Learning in a Multisensory World

Grant Completion Research Summary, January 2018

THANK YOU!

We would like to express our gratitude to all the schools, teachers, students and parents who supported our research. **Over 2000 children have taken part in our studies!** Without their and your help, educational research involving school-age children could not take place and go on to inform future best practice.

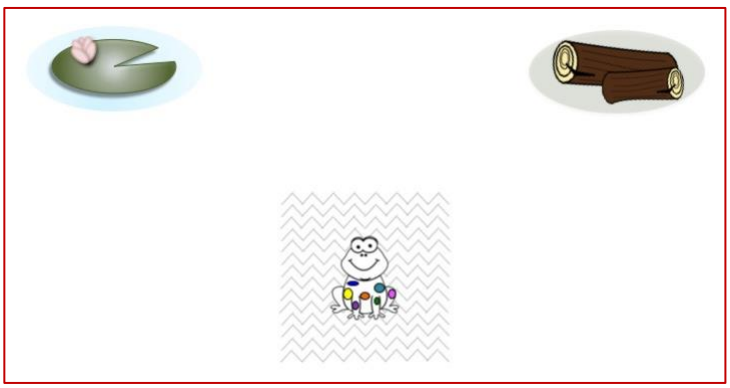
RESEARCH FINDINGS

The aim of our research was to understand how multisensory information helps children learn at different ages. Multisensory learning uses information that is available to different senses at the same time, for example visual and auditory. Research has established that this method of learning is beneficial to adults, yet there has been no systematic research of this in children. We wanted to find out if children learn best using more than one sense, and which sense or combination of senses optimise learning for children of different ages.

Overall, we found that the combination of visual and auditory information enhances category learning for children aged 5 to 10 and also improves retention of learning. Interestingly, two pieces of visual information or two pieces of auditory information also enhanced learning more than having just one piece of sensory information. However, not quite to the same extent as having information presented across different sensory modalities. Reinforcing learning with two pieces of sensory information, from the same or different sense, appears particularly beneficial for the younger children, who performed less well than the older children when presented with just one piece of sensory information. Furthermore, findings from our studies suggest that even though visual information dominates auditory information, tactile information dominates visual information.

Multisensory Attention Learning Task – Catch the Frog! (MALT, MALT24, MALT4, MALT2C)

What we did



To find out if two types of visual or two types of auditory information presented simultaneously are as effective as multisensory (audiovisual) information at enhancing learning. Children were shown a series of cartoon animals and instructed to press a key whenever they saw a frog. The frogs differed based on how they looked and/or sounded. Each time the child caught a frog it travelled to its home. After the game, the children were shown a series of frogs and asked where they lived. The children were not explicitly asked to remember where the frogs lived as we wanted to see how different sensory information impacted on their incidental learning.

What we found

After testing over 1000 children (!), in five differing versions of Catch the Frog, it appears that the combination of auditory and visual information enhances incidental category learning and retention of that learning. However, it also appears that two pieces of visual information or two pieces of auditory information are almost as effective as multisensory information at enhancing learning. Specifically, younger children particularly benefit from having their learning reinforced with an additional piece of auditory or visual information.

Alien Beanies & Alien Beanbods (Sight & Touch)

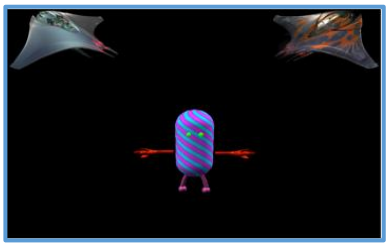
What we did

Children played a live action game where they had to categorise 'alien' beanbags as belonging to one of two spaceships using multisensory information (touch-visual) or unisensory information (visual-only or touch-only). Children guessed where the alien lived based on how it looked, how it felt, or how it looked and felt, and were then told if they were correct or not. This allowed them to make more informed guesses throughout the game. At the end of the game children were asked how they knew where the aliens lived. We were interested to see how the different types of sensory information influenced learning outcomes.

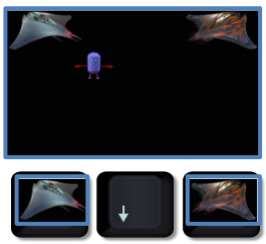
What we found

All three age groups (5, 7 and 10 year olds) performed more poorly when given visual-only information. All ages performed just as well with touch-only information as they did with multisensory information (both touch and visual). Also, when asked what information they used, most children reported that it was the touch-only information, even when they were also given visual cues. In conclusion, touch information appears more powerful than visual information.

Aliens and Spaceships

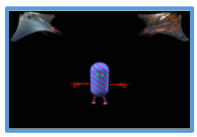


'Which spaceship do you think this alien lives in?'



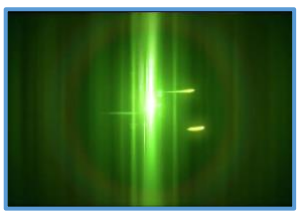
Left/right response

Auditory only



Visual only

Unimodal presentation



Aliens teleport to their correct home

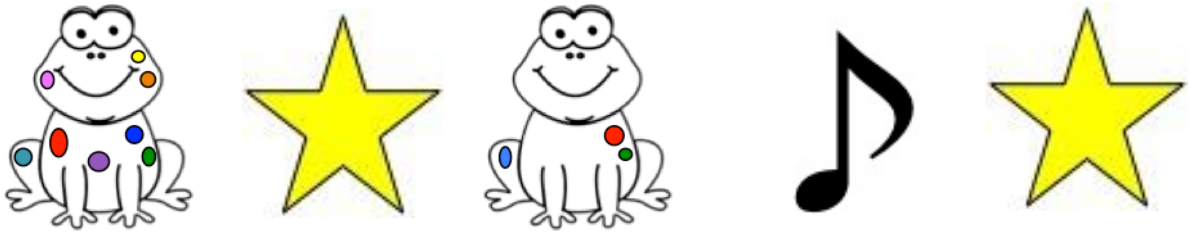
What we did

Children were initially shown different multisensory "aliens" which varied by look and sound, and asked to guess which spaceship the aliens belonged to. The computer then sent the alien to the correct spaceship. The children used this feedback to learn the spaceship categories. After the training game children were shown unisensory aliens, and asked where they lived. In a previous category learning task, audiovisual information supported learning by 5-year-olds,

but by 10 years of age, children performed better using auditory-only information. We wanted to know if in the multisensory condition, children are learning both modalities equally during the task or if they are grouping information together.

What we found
Results suggest that learning using multiple modalities does indeed support learning of each individual modality. In addition, children who learned the categories during the training session performed better than those who didn't on both types of unisensory trials. Interestingly, children of all ages also performed better on auditory versus visual trials. This suggests that the different senses are not equal when it comes to multisensory learning.

Frogs and Stars



What we did
We wanted to find out how children can hold their attention on two tasks at the same time during an incidental learning task (where the learning is secondary to the primary task), and how additional auditory, visual, or combined auditory *and* visual information helps or hinders their learning. During the game children were asked to press a key to catch multisensory ribbiting frogs, whilst ignoring other animals. At the same time, children were asked to count either the number of stars that flashed on screen (visual), the number of dings they heard (auditory) or the number of multisensory stars (dinging stars that flashed up on screen). Once frogs were caught they travelled in a net to their home; either a lily pad or a log. After the game, children were shown frogs from the game and asked where they lived and how they knew that.

What we found
Results found that children who were asked to count dings (auditory only) on a concurrent task had poorer performance on incidental category learning compared to children who had to count stars (visual only) or dinging stars (multisensory). At 5 years of age, category test performance was at chance in the auditory-only condition. This suggests an auditory-only concurrent task may interfere with learning in younger children, but the addition of visual information may serve to focus attention; a finding not seen in older primary school children. This may be to do with difficulties in younger children in switching between using different sensory modalities. So if they are given a visual task, a secondary auditory task is more distracting than other tasks that include visual information.

Faces

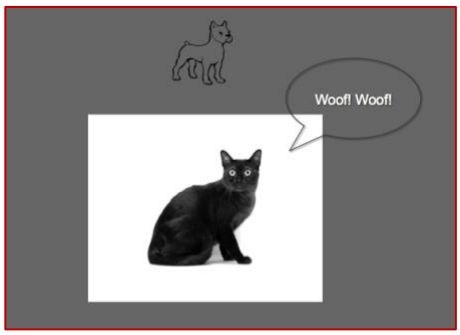
What we did
Children were shown different computer generated faces with "funny" eyes and asked to decide where the faces were looking. The eyes were blurred and became more so depending on the child's performance, increasing the uncertainty of gaze direction. The children were then shown two different faces in succession and asked to determine which face was looking more in a certain direction. Gaze perception in children

develops over time. Interpreting gaze accurately is an important indicator for what people plan to do. Adults have a tendency to think ambiguous eye gaze is directed at them. We were interested in how accurately children of different ages perceive eye gaze in faces of all ages and if they have the same interpretation bias as adults.

What we found

Initial findings suggest that children look at faces of other children differently to how they look at faces of adults. Specifically, children look more to where an adult face is looking, but they don't seem to do this with other children's faces.

Cross-Modal Task-Switching



What we did

In cross-modal task-switching, children and adults were instructed to detect the target which could randomly appear on the screen (visually) or through headphones (auditorily). The target categories were birds (noise or picture) and dogs (noise or picture). In the task-switching condition the target category occasionally changed, and so children had to pay attention to which target they were looking for. We were interested in understanding whether children and adults would show a similar behavioural pattern when switching attention between senses and between tasks.

What we found

Switching attention between senses and between modalities required different attention controls. We found that younger participants showed larger made more errors and were slower when switching from one task to the other. In contrast, even though shifting attention between different senses produced these errors, the errors were the same across different ages. Interestingly, shifting attention from visual target to auditory target was more difficult than shifting attention from auditory target to visual target.

FUTURE RESEARCH

We are always in great need of more schools to take part!

If you, your school, or any other schools you know would like further details or to take part in our research at the Centre for Brain and Cognitive Development, *please get in touch*. Our research is ongoing and support from schools is greatly appreciated.

Email babylab@bbk.ac.uk

Best wishes,

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