Research Report: 19.07.2022

Little Climby - Tind Grow with me - a tool for bringing about cascades in development

Tind Grow with me (Tind Aktivitetspakke) consists of a wooden frame with accompanying playing mat and a variety of small toys and a sit pad. Here tested out by two sisters in their home (Photo: Zoë van der Weel/Oslo).

Information about Little Climby

Studies indicate that early motor stimulation is beneficial for infant perceptuomotor development as well as for cognitive skills such as the development of visual motion perception (Van der Meer & Van der Weel, 2020; 2022). Little Climby is a new Norwegian sustainable brand that focuses on providing a safe learning environment by providing infants with sensorimotor stimulation. Little Climbys "Tind Grow with me" (Tind Aktivitetspakke) includes, among a variety of products, a Tind standing-alone wooden frame with an accompanying mat, as well as additional toys that can be suspended from the frame to promote the development of eye-hand coordination.

Little Climby infants

Four baby girls (one pair of identical twins), born between 37-42 weeks GA, received the Little Climby "Tind Grow with me" (Tind Aktivitetspakke) at birth and tested the brand during the first year of life to investigate the effect of the early stimulation on the infant's perceptuomotor and brain development. All infants regularly practiced tummy-time on the mat from an early age, they were given sensory stimulation with toys suspended from the frame promoting eye-hand coordination, and they used the Little Climby frame to pull to stand from about 7 months. Their brain development for visual motion perception was measured in the Developmental Neuroscience Laboratory (Nu-Lab) at NTNU in Trondheim twice during the first year of life, once around 4 months before they developed locomotor skills and once around 10 months after several weeks of self-produced crawling experience.

Motor milestones

The parents filmed the infants and sent us monthly updates. Then we tracked the infants' motor milestones from birth until they could walk alone. Compared to a large control group (100+ infants) who received a traditional Norwegian upbringing spending relatively a lot of their awake time lying in a supine position, the Little Climby infants reached the motor milestones below considerably earlier:

- Around 1.5-2 months they were able to roll over from stomach to back
- Around 4-5 months they rolled over from back to stomach
- Around 6 months the infants could stand on all fours (crawling position)
- Around 6-7 months they started "commando crawling"

- Around 7 months they were able to sit with no support and stand upright by holding onto the Little Climby or to furniture
- Around 10-11 months they could walk alone

The experiments

The infants were tested twice during their first postnatal year, with the first testing session at 4-5 months, and the second session at 9-11 months. At the second session, they had acquired experience with self-produced locomotion such as crawling. While wearing a high-density EEG net consisting of 128 sensitive electrodes, the infants were seated in front of a big screen and were presented with three visual motion experiments: optic flow, frequency, and looming (https://www.frontiersin.org/articles/10.3389/fpsyg.2016.00100/full).

Optic flow

With the optic flow paradigm, we can simulate forwards and reversed self-motion, and compare it to random visual motion (Agyei et al., 2015, 2016; Borge Blystad & Van der Meer, 2022; Van der Meer et al., 2008). One hundred black circles are presented on a white background moving under different conditions (see Fig. 1). When simulating forwards optic flow, the dots move away from the centre of the screen, giving the impression of the infant moving forwards. For simulating reversed optic flow, the dots move towards the centre of the screen, giving the impression of the infant moving backwards. When presenting random visual motion, the dots move in random directions on the screen.

Figure 1. Measuring the infant's brain responses to different directions of visual motion.

Frequency

The frequency paradigm consists of a virtual road with moving poles at either side of it, simulating forward motion at three different ecologically valid speeds (see Fig. 2). The three different motion speeds used were comparable to walking, jogging, and cycling (Rasulo et al., 2021).

Figure 2. Measuring the infant's brain responses to different speeds of visual motion.

Looming

The looming paradigm investigates how the infant brain processes information about imminent collisions (see Fig. 3). Looming refers to the last part of the approach of an object that is accelerating towards the infant. By simulating a looming ball on a direct collision course toward infants, we can investigate the brain activities in response to looming information (Van der Meer et al., 2012; Van der Weel & Van der Meer, 2009).

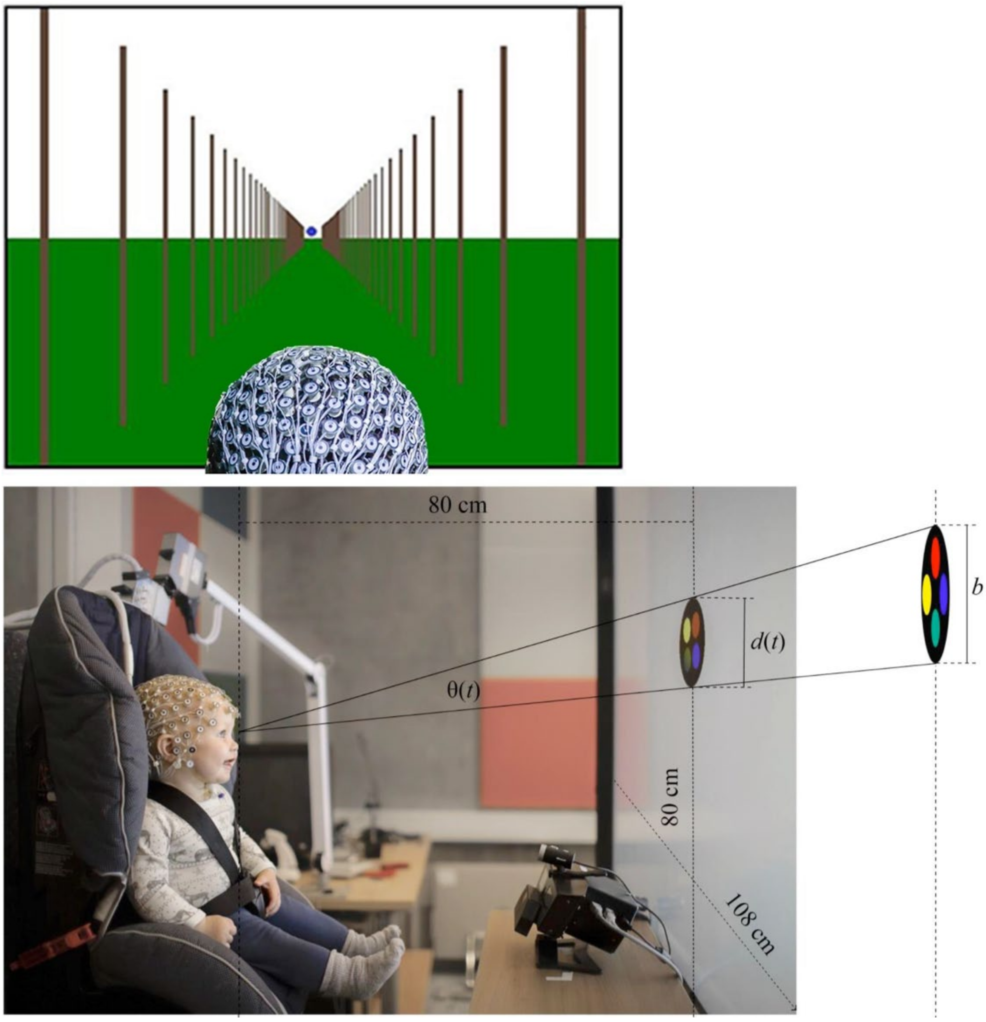

Figure 3. Measuring brain responses to fast-moving virtual balls looming towards the baby's face. Photo: Elin Iversen/NTNU.

The results

Optic flow

VEP-results
At 4-5 months, the Little Climby infants showed a mean latency of 351 ms, while the control infants showed a mean latency of 411 ms in response to forwards optic flow. This shows a mean difference of 60 ms shorter latencies for the Little Climby infants compared to the control infants in response to forwards optic flow.

In the second testing session at 8-12 months, the Little Climby infants show mean latency of 271 ms and the control infants show mean latency of 315 ms. The Little Climby infants show 44 ms shorter latencies in response to forwards optic flow than the control infants.

TSE results

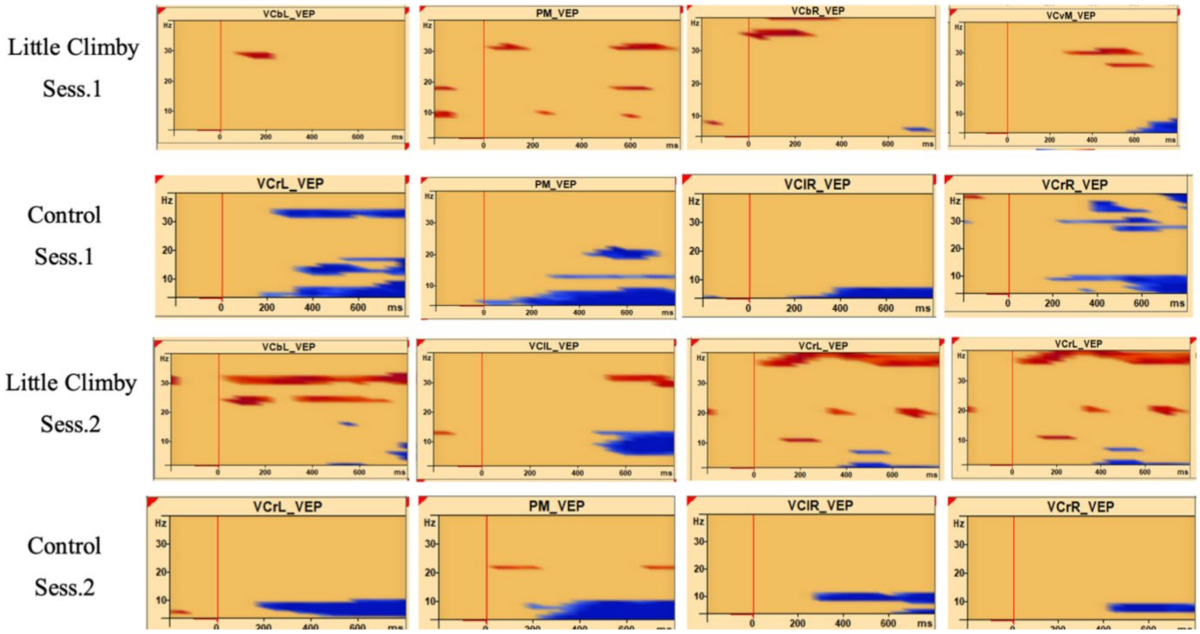

Figure 4. TSE plots for Little Climby and control infants before and after they became mobile.

In the first session, control infants showed widespread low-frequency theta-band activity in response to visual motion which is a sign of an immature cognitive processing system. On the other hand, the Little Climby infants showed high-frequency activity in response to motion already at 4-5 months, which indicates a higher-level processing of motion (see Fig. 4). In the second session, control infants showed desynchronised alpha-band activity. The activity is also less widespread than in the first session which indicates a more efficient processing of

motion information. The Little Climby infants still showed high-frequency synchronisation in response to motion processing which indicates efficient processing of the motion information.

Overall, we see that the Little Climby infants are processing the optic flow information more efficiently than the control infants. This is reflected in the TSE results where the Little Climby infants display high-frequency activity in response to motion information, as well as in the VEP responses where the Little Climby infants show shorter latency to optic flow information in both session 1 and session 2 compared to control infants.

Frequency

VEP results

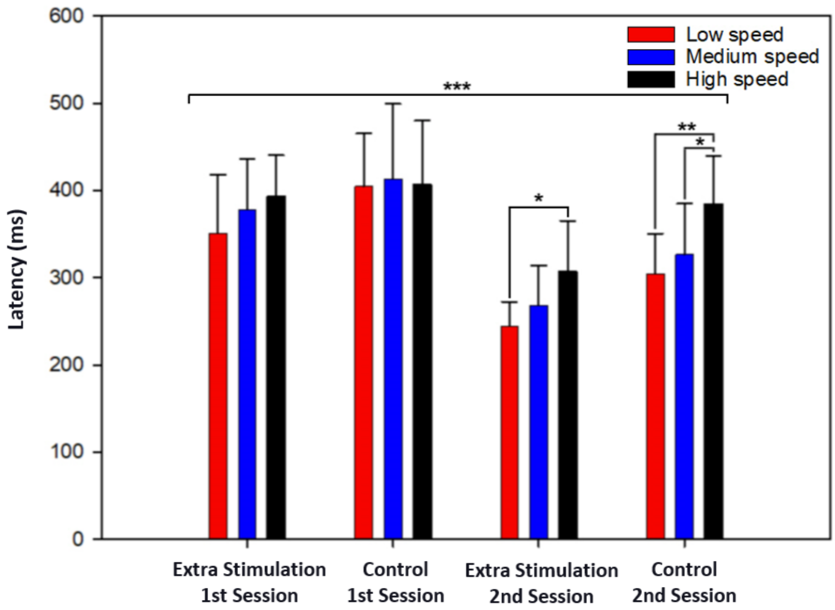

Figure 5. Group mean latencies (and SD's) for low, medium, and high speed for infants receiving extra motor stimulation and control infants in the first and second session. *p<0.05; **p<0.01; ***p<0.001

For infants who received extra motor stimulation in the form of weekly baby swimming classes and a control group who received a traditional upbringing, latency decreased significantly with age during the first year of life, especially for low and medium speed (see Fig. 5). Latency for high speed hardly changed with age, except for extra-stimulated infants in the second session who reduced their latency for high speed with almost 90 ms. The Little Climby infants showed a similar reduction in latency, especially for high speed, as the extra-stimulated infants. With age, infants were able to differentiate between visual motion

conditions, with increasing latency from low speed to high speed, while infants when they were younger showed no significant differences in latencies between speeds. Both extra-stimulated infants and the Little Climby infants showed overall shorter mean latencies compared to control infants.

TSE results

TSE results indicated a progression from low-frequency theta-band activity to high frequency alpha-band activity in response to motion during the first year. Only older extrastimulated infants and Little Climby infants with crawling experience showed adult-like beta band activity in addition.

Looming

VEP results

Results showed VEP peaks to appear closer to collision with increasing age. Like extrastimulated infants, Little Climby infants showed their responses closer to collision than controls at both testing sessions. All infants displayed their looming-related responses at longer times-to-collision (TTC) for slow looms, and shorter for medium and fast approaching looms at the first session, while they showed more time-fixed responses (at -0.6 s before impact) for all looming speeds at the last session, suggesting a shift to a more efficient timing strategy in response to the approaching loom.

TSE results

Time-frequency analyses revealed low-frequency activity (delta- and theta-band) at an early age and activity in higher frequency-bands (alpha- and beta-band) later in the first year of life in all infants in visual brain areas, suggesting more mature processing of the loom. In addition, extrastimulated and Little Climby infants alike also showed more sophisticated, less widespread activity in response to looming at the first testing session than controls.

Conclusions

The findings from the four Little Climby infants show that both their brain and behavioural development was accelerated in comparison to about 150 control babies who received a traditional Norwegian upbringing spending a lot of their awake time in a supine position. The developmental pathway followed by the Little Climby infants had a lot in common with a

sample of about 25 infants tested longitudinally in the lab who received extra motor stimulation in the form of baby swimming, tummy time, and baby massage. Similar to the extrastimulated infants https://onlinelibrary.wiley.com/doi/10.1002/dev.22276, the Little Climby infants showed accelerated development on the motor milestones of rolling over, sitting alone, commando crawling and crawling on all fours, pulling to stand and cruising while holding on to furniture, as well as an earlier onset of independent walking. Over and above, the channelled early motor stimulation was also related to improved brain development in the form of more mature cortical mechanisms for visual motion perception, as shown by shorter latencies reflecting faster processing and higher-frequency brain oscillations, while infants performed our paradigm tasks of optic flow, frequency, and looming.

Recommendation

Based on these promising findings, we recommend the "Tind grow with me" (Tind Aktivitetspakke) to young babies from birth. Initially, the mat can be used to give the baby tummy time. This is an excellent exercise that allows the baby to develop neck muscles strong enough to hold up its own head and, as a result, the development of head-eye coordination can commence. From about two months, with the lower bars removed from the Little Climby frame, toys can be suspended from the frame with the rings. This will improve the baby's eye- hand coordination (Van der Meer et al, 1995). From about seven months, when babies who have experienced plenty of tummy time will start commando crawling and crawling on all fours, the Little Climby frame with all horizontal bars in place will help the baby to pull to stand in a safe way.

We recommend "Tind Grow with me" (Tind Aktivitetspakke) as a safe and fun tool to accelerate perceptuomotor and brain development in babies from birth.

Our research shows that stimulating motor development from birth, by allowing babies to adopt upright and prone positions, is related to an earlier onset of self-produced locomotion which, in turn, gives a boost to the infant brain important for the development of advanced perceptual and cognitive skills https://norwegianscitechnews.com/2016/12/babies-exposed-stimulation-get-brain-boost/.

We recommend Tind Grow with me as a safe and fun tool to accelerate perceptuomotor and brain development in babies from birth.

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Rasulo, S., Vilhelmsen, K., Van der Weel, F. R., Van der Meer, A. L. H. (2021). Development of motion speed perception from infancy to early adulthood: A high- density EEG study of simulated forward motion through optic flow. *Experimental Brain Research*, *239*(10), 3143-3154.

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Van der Meer, A. L. H., & Van der Weel, F. R. (2020). The optical information for self-perception in development. In J. B. Wagman & J. C. Blau (Eds.), *Perception as Information Detection: Reflections on Gibson's Ecological Approach to Visual Perception* (pp. 110-129). Routledge/Taylor and Francis.

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NTNU MSc theses (Psychology & Neuroscience) on the effects of early stimulation on brain development

1. Magdalena Ljungberg Qvarnström (2020): Extra motor stimulation and the development of optic flow perception in infancy: A high-density EEG study.
2. Malin Gullsvåg (2020): A longitudinal study investigating brain responses to an audio-visual loom in extra-stimulated infants using high-density EEG.
3. Katharina Bock (2021): Extra motor stimulation and the development of speed perception in infants: A longitudinal high-density EEG study.
4. Julie Borge Blystad (2021): Longitudinal study of extra-stimulated, full-term control infants, and preterm infants: High-density EEG analysis of cortical activity in response to visual motion.
5. Malin Graneng Olafsen (2022): Longitudinal study on receiving extra motor stimulation in early infancy: High-density EEG analysis of cortical responses to visual motion.

Relevant links to disseminated research findings

Developmental Neuroscience Laboratory/ Nevrovitenskapelig utviklingslaboratorium NTNU

https://www.ntnu.edu/psychology/nulab#/view/about
Audrey van der Meer at NTNU https://www.ntnu.edu/employees/audrey.meer
Nye funn om babyhjernen. NTNU-forskere har funnet ut at hjerneutvikling hos spedbarn kan fremskyndes. Ukeadressa, Bergens Tidende, Stavanger Aftenblad (May 2022)
https://www.aftenbladet.no/magasin/i/a7MaeO/her-forsker-de-paa-hvordan-hjernen-til-magnus-kan-utvikle-seg-raskere
Expert opinion (forskning.no, 2022) https://forskning.no/barn-og-ungdom-hjernen/pandemi-babyer-gjorde-det-darligere-nar-forskerne-malte-motorikk-og-sosiale-ferdigheter/1963685
Participation to Netflix documentary series "Babies" (2020, Part 2, Episode 2)
https://youtu.be/wfE6vwk8Sfs (trailer)
Babyens klossete armbevegelser viser hvor smart de er (Gemini.no)
https://gemini.no/2020/12/babyens-klossete-armbevegelser-viser-hvor-smart-den-er/
Skal spedbarnshjernen modnes eller stimuleres? (2020, produsert og finansiert av NFR)
https://www.forskningsdagene.no/artikler/skal-spedbarnshjernen-modnes-eller-stimuleres!t-8122
Babyer er smarte (podcast) https://open.spotify.com/episode/3wGmkHj2ac5i8kJibg7Mw

Krabbing stimulerer hjernen (forskning.no) https://forskning.no/hjernen-barn-og-ungdom-partner/krabbing-stimulerer-hjernen/631341
Knekker koder i babyhjernen (forskning.no) https://forskning.no/barn-og-ungdom-hjernen-medisin/knekker-koder-i-babyhjernen/515762

Boost your baby's brain (TEDx Trondheim, 2018)

https://www.youtube.com/watch?v=cvX6HOIiN9k

Schrödingers katt (NRK1, 2016), Teknologien som forandrer oss. Episode 3, Er det håp for hjernen? https://tv.nrk.no/serie/teknologien-som-forandrer-oss/sesong/1/episode/3

Research on early stimulation presented at conventions in 2021/2022

Master class at Queen Maud University College of Early Childhood Education (September 2022).
Symposium talk at the European Conference on Visual Perception in Nijmegen, the Netherlands (September 2022).

Keynote speaker at professional day at Children's Clinic (BUK), St Olav's University Hospital (August 2022)
XXIII International Congress on Infant Studies, Ottawa, Canada (July 2022)