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Nature and Parental Well-Being: The Relation of Outdoor Visits with Young Children and Affective State, Parental Self-Efficacy, and Parental Stress.

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Nature and Parental Well-Being: The Relation of Outdoor Visits with Young Children and Affective State, Parental Self-Efficacy, and Parental Stress.

Abstract

Prior research showed that time spent outdoors, and nature contact in particular, can enhance well-being, but the specific target group of parents with young children has been less explored. This pre-registered study investigated potential benefits of time spent outdoors (vs. indoors and in means of transport) and nature contact with young children for parental emotions (affective state, parental stress) and parental self-efficacy (PSE). A short version of the Day Reconstruction Method (DRM) was used in late spring to midsummer 2024 with $N = 150$ parents ($n = 149$ mothers, mainly in parental leave) of children under three years to investigate four consecutive episodes ($n = 596$) the previous day. Results revealed that net affect was more positive and self-reported parental stress lower during outdoor episodes with their child and in locations perceived as more natural. PSE was higher during outdoor episodes, but unrelated to naturalness. Child's behavior (as perceived by the parent) partially mediated the positive relationships between being outdoors/naturalness and net affect, and fully mediated the associations with PSE and parental stress. No positive spill-over effects of being outdoors in episode 2 were found for outcomes in the subsequent episodes. However, exploratory analysis revealed that a higher percentage of episodes outdoors predicted better overall mood. Findings suggest that being outside in nature can benefit parents 'at home' with young children both by directly improving their own well-being and helping to make the child's behavior more manageable. Results imply that encouraging and facilitating access to nature for parents of young children, particularly during parental leave, may be worthwhile.

Introduction

Exposure to natural environments and mental well-being

Benefits of natural spaces have long been studied with growing interest and there is now ample evidence indicating that green space exposure is linked to enhanced mental well-being and health (Twohig-Bennett & Jones, 2018; Zhang et al., 2020). Two prominent theories explaining beneficial effect of nature contact for mental well-being are the Stress Reduction Theory (Ulrich et al., 1991) and the Attention Restoration Theory (Kaplan & Kaplan, 1989). Also, the theory of nature-based biopsychosocial resilience provides valuable insights, emphasizing the role of resilience and coping mechanisms fostered by nature contact (White et al., 2023). While they focus on different processes, they are interrelated and all contribute to explaining nature's beneficial effects (Berto, 2014; Kondo, Triguero-Mas, et al., 2020; White et al., 2023).

Meta-analytical studies and reviews have found that green space and outdoor exposure are linked to reduced stress (Kondo et al., 2018; Yao et al., 2021), enhanced mood (Kondo et al., 2018), restoration (Berto, 2014), and self-efficacy (B.-B. Fang et al., 2021). Evidence suggests that exposure to natural environments influences both positive and negative affect, with a stronger association with enhanced positive affect (Berto, 2014; McMahan & Estes, 2015). Using ecological momentary assessment (EMA) this was observed on a daily basis too, though the decrease in negative affect was non-significant (Kondo, Oyekanmi, et al., 2020). A Day Reconstruction Method (DRM) study during COVID-19 lock-down, assessing within-day fluctuations of well-being, also showed that spending time outdoors / in natural spaces predicted better affective state, with a stronger effect on positive than negative affect (Lades et al., 2020). Another DRM study reported outdoor activities as the most pleasurable (White & Dolan, 2009), which might explain the observed effects. Positive and negative affect, alongside life satisfaction, constitute emotional well-being (Langeland, 2020).

Contact with natural environments has been operationalized in various ways, from objective measures to subjective reports (Frumkin et al., 2017). These environments encompass a range of blue and green spaces, including for example urban parks, forests, rivers, and coastal areas (White et al., 2020). Operationalization is crucial, Triguero-Mas et al. (2017) for example, observed that residential natural outdoor environments (NOE) did not significantly predict mental health, whereas direct NOE contact was related to reduced somatization, enhanced psychological well-being, vitality, and partly sleep quality, mediated by perceived stress. Further, the positive impact of environmental characteristics such as (perceived) naturalness and biodiversity on the associations between nature contact and well-being have been shown in diverse studies (Reyes-Riveros et al., 2021). These effects may be mediated by the perceived restorativeness of an environment (Marselle et al., 2016),

and also showed moderating effects, for example mitigating negative impacts of stressful life events (Berto, 2014; Frumkin et al., 2017). Perceived naturalness thus appears to be an important factor and may be associated with the type of exposure and environment.

Research has predominantly focused on the general population and some specific target groups, such as children, adolescents or disadvantaged persons (Rigolon et al., 2021), while benefits of nature for parents' well-being remain underexplored. Studies on children have consistently revealed positive associations with psychological well-being (B.-B. Fang et al., 2021; Liu & Green, 2023). For example, higher nature exposure predicting higher self-regulation in kindergarten girls (but not boys) (Taylor & Butts-Wilmsmeyer, 2020), and reduced inattention and hyperactivity symptoms in young children (Ulset et al., 2017). These benefits, especially regarding behavioral aspects, might also mediate positive effects of outdoor time for parental well-being.

Parental well-being

Like the benefits of nature, parental well-being has garnered considerable academic interest for decades (McLanahan & Adams, 1987; Nelson et al., 2014; Nomaguchi & Milkie, 2020), though only to a limited extent in combination (Hall et al., 2023; Peters et al., 2022; Peters et al., 2021; Razani et al., 2018). While there is no uniform definition of parental well-being, in recent decades it has mainly been theorized within the framework of the demands-rewards perspective, the life course perspective or Pearlin's (1989) stress-process model (Nomaguchi & Milkie, 2020). Nelson et al. (2014) proposed a comprehensive model on parents' well-being, encompassing a variety of parenting-specific aspects like parental satisfaction and parental self-efficacy (PSE) and indicators of general well-being, such as life satisfaction, stress, and depressive symptoms. The model also incorporates mediators (e.g., positive and negative emotions), and moderators (e.g., child age). Nature exposure has been found to benefit many of these aspects, but not explicitly focusing on parents.

Psychological stress, for example, is a central part for understanding well-being in parents and parental stress arises when the childcare demands exceed a parent's resources (Nelson et al., 2014; Nomaguchi & Milkie, 2020). Higher stress in parents has a number of adverse associations, like increased fatigue (Dunning & Giallo, 2012), general stress and anxiety (Albanese et al., 2019; Skreden et al., 2012), child stress (Razani et al., 2019), reduced parenting satisfaction and PSE (Albanese et al., 2019; Dunning & Giallo, 2012; Y. Fang et al., 2021). Even though directionality is less clear, perceived stress in parents is a key determinant for parental well-being. Regarding benefits of nature, extensive research has demonstrated general stress-reducing effects (Kondo et al., 2018; Yao et al., 2021).

Considering positive and negative affect as components of parents' well-being enables the assessment of within-day changes in well-being. Sevón et al. (2014), for instance, observed that families with harmonious weeks differed from those with disharmonious weeks primarily in the frequency of positive and negative moments. DRM studies (Kahneman et al., 2004; Krueger & Schkade, 2008) found discrepancies in affective ratings of childcare activities and child interactions. While affect during childcare was rated relatively low compared to other activities, interactions with one's own child were rated more positively than interactions with others. Exploring additional factors, such as the influence of nature contact, could yield new insights into this relationship.

PSE, another key concept regarding parents' well-being, has been associated with diverse mental health outcomes, the parent-child relationship, and even child development (Albanese et al., 2019). For instance, higher PSE is linked to reduced psychological distress and depression, and higher parenting satisfaction. The directionality is less clear and may even be bidirectional (Albanese et al., 2019; Y. Fang et al., 2021). However, the nature-based biopsychosocial resilience theory, drawing on previous research, suggests that nature contact can improve coping appraisals, such as self-efficacy, which in turn improve the ability to manage stressors (White et al., 2023). While within-day fluctuations in PSE have not been studied yet, Kahneman et al.'s (2004) DRM findings on perceived competence suggest potential variations. Although most studies on nature exposure and self-efficacy focused on outdoor intervention programs (B.-B. Fang et al., 2021; Kang et al., 2021), even brief encounters with nature may enhance perceived (parental) self-efficacy (Hall et al., 2023; Kahneman et al., 2004). Taken together, these findings highlight the broad relevance of PSE and suggest that it may be influenced by environment and assessable on day level.

Despite limited research on nature exposure and parental well-being, some key elements (affect, parental stress, PSE) can be identified that, although specific to the parental role, align with broader well-being constructs. This suggests that exposure to natural outdoor environments may enhance parental well-being in ways similar to its effects on general well-being. The following section reviews the yet limited evidence on the specific well-being benefits of nature visits for parents.

Nature contact and parental well-being, stress, and self-efficacy

A recent focus group study (Hall et al., 2023) on postnatal well-being of mothers revealed that the home indoor environment and pending tasks can feel oppressive with young children. Outdoors visits may offer an escape from home stresses and the permanent targeted attention, as nature offers multisensory experiences and opportunities for positive interactions, promoting well-being and sleep quality and a sense of self-efficacy (Hall et al., 2023). Professionals in women's

shelters echo these sentiments, emphasizing nature's role in alleviating stress, fostering problem solving, and offering the potential to experience parenting competence (Peters et al., 2022; Peters et al., 2021). Also, some studies observed improved parent-child interactions (Cameron-Faulkner et al., 2018; Izenstark et al., 2021). Park prescriptions for low-income parents have been shown to increase park visits and reduce stress levels, underscoring the benefits of nature exposure for parental well-being. Interestingly, supported prescriptions, which included group nature outings and reminders, did not result in greater well-being improvements than independent prescriptions. In fact, the independent group visited parks more frequently, suggesting that providing basic information on nearby parks and the natures' benefits can encourage outdoor time and improve well-being as effectively as offering more intensive support (Razani et al., 2018). These results underscore the relevance of regular nature encounters for parents and for the parent-child relationship.

Research questions and hypotheses

Based on these findings, we were interested in investigating the relationship between spending time outdoors and parental well-being on a fine-grained level, utilizing the Day Reconstruction Method (DRM). Focusing on three relevant indicators for the well-being of parents, namely net affect, parental self-efficacy (PSE), and parental stress we aimed at assessing established state variables, and variables specific for parenthood. Further, we wanted to shed light on the relation of naturalness of the environment and parental well-being as well as on the potential mediating role of the behavior of the child. As we decided for an observational study design, directionality cannot be tested, but using a longitudinal design, we could assess potential spill-over effects on the time after being outdoors. We narrowed down parents of young children under three years to focus on parents with high childcare responsibilities. The age of three corresponds to the standard duration of eight weeks maternity protection (MSchG, 1979/10.02.2024) plus the maximum duration of 1063 days parental leave (Arbeitsmarktservice [AMS], 2023) in Austria. This led to the following research questions and hypothesis:

Q1 Is spending time with one's own child in natural outdoor spaces associated with enhanced parental well-being with children under three years? (Episode level) We narrowed down the question on the following hypotheses: H1 a-c) Subjectively perceived, net-affect and PSE is higher, and parental stress is lower during times spent outdoors with one's youngest child than in other settings, H2 a-c) These relations are mediated by the extent to which the child's behavior during the episode is perceived as exhausting by the parent, with the child's behavior being perceived as less exhausting in outdoor episodes, net-affect and PSE being higher, and parental stress being lower if the child's behavior is perceived less exhausting, H3 a-c) Higher subjectively

perceived net-affect, PSE, and lower subjectively perceived parental stress during times spent outdoors with one's youngest child is predicted by a higher perceived naturalness of the environment, and H4 a-c) These relations are mediated by the extent to which the child's behavior during the episode is perceived as exhausting by the parent, with the child's behavior being perceived as less exhausting for if the environment is perceived as more natural, net-affect and PSE being higher, and parental stress being lower if the child's behavior is perceived less exhausting.

Q2 Are the beneficial effects of time spent in outdoor environments still observable one and two episodes after the outdoor visit? With the hypotheses H5 a-c) Net-affect and PSE are higher, and parental stress is lower in the post-index episode than in the pre-index episode if the episode was spent outdoors, but not, if the episode was spent in another setting.

As additional exploratory research question Q3, we investigated if overall mood is better if parents spent more episodes outdoors with the youngest child (Day Level) with the hypothesis EH1) Better overall mood on the reported day is predicted by a higher percentage of outdoor episodes with their youngest child.

Methods

Procedure

Data was collected from May 20th – July 7th, 2024, using the online survey tool Qualtrics (<https://www.qualtrics.com>), with minor changes in wordings after four days. The survey was administered in German. An adapted and shortened version of the Day Reconstruction Method (DRM) was applied with an estimated duration of 30 minutes. The DRM is a technique to collect fine-grained data of the previous day with focus on affective states, reducing recall-bias by asking participants to reconstruct the day in a series of episodes.

Participants first rated their life satisfaction and provided some demographic information, followed by general questions about their previous day. They then should reconstruct their previous day in detail, giving the option to make notes to aid recall. Following, participants reported the total number of identified episodes, of those spent with the youngest child and those primarily spent outdoors with the youngest child. The participants were randomly asked about one of the outdoor episodes with their youngest child, along with the preceding episode and two subsequent ones. They were asked to give the episodes a title, specify the start and end times and think about how they felt during these episodes. If no outdoor episodes were reported, a random episode with the youngest child was drawn instead. Some restrictions were made to increase the chances that participants did not have to report on nighttime-episodes. Detailed questions were then asked

about each of the four episodes (see Measures), with an option to additionally provide open comments for each episode. The survey concluded with additional demographic questions, queries about the previous day, and the opportunity to enter a lottery for one of five gift cards. The analysis plan for the project was preregistered (AsPredicted#181414).

Sample

Participants were recruited all over Austria via print and digital flyers placed at pediatricians, kindergartens, shops, pharmacies, parent counselling centers and via personal contacts, who acted as multipliers. A total of 273 survey starts were registered, of which 37 did not meet the initial inclusion criteria and 86 were excluded, primarily due to cancellation (see Appendix A.1 Overview of data collection and pre-processing). Three additional cases (extreme outliers) were retained after a detailed review confirmed their validity. Exclusion rates were higher among participants from urban areas, and those with primary or secondary education. Also, males were more likely to be excluded, mainly due to not identifying as primary caregivers. Otherwise, demographic differences between excluded and valid cases were small.

The final sample of $N = 150$ consisted mainly of female participants ($n = 149$, 99.3%) with tertiary education ($n = 101$, 67.3%), and a mean age of 33.8 years ($SD = 4.2$, range 23-47). At the time of the survey, the majority was on parental (part-time) leave ($n = 104$, 69.3%) with only 10 participants (6.9%) working > 20 hours/week. They had an average of 1.6 children ($SD = 0.8$) and only five (3.3%) participants reported being a single parent. 78 (52%) of the youngest children were male, with a mean age of 14.9 months ($SD = 9.2$). All federal states were represented in the sample except from Carinthia. The majority lived in Lower Austria ($n = 62$, 41.3%), followed by Upper Austria ($n = 32$, 21.3%), Vienna ($n = 28$, 18.7%), and Vorarlberg ($n = 10$, 6.7%). Most participants rated the region where they live as rural ($n = 102$, 68%).

Most participants filled out the survey on a Thursday ($n = 44$, 29.3%) or a Tuesday ($n = 34$, 22.7%) and reported yesterday to be a relatively typical day for this weekday ($n = 122$, 81.3%). The lowest participation was on weekends ($n = 11$, 7.3%). On the reported day, the participants got up at 6:30 am ($SD = 1$ hour) and went to bed at 10:30 pm ($SD = 1$ hour). They identified 8.6 episodes on average ($SD = 4.1$), of which they spent 7.3 episodes ($SD = 3.6$) with their youngest child, and 2.6 episodes ($SD = 1.9$) mainly outdoors with the youngest child.¹ Only nine participants (6%) did not spend any episode outdoors with their child. In total, reports on 596 episodes were collected of which 585 episodes have no missing answers. In three cases, values for outcome variables of single

¹ For total episodes, participants could choose "<5 episodes", 5-20 episodes in single steps, and "> 20 episodes". 17 participants chose either <5 or >20 episodes. For episodes with the youngest child 0-19 episodes stepwise or ">=20 episodes and for episodes outdoors 0-9 stepwise or ">=10 episodes" (2 participants each).

episodes were excluded because the participants were either sleeping or the episodes were not named. The mean duration of an episode was 90.5 minutes ($SD = 76.0$) with a median of 60 minutes (range 5-660). The first reported episode started at 11:20 ($SD = 3.3$ hours, range 4:00 – 18:00) and the last episode ended at 17:40 ($SD = 3.8$ hours, range 8:50 on the same day – 9:00 on the next day). Although participants were instructed to report on subsequent episodes, gaps between episodes were often left unaccounted for, and in four cases, episodes overlapped. This may be due to the open-ended answer format. The average gap duration was seven minutes ($SD = 24$) with a median gap duration of 0.

Measures

Given the specific target group, study design, and concepts of interest, new scales were developed to measure the main outcome variables (affective state, PSE, parental stress). The items focus on the participant's subjective perception and are oriented on existing scales. The item list is provided in Appendix A.2 Item wordings.

Affective state

Net-affect was assessed by three positive affective states (good, contented, happy) and three negative affective states (bad, sad, anxious). The items were selected, to include one broad state, one high arousal, and one low arousal item for each valence. Participants had to rate on a 7-point Likert scale how much each item applied during the episode. The negative items were then reversed to create a single score for net affect. Cronbach's alpha ranged from 0.80 (episode 2) to 0.83 (episode 3).

Parental self-efficacy

PSE was assessed by three items regarding how competent participants felt in their role as a parent, how well they could sense what their youngest child needed and if they had a positive influence on their youngest child's behavior and feelings, for example "During this episode I felt competent in my role as a parent." Participants had to rate on a 7-point Likert scale how much each item applied during the episode. Cronbach's alpha ranged from 0.68 (episode 1) to 0.79 (episodes 2 & 4).

Parental stress

Parental stress was assessed by three items targeting, how much energy it took looking after the youngest child, how nervous/stressed the participant felt by looking after the youngest child, and how strenuous it was to coordinate caring for the youngest child with other obligations, for example "During this episode looking after my youngest child took a lot of energy." Again,

participants had to rate on a 7-point Likert scale how much each item applied during the episode. Cronbach's alpha ranged from 0.71 (episode 1) to 0.87 (episode 4).

Perceived child's behavior

On a 7-point scale, the behavior of the youngest child during an episode was assessed by the item "During this episode the behavior of my youngest child's was exhausting."

Additional items

Episode level. On episode level, participants could choose between 22 activities and eight interaction partners in a multiple-choice format. Further, they had to select the main setting of the episode, they could choose between outdoor, indoor, and means of transport. Based this answer, they could choose between 5-10 specific environments, like "in my private garden", "in a public building", or "public transport". Further, if the episode was primarily spent outdoors, they had to rate, how natural they found the place they mainly where in during the episode on a 7-point scale (not at all – completely).

Day level. On a 7-point scale from "very bad" to "very good" participants rated their overall mood yesterday, how they perceived the weather, and how accessible green spaces that meet their needs are.

Analysis Strategy

For testing the hypothesis, several analyses were conducted using R version 4.4.1 (R Core Team, 2024). Focus was on multilevel models (MLM) (H1, H2, H5) to account for the repeated measurements per person, mainly using the *nlme* package 3.1-164 (Pinheiro et al., 2023). Before running MLM analysis, the intraclass correlation (ICC) of empty random intercept models were calculated for each outcome variable to verify if MLM are indicated. Subsequently, different models were tested stepwise against each other using ANOVA: 1) an empty null model, 2) an empty null model with random intercept, 3) a covariate model with random intercept, 4) a predictor model with random intercept, 5) a predictor model with random intercept and a random slope for the setting (outdoor vs. other). For H2, a sixth model, including the potential mediator perceived child's behavior was added. Maximum-Likelihood estimation was used and by default the "nlminb" optimizer was applied. If a model showed convergence-issues, the "optim" optimizer was used instead.

Additionally, dependent t-tests were used to assess H1 and multiple regressions for H3 and EH1 using the *stats* package 4.4.1 (R Core Team, 2024). Planned independent t-tests for H1 were skipped due to few participants having spent no episode outdoors.

For basic mediation analysis (H4), a stepwise approach was applied (Baron & Kenny, 1986) and the *mediation* package 4.5.0 (Tingley et al., 2014) was used. For multilevel mediation analysis (H2), the *multilevelmediation* package 0.3.1 (Falk et al., 2024), utilizing the approach of Bauer et al. (2006), where both MLM models (predictor → mediator, and predictor + mediator → outcome) are included in a single equation.

Assumptions for all types of analysis were checked. Due to slight issues regarding normal distribution of residuals and homoscedasticity, percentile bootstrap confidence intervals were interpreted for simple and MLM regression models to determine significance, and bias-corrected and accelerated bootstrap confidence intervals for mediation analysis. For the MLM mediation, 1000 bootstrap samples were simulated, for all other analysis 2000 bootstrap samples were simulated. For all MLM, significant correlations of Level-1 residuals with the random effects were found, suggesting potential violations of the independence assumption. Despite exploring various model specifications and adding potential predictors, the correlations persisted.

Episodes with no interaction with the youngest child ($n_{\text{episodes}} = 64$, 12%) were excluded from hypothesis testing to focus on relevant episodes and reduce noise. This step was not preregistered. Two further adaptations were made: education level was dichotomized (tertiary = 1 versus lower education = 0) due to low frequencies in the lower education groups, and the gender was excluded as a covariate due to the sample containing only one male participant.

Results

Episode Characteristics

The most frequently reported activity was "caring for my children" ($n = 300$, 50.4%). On average, participants reported 2.6 activities ($SD = 1.64$) per episode. The youngest child was the primary interaction partner ($n = 532$, 89.3%), likely due to the study design. In 36.1% of episodes ($n = 215$), participants interacted with their other children, which accounts to 71.7% of episodes among participants with more than one child. On average, there were two interaction partners ($SD = 0.9$) per episode. Most episodes were spent indoors, with 11.6% of episodes ($n = 69$) involving other settings (outdoor, indoor, means of transport). On average, participants selected 1.2 ($SD = 0.6$) specific environments per episode. Episodes 1, 3, and 4 were predominantly indoors (75.8% - 78%), while episode 2 was mainly outdoors ($n = 130$, 86.7%)². Activities varied by setting: The most common outdoor activities were "playing with my children" ($n = 103$, 56.9%), "taking a walk" ($n = 59$, 32.6%) and "caring for my children" ($n = 58$, 32%), indoor activities were mainly "caring for my

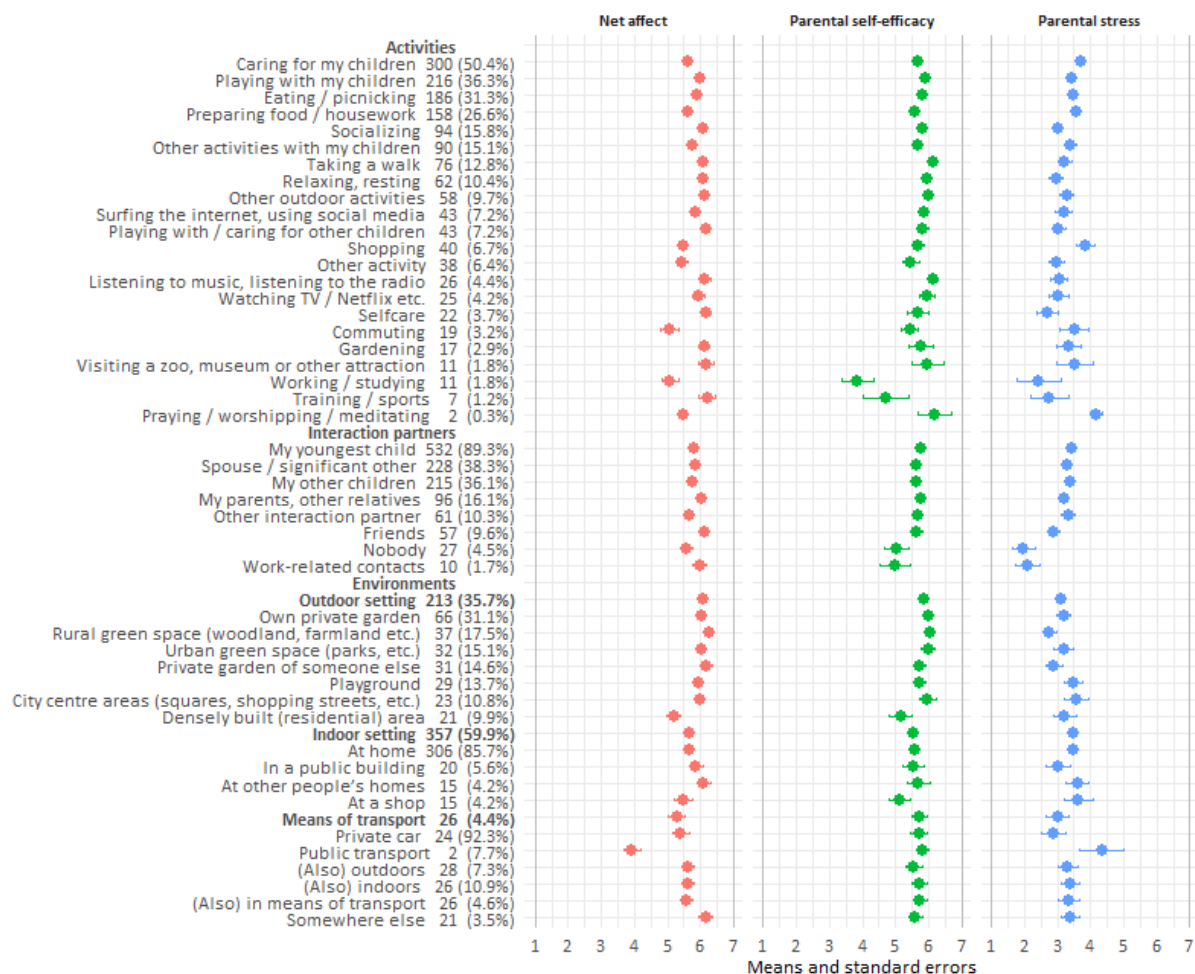
² Note that 11 participants did not follow instructions, because they reported being mainly indoors in episode 2, even though they spent at least one episode outdoor with their youngest child.

children" ($n = 205$, 63.1%), followed by "preparing food / housework" ($n = 125$, 38.5%) and "eating / picnicking" ($n = 122$, 37.5%). The most common activity in means of transport unsurprisingly was "commuting" ($n = 7$, 36.8%).

Detailed frequencies of specific activities, interaction partners, and environments, as well as the means and standard errors of net affect, PSE, and parental stress can be found in Figure 1.

Figure 1

Frequencies of Responses and Dot Plot of Net-Affect, Parental Self-Efficacy, and Parental Stress by Activity, Interaction Partner, and Environment (Means and Standard Errors).



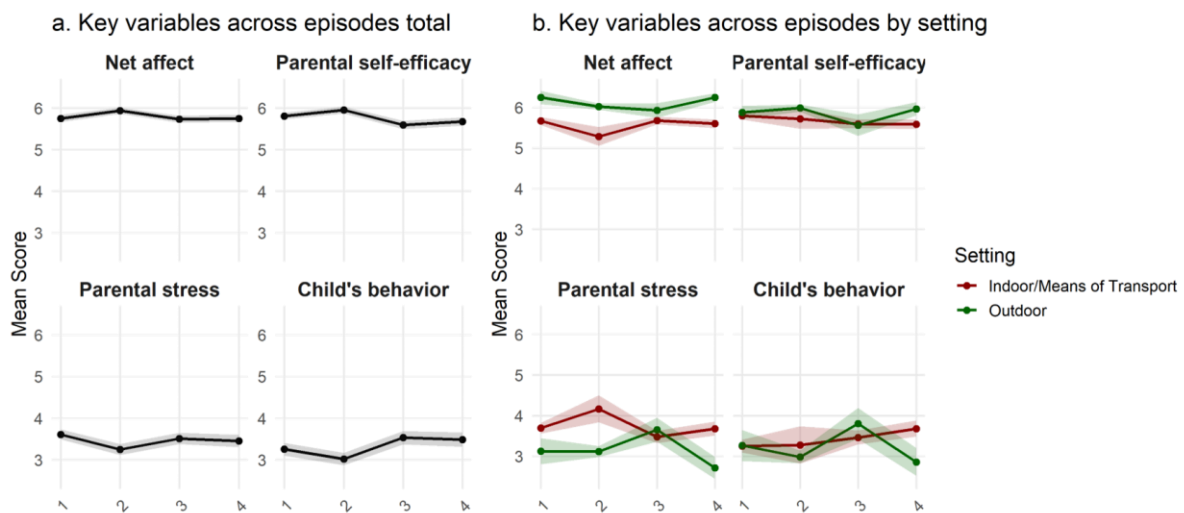
Note: For each variable category (activities, interaction partners, environments) there were max. five missing responses. Only the specific environments that fit the selected broad setting were presented to the participants.

Mean net affect over all episodes and settings was 5.79 ($n = 592$, $SD = 0.95$, range: 1.17 – 7, $skew = -1.14$, $kurt = 2.12$), mean PSE 5.67 ($n = 585$, $SD = 1.15$, range: 1-7, $skew = -1.04$, $kurt = 0.97$), and mean parental stress 3.32 ($n = 586$, $SD = 1.59$, range: 1-7, $skew = 0.21$, $kurt = -0.92$) and mean perceived child's behavior 3.2 ($n = 585$, $SD = 1.85$, range: 1-7, $skew = 0.35$, $kurt = -1$). Figure 2 additionally shows the changes in these key variables over the four episodes a) in total and b) contrasted by the setting. Mean perceived naturalness of outdoor environments was 4.54 ($n = 211$,

$SD = 1.69$, range: 1-7, $skew = -0.38$, $kurt = -0.64$), with the highest values for rural green spaces ($M = 5.54$) and playgrounds ($M = 5.31$), and lowest values for city center areas ($M = 3.61$) and densely built (residential) areas ($M = 3.33$). In episodes where the youngest child was interacted with, correlations between the predictors (being outdoors, naturalness) and the main outcome variables (net affect, PSE, parental stress) were significant but small in effect (Cohen, 1977/2013). The main outcome variables themselves showed medium-sized correlations with each other. The mediator, child's behavior, strongly correlated with parental stress, moderately with net affect and PSE, but weakly with being outdoors and naturalness, with the latter showing a non-significant correlation. After adjusting for multiple testing, all correlations with naturalness, except for net affect, became insignificant (see Table 1).

Figure 2

Mean Scores (and Standard Errors) in the Key Variables Over the Four Episodes.



Note: Only episodes where participants reported an interaction with their youngest child are included in these plots. Higher values in child's behavior mean that the behavior of the child was perceived as more exhausting.

Table 1

Pearson Product Moment Correlations Between the Key Variables

Variables	Being outdoors	Naturalness	Net Affect	Parental Self-Efficacy	Parental stress	Child's behavior
Being outdoors	-	-	0.22	0.12	-0.16	-0.09
Naturalness	-	-	0.22	0.15	-0.16	-0.12
Net Affect	<.001	.002	-	0.46	-0.46	-0.38
Parental Self-Efficacy	.008	.037	<.001	-	-0.36	-0.36
Parental stress	<.001	.025	<.001	<.001	-	0.73
Child's behavior	.036	.082	<.001	<.001	<.001	-

Note: ns = not significant at $\alpha < .05$, bold = significant at $\alpha = .05$ with bonferroni correction for multiple testing (5). $N = 199/200$ episodes for bivariate correlations with naturalness, N of all others range from 526 to 532, no correction for multiple responses per person was made for this analysis. Only episodes where participants reported an interaction with their youngest child are included.

Well-being and being outdoors

Supporting hypotheses 1a-c, dependent t-tests comparing outdoor vs. other settings revealed significant differences in net affect [$t(119) = 4.81, p < .001$], PSE [$t(117) = 4.88, p < 0.001$], and parental stress [$t(117) = -5.47, p < .001$]. During outdoor episodes with the youngest child, net affect 0.39 points better ($d = 0.44$), PSE 0.38 points higher ($d = 0.45$), and parental stress 0.67 points lower ($d = -0.50$) than in other settings. Intra-class-correlations ($ICC_{\text{net affect}} = 0.35$, $ICC_{\text{PSE}} = 0.43$, and $ICC_{\text{parental stress}} = 0.42$) and significant ANOVA further indicated that MLM would add value to the analysis. Including being outdoors as a predictor significantly improved the MLM with only covariates (with random intercept), but adding additional random slopes for being outdoors did not outperform the random intercept models. Nonetheless, the latter were interpreted. Results of the stepwise model comparisons are detailed in Appendix A.3 Model building Hypothesis 1 & 2.

The MLM results further reinforced support for hypotheses 1a-c, showing that outdoor episodes predicted higher net affect ($b = 0.40 [0.22, 0.59]$) and PSE ($b = 0.28 [0.06, 0.51]$) and lower parental stress ($b = -0.54 [-0.87, -0.22]$), accounting for the hierarchical data structure. Net affect, PSE, and parental stress during the previous episode were highly significant predictors for the respective outcomes, while other covariates were only marginally significant without a consistent pattern. Detailed results are in Table 2. For PSE and parental stress, the random effects variances for the selected models were almost zero. For net affect, participants varied both in their mean net affect and in the predictive capability of being outdoors, with lower baseline net affect being associated with greater profit from being outdoors. Graphical analysis revealed lower inter-individual variance during outdoor episodes, suggesting that being outdoors both improved affect and reduced differences among participants. However, this result must be interpreted cautiously given the observational design and that the random slope model was not significantly better than the random intercept model.

Next, to test Hypotheses 2a-c, the models were expanded to examine whether the relationship between being outdoors and the outcome variables was mediated by the perceived child's behavior during an episode. First, an MLM predicting perceived child behavior was built ($ICC_{\text{behavior}} = 0.37$). As with the previous models, the random intercept model with the predictor included was preferred based on ANOVA, but we continued with the random slope + intercept model where neither random effect was substantial ($SD_{\text{random_intercept}} < 0.01$, $SD_{\text{random_slope}} < 0.01$). Being outdoors significantly predicted that the child's behavior was perceived as less exhausting ($b = -0.47 [-0.83, -0.12]$). Second, perceived child behavior was added to all models from H1a-c. This improved the models significantly (see Appendix A.3 Model building Hypothesis 1 & 2), as it was a highly significant predictor ($b_{\text{net affect}} = -0.18 [-0.22, -0.13]$, $b_{\text{pse}} = -0.24 [-0.30, -0.19]$, $b_{\text{parental stress}} = 0.62$

[0.56, 0.68]). The explained variances increased substantially from 31.5% to 43% (net affect), 25.3% to 50.1% (PSE), and 19.4% to 70.7% (parental stress).³

Table 2

Unstandardized Model Parameters and Variances of the Final Models for Net Affect, Parental Self-Efficacy, and Parental Stress

	Net affect		Parental self-efficacy		Parental stress	
	<i>b</i> (se)	Bootstrap 95% CI	<i>b</i> (se)	Bootstrap 95% CI	<i>b</i> (se)	Bootstrap 95% CI
<i>Intercept</i>	4.14 (0.58)	2.94, 5.19	2.92 (0.67)	1.68, 4.19	0.91 (0.86)	-0.80, 2.54
<i>Starting time</i>	-0.01 (0.01)	-0.04, 0.01	-0.03 (0.02)	-0.06, 0.00	0.03 (0.02)	-0.02, 0.07
<i>Previous net affect / PSE / parental stress</i>	0.31 (0.05)	0.22, 0.41	0.48 (0.05)	0.38, 0.58	0.40 (0.05)	0.30, 0.51
<i>Being outdoors</i>	0.40 (0.10)	0.22, 0.59	0.28 (0.11)	0.06, 0.51	-0.54 (0.16)	-0.87, -0.22
<i>Number of rooms</i>	-0.02 (0.03)	-0.07, 0.03	-0.02 (0.03)	-0.07, 0.04	0.09 (0.04)	0.00, 0.17
<i>Education</i>	-0.20 (0.10)	-0.40, -0.01	-0.09 (0.11)	-0.32, 0.11	0.23 (0.17)	-0.12, 0.53
<i>Age</i>	-0.00 (0.01)	-0.02, 0.02	0.00 (0.01)	-0.02, 0.03	0.01 (0.02)	-0.03, 0.05
<i>Child's age</i>	-0.00 (0.01)	-0.01, 0.01	-0.00 (0.01)	-0.01, 0.01	0.01 (0.01)	-0.01, 0.03
<i>Child's sex</i>	-0.04 (0.10)	-0.22, 0.16	0.16 (0.11)	-0.06, 0.36	-0.00 (0.16)	-0.33, 0.32
<i>Perceived weather</i>	0.05 (0.03)	-0.01, 0.11	0.02 (0.04)	-0.05, 0.09	-0.01 (0.05)	-0.12, 0.09
	<i>SD</i>	<i>95% CI</i>	<i>SD</i>	<i>95% CI</i>	<i>SD</i>	<i>95% CI</i>
<i>Random intercept*</i>	0.42	0.17, 0.57	<0.01	0.00, 0.47	0.02	0.00, 0.69
<i>Random slope for being outdoors*</i>	0.39	0.10, 0.69	0.01	0.00, 0.79	0.04	0.00, 1.06
<i>Residual*</i>	0.77	0.67, 0.82	0.94	0.81, 0.97	1.43	1.24, 1.48
	<i>r</i>	<i>95% CI</i>	<i>r</i>	<i>95% CI</i>	<i>r</i>	<i>95% CI</i>
<i>Random effects</i>	-0.98	-1.00, -0.64	-0.01	-1.00, 1.00	-0.02	-1.00, 1.00
Components of explained variance						
<i>Fixed slopes</i>	18.3%		25.3%		19.4%	
<i>Slope variation</i>	4.2%		0.0%		0.0%	
<i>Intercept variation</i>	9.0%		0.0%		0.0%	
<i>Total</i>	31.5%		25.3%		19.4%	
<i>Observations</i>	360		360		360	
<i>Groups</i>	141		141		141	

*Note: Start time in hours; age in years; child's age in months; child's sex 1 = male, 2 = female; Significant beta-estimates are printed bold. Percentile bootstrap CIs with 2000 runs. During bootstrapping, 16 models did not converge for net affect, 237 for parental self-efficacy, and 204 for stress. The variable number of rooms is not completely interval scaled, because 10 or more rooms were collected as one category (n = 5 selected that option). * Bootstrap confidence intervals cannot be negative.*

For the actual mediation analysis, variables were z-standardized, and bootstrap on the 2-level was used to generate 95% percentile CIs for significance testing. The results revealed a full mediation of being outdoors via perceived child behavior for PSE (though the c-path was marginally non-significant) and parental stress, and a partial mediation for net affect, thus supporting hypotheses 2a-c (see Table 3).

Across all analyses, spending episodes outdoors with their youngest children predicted better net affect, higher PSE, and lower parental stress, confirming Hypotheses 1a-c. Additionally,

³ Of the four reported models, the non-convergence rates of the bootstrap samples were 48 (net affect), 10 (PSE), 12 (parental stress), and 369 (child's behavior).

there may be a balancing effect of being outdoors for net affect, with participants experiencing greater improvement when their net affect was lower indoors/in means of transport. Including perceived child behavior improved the models substantially and was a very strong predictor especially for parental stress. It further mediated the positive effects of being outdoors, particularly for PSE and parental stress where a full mediation was found, thus confirming Hypothesis 2a-c.

Table 3

MLM Mediation Results With z-Standardized Variables Regarding the Relationship Between Being Outdoors and the Three Main Outcome Variables.

	Indirect effect a*b	Path a	Path b	Path c
Net affect	0.05 [0.02, 0.09]	-0.13 [-0.22, -0.04]	-0.37 [-0.49, -0.22]	0.16 [0.07, 0.26]
Parental self-efficacy	0.05 [0.01, 0.11]	-0.12 [-0.22, -0.03]	-0.45 [-0.60, -0.25]	0.08 [-0.02, 0.18]
Parental stress	-0.09 [-0.16, -0.02]	-0.12 [-0.22, -0.03]	0.73 [0.58, 0.84]	-0.07 [-0.15, 0.003]

Note: Results of the MLM mediation analysis with percentile bootstrap 95% CIs for direct paths and bias corrected and accelerated bootstrap 95% CIs for the indirect path, 1000 bootstrap samples on level 2. During bootstrapping, 19 models did not converge for net affect, 19 for parental self-efficacy, and 18 for stress. Path a: being outdoors -> perceived child's behavior, path b: perceived child's behavior -> net affect / parental self-efficacy / parental stress, path c: being outdoors -> net affect / parental self-efficacy / parental stress.

Well-being and perceived naturalness of the outdoor environment

To test hypotheses 3a-c, we focused on the 2nd episodes that were spent outdoors ($n = 124$) to investigate whether the perceived naturalness of an outdoor environment predicts net affect, PSE, and parental stress. Multiple regressions revealed mixed results. Naturalness significantly predicted better net affect ($\beta = 0.28$ [0.10, 0.47]) and lower parental stress ($\beta = -0.23$ [-0.41, -0.07]). The models showed small effect sizes (adjusted $R^2_{net\ affect} = .10$, adjusted $R^2_{pse} = .05$) (Cohen, 1977/2013), and the model for parental stress was non-significant, likely due to many insignificant covariates. Both models, however, were significantly better than models with only covariates (net affect: $F(1, 115) = 10.27$, $p = 0.002$; parental stress: $F(1, 115) = 6.65$, $p = 0.011$). Naturalness did not significantly predict higher PSE ($\beta = 0.12$ [-0.08, 0.31]) and model was not significantly better than the covariate model, $F(1, 115) = 1.66$, $p = 0.201$. Hypothesis 3 was thus confirmed for net affect and parental stress, but not for PSE. Detailed results are in Table 4.

Investigating hypotheses 4a-c, the models were expanded to test if the relationships between naturalness and the outcomes were mediated by perceived child behavior. Including naturalness as a predictor for child behavior outperformed the covariate model ($F(1, 115) = 5.06$, $p = 0.026$), and a higher level of naturalness was a marginally significant predictor for the child's behavior being perceived as less exhausting. Perceived child behavior in turn significantly predicted all three outcomes, boosting explained variance from small to medium/high effects. ANOVA confirmed the additional explained variance to be significant (net affect: $F(1, 114) = 15.94$, $p < .001$; PSE: $F(1, 114) = 16.78$, $p < .001$, parental stress: $F(1, 114) = 141.67$, $p < .001$). Detailed results of the final models are in Table 4.

The mediation analysis revealed a partial mediation for net affect via perceived child behavior, and a full mediation for parental stress. Notable, a significant full mediation was found for PSE, despite the total effect being non-significant and the same directionality for the direct and indirect effect. Consequently, these results support hypotheses 4a-c (see Table 5).

Table 4

Multiple Linear Regression Model Parameters for Net Affect, Parental Self-Efficacy, and Parental Stress

	Covariate model		Predictor model		Mediation model	
	<i>b</i> (se)	Bootstrap 95% CI	<i>b</i> (se)	Bootstrap 95% CI	<i>b</i> (se)	Bootstrap 95% CI
Net affect						
Intercept	5.33 (0.84)	3.37, 7.24	4.45 (0.85)	2.53, 6.42	4.99 (0.82)	2.92, 6.85
Naturalness			0.14 (0.05)	0.06, 0.25	0.11 (0.04)	0.02, 0.21
Child's behavior					-0.17 (0.04)	-0.25, -0.10
Rooms	-0.03 (0.04)	-0.19, 0.06	-0.02 (0.04)	-0.14, 0.07	-0.00 (0.04)	-0.12, 0.07
Education	0.04 (0.17)	-0.24, 0.36	0.08 (0.16)	-0.22, 0.39	0.11 (0.15)	-0.17, 0.41
Age	-0.01 (0.02)	-0.04, 0.04	0.00 (0.02)	-0.04, 0.04	0.00 (0.02)	-0.04, 0.04
Child's age	-0.01 (0.01)	-0.03, 0.01	-0.01 (0.01)	-0.03, 0.01	0.00 (0.01)	-0.02, 0.02
Child's sex	-0.01 (0.16)	-0.31, 0.28	0.01 (0.15)	-0.32, 0.28	-0.02 (0.14)	-0.29, 0.25
Life satisfaction	0.12 (0.06)	-0.01, 0.27	0.10 (0.06)	-0.02, 0.25	0.08 (0.06)	-0.04, 0.22
Perceived weather	0.09 (0.05)	-0.01, 0.19	0.10 (0.05)	-0.01, 0.20	0.10 (0.05)	0.02, 0.20
<i>R</i> ² (adj. <i>R</i> ²)	0.08 (0.03)		0.16 (0.10)		0.26 (0.20)	
<i>F</i> (df), <i>p</i> -value	1.51 (7, 116), <i>p</i> = .170		2.71 (8, 115), <i>p</i> = .009		4.50 (9, 114), <i>p</i> < .001	
Parental self-efficacy						
Intercept	6.75 (1.03)	4.82, 8.80	6.30 (1.09)	4.03, 8.59	7.01 (1.03)	4.96, 9.26
Naturalness			0.07 (0.06)	-0.04, 0.21	0.03 (0.06)	-0.08, 0.12
Child's behavior					-0.22 (0.05)	-0.36, -0.10
Rooms	-0.01 (0.05)	-0.11, 0.09	-0.01 (0.05)	-0.12, 0.08	0.02 (0.05)	-0.08, 0.11
Education	-0.03 (0.20)	-0.41, 0.35	-0.01 (0.20)	-0.43, 0.33	0.03 (0.19)	-0.33, 0.40
Age	-0.05 (0.02)	-0.09, -0.00	-0.04 (0.02)	-0.09, 0.00	-0.04 (0.02)	-0.09, 0.00
Child's age	-0.01 (0.01)	-0.03, 0.02	-0.01 (0.01)	-0.03, 0.02	0.01 (0.01)	-0.02, 0.03
Child's sex	0.15 (0.19)	-0.23, 0.56	0.16 (0.19)	-0.23, 0.57	0.12 (0.18)	-0.27, 0.49
Life satisfaction	0.07 (0.07)	-0.07, 0.23	0.06 (0.07)	-0.07, 0.24	0.03 (0.07)	-0.11, 0.18
Perceived weather	0.06 (0.07)	-0.08, 0.20	0.06 (0.07)	-0.08, 0.20	0.07 (0.06)	-0.06, 0.19
<i>R</i> ² (adj. <i>R</i> ²)	0.07 (0.02)		0.09 (0.02)		0.20 (0.14)	
<i>F</i> (df), <i>p</i> -value	1.36 (7, 116), <i>p</i> = .249		1.36 (8, 115), <i>p</i> = .220		3.24 (9, 114), <i>p</i> = .002	
Parental stress						
Intercept	1.42 (1.55)	-1.69, 4.20	2.75 (1.60)	-0.26, 5.92	0.59 (1.09)	-1.20, 2.63
Naturalness			-0.22 (0.08)	-0.38, -0.04	-0.08 (0.06)	-0.19, 0.04
Child's behavior					0.66 (0.06)	0.55, 0.76
Rooms	0.10 (0.08)	-0.04, 0.25	0.10 (0.07)	-0.04, 0.25	0.02 (0.05)	-0.06, 0.10
Education	0.02 (0.31)	-0.60, 0.56	-0.03 (0.30)	-0.66, 0.53	-0.17 (0.20)	-0.62, 0.22
Age	0.03 (0.04)	-0.04, 0.10	0.02 (0.03)	-0.05, 0.09	0.01 (0.02)	-0.03, 0.06
Child's age	0.03 (0.02)	-0.00, 0.06	0.03 (0.02)	-0.00, 0.06	-0.00 (0.01)	-0.03, 0.02
Child's sex	0.12 (0.29)	-0.49, 0.65	0.10 (0.29)	-0.47, 0.64	0.21 (0.19)	-0.19, 0.57
Life satisfaction	-0.05 (0.11)	-0.26, 0.14	-0.02 (0.11)	-0.24, 0.15	0.07 (0.07)	-0.04, 0.16
Perceived weather	0.01 (0.10)	-0.22, 0.20	-0.01 (0.10)	-0.23, 0.19	-0.03 (0.07)	-0.16, 0.10
<i>R</i> ² (adj. <i>R</i> ²)	0.06 (0.00)		0.11 (0.05)		0.60 (0.57)	
<i>F</i> (df), <i>p</i> -value	1.03 (7, 116), <i>p</i> = .418		1.77 (8, 115), <i>p</i> = .090		19.24 (9, 114), <i>p</i> < .001	

Note: Age in years; child's age in months; child's sex 1 = male, 2 = female. Significant beta-estimates are printed bold. Percentile bootstrap CIs with 2000 runs.

Analysis of outdoor 2nd episodes showed that naturalness predicted improved net affect and reduced parental stress, confirming hypotheses 3a and 3c. Naturalness did not significantly predict PSE, so hypothesis 3b had to be rejected. Including perceived child behavior substantially improved the three models and proved to be essential in explaining variation in net affect, PSE, and especially parental stress during outdoor episodes. Perceived child behavior mediated the effect of naturalness on all outcomes, being of particular importance for parental stress where a full mediation was found. Thus, hypotheses 4a-c are supported, though the relevance for PSE is negligible due to the small, non-significant total effect.

Table 5

Basic Mediation Results With z-Standardized Variables Regarding the Relationship Between Perceived Naturalness and the Three Main Outcome Variables.

	Indirect effect a*b	Path a	Path b	Path c
Net affect	0.07 [0.01, 0.14]	-0.20 [-0.39, -0.01]	-0.35 [-0.54, -0.20]	0.21 [0.04, 0.41]
Parental self-efficacy	0.07 [0.02, 0.20]	-0.20 [-0.39, -0.01]	-0.37 [-0.61, -0.18]	0.04 [-0.11, 0.22]
Parental stress	-0.15 [-0.29, -0.02]	-0.20 [-0.39, -0.01]	0.77 [0.63, 0.89]	-0.08 [-0.20, 0.04]

Note: For path a and path b percentile bootstrap 95% CIs are displayed, and for the indirect effect and path c bias-corrected and accelerated bootstrap CIs were used. Path a: perceived naturalness -> perceived child's behavior, path b: perceived child's behavior -> net affect / parental self-efficacy / parental stress, path c: perceived naturalness -> net affect / parental self-efficacy / parental stress.

Well-being before and after time spent outdoors

To test Hypotheses 5a-c, we examined whether the observed positive relationships between outdoor episodes and the outcomes persisted into the following episode, suggesting causal effects. MLM modeling the interaction between being outdoors in second episode and a dummy variable indicating the third (vs. the first) episode showed no interaction effects for PSE ($b = -0.46 [-1.08, 0.18]$, $n = 139$, $n_{\text{episodes}} = 252$) and parental stress ($b = 0.20 [-0.69, 1.06]$, $n = 140$, $n_{\text{episodes}} = 253$) in the third episode, indicating no spill-over effects. For net affect, a significant interaction was found, but contrary to expectations, spending the second episode indoors/in means of transport was associated with better net affect in the third episode ($b = -0.72 [-1.38, -0.07]$, $n = 140$, $n_{\text{episodes}} = 253$). However, given that only 18 participants did not spend the second episode outdoors, the results may not be reliable. Separate analysis for participants who spent the second episode outdoors ($n = 121/122$, $n_{\text{episodes}} = 222/223$) revealed no significant differences in the three outcomes between the first and third episodes. The models included random intercepts, and percentile 95% bootstrap confidence intervals were used for significance testing. Covariates included start time, setting, parent's education and age, child's age and sex, the number of rooms in the household, and perceived weather.

Hypothesis 5a-c must be rejected for all outcomes, with even a slight tendency toward lower well-being during the subsequent episode after outdoor episodes. No analyses contrasting the

first and the fourth episode were conducted due to the lack of support for Hypothesis 5a-c regarding episode 3.

Day-level analysis

Exploratory analysis assessed whether the percentage of episodes spent outdoors predicted overall daily mood. Due to the study design, the percentage of episodes outdoors with the youngest child of all episodes with the youngest child was utilized as a proxy. To ensure a more accurate approximation, only participants who spent at least 80% of all episodes with their youngest child (25th percentile of the distribution) were included in the analysis ($n = 106$). Sensitivity analyses with varying cut-offs revealed that stricter thresholds tended to yield stronger unstandardized beta values, supporting the assumption that including participants who spent proportionally fewer episodes with their youngest child could dilute the results.

With the chosen cut-off, multiple regression revealed that better mood was predicted by a higher percentage of outdoor episodes ($b = 0.01$ [0.002, 0.02], $\beta = 0.26$), though only marginally. The model was significantly better than the covariate-only model (perceived weather, life satisfaction, number of rooms, age, education level, child's age, child's sex), $F(1, 97) = 6.74$, $p = .011$. This supports the notion that spending more time outdoors is associated with better daily mood, though the effect is small and only a proxy could be used for analysis.

Discussion

The goal of this study was to shed light on potential benefits of time spent outdoors and nature contact with young children (under three years old) for parental well-being, utilizing a shortened DRM version. State net affect, PSE, and parental stress were used as indicators for parental well-being and were measured across four consecutive episodes of the day preceding the survey, allowing for a fine-grained analysis of within-day fluctuations and a focus on concepts relevant for parents' well-being.

Our findings revealed that net affect and PSE were higher, and parental stress was lower outdoor interactions between parents and their youngest children. During outdoor episodes, higher perceived naturalness of the environment significantly predicted better net affect and lower parental stress. These results contribute to the growing evidence on the psychological benefits of nature contacts, highlighting their value for parents specifically. Contrary to expectations, the perceived naturalness did not significantly predict PSE. This underscores the importance of distinguishing between well-being constructs in this research field and between their associations with being outdoors vs. specific qualities of the outdoor environment. The findings add new and

multifaceted evidence to the yet small body of research on parental well-being in nature, complementing qualitative studies from Hall et al. (2023), Peters et al. (2022) and Peters et al. (2021).

Beyond the total effects of being outdoors and environmental naturalness, we examined the potential mediating role of child behavior. Though directionality between child factors and parental well-being remains debated, prior research shows that being in natural spaces can improve children's well-being and behavior (e.g. B.-B. Fang et al., 2021; Liu & Green, 2023; Ulset et al., 2017). This suggests a potentially relevant pathway, especially for well-being aspects directly related to childcare, such as parental stress and PSE. Our results strongly support this perspective: being outdoors and higher perceived naturalness significantly predicted the child's behavior being perceived as less exhausting, which in turn was a strong predictor of all three outcome variables, particularly parental stress. Child behavior partially mediated the relationships of being outdoors and naturalness with net affect, and fully with parental stress and PSE. However, since the total effect of naturalness on PSE was insignificant, the mediating role of child behavior may be limited. These results highlight the importance of considering parental well-being and child's behavior together, preferably applying objective and more nuanced measures of child behavior in future research.

Finally, we assessed potential spill-over effects of outdoor time on well-being during the subsequent episodes to further explore the pathways between outdoor nature contacts and parental well-being. However, we found no positive effects, and for net affect, we even observed a significant negative effect. Spending time outdoors predicted slightly worse affect in the following episode, but this result is of limited reliability due to the small number of participants not outdoors during the second episode. Nonetheless, these results strongly call for further investigation, because previous research has repeatedly shown that spending time in (natural) outdoor spaces not only has immediate but also lasting benefits (2020) (e.g. Razani et al., 2018; Shanahan et al., 2016; Taylor & Butts-Wilmsmeyer, . Explorative analysis revealed that spending more episodes outdoors with the youngest child positively predicted overall daily mood. While this aligns with existing research, the insights from this exploratory analysis are limited and the directionality between outdoor time and subsequent well-being remains unclear.

This leads to a general limit of this study, as causal pathways could not be explored. This is particularly relevant for the dynamics between parental well-being and child behavior, which have mainly been assessed observationally. The longitudinal study design had the potential to shed some light on this topic, but the results did not provide conclusive insights in this regard, and the directionality remains theoretical. Strengths of the study include the within-person design using a

modified DRM approach, and a relatively large sample size, providing new insights into daily fluctuations in the well-being of parents. However, the short-version DRM may have been too complicated, and prone to skipping important parts of the DRM design, leading to potential misunderstandings (e.g. unaccounted gaps between episodes, inconsistencies in the number of reported episodes). Further, the scales for net affect, PSE, and parental stress were newly developed to be able to capture temporary changes and be of reasonable length within a DRM-design. For future studies, the used DRM-adaption and scales should be further refined and validated. Another limitation is, that an outdoor episode was explicitly set as the index episode, potentially leading to socially desirable response behavior. In addition to that, the study was conducted during the warmer seasons of the year and not all MLM assumptions were met. These issues could have led to overestimating of the benefits of outdoor time. Future research should thus include a broader variety of seasons, focus on blinded longitudinal or experimental designs, and utilize objective measures. Also, future studies should aim to reach more fathers and investigate whether findings extend to parents of older children.

From a practical perspective the study shows that going outdoors with young children might alleviate parenting. Being outdoors could offer temporary relieve for parents, especially in more natural environments, which aligns with results from previous research (e.g. Razani et al., 2018). Encouraging parents to spent time outside with their children might be an easy and cheap intervention for people with low net affect, who are stressed, and show low self-efficacy in their role as parent. However, it must be noted that the effects don't seem to be lasting, at least when considering the direct phase after having been outdoors. A generally better mood on the day, if more episodes are spent outdoors with the child might be positive consequence though.

Conclusion

The study with its focus on day-level fluctuations contributes to understanding the relationship between being outdoors / nature contact and well-being and sheds light on the relevant but largely neglected group of parents. Being outdoors (in natural spaces) goes hand in hand with enhanced well-being of parents with young children. The focus on the net affect, PSE, and parental stress offers insight into specific constructs constituting parents' well-being on a day-level. The study also highlights the importance of considering the child's behavior when thinking about parental (state) well-being. Additionally, as previous research indicates, better parental well-being may also have further-reaching effects on parent-child interactions, and child development. By exploring the benefits of daily outdoor episodes, the project offers promising avenues for designing easy-to-

implement interventions such as green prescriptions tailored to this target group, potentially fostering healthier family dynamics, and enhancing overall long-term societal well-being.

Statement

The author utilized DeepL Translator and ChatGPT to revise linguistic aspects of the work to improve readability and ChatGPT was used to assist with code writing. All contents were reviewed and edited by the author and the author takes full responsibility for the content. For managing references, Citavi was used.

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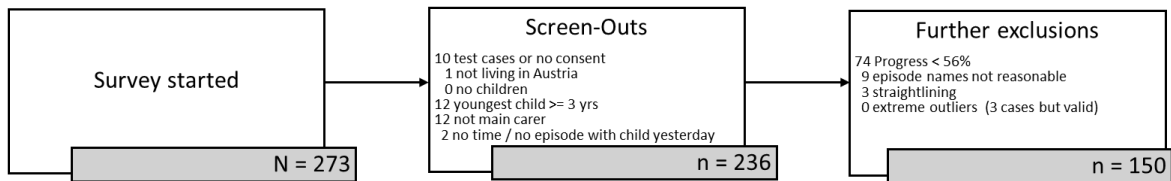
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Appendix

A.1 Overview of data collection and pre-processing



A.2 Item wordings

German (original, as applied in the survey)

Positive and negative affect Wie hast du dich während dieser Episode gefühlt?

gut

schlecht

fröhlich

zufrieden

traurig

besorgt

(Trifft gar nicht zu – 2 – 3 – Mittel – 5 – 6 – Trifft voll zu)

Die folgenden Fragen beziehen sich auf deine Gefühle und Eindrücke als Elternteil:

Während dieser Episode ...

Parental stress nahm die Betreuung meines jüngsten Kindes viel Energie in Anspruch.
fühlte ich mich nervös und/oder gestresst durch die Betreuung meines
jüngsten Kindes.
war es anstrengend, die Betreuung meines jüngsten Kindes und andere
Verpflichtungen miteinander zu vereinbaren.

PSE fühlte ich mich kompetent in meiner Rolle als Elternteil.
konnte ich spüren, was mein jüngstes Kind in diesem Moment brauchte.
hatte ich einen positiven Einfluss auf das Verhalten und die Gefühle meines
jüngsten Kindes.

Child's behavior war das Verhalten meines jüngsten Kindes kräftezehrend.
(Trifft gar nicht zu – 2 – 3 – Mittel – 5 – 6 – Trifft voll zu)

English (translation by the authors)

Positive and negative affect How did you feel during this episode?

good

bad

happy
 contented
 sad
 anxious
 (Strongly disagree – 2 – 3 – Medium – 5 – 6 – Strongly agree)

The following questions regard your feelings and impressions as a parent:

During this episode ...

Parental stress looking after my youngest child took a lot of energy.
 I felt nervous and/or stressed by looking after my youngest child.
 it was strenuous to coordinate caring for my youngest child with other obligations.

PSE I felt competent in my role as a parent
 I was able to sense what my youngest child needed at the moment.
 I had a positive influence on my youngest child's behavior and feelings.

Child's behavior the behavior of my youngest child's was exhausting
 (Strongly disagree – 2 – 3 – Medium – 5 – 6 – Strongly agree)

A.3 Model building Hypothesis 1 & 2

Table A.1

ANOVA Results From Building MLM for Net Affect, Parental Self-Efficacy, and Parental Stress

Model	df	AIC	BIC	Likelihood-Ratio	p-value
Net affect					
Null model	2	980.9	988.6		
Random intercept null model	3	946.2	957.8	36.7	<.001
Covariate model	11	925.8	968.6	36.3	<.001
Predictor model 1	12	909.5	956.1	18.3	<.001
Predictor model 2 (random slope for setting)	14	908.7	963.1	4.8	.092
Predictor model 3 (plus child's behavior)	15	856.6	914.9	54.1	<.001
Parental self-efficacy					
Null model	2	1087.5	1095.3		
Random intercept null model	3	1036.4	1048.0	53.1	<.001
Covariate model	11	1007.7	1050.4	44.7	<.001
Predictor model 1	12	1002.6	1049.3	7.0	.008
Predictor model 2 (random slope for setting)	14	1006.6	1061.0	<.01	>.999
Predictor model 3 (plus child's behavior)	15	945.7	1004.0	62.9	<.001
Parental stress					
Null model	2	1361.2	1368.9		
Random intercept null model	3	1316.7	1328.3	46.5	<.001
Covariate model	11	1313.0	1355.7	19.7	.012
Predictor model 1	12	1303.8	1350.5	11.1	.001
Predictor model 2 (random slope for setting)	14	1307.8	1362.2	<0.1	.997
Predictor model 3 (plus child's behavior)	15	1041.1	1099.4	268.7	<.001

Zusammenfassung

Frühere Untersuchungen zeigten bereits, dass Zeit im Freien – und im Speziellen Naturkontakte – das Wohlbefinden steigern kann, aber die spezifische Zielgruppe von Eltern mit kleinen Kindern ist weniger erforscht. Diese präregistrierte Studie untersuchte den möglichen Nutzen von Zeit im Freien (vs. in Innenräumen und in Verkehrsmitteln) und Naturkontakten mit kleinen Kindern für die elterlichen Emotionen (affektiver Zustand und elterlicher Stress) sowie die elterliche Selbstwirksamkeit (PSE). Dafür wurde eine Kurzversion der Day Reconstruction Method zwischen Spätfrühling und Hochsommer 2024 mit $N = 150$ Eltern ($n = 149$ Mütter, vor allem in Elternkarenz/Elternteilzeit) von Kindern unter drei Jahren genutzt, um Daten von vier aufeinanderfolgenden Episoden ($n = 596$) des vorigen Tages zu erheben. Die Ergebnisse zeigten, dass während Episoden, die mit den Kindern im Freien verbracht wurden und in Umgebungen, die als naturbelassener wahrgenommen wurden, der affektive Zustand positiver und der selbstberichtete elterliche Stress geringer war. Die elterliche Selbstwirksamkeit war höher während Episoden im Freien, aber zeigte keinen Zusammenhang mit der wahrgenommenen Naturbelassenheit. Das wahrgenommene Verhalten des Kindes medierte die positiven Beziehungen zwischen dem Aufenthalt im Freien / der Naturbelassenheit und dem Affekt partiell und die Beziehungen zu elterlicher Selbstwirksamkeit und elterlichem Stress vollständig. Es wurden keine positiven Auswirkungen des Aufenthalts im Freien in Episode 2 auf das Wohlbefinden während der anschließenden Episoden festgestellt. Eine explorative Analyse zeigte jedoch, dass ein höherer Prozentsatz an Episoden im Freien eine bessere Gesamtstimmung an diesem Tag voraussagt. Die Ergebnisse legen nahe, dass der Aufenthalt im Freien/in der Natur vorteilhaft für Eltern mit jungen Kindern ist, indem er sowohl das elterliche Wohlbefinden direkt verbessert als auch dazu beiträgt, das Verhalten des Kindes besser handhabbar zu machen. Die Ergebnisse weisen darauf hin, dass es hilfreich sein könnte, Eltern mit kleinen Kindern – insbesondere während der Elternkarenz – den Zugang zur Natur zu erleichtern und zu fördern.