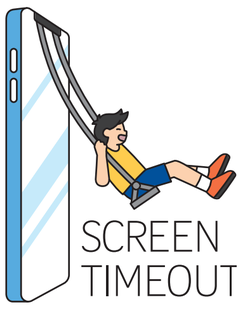
SINGAPORE

Tan Yin Ling smiles, makes faces and plays peek-a-boo with her baby, eight-month-old Raynera, as they take part in an experiment at NUS Medicine, where their brain activity is detected using the equipment they wear on their heads. ST PHOTOS: NG SOR LUAN

More exposure to screens linked to passive brain activity in children: Study



Findings add to evidence that device overuse affects cognitive development and learning

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Tan Yin Ling and her baby, eight-month-old Raynera, are taking part in an experiment at NUS Medicine, where their brain activities are detected using the equipment they wear on their heads.

They sit face to face at first, with Tan smiling, making faces and playing peek-a-boo with Raynera.

There is a beautiful rhythm to their interaction, a back-and-forth response that looks almost like a dance.

Then, under the instructions of clinician scientist Evelyn Law from NUS Medicine, who is conducting the experiment, Tan turns away briefly.

When she faces her daughter again, she is holding her phone, head down and absorbed in reading an e-mail on her phone.

She does not smile and does not react to anything Raynera does.

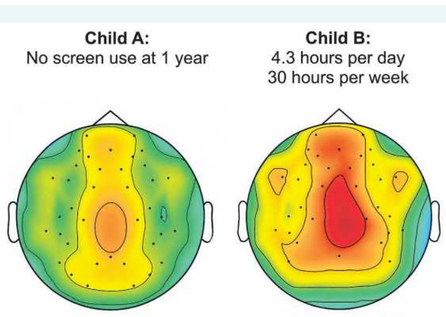
What happens next is most striking.

Within seconds, Raynera senses a change in her mother, and seems to seek assurance from her father. But he is not around. With her mother still unresponsive, she cries, gets agitated and eventually wails.

Adapted from a famous experiment from the 1970s, similar experiments are being replicated around the world. The results are similar – infants cry when their parents and caregivers turn their attention from the child to their mobile phones.

This phenomenon is called "technoference". It is one of the issues being studied by Law, an associate professor specialising in developmental and behavioural paediatrics, and teams of researchers at NUS Medicine and A*STAR, as they examine the effects of screens on children.

They are among researchers worldwide looking into the impact of screen exposure on growing children – including their social, emotional and cognitive development at a young age and into their teenage years.



The study by an NUS team found differences in the brains of toddlers as young as 18 months of age. Child A, who has had no screen time, has more blue and green brainwaves, associated with active thinking and focus. Child B, who has more than four hours of screen time a day, has more orange and red brainwaves, reflecting a more passive and unengaged state. PHOTO: NUS MEDICINE AND A*STAR

BETA WAVES V THETA WAVES

One of the most impactful studies to date by the NUS team led by Law looked inside the brains of babies with varying levels of screen exposure to investigate whether and how it might affect them.

The study, published in 2023 in the peer-reviewed medical journal JAMA Pediatrics, found differences in the brains of toddlers as young as 18 months of age.

Child A, who has had no screen time, has more blue and green brainwaves.

Child B, who has more than four hours of screen time a day, has more orange and red brainwaves.

The blue and green ones are beta waves – faster brainwaves that are associated with active thinking, focus and executive function.

Orange and red waves are theta waves – slower brainwaves that, when a child is awake, reflect a more passive and unengaged state.

Law said the findings add to the evidence that excessive screen time is linked to differences in brain development and learning in children from a very young age.

Law specialises in developmental and behavioural paediatrics at the NUS Yong Loo Lin School of Medicine and National University Hospital. She is also principal investigator at the A*STAR Institute for Human Development and Potential.

The children are part of the GUSTO (Growing Up in Singapore Towards Healthy Outcomes) study, a long-term project that tracks mothers and their children from pregnancy to childhood and adolescence.

When the 500 babies were 12 months old, researchers asked their parents how much time their babies spent with screens on weekdays and weekends. The children were then divided into four groups according to their daily screen exposure – less than one hour, one to two hours, two to four hours, and more than four hours.

Law explained that researchers included TV viewing as part of screen time because a television is a digital display device that emits light, motion and sound, capturing a toddler's attention just like a phone or tablet.

In child development research, any time spent watching a video display counts as screen exposure because it replaces active play, human interaction and hands-on learning.

When the same group of children were 18 months old, the researchers used electroencephalograms to study the electrical activity in their brains. The toddlers wore a flexible cap or "net" equipped with electrodes to detect electrical activity.

This revealed that infants with high daily screen time had disproportionately stronger theta waves compared with beta waves, when they were awake.

WHEN UP IS DOWN, AND VICE VERSA

At age nine, the children in the study were assessed again. The aim was to find out whether screen time and the changes observed in their brain activity had impacted them as they grew up.

This time, the researchers used a neuropsychological test, the Nepsy-II, to assess executive function abilities, such as the ability to focus and pay attention, memory and self-control.

Again, the pattern in the earlier findings held. As screen exposure increased, the greater the difficulties with attention and executive functioning.

In one part of the Nepsy test, a child sees a series of black and white arrows, which randomly point up and down.

First, the child is asked to state the direction of each arrow.

Then the rules change: An arrow pointing up must be called "down", and vice versa.

The next level is even harder: The children are asked to state an arrow's correct direction when it is black and the opposite direction when it is white.

Law explained that this test measures attention, self-monitoring and inhibitory control – how well the brain can adapt when the rules of a task change suddenly, and the ability to override an automatic response and do the opposite.

These are the same skills children with executive function deficits struggle with when they have to follow multi-step instructions, control an impulse, persist in a difficult task or manage their impulses or emotions, she said.

These are essential skills for learning, Law added.

So what does screen time actually do to the brain?

According to the researchers, one explanation is that the bombardment of fast movements, sounds and scene changes can leave few resources for the brain to build self-regulation skills. This then leads to an inability to follow multi-step instructions or persist in challenging activities.

Law, who is a mother of two children, said the findings of the study made her think of the times she herself had resorted to using the TV or iPad as a babysitting tool.

"I am a parent myself and I know how hard it is to keep screens away from kids. But as the brain scans and Nepsy test results show, it is important for all of us, parents and caregivers, to keep screen time to a minimum."

The results of the Singapore study are not isolated findings. Research elsewhere in the world has also found possible links between more screen exposure and differences in brain development, cognition and behaviour.

Research carried out in the Cincinnati Children's Hospital in the US using brain scans found that higher screen usage among children of pre-school age was associated with "lower integrity" in parts of the brain supporting language and emergent literacy skills.

The US Adolescent Brain Cognitive Development Study (ABCD Study) has similarly found links between high digital media use in youth and structural differences in brain regions tied to visual processing, attention and memory. More behavioural problems were also reported among the youngsters by their parents.

ABCD Study, the largest long-term study of brain development and child health in the US, tracks nearly 12,000 young people starting at ages nine to 10 till early adulthood.

HOW TO MITIGATE SCREEN-TIME IMPACT

But all is not lost.

Law said that the effects of screen time can be mitigated.

For children under five years of age, Law said parents should seize every opportunity to talk and play with them.

A baby does not need to be able to speak to benefit from conversation.

"Parent talk is one of the most important things you can do with your child to develop their brain," Law said.

In early child development research, back-and-forth exchanges between a young child and a caring adult are called "serve and return".

A glance, a pointed finger, a little kick of the legs, making a sound or a facial expression – these are a child's "serves", said Law.

When a parent responds by naming what the child sees, does or expresses, the exchange helps build early language and social connections in a developing brain.

These serve as a foundation for more complex cognitive abilities that form later in life.

"Whether it is playing or reading a book together, the best thing about serve-and-return interactions is that you don't need any special knowledge or training to do it. It's just you and your baby or child having fun and responding to each other," Law said.

She also recommends reading books aloud to babies.

When a father and his young son play and read together, their brain activity, heartbeats and breathing often synchronise, she said, pointing to research done in her lab as well as research led by Alan Mendelsohn, a renowned developmental-behavioural paediatrician at New York University.

This shared rhythm calms their developing mind, while the reading itself stimulates the child's frontal lobe and builds crucial neural pathways for language and emotional safety.

Another study using some children from GUSTO, headed by researcher Tan Ai Peng at NUS and A*STAR, showed that parent-child reading at the age of three acts as a critical buffer against the negative neurological impacts of early childhood screen time.

In a study published in Psychological Medicine in 2024, the team found that infant screen time can alter brain networks that govern emotional regulation, but consistent parent-child reading could counteract some of these brain changes.

The finding points to what screens cannot easily replicate: the back-and-forth of a shared experience, from language exposure and responsive interaction to emotional connection.

Given how crucial the bond between a parent and baby is to a child's healthy development, and how building this bond requires parents to respond appropriately to their child's cues, technoference is a huge problem, Law said.

Observational research done by the University of Washington in the US has found that 35 per cent of parents spend about one in every five minutes of their time – or even more – on their phone while at the playground with their child.

Babies look to parents and caregivers to learn how to calm down. Occasional phone use by parents is normal, said Law, and not harmful to children, especially when parents know how to re-engage with the baby and repair the connection.

When Raynera got upset and wailed, Tan softened her facial expression and started interacting with her again, re-establishing and repairing their connection.

But Law cautioned that if those moments of connection between parent and child are repeatedly interrupted and for long periods of time, there may be fewer opportunities for this kind of co-regulation and social-emotional learning.

"Constant inattentiveness can also lead to higher anxiety or attachment issues in children over time," she added.

What we have to ask ourselves is this, she said: "Do we need to disconnect to reconnect with our children?"

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Tan turns away briefly. When she faces her daughter again, she is absorbed in reading an e-mail on her phone. She does not smile and does not react to anything that Raynera does. Within seconds, the baby senses the change.

Puzzled by her mother's sudden unresponsiveness, Raynera looks around for her father, seeming to seek assurance from someone else. Not seeing him, she cries, as if protesting that Tan is no longer available to her.

Evelyn Law, an associate professor and clinician scientist from NUS Medicine and the National University Hospital, with the flexible cap or "net" used by Tan and Raynera, which is equipped with electrodes to detect electrical activity.

KEY TO KEEP SCREEN TIME TO MINIMUM

I am a parent myself and I know how hard it is to keep screens away from kids. But as the brain scans and Nepsy test results show, it is important for all of us, parents and caregivers, to keep screen time to a minimum.

EVELYN LAW, an associate professor specialising in developmental and behavioural paediatrics and a mother of two. The study findings made her think of the times she resorted to using the TV or iPad as a babysitting tool.