Full-day, in home validation of infant body position measurements from inertial sensors

John M. Franchak[1], Maximilian Tang[1], Hailey Rousey[1], & Chuan Luo[1]

Author Note

Add complete departmental affiliations for each author here. Each new line herein must be indented, like this line.

Enter author note here.

Correspondence concerning this article should be addressed to John M. Franchak, UC Riverside Department of Psychology, 900 University Avenue, Riverside, CA 92521. E-mail: franchak@ucr.edu

Abstract

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Keywords: body position, motor development, everyday experiences, sitting, machine learning

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Full-day, in home validation of infant body position measurements from inertial sensors

Current Study

Methods

Participants

Apparatus

Procedure

Body position annotation

Body position classification

Results

Goal 1: Optimize and validate body position classification model

Goal 2: Assess classification accuracy over long recordings

Goal 3: Examine wear time and compliance in full-day data collection

Goal 4: Determine sensitivity of classification to measure age differences in body position

Discussion

References

Table 1

Summary statistics for model performance metrics shown separately for group and individual models.

	Group			Individual		
Metric	Median	Mean	SD	Median	Mean	SD
Overall Accuracy	0.908	0.848	0.143	0.936	0.919	0.071
Balanced Accuracy	0.909	0.897	0.074	0.916	0.907	0.072
F1	0.813	0.827	0.101	0.873	0.870	0.089
Sensitivity	0.840	0.836	0.123	0.848	0.840	0.121
Pos Pred Value	0.822	0.815	0.125	0.915	0.899	0.108
Kappa	0.769	0.757	0.160	0.846	0.820	0.141

Table 2

Correlations between human-coded and model-predicted body position durations across the entire long delay period. Correlations are provided within each posture and overall, and computed separately using group and individual models with and without outlier participants.

	With Outliers		Without Outliers	
Position	Group	Individual	Group	Individual
Held	-0.02	0.16	0.55	0.63
Prone	0.97	0.83	0.97	0.84
Sitting	0.72	0.93	0.91	0.97
Supine	0.84	0.93	0.94	0.97
Upright	0.84	0.93	0.99	0.94
Overall	0.79	0.90	0.95	0.96

Table 3

Correlations between human-coded and model-predicted body position durations using 10-minute bins during the long delay period. Correlations are provided within each posture and overall, and computed separately using group and individual models with and without outlier participants.

	With Outliers		Without Outliers	
Position	Group	Individual	Group	Individual
Held	0.45	0.44	0.57	0.56
Prone	0.96	0.81	0.96	0.88
Sitting	0.72	0.93	0.91	0.93
Supine	0.75	0.93	0.90	0.94
Upright	0.93	0.95	0.97	0.95
Overall	0.80	0.92	0.92	0.94

Table 4

Summary of age differences in full-day body position for younger (4- to 7-month) and older (11- to 14-month) infants. Values shown are the mean percent of time for each body position averaged across infants in each group. Standard deviations are shown in parentheses. Descriptive statistics are shown separately for group and individual models.

	Group		Individual	
Position	Younger	Older	Younger	Older
Upright	7.6% (8.9)	18.6% (7.4)	9.9% (13.1)	18.7% (8.4)
Sitting	26.3% (12.1)	44.4% (10.1)	20.2% (16.3)	46.9% (13.3)
Prone	13.8% (13.5)	14.4% (6.0)	11.9% (9.9)	16.9% (10.6)
Supine	37.9% (23.2)	14.0% (8.4)	39.4% (30.3)	10.0% (9.5)
Held	12.7% (6.9)	8.5% (5.4)	17.6% (19.9)	7.4% (7.6)

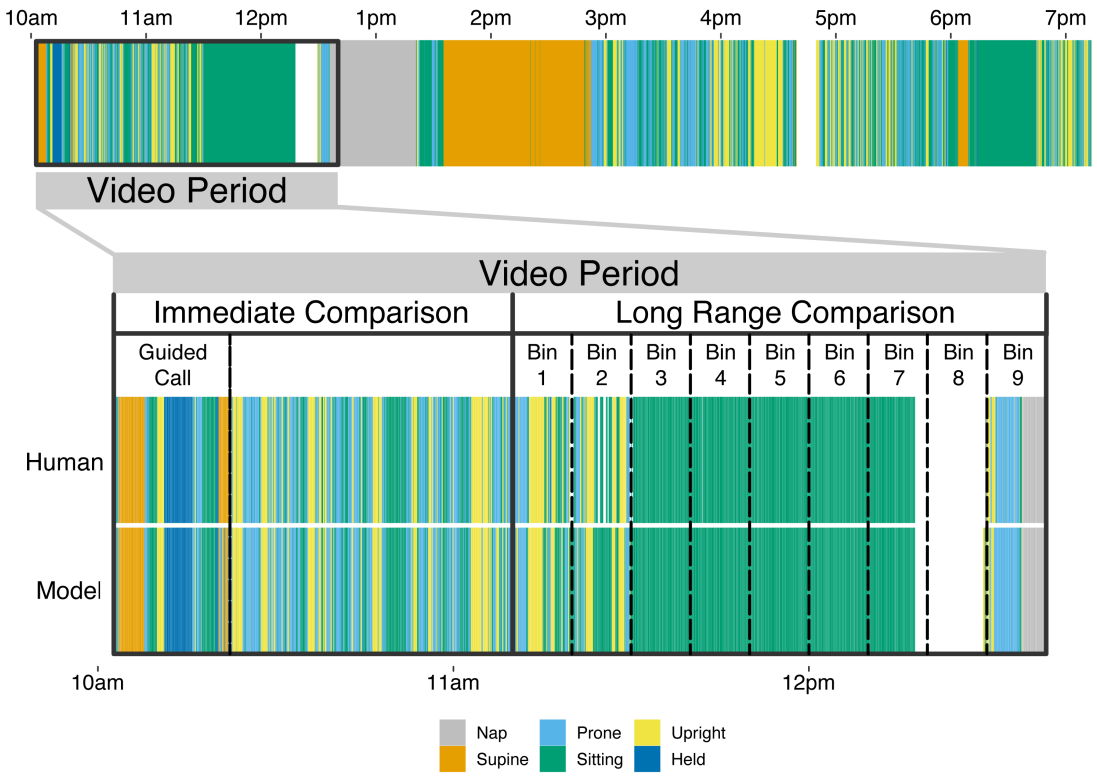

Figure 1. Example Timeline Caption.

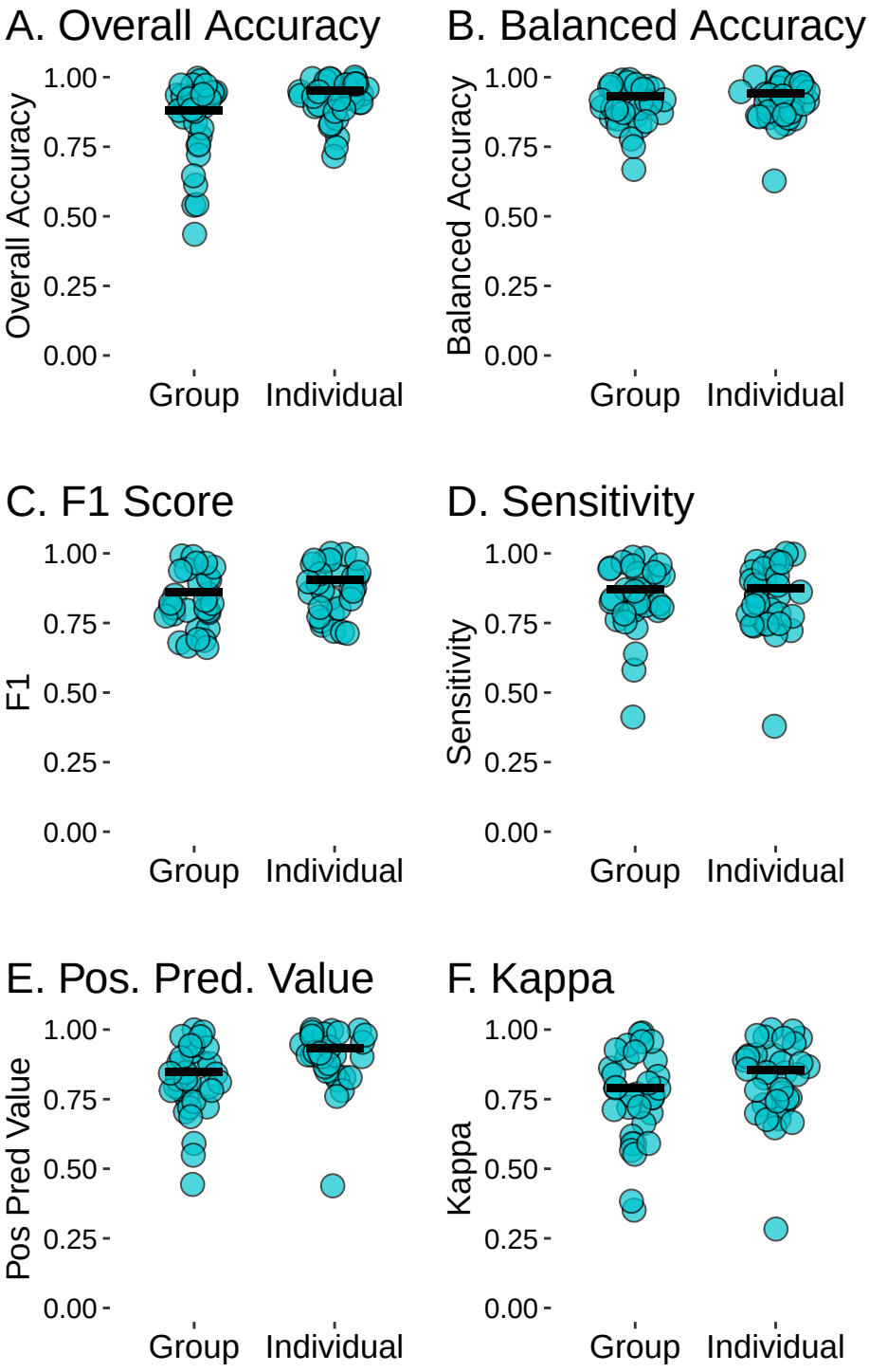

Figure 2. Metrics

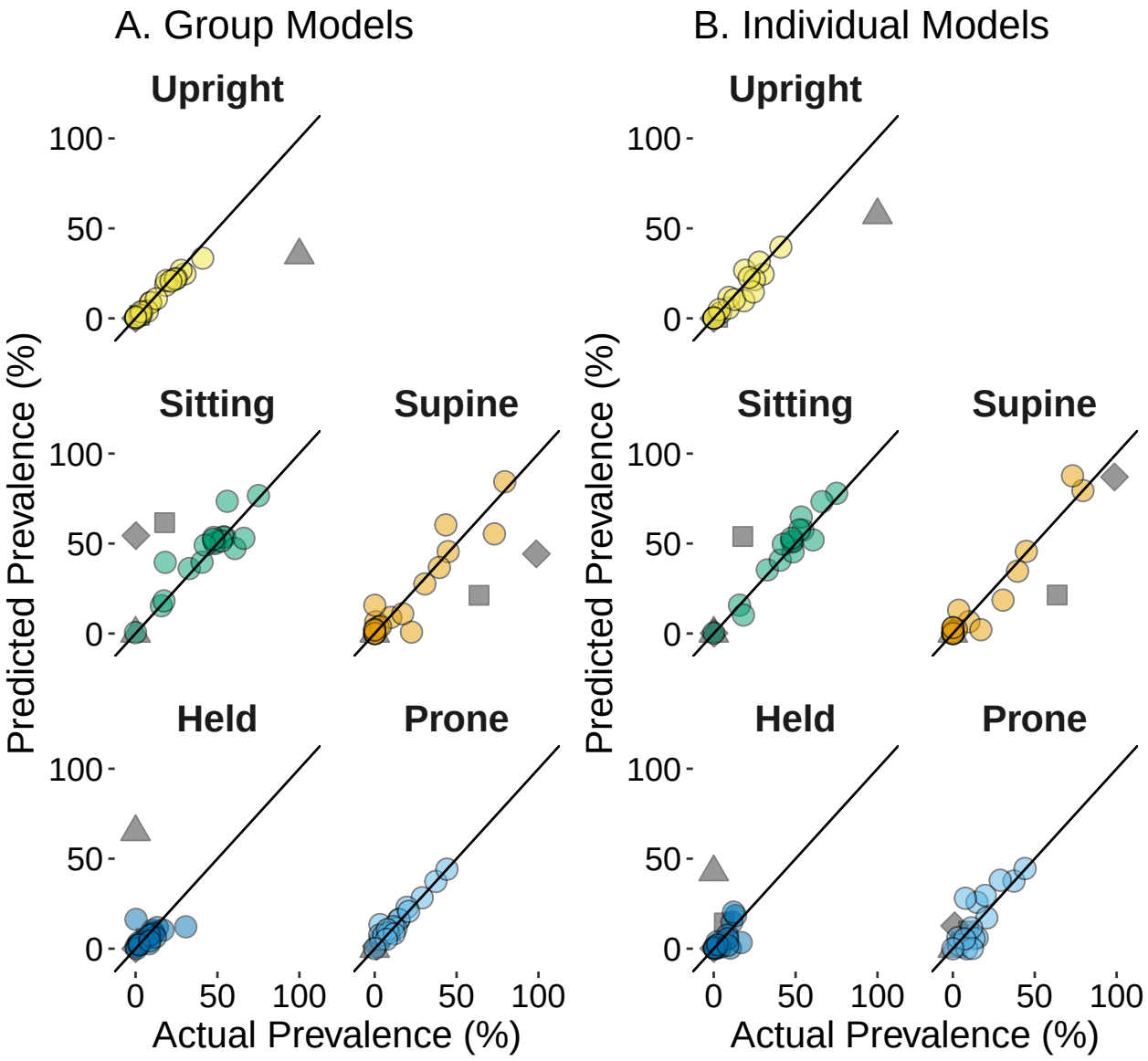

Figure 3. Overall agreement between human-coded body position and model-predicted body position in the long-delay period. Agreement for group models is shown in (A) and agreement for individual models is shown in (B). Plots are shown separately for each body position with a reference line that indicates perfect agreement; each point in a plot represent data for a single participant. The three outlier participants are plotted in dark gray, with a different shape marking each individual.

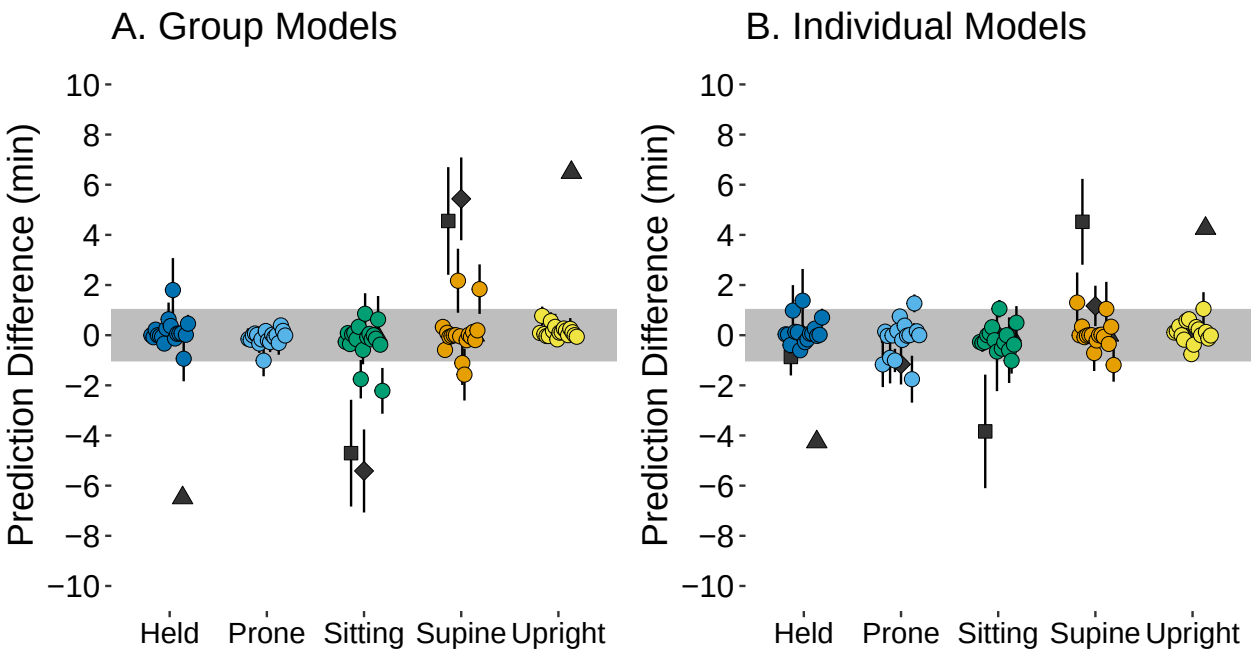

Figure 4. Prediction performance (difference in minutes between human-coded and model-predicted body position) for 10-minute bins in the long delay period. Each point shows the mean and SE for a single participant for each body position, summarizing the prediction difference for each of their 10-minute bins. Points falling within the gray shaded region indicate that average prediction errors were less than 1 minute. Performance is plotted separately for (A) group models and (B) individual models. The three outlier participants are plotted in dark gray, with a different shape marking each individual.

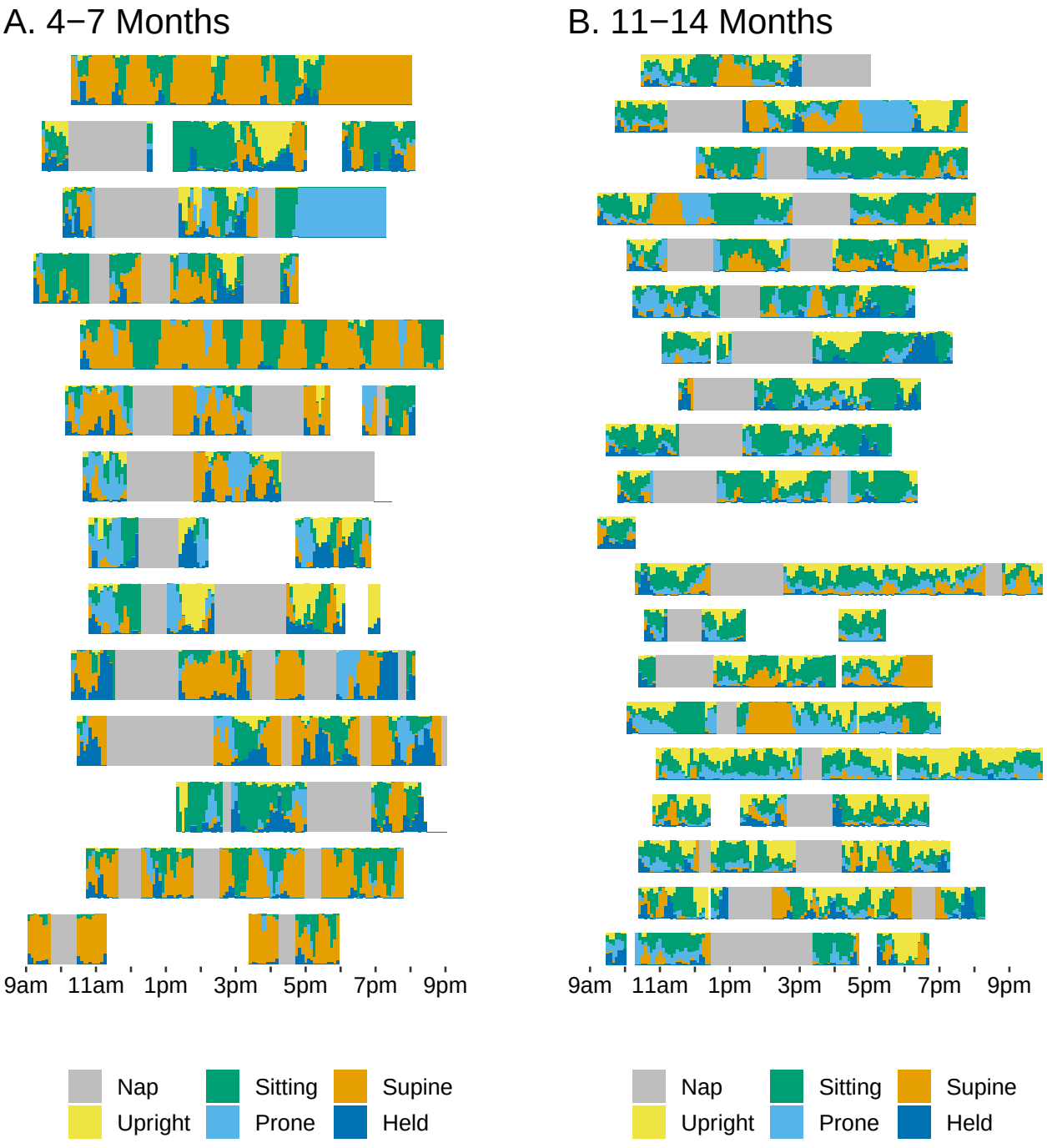

Figure 5. Timelines

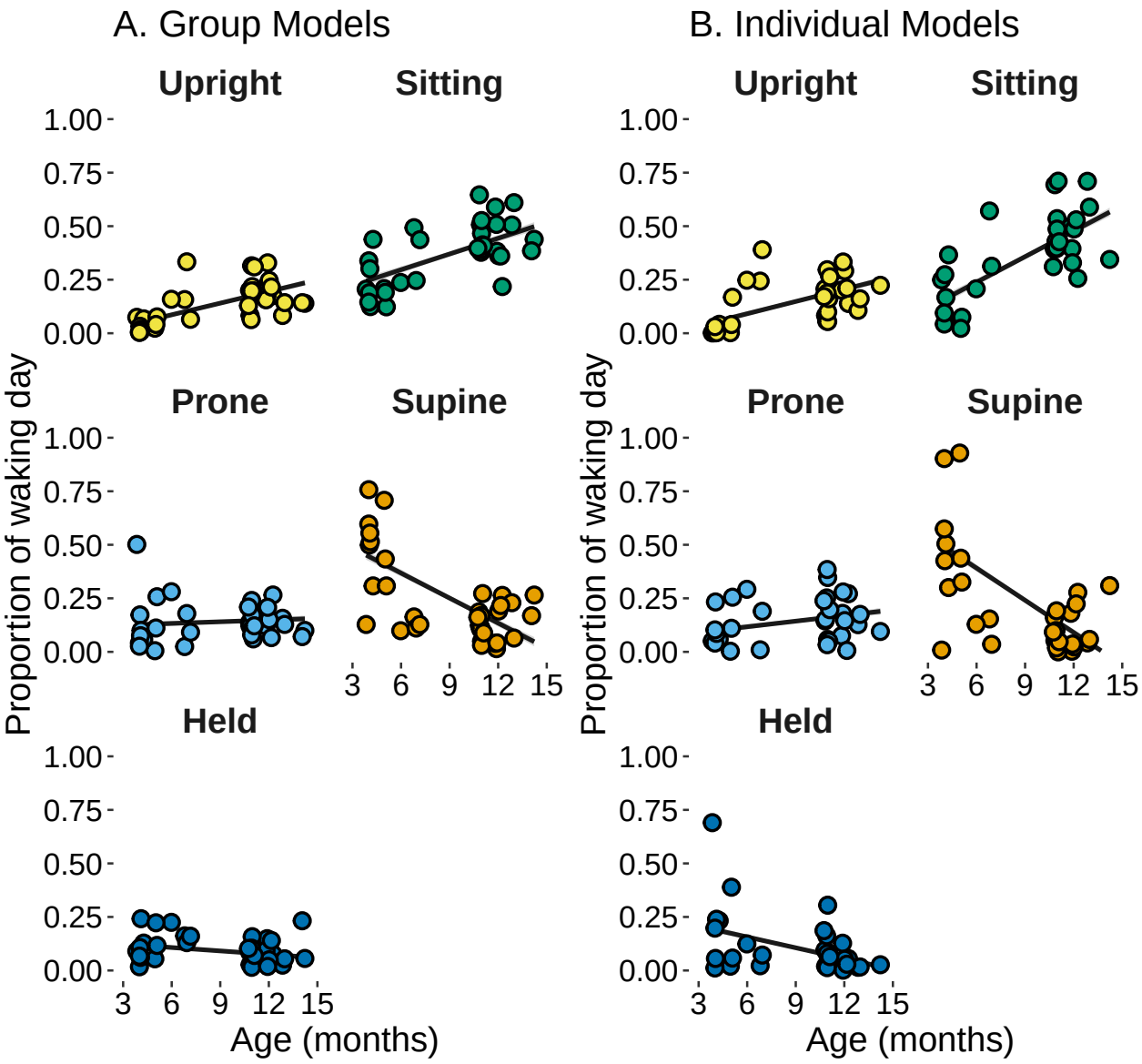

Figure 6. Age trends