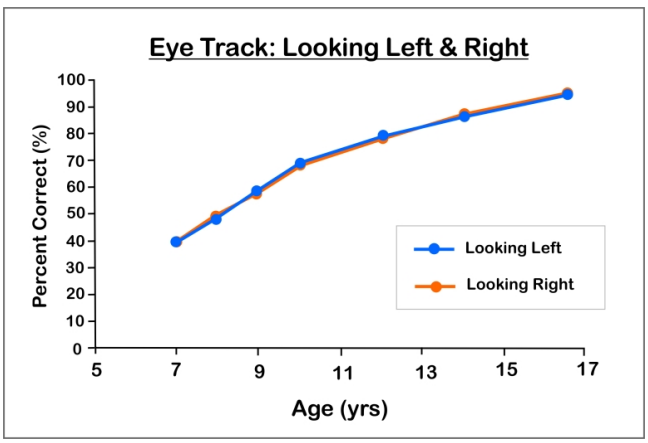
For ages 7 to 17 years of age

THE ICEPT TASKS

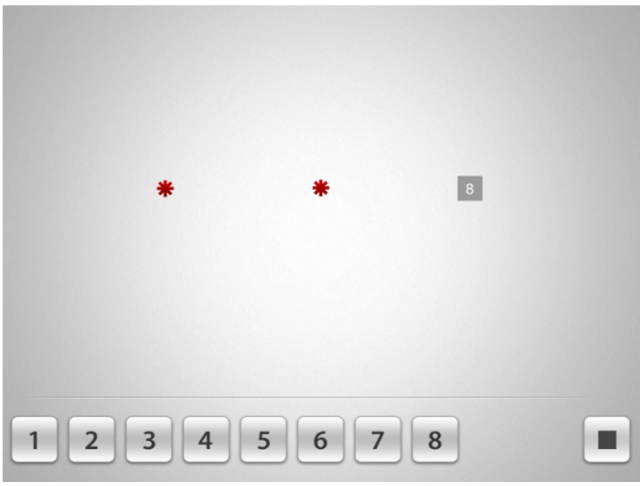
EYE TRACK

Voluntary saccades or "anti-saccades" (so called because the subject is asked to look the other way to the test stimulus) requires making consciously directed eye movements. This taps the neural pathways active for reading. In every day viewing however we do not need the same level of eye control as we do for reading a book, hence despite making over a hundred thousand eye movements a day this will not result in highly developed voluntary saccades. Poor voluntary eye saccades will lead to skipping words and lines (ie. reading errors) and can also affect maths and handwriting.

Voluntary saccades are controlled by the frontal cortex in the brain (the last part of the brain to mature) and thus provide a very sensitive marker of neurological dysfunction (eg. due to developmental delay, premature birth or trauma such as in closed head injury).



The iCept task used to measure eye tracking is called "**Eye Track: Voluntary**". It is actually a *dynamic perceptual task* since it does not directly measure saccades. To do so would require measuring the saccades with an eye tracking device. The test is a reasonable approximation but it will tend to UNDER ESTIMATE the problem. Consequently, if a student fails on ANY part of the Eye Track: Voluntary task on iCept testing (even the central finding) then they should be considered as a candidate for eye tracking therapy. Sometimes a student will PASS the Eye Track test BUT STILL have a problem with their voluntary saccades or some OTHER aspect of their eye movements. The decision may therefore be made to train voluntary eye tracking *despite* the seemingly good results.



Details: The iCept test compares the mean scores of 40 eye movements to the left, 40 eye movements to the right and 20 in the centre (a total of 100 eye movements) to a control database of 700 students no more than 6 months behind in reading, spelling and maths. The test flashes a star to one side and then moments later a number to the other side (see slide). Although an initial shift of attention may be made towards the star, if a full eye movement is made to the star it is extremely difficult to detect the number. To generally see the number correctly requires moving the eyes in the direction of the number.

Binocular Stability – This refers to how stable the two eyes are with respect to each other. Like saccades, stability improves with age and can also be improved with training. Binocular stability is worse at near when turning our eyes in for reading and is most stable when looking at distance. Training may involve alternate occlusion (ie. alternately covering one eye while doing reading and/or eye tracking training) over a period of weeks to months and best works until around age 10 to 12 years.

Training Saccades – for older students more days (sessions) are added for saccade training. Most 7 year old children should be expected to reach the top level for iCept Eye Tracking: Voluntary. In some cases students will reach the top levels in just a few days. This does NOT guarantee however that their

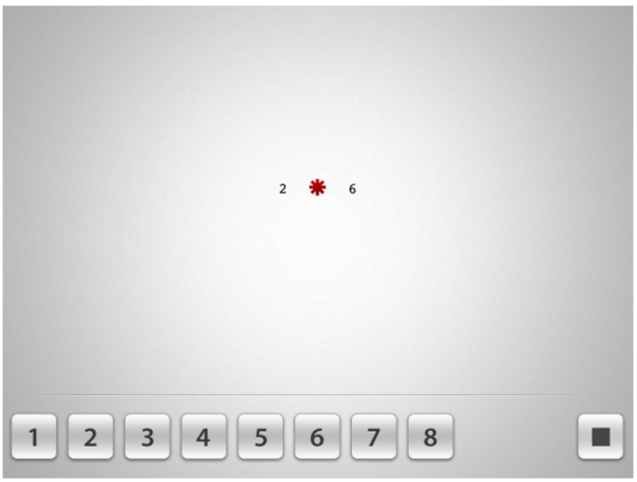
tracking is normal since if they were analysed on an eye tracking device it would show they are still significantly delayed. It is therefore **very important** for students to stay with the *full number of training sessions* even if they reach the top level since improvements are still occurring at a neurological level. Studies show that training voluntary saccades improves both reading accuracy and fluency. Fixation and Reflex eye movement training should only be done if advised by an optometrist.

VISUAL SPAN

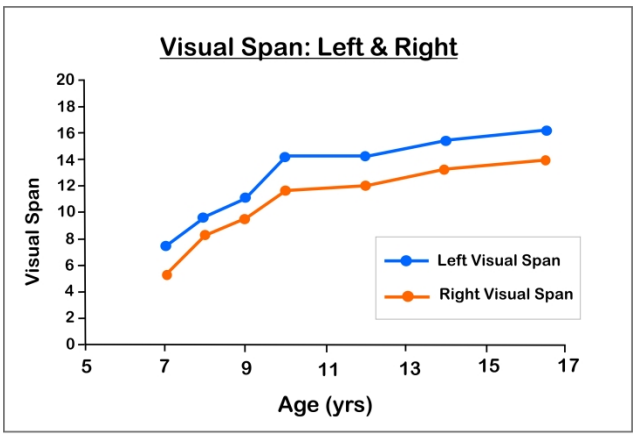
The *visual span* has been defined as the number of letters in a line of text that can be recognized reliably without moving the eyes. It should not be confused with the *perceptual span* which is a dynamic span described by Rayner for reading (which is about 15 characters to the right and 4 to the left - although reverse for readers of Hebrew) and is influenced by eye movements as well as linguistic factors.

The visual span predicts reading *independently* of phonemic awareness and accounts for around 34–52% of variability in reading speed and is known to be impaired in dyslexia. Training the visual span has been shown to improve reading speed.

Details: The method used by iCept to test the visual span uses a central fixation target and two numbers flashed on either side in parallel (see below). This effectively measures the *uncrowded window of visual attention*. Training the window of attention (crowded or uncrowded) allows more characters to be processed in parallel which increases the visual span thus allowing faster reading speed.



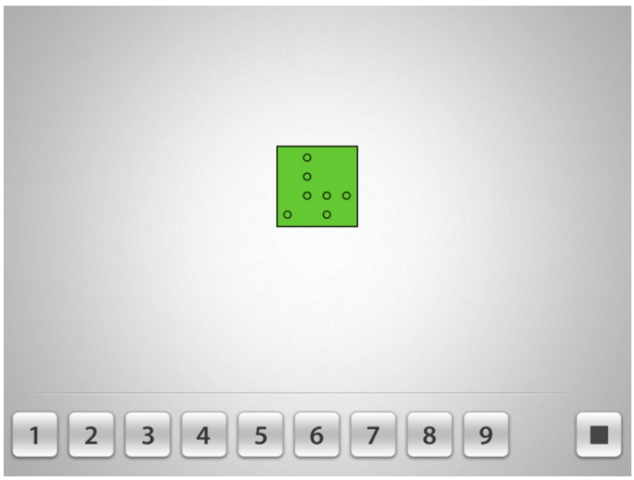
The iCept visual span test assesses the window of attention for both the left and right side and compares this to age expected values. Development is not quite linear as the most rapid development occurs during the first 10 years and then slows down after this. This is consistent with all the other visual tasks and probably reflects the development of the magnocellular pathways. The long development period also suggests a high level of plasticity in the visual system. A curiosity is the slightly larger window of visual attention found on the left side. It has been reported by other investigators that attention to the left visual field is more accurate compared to the right visual field for *both* American college students and also Israeli students who read Hebrew.



Training the visual span should be commenced if the results are failed on *either* the right or left side.

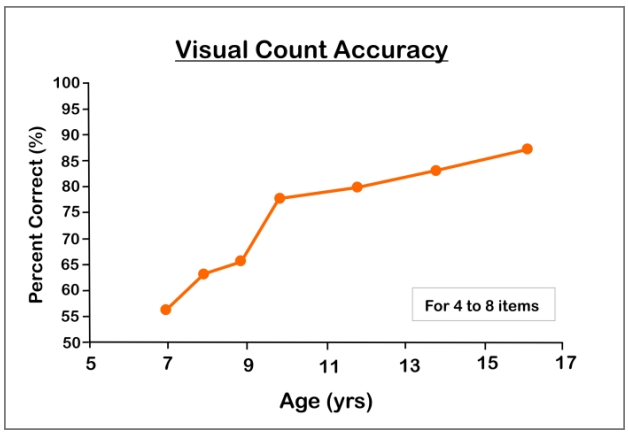
VISUAL COUNT

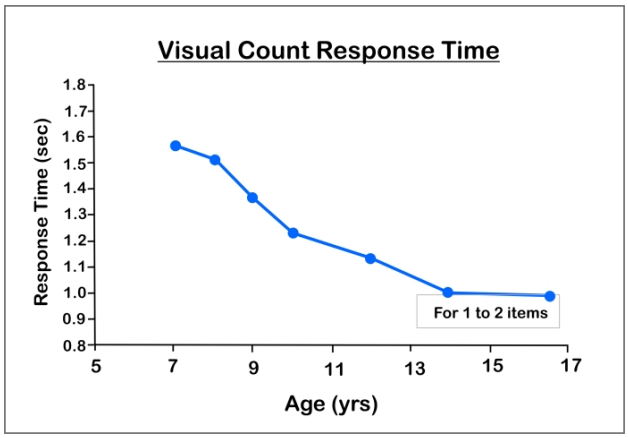
Measures how many items can be recognised per look without counting (subitizing) in addition to those visually counted. Most adults can subitize around 4 to 5 items when presented quickly but after this we tend to count them in our head which requires visual memory. It is foundational for *number concept* in basic arithmetic and also allows us to estimate the number of letters in a word.



Details: The iCept test measures the response times or perceptual speed for 1-2 items (which is similar)

as well as the response times for 4-8 items (which increases in a linear fashion so a regression analysis is applied). Note that if the response time/item is 0.34 seconds then the mean time for responding to 6 items is 0.34 x 6 = 2.04 sec. The *accuracy* for 4-8 items is also displayed. Training should be considered if ANY one of these parameters is reduced and *especially* if the student has a problem with basic arithmetic. If any of the results are borderline the general rule is to include this for training if other skills are failed OR if other skills are passed then it should at least be re-checked again in 6 months.



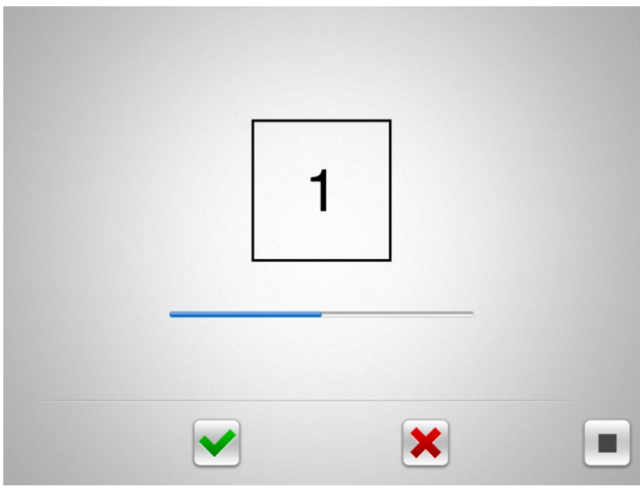


Improving the skill of visual count training has been shown to improve basic arithmetic operations however it is also useful for training simultaneous memory and probably assists with reading due to the fact that we attend to all of the letters in a word when we read (even for whole word reading).

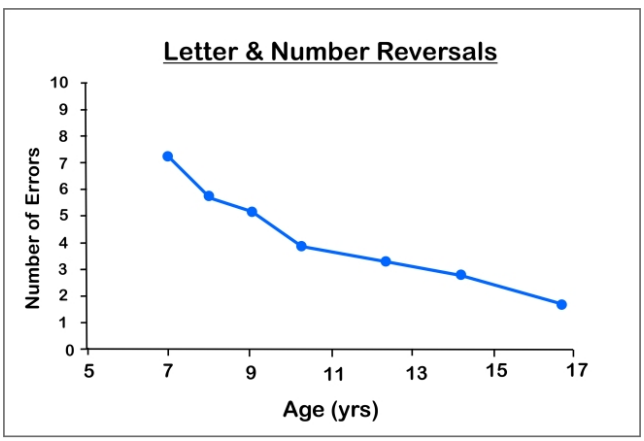
VISUAL SPATIAL

The focus of Visual Spatial is *directionality* which may reflect an underlying problem with our awareness of body space. As we get older we may learn to compensate for this by using external cues or linguistic mechanisms (eg. phonological, semantic and syntactic) for making spatial decisions. The nature of the spatial problem is thought to be at the *automated* level which affects rapid naming of letters and numbers.

Students who fail this may still be good at other spatial skills that use higher cognitive functions (eg. the WISC-R Block Design Test). Training on iCept is advised for students 10 years and below. It requires working with a parent at home or a teacher aide at school. For younger students we advise that the "Reduce Difficulty" button is selected when necessary. For older students with severe spatial difficulties (ie. more than 10 errors on the iCept test) then training may still be advised. Generally speaking however older students are less keen to engage in this type of intervention and prefer to work autonomously.



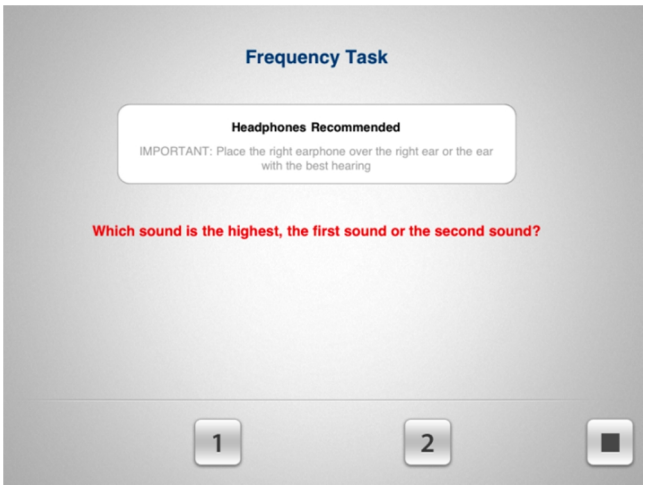
The main GOAL of visual spatial training is to improve directionality. This is an important foundation for eye tracking and most visual tasks. Making less letter reversals, not losing place and better fine motor control are all key indicators of improved visual spatial development. The method used by iCept links visual coding to kinaesthetic awareness (Stepping Arrows & bdpq's) and vice versa (Body Map). This requires both visual recognition and visual recall. More recently, it has been shown that targeting the visual spatial network directly can improve reading performance.



AUDITORY DISCRIMINATION

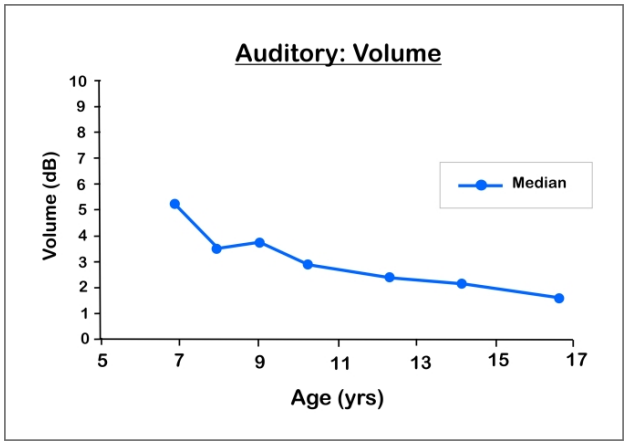
Auditory processing is essential for distinguishing word sounds (phonemic awareness). Like visual processing there are many tests of auditory processing including *auditory discrimination*. The iCept app includes 4 such tests: Volume, Gap Detection, Frequency & Temporal Order. Poor auditory processing may be referred to as Auditory Processing Disorder or APD. Testing auditory processing is found to be more *variable* than testing for visual processing and in some cases students cannot accurately discriminate the sounds at even the most basic level despite the fact they seem to understand the test. These are referred to as "Low Performers". A problem with the *frequency* and *temporal order* task is characteristic of dyslexia.

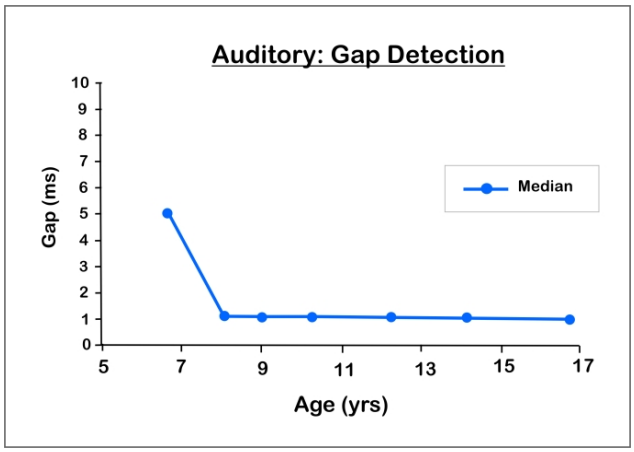
Details: This test should be done on the iPad with the volume set to HALF WAY (8 clicks). The right earphone should cover the right ear or the ear with the best hearing if there is a known problem. The reason for this is because the time dependent tasks (gap detection and temporal order) use only *one* earphone (right side by default) to avoid any timing difference. The threshold is taken as the last correct response made following 3 errors in the last 6 presentations.

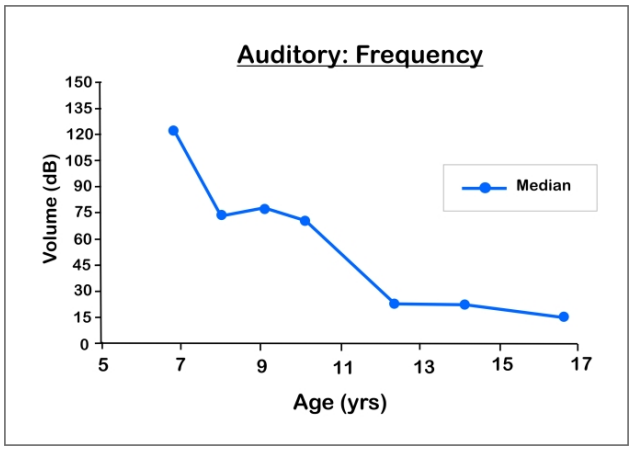


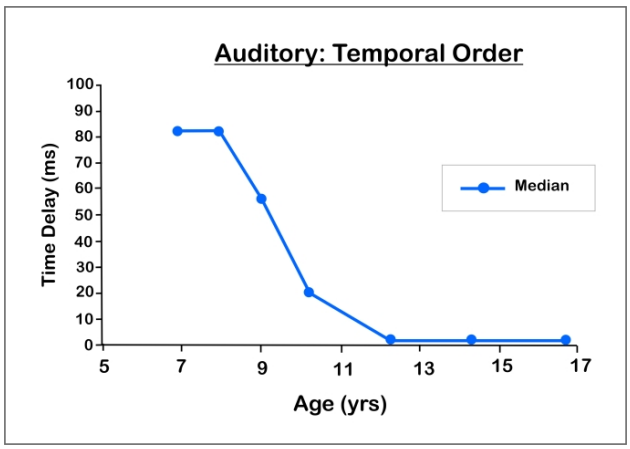
It is interesting to note that if one or more of the auditory tests are failed this is *less* likely to be associated with an observable learning difficulty than if one or more visual tests are failed. This probably reflects the fact that most of our learning is derived from vision. If *all* of the auditory tests are failed but a student has a history of normal hearing (from the school screening), this is considered to be an adequate basis for training. Training takes 10 days for each task but often needs to be repeated.

If the skills fail to improve or the history indicates, then referral to an audiologist who specializes in APD may be necessary.









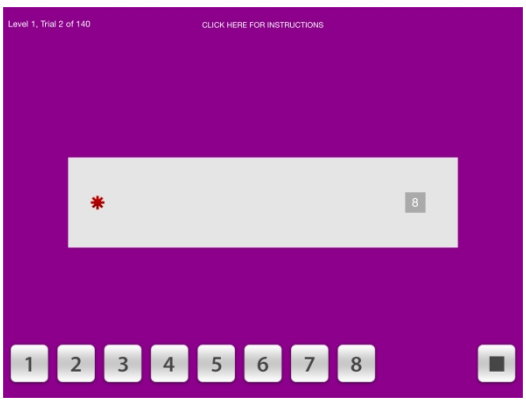
Auditory training has been shown to help students who have problems with spelling (converting sounds to words - the opposite of reading). It is also likely to be helpful for following instructions and decoding words for beginner readers. It should be noted however that NOT all spelling problems are caused by auditory deficits! Often poor spellers have poor visual spatial skills for example.

PREVALENCE OF PROBLEMS

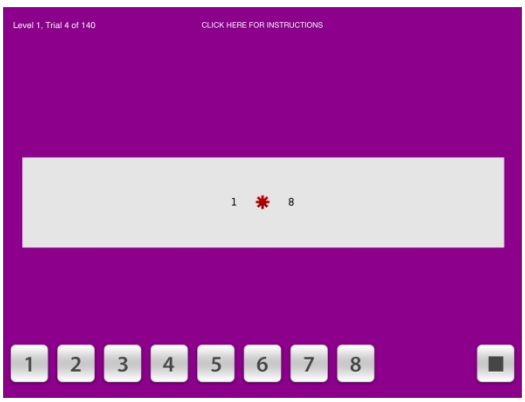
Preliminary investigation by VFL indicates a high prevalence of visual and auditory developmental problems. It is estimated that at least two thirds of children at primary school fail in at least one of the 8 iCept tasks (4 visual and 4 auditory). Furthermore, it is estimated that around a third of primary aged students 7 years and over fail in at least 2 visual tasks (the fail criteria for optometric referral). A certain percentage of students failing the auditory tasks are “Low Performers” who will improve over time without any specific intervention.

GRAPHICS OF TRAINING

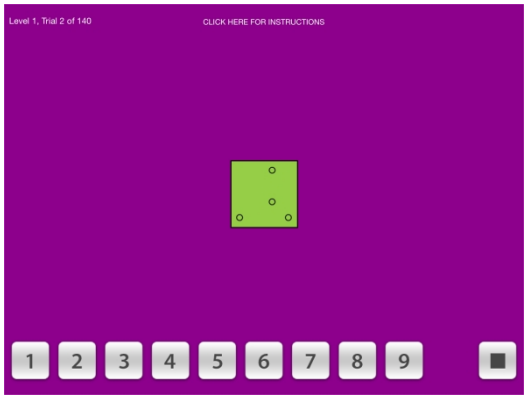
EYE TRACK: VOLUNTARY



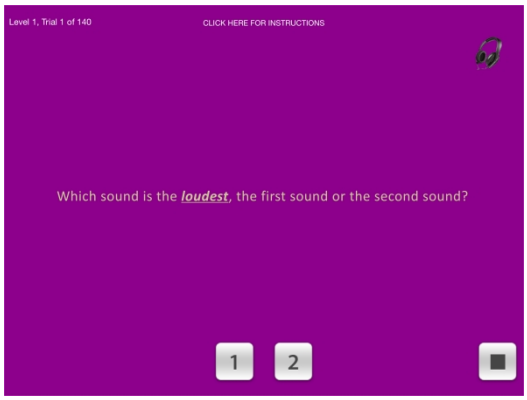
VISUAL SPAN



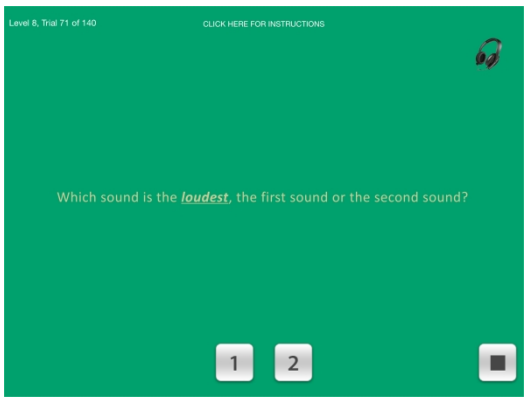
VISUAL COUNT



AUDITORY (4 Tasks)



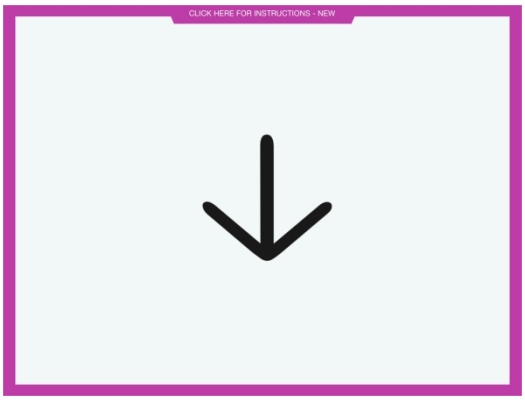
HALF WAY (Background colour changes)



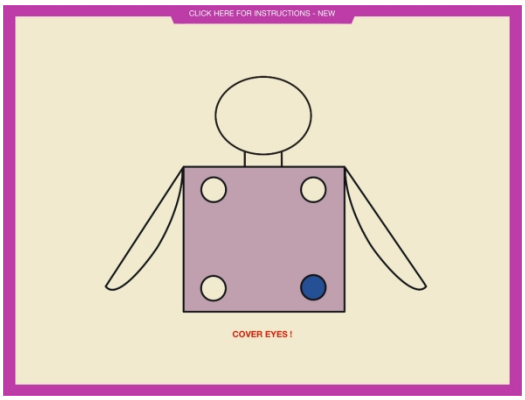
VISUAL SPATIAL

The visual spatial training changes as the levels progress. These are referenced below.

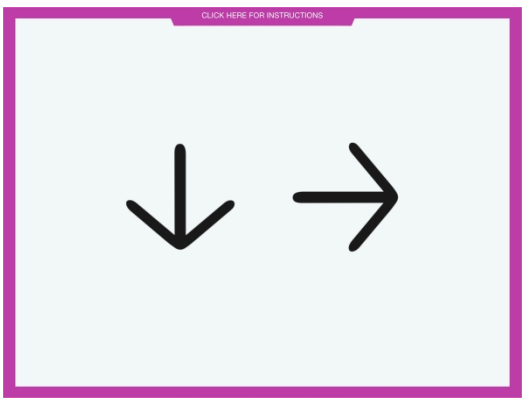
Level 1: Stepping Arrows
INFO: Sequence of 1, 8 trials



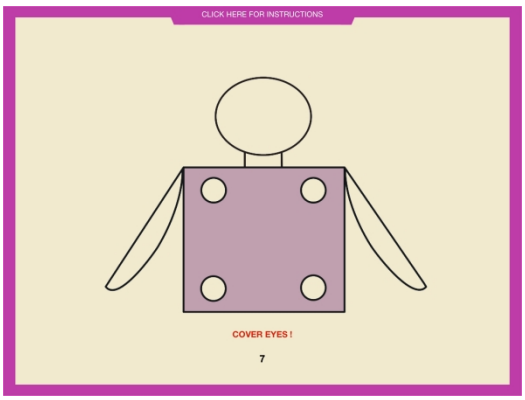
Level 2: Body Map (2x2) – 4 points
INFO: Sequence of 1, 6 trials (random)



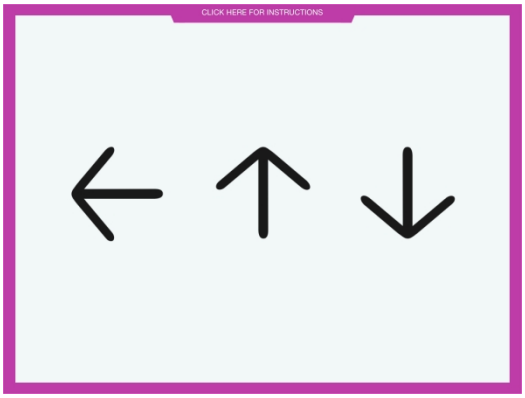
Level 3: Stepping Arrows
INFO: Sequence of 2, 6 trials



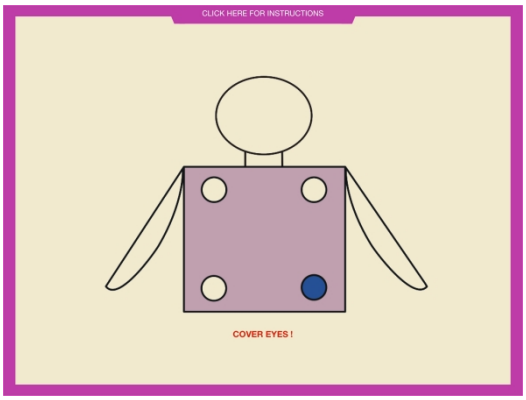
Level 4: Body Map (2x2) – 4 points
INFO: Sequence of 1+time delay, 6 trials



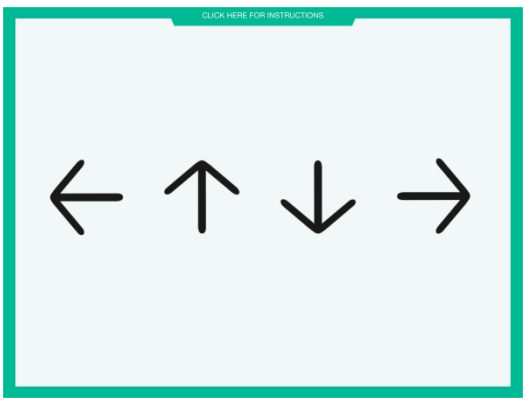
Level 5: Stepping Arrows
INFO: Sequence of 3, 6 trials



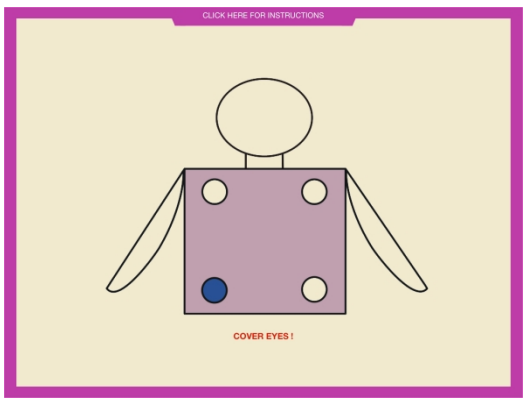
Level 6: Body Map (2x2) – 4 points
INFO: Sequence of 2, 6 trials



Level 7: Stepping Arrows
INFO: Sequence of 4, 6 trials

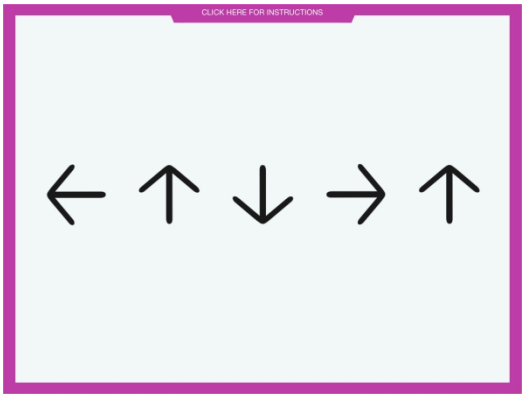


Level 8: Body Map (2x2) - points
INFO: Sequence of 2+time delay, 6 trials



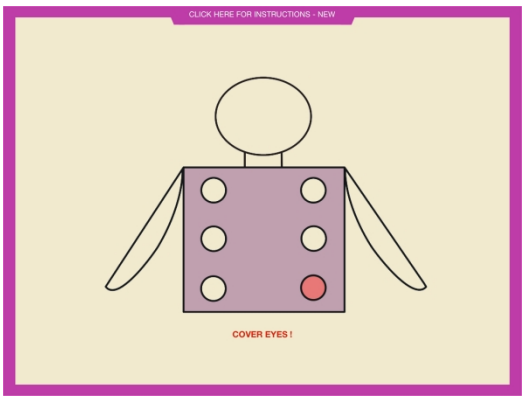
Level 9: Stepping Arrows

INFO: Sequence of 5, 6 trials



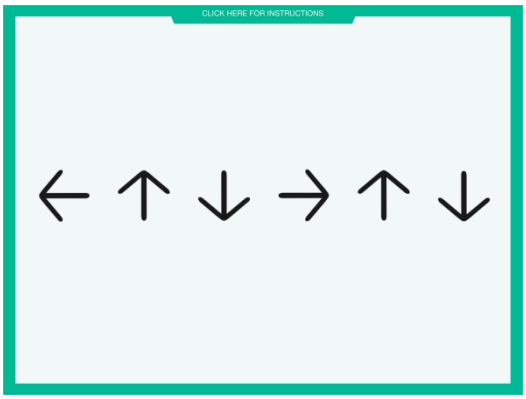
Level 10: Body Map (2x3) – 6 points

INFO: Sequence of 1, 6 trials



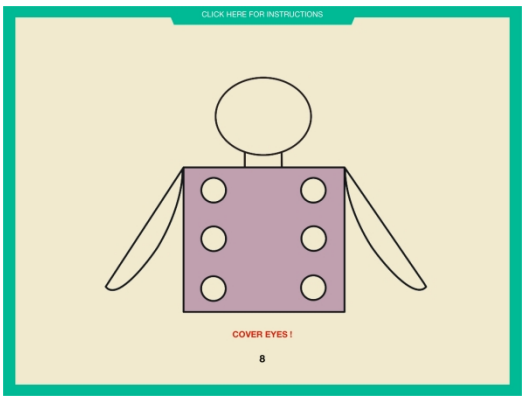
Level 11: Stepping Arrows

INFO: Sequence of 6, 6 trials



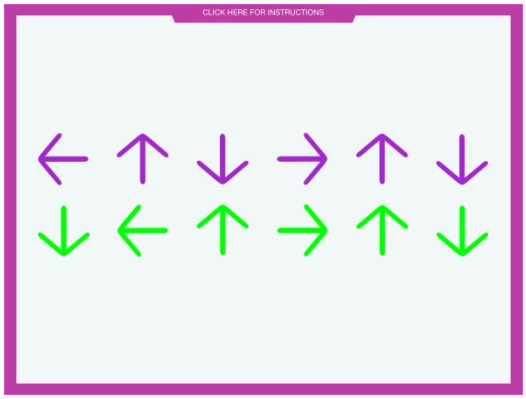
Level 12: Body Map (2x3) – 6 points

INFO: Sequence of 1+time delays, 6 trials



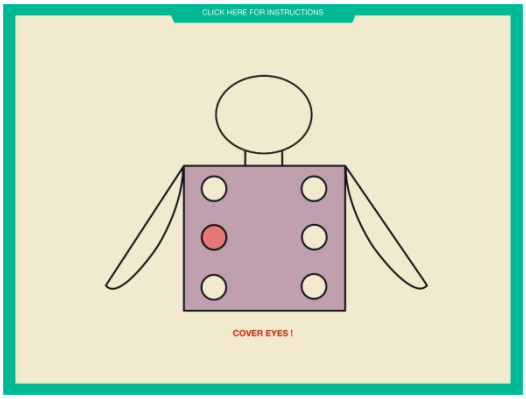
Level 13: Stepping Arrows

INFO: Sequence 6 arrows, 2 lines alt. colours



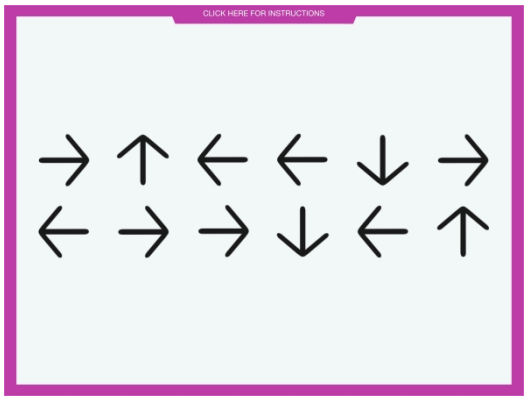
Level 14: Body Map (2x3) – 6 points

INFO: Sequence of 2, 6 trials



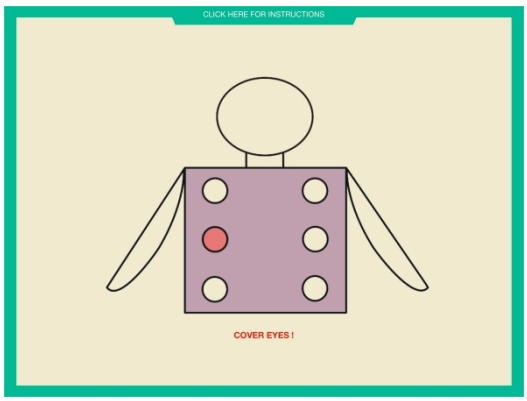
Level 15: Stepping Arrows

INFO: Sequence of 6 arrows, 2 lines same colour



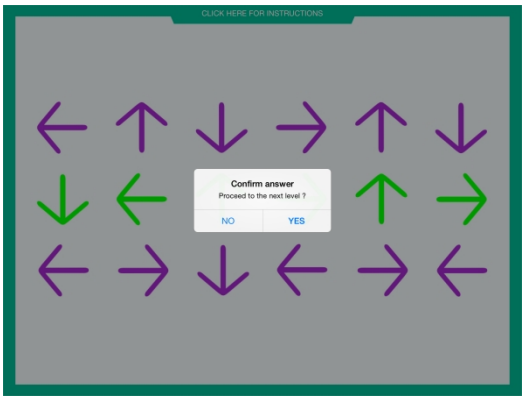
Level 16: Body Map (2x3) – 6 points

INFO: Sequence of 2+time delay, 6 trials



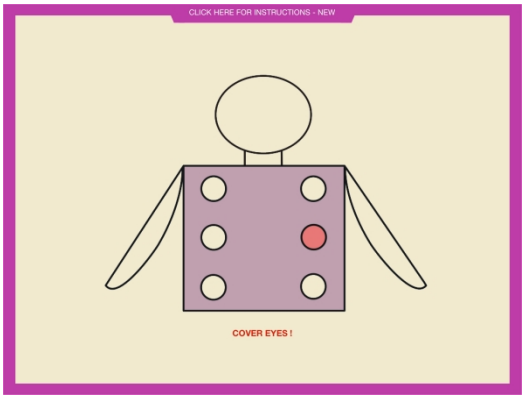
Level 17: Stepping Arrows

INFO: Sequence of 6 arrows, 3 lines alt colour



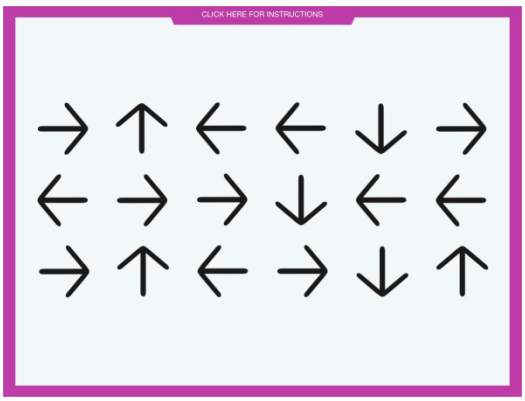
Level 18: Body Map (2x3) – 6 points

INFO: Sequence of 3, 6 trials



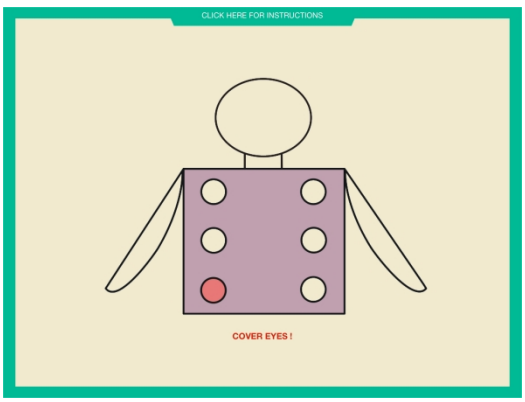
Level 19: Stepping Arrows

INFO: Sequence of 6, 3 lines same colour



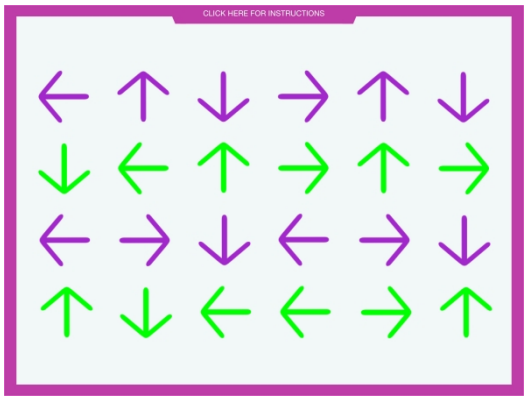
Level 20: Body Map (2x3) – 6 points

INFO: Sequence of 3+time delay, 6 trials



Level 21: Stepping Arrows

INFO: Sequence of 6, 4 lines alt colour

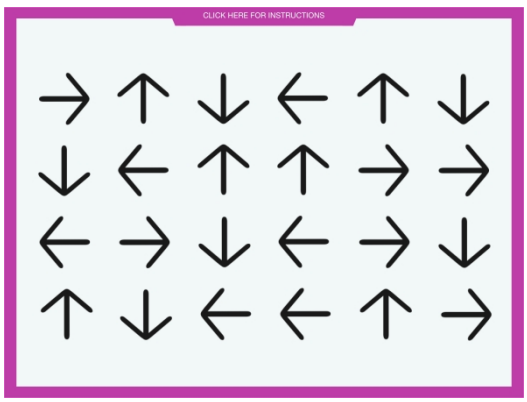


Level 22: bdpq

INFO: Sequence of 1, 6 trials

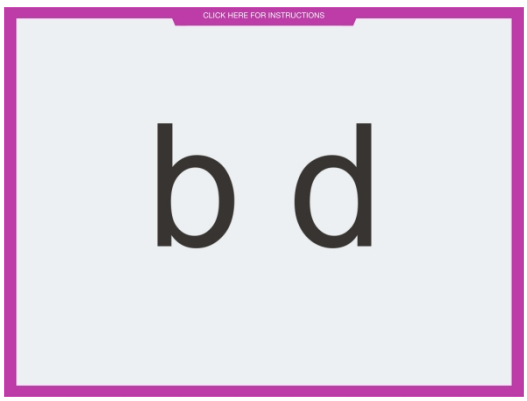
Level 23: Stepping Arrows

INFO: Sequence of 6, 4 lines same colour



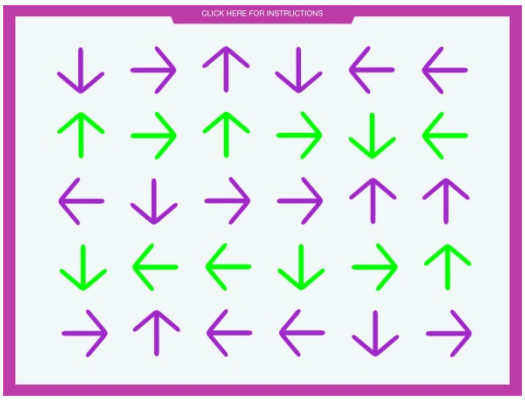
Level 24: bdpq

INFO: Sequence of 2, 6 trials



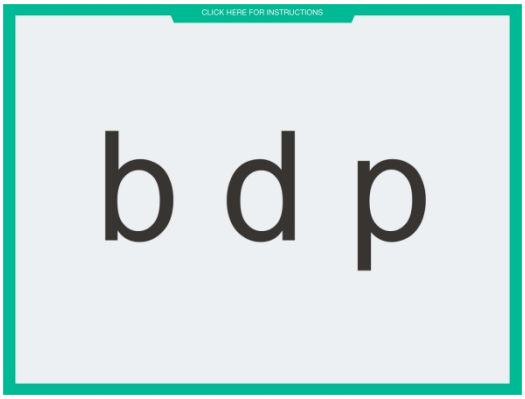
Level 25: Stepping Arrows

INFO: Sequence of 6 arrows, 5 lines alt colour



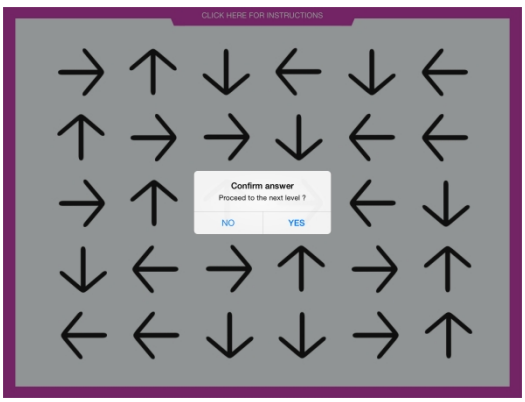
Level 26: bdpq

INFO: Sequence of 3, 6 trials



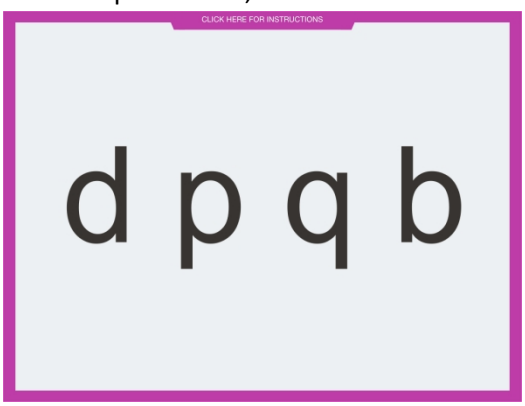
Level 27: Stepping Arrows

INFO: Sequence of 6 arrows, 5 lines same colour



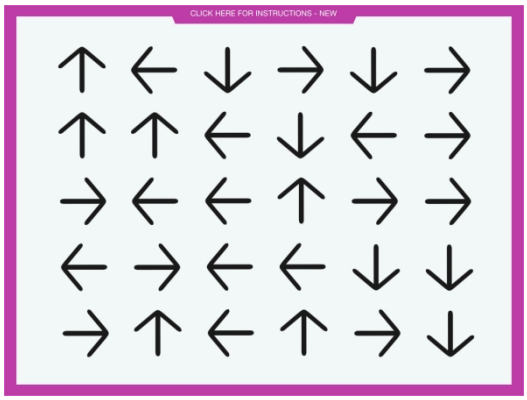
Level 28: bdpq

INFO: Sequence of 4, 6 trials



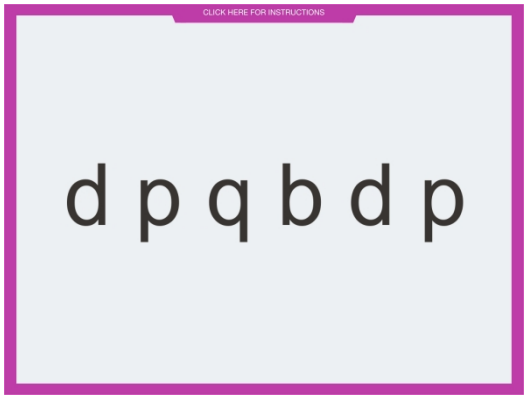
Level 29: Stepping Arrows

INFO: Sequence 6x5 + 40bpm, reduce to 20bpm



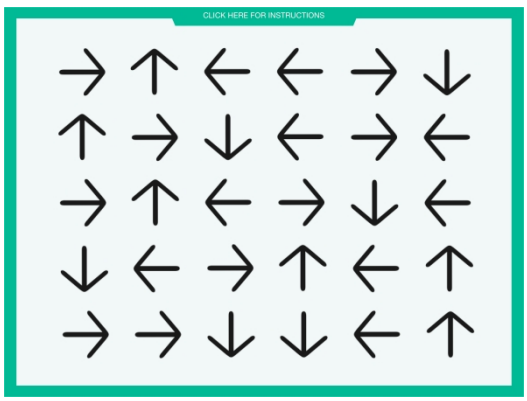
Level 30: bdpq

INFO: Sequence of 5, 6 trials



Level 31: Stepping Arrows

INFO: Sequence 6x5 + 60bpm, reduce to 30bpm

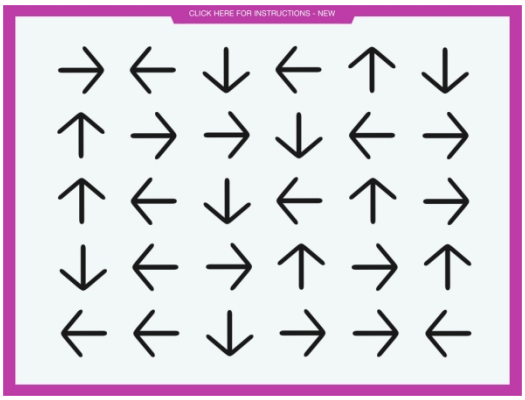


Level 32: bdpq

INFO: Sequence of 6, 6 trials

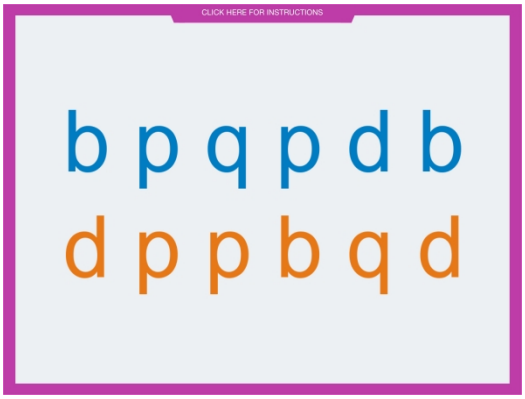
Level 33: Stepping Arrows

INFO: 6x5 + 40bpm + arms, reduce to no arms



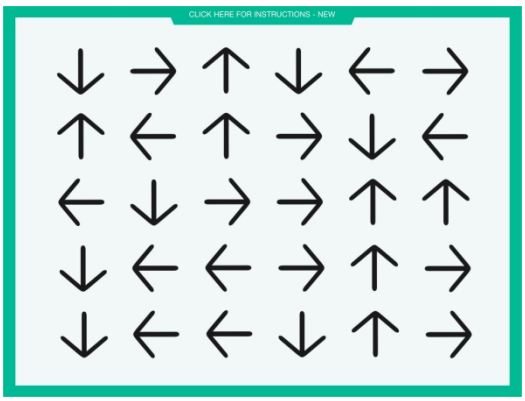
Level 34: bdpq

INFO: Sequence of 6, 2 lines alt colour



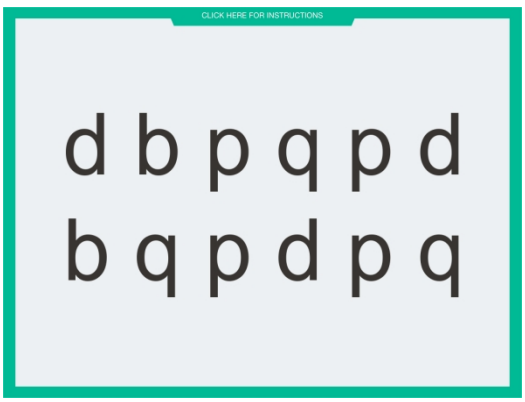
Level 35: Stepping Arrows

INFO: 6x5+40bpm+arms+verbal, reduce to 0bpm



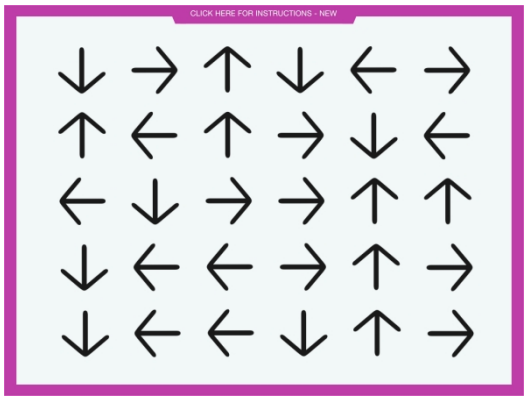
Level 36: bdpq

INFO: Sequence of 6, 2 lines no colour



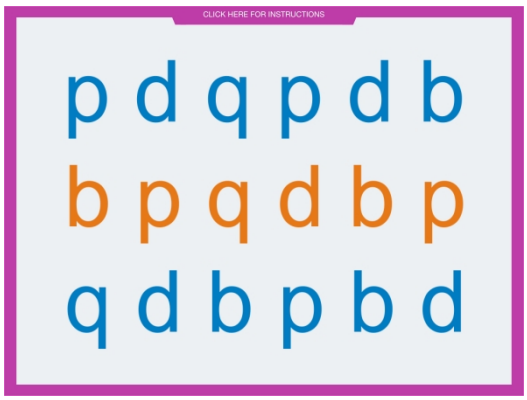
Level 37: Stepping Arrows

INFO: 6x5+60bpm+verbal, reduce to 30bpm



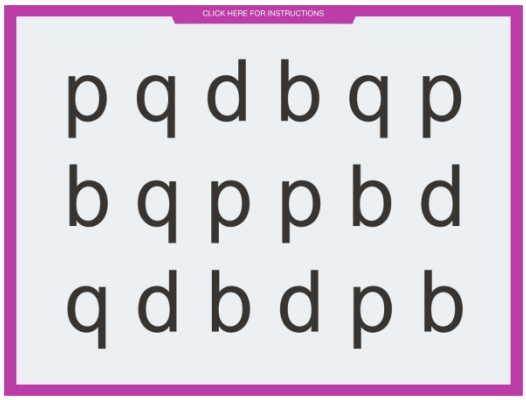
Level 38: bdpq

INFO: Sequence of 6, 3 lines alt colour



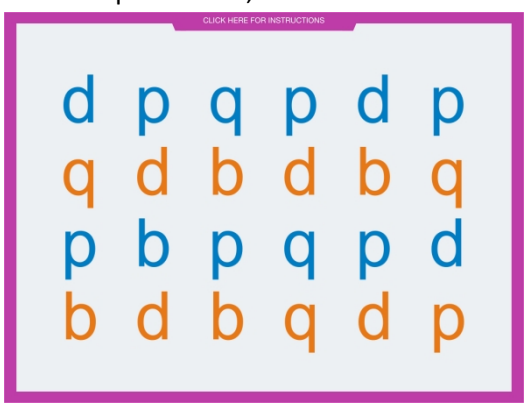
Level 39: bdpq

INFO: Sequence of 6, 3 lines same colour



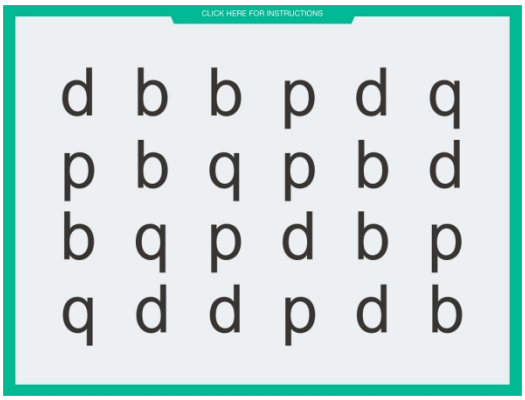
Level 40: bdpq

INFO: Sequence of 6, 4 lines alt colour



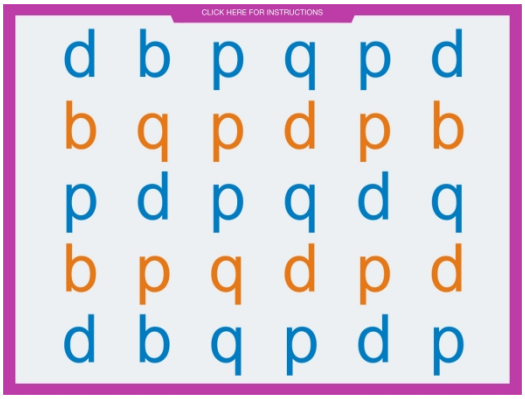
Level 41: bdpq

INFO: Sequence of 6, 4 lines same colour



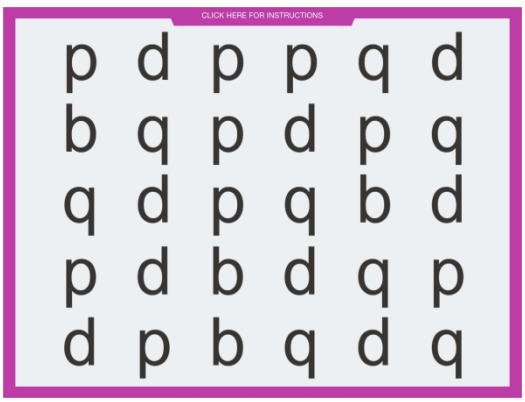
Level 42: bdpq

INFO: Sequence of 6, 5 lines alt colour



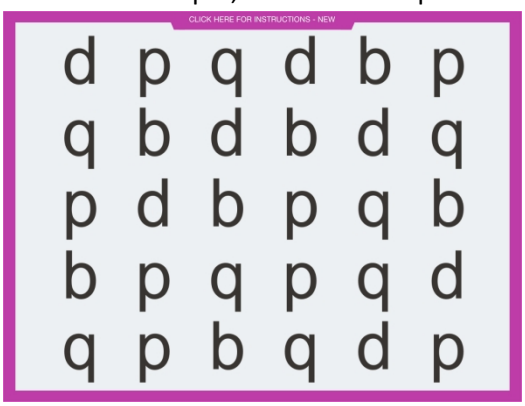
Level 43: bdpq

INFO: Sequence of 6, 5 lines same colour



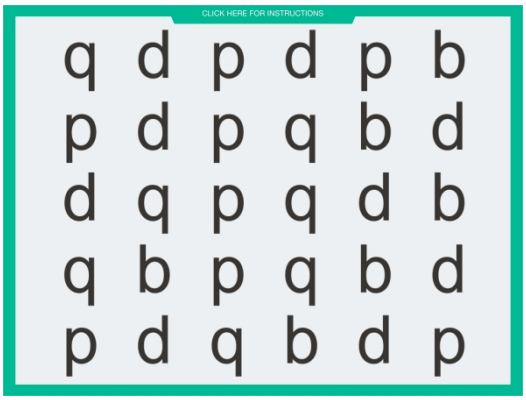
Level 44: bdpq

INFO: 6x5 + 40bpm, reduce to 20 bpm



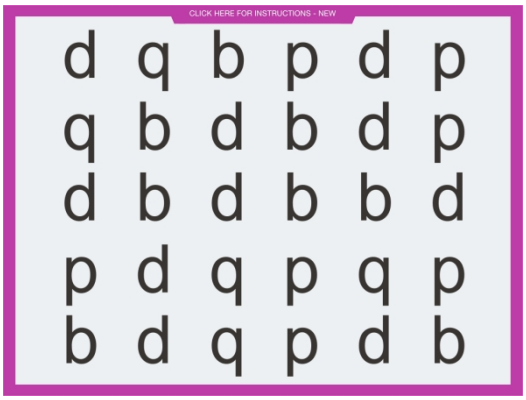
Level 45: bdpq

INFO: 6x5 + 60 bpm, reduce to 30 bpm



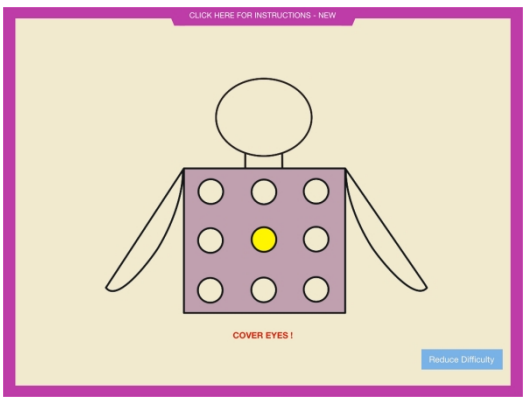
Level 46: bdpq

INFO: 6x5 + 60 bpm + verbal, reduce to 30 bpm



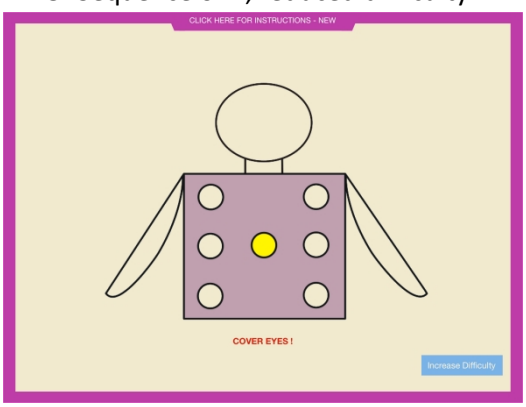
Level 47: Body Map (3x3) - 9 points

INFO: Sequence of 1, reduce to 7 spots



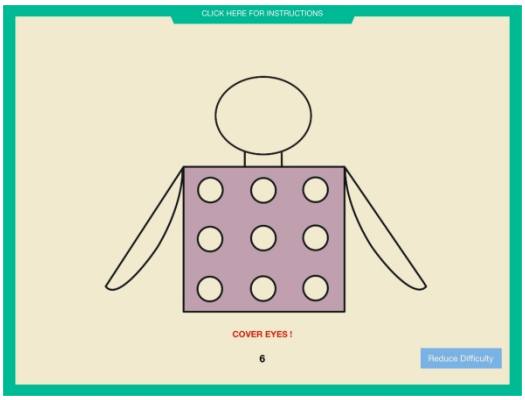
Level 47: Body Map – 7 points

INFO: Sequence of 1, reduced difficulty



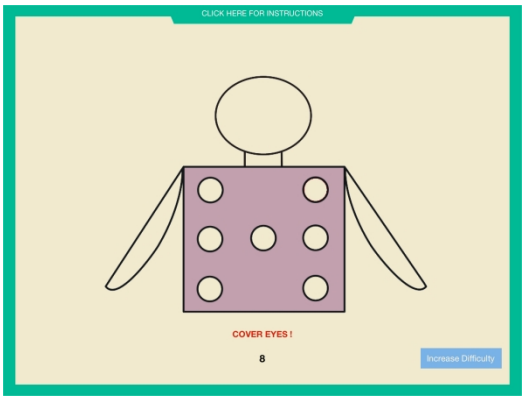
Level 48: Body Map (3x3) – 9 points

INFO: Sequence of 1 + time delay, reduce to 7 points



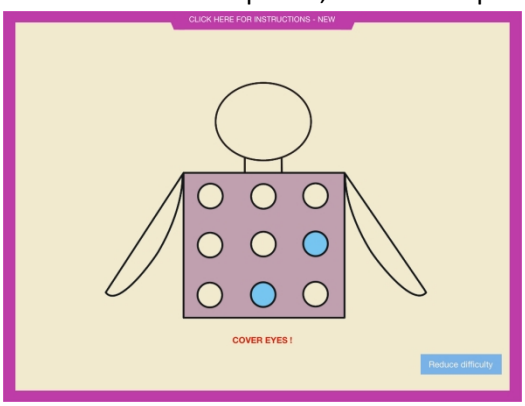
Level 48: Body Map (3x3) – 7 points

INFO: Sequence of 1 + time delay, reduced



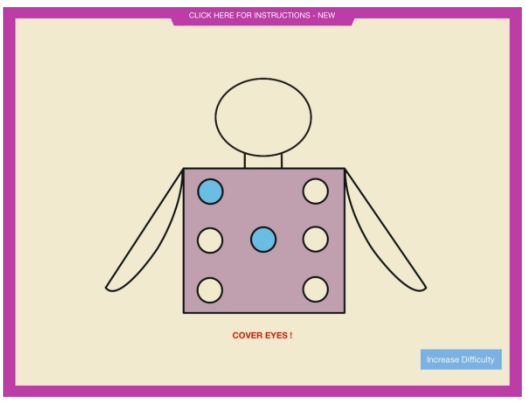
Level 49: Body Map (3x3) – 9 points

INFO: Simultaneous points, reduce to 7 points



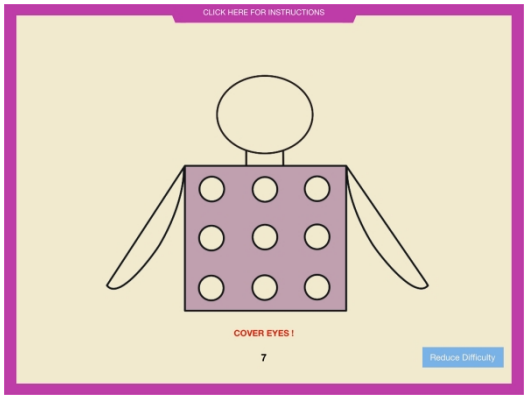
Level 49: Body Map (3x3) – 7 points

INFO: Simultaneous points, reduced



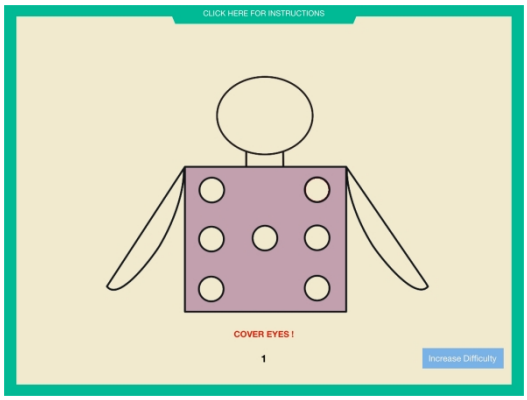
Level 50: Body Map (3x3) – 9 points

INFO: Sim points + time delay, reduce to 7 points



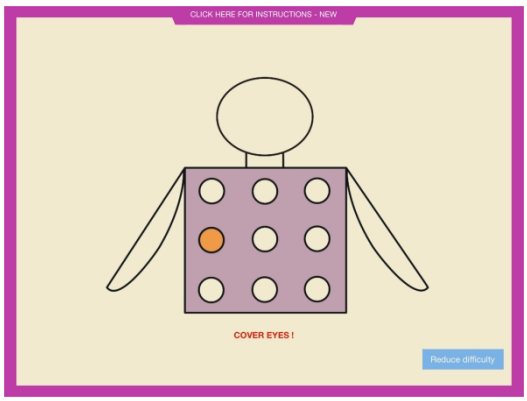
Level 50: Body Map (3x3) – 7 points

INFO: Simultaneous points + time delay, reduced



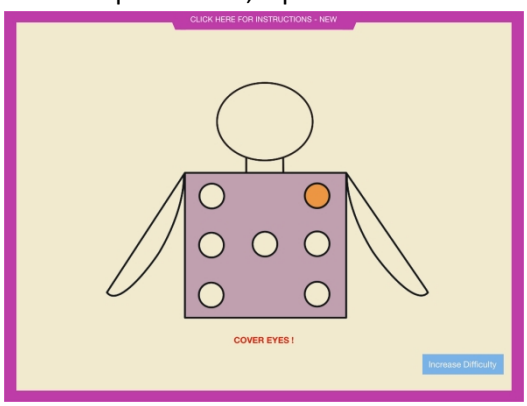
Level 51: Body Map (3x3) – 9 points

INFO: Sequence of 2, reduce to 7 points



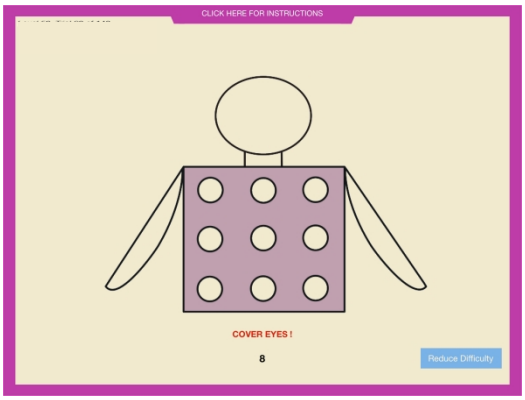
Level 51: Body Map (3x3) – 9 points

INFO: Sequence of 2, 7 points



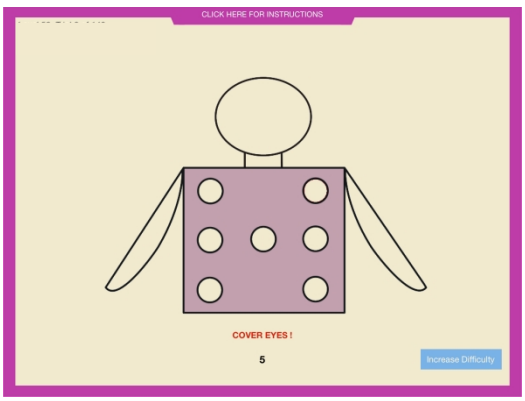
Level 52: Body Map (3x3) – 9 points

INFO: Sequence of 2 + time delay, reduce to 7 points



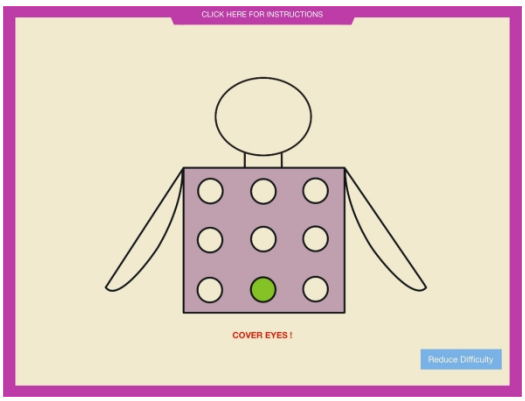
Level 52: Body Map (3x3) – 7 points

INFO: Sequence of 2 + time delay



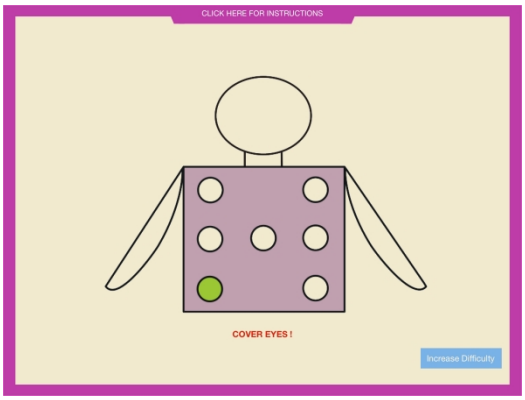
Level 53: Body Map (3x3) – 9 points

INFO: Sequence of 3, reduce to 7 points



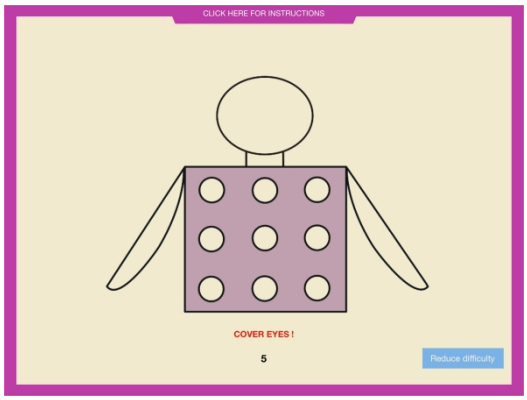
Level 53: Body Map (3x3) – 7 points

INFO: Sequence of 3



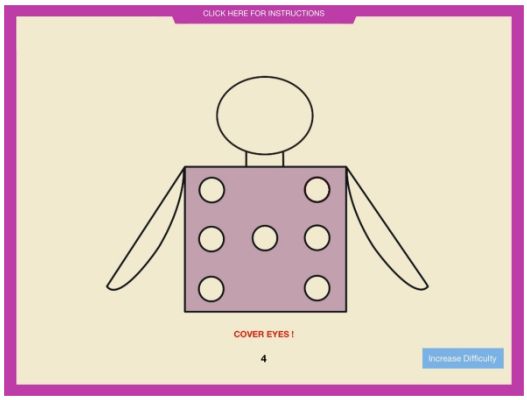
Level 54: Body Map (3x3) – 9 points

INFO: Sequence of 3 + time delay, reduce to 7 points



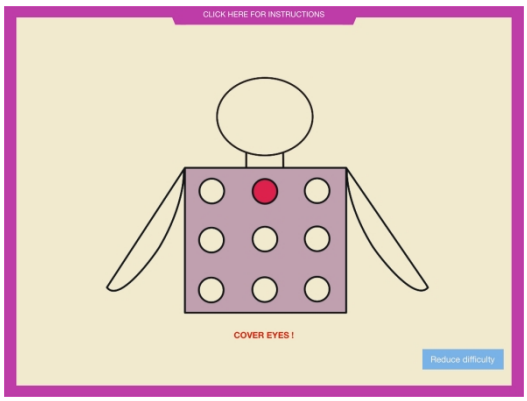
Level 54: Body Map (3x3) – 7 points

INFO: Sequence of 3 + time delay



Level 55: Body Map (3x3) – 9 points

INFO: Sequence of 4, reduce to 7 points



Level 55: Body Map (3x3) – 7 points

INFO: Sequence of 4