socioeconomic status and the developing brain. *Trends in Cognitive Sciences*, 13(2), 65–73. <https://doi.org/10.1016/j.tics.2008.11.003>
- Halle, T., Forry, N., Hair, E., Perper, K., Wandner, L., Wessel, J., & Vick, J. (2009). *Disparities in early learning and development: Lessons from the Early Childhood Longitudinal Study—Birth Cohort (ECLS-B)*. Child Trends.
- Hurt, H., & Betancourt, L. M. (2016). Effect of socioeconomic status disparity on child language and neural outcome: How early is early? *Pediatric Research*, 79(1), 148–158. <https://doi.org/10.1038/pr.2015.202>
- Kavšek, M. (2004). Predicting later IQ from infant visual habituation and dishabituation: A meta-analysis. *Journal of Applied Developmental Psychology*, 25(3), 369–393. <https://doi.org/10.1016/j.appdev.2004.04.006>
- Kavšek, M. (2013). The comparator model of infant visual habituation and dishabituation: Recent insights. *Developmental Psychobiology*, 55(8), 793–808. <https://doi.org/10.1002/dev.21081>
- Kavšek, M., & Bornstein, M. H. (2010). Visual habituation and dishabituation in preterm infants: A review and meta-analysis. *Research in Developmental Disabilities*, 31(5), 951–975. <https://doi.org/10.1016/j.ridd.2010.04.016>
- Lee, T., & Shi, D. (2021). A comparison of full information likelihood and multiple imputation in structural equation modeling with missing data. *Psychological Methods*, 26(4), 466–485. <https://doi.org/10.1037/met0000381>
- Mayes, L. C., & Bornstein, M. H. (1995). Infant information-processing performance and maternal education. *Early Development and Parenting*, 4(2), 91–96. <https://doi.org/10.1002/edp.2430040206>
- McCall, R. B. (1972). Habituation and the response to discrepancy: Implications for memory, retrieval, and processing perceptual information. *Paper presented at the Annual Meeting of the American Psychological Association*, Honolulu, September 4–8.
- Mollborn, S., Lawrence, E., James-Hawkins, L., & Fomby, P. (2014). When do socioeconomic resources matter most in early childhood? *Advances in Life Course Research*, 20, 56–59. <https://doi.org/10.1016/j.alcr.2014.03.001>
- Neckerman, K. M., & Torche, F. (2007). Inequality: Causes and consequences. *Annual Review of Sociology*, 33(1), 335–357. <https://doi.org/10.1146/annurev.soc.33.040406.131755>
- Oakes, L. M. (2017). Sample size, statistical power, and false conclusions in infant looking-time research. *Infancy*, 22(4), 436–469. <https://doi.org/10.1111/inf.12186>
- OECD. (2013). *OECD framework for statistics on the distribution of household income, consumption and wealth*. OECD Publishing. <https://doi.org/10.1787/9789264194830-en>
- Seitz, M., Attig, M., Möwisch, D., & Weinert, S. (2023). *Visual habituation-dishabituation tasks in NEPS starting Cohort 1: Approaches to interpreting the data*. NEPS survey paper No. 102. Leibniz Institute for Educational Trajectories. <https://doi.org/10.5157/NEPS:SP102:2.0>

- Skopek, J., & Passaretta, G. (2021). Socioeconomic inequality in children's achievement from infancy to adolescence: The case of Germany. *Social Forces*, 100(1), 86–112. <https://doi.org/10.1093/sf/soaa093>
- Smith, E. A., Borgerhoff Mulder, M., Bowles, S., & Hill, K. (2011). Wealth inequality in foraging, horticultural, pastoral, and agricultural populations. *Current Anthropology*, 52(4), 579–580. <https://doi.org/10.1086/660846>
- Smith, L., Fagan, J. F., & Ulvund, S. E. (2002). The relation of recognition memory in infancy and parental socioeconomic status to later intellectual competence. *Intelligence*, 30(3), 247–259. [https://doi.org/10.1016/S0160-2896\(01\)00099-X](https://doi.org/10.1016/S0160-2896(01)00099-X)
- StataCorp LLC. (2021). *Stata statistical software (Release 17) [Software]*. StataCorp LLC.
- Weinert, S., Attig, M., & Roßbach, H.-G. (2017). The emergence of social disparities—evidence on early mother-child interaction and infant development from the German National Educational Panel Study (NEPS). In H.-P. Blossfeld, N. Kulic, J. Skopek, & M. Triventi (Eds.), *Childcare, early education and social inequality* (pp. 89–108). Edward Elgar Publishing. <https://doi.org/10.4337/9781786432094.00014>
- Weinert, S., & Ebert, S. (2024). Developmental dynamics and social disparities in early education-related child development: Results from the BiKS-3-18 study. In S. Weinert, H.-G. Rossbach, J. von Maurice, H.-P. Blossfeld, & C. Artelt (Eds.), *Educational processes, decisions, and the development of competencies from early preschool age to adolescence: Findings from the BiKS cohort panel studies* (pp. 91–129). Springer. https://doi.org/10.1007/978-3-658-43414-4_4
- Weinert, S., Linberg, A., Attig, M., Freund, J.-D., & Linberg, T. (2016). Analyzing early child development, influential conditions, and future impacts: Prospects of a German newborn cohort study. *International Journal of Child Care and Education Policy*, 10(1), 1–20. <https://doi.org/10.1186/s40723-016-0022-6>
- Young, D. S., & Hunter, D. R. (2015). Random effects regression mixtures for analyzing infant habituation. *Journal of Applied Statistics*, 42(7), 1421–1441. <https://doi.org/10.1080/02664763.2014.1000272>