# A Central Auditory Processing Deficit Will Affect Learning Potential

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Central Auditory Processing is essentially a precognitive function in that it is the name given to a series of processes that allow us to selectively focus on, attend to, isolate, collect, resynthesize and recognize the sensory data provided by our ears. Many students do not possess efficiently functioning auditory processing mechanisms and, as a result, may experience difficulty with language development, mathematics, reading, attending and staying on task. To the non-crltical observer, the observable symptoms of dysfunctional Central Auditory processing can often be masked as a behaviour problem or attention deficit. In most locations educators, parents and diagnosticians have not yet formed the efficient bonds of communication necessary to diagnose and treat this syndrome.

This paper presents a discussion of the various central auditory processes and the effect their dysfunction can have on the student. Diagnostic possibilities are explored and instruction tables included. An awareness of the possibilities of central auditory weakness and an identification of the student's perceptual auditory signature Is essential for the complete diagnostic work up and should be included In every diagnostic assessment.

An article on the measurement, identification and treatment of a specific skill deficit is not out of place in a journal of dynamic assessment and instruction. Indeed, the identification of auditory strengths, weaknesses and even deficits is imperative to the process of complete assessment. It is insufficient to merely observe the level at which a particular student can use a variety of cognitive skills. While this is extremely valuable, it is only part of the picture.

In the classroom, surrounded by a highly complex auditory environment, a student's functioning, including concentration and attention, may begin to falter. Why? One of the reasons is to be found in a complex called **Central Auditory Processing Deficit**, or **CAD** for short. A process best described as the means by which humans identify and route auditory perceptual stimuli so that it can be processed and integrated for understanding and retention. It is important to note that children with CAD may not have actual hearing problems and may have passed a number of standard hearing tests already. In other words, the child may hear with acuity but may be experiencing Central Auditory Processing problems nonetheless.

It has been my observation that, while working with children who are having difficulty reading or attending in the classroom, many exhibit active signs of CAD. In fact, a majority of the low

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readers who attend our clinics show some form of auditory weakness. This is not to say that CAD is the primary cause of reading difficulty, it merely compounds an issue which contains other variables such as class size, noise and activity levels and program design but it is significant enough to be included in any dynamic process of measurement or assessment of the whole child.

Indeed, identification of perceptual auditory signatures is vital to the understanding of assessment results. This paper then presents a synopsis of the CAD problem in today's classroom. A forthcoming work will present a series of informal screens designed to facilitate the identification of the student's perceptual signatures by the assessor, signatures that often reveal the student's strengths and weaknesses and give reason to the student's particular cognitive style of learning. The rationale for presenting a paper focussed on CAD is to enable professionals, teaching, proscribing and diagnosing, to see this syndrome in the light of the damage it can wreck on students. Once we are aware of this signature, we will be more able to take account of the students 'real' potential to learn.

While audiologists today routinely test for Central Auditory Processing Deficits (CAD) in students, there still exists a certain amount of controversy and confusion among those serving these students as to the importance of these deficits. Until recently, medical practitioners have lacked the sort of research done by Jerome and Ivey, 1991, to assist them in distinguishing the difference between auditory and attentional deficits and many teachers and school administrators are unaware of the syndrome and its concomitant effects on the student. Does a CAD interfere with learning? What can a teacher or parent do to help? What is the difference between CAD and a hearing problem? In trying to understand the difference between the two problems it is helpful to remember that the ears are found on the sides of the head and thus are not central, while Central Auditory processing describes a series of auditory processes which occur between the ears, or in the central part of the head. While the brain interprets all sensory information, in children with CAD, the auditory routing and sorting does not make for efficient filing, interpreting, integrating and understanding of this sensory data. Just as a child with Cerebral Palsy may have a perfectly formed hand physically, it does not work very well when connected to the C.P. brain.

***Hearing*** is defined as the accurate and discriminatory collection of auditory data via the sensory system. The ear has three basic parts with individual and specific functions. The outer car collects and directs sound waves to the tympanic membrane while the middle car amplifies and transmits these vibrations to the inner car which processes these air movements and vibrations, sets the fluid in the inner car vibrating and transmits these impulses to the Auditory Nerve and on to the auditory centres of the brain.

***Processing*** is defined as the coordination of sounds and meaning between the ears, routing of data to recognition centres, differential inhibition as well as association with other sensory systems (touch and sight).

It is important to restate that a child may hear with acuity but may be experiencing Central Auditory Processing problems nonetheless. If this complex system fails in whole or in part, the student may not be able to ***appropriately monitor*** his or her environment, may have difficulty developing the visual/spatial relationships necessary for appropriate ***visual tracking*** of his or her eyes along a straight path, may be ***unable to pay attention*** and/or understand in a complex auditory environment (the classroom), ***may be distractible,*** may be ***unable to remember*** verbal information, may ***appear to be unmotivated*** and may be ***unable to organize*** visual information on the page. There are also a number of non-hearing functions for which the ear is responsible.

These are called proprioceptive functions and have to do with monitoring changes in head position, stopping or starting movement and equilibrium. When these functions fail the student may experience words ***jumping*** on the page, ***back-tracking*** while reading***, word by word***

***reading*** and ***organization difficulty*** on the page. Livingston's vestibular concepts (1990) support identification of this data. While it appears that poor feedback through the visual system is the cause of dysfunction, these processes can also properly be identified as perceptual signal processes and observations of their function appropriately included in the complete assessment.

Of the numerous central auditory processes discussed by Barr in *Auditory Perceptual Disorders* (1976) and by Keith in *Central Auditory Dysfunction* (1977), I shall currently discuss only those four which appear to have the most influence on a student's ability to learn. If we look at each of the processes individually, what they are and how dysfunction may interfere with learning, we will better understand the need for immediate attention and teaching practice modification.

***Auditory Discrimination*** is the process by which the student recognizes the similarities and differences between sounds. Often students with poor discrimination skills have difficulty learning to read by sound (phonics) because they tend to confuse similar sounding letters such as 'P' and 'D' or 'D' and 'T'. These students may also not hear the speaker's intensity or inflection and thus miss the exact meaning of the passage. Poor discrimination skills can have an effect on the process of closure, or blending in phonics, as the student may not be able to tell the actual difference between the sounds (s)he is trying to blend or may be hearing the sounds as if in a hollow tube. Of all the central auditory processes, auditory discrimination appears to be most adaptable. Students can be taught to listen discretely for the differences and similarities in sounds.

***Selective Attention*** is the process of being able to choose what the focus of your hearing attention will be. It means that, even in a noisy classroom, a student will be able to identify in auditory space where the teacher's voice is coming from and will be able to listen to it. Children experiencing difficulty with this process often do not hear instructions and may not respond immediately, if at all, to a teacher's requests. It may appear that this student is ignoring us but, in truth, he or she is just not monitoring the environment as well as the 'average' student and is actually not responding to signals being picked up by the ears. If it sounds confusing, it is - this student may "hear" but "not hear" at the same time.

***Auditory Figure-Ground*** skills go hand in hand with the ability to selectively attend. Once the student has located the source of the teacher's voice by the process of selective attention, the 'average' student will be able to learn by focusing and staying focused on that voice. The process of figure/ground discrimination suggests that the brain allows a certain "space" between the figure of speech, in this case the teacher's voice and the ground, or the background sounds. If you think of this "space" as being measurable, then the 'average' student might have say, two inches between the figure and the ground sounds, while a student with an auditory figure/ground deficit might have a significantly reduced measurable threshold such as one inch, or even one half an inch.

In the. classroom, the student with the reduced threshold has much more difficulty ***sorting*** out the figure sounds, such as the teacher's voice, from the ***ground*** sound, such as other kids talking or dropping rulers, etc. Staying focused and 'on task' will be much harder for this student and you often observe that he or she:

- may grow restless quickly and interfere with a neighbor's work;
- can't stay focused on the task at hand for long and may even appear hyperactive;
- is easily distracted by outside noises or by the regular classroom sounds of his/her peers moving,
- sighing, talking, etc.;
- may not answer when his/her name is called;
- may appear to tire quickly

A recent, but common, case involved a student who was fine in quiet places but immediately became physically agitated and restless when he entered the classroom. Information from his concerned parents indicated that he could be playing quietly at home but become instantly unmanageable when they took him to his favourite restaurant. The noise, cascading over itself made it impossible for him to sort out meaningful patterns and he responded with actions to escape his internal din. This was not a case of a disobedient, or spoiled, child but merely one who had developed coping strategies to deal with life as it was presented to him. The same child was considered a behaviour problem in the classroom until his program was modified and he was moved to a more appropriate seating position.

Auditory Closure is the ability to understand a word even when you have not heard it completely. It is often expressed in classroom achievement as the ***ability to 'blend' sounds, such as letter sounds or syllables, into words.*** Students with closure difficulty may not understand words or sentences well when there is noise in the room. In reality, auditory closure is significantly different than the metalinguistic skill of phonetic resynthesis (blending). Students can learn blending as a new skill and, with practice, are able to become quite good at it. If the student is learning to read by a phonetical process it may be necessary to help him or her develop these skills both in isolation, in games and drills as well as in context with **oral** reading practice in order to facilitate better reading.

## Implications of CAD for Learning

With a deficit as complex as a CAD we find many overlapping implications. Language understanding and development, reading decoding and comprehension, visual tracking, mathematics skills, behaviour and self esteem may all be adversely affected.

### *LANGUAGE CLASSIFICATION*

Students often miss the differences between sounds and thus may not understand the differences or similarities in categories being discussed orally. Word meaning, sentence structure and identification concepts can all be misunderstood and/or poorly integrated into the student's existing body of known language. The process of classification is primary to the use of language for cognition. Students who do not learn to classify precisely will not be able to integrate precise definitions.

### *LANGUAGE ASSOCIATION*

Students may not be able to properly connect meaning between spoken and written words; they may find conversation difficult to follow and thus miss making appropriate conceptual discoveries; some figures of speech may be difficult to understand and use; sometimes words may be heard but not associated with meaning; auditory to visual associations may be difficult and students may be unable to put sounds to letters or symbols.

### *READING*

As both language association and classification can be affected, reading comprehension will suffer as a result. Students who do not fully understand their language do not learn how to develop meaning from text (written and spoken). As it is usually necessary for the student to possess an appropriate understanding of the spaces between things both visually and auditorily in order to fully process sensory data. Students with CAD often lack, or are late in developing,

this precise skill and visual/spatial relationship weaknesses may result which can affect visual tracking--reading fluidly left to right across the page. CAD students often tend to read one word at a time, back-read words they have skipped, jump past the end of the Iine and miss the next line altogether. This slows down reading and affects comprehension.

***MATHEMATICS***

Students my be unable to visualize numbers or problems when too much information is presented on one page. Sequential memory may be below the mean as auditory information is not being processed as appropriately as it might. This may affect the student's understanding, or even following, the correct mathematical order of operations. Problem solving can be adversely affected as the student's reading comprehension may be low.

***BEHAVIOUR***

Students with CAP who are distractible. tire easily, bother others, move restlessly, appear to ignore instructions, forget to do assignments and are messy and disorganized, are often incorrectly considered to have an attentional or behavioural problem. Most often this student is merely attempting to cope with the demands of classroom learning.

***SELF-ESTEEM***

When a student sees that (s)he is not functioning as capably as his/her peers, the judgment they inevitably pass upon themselves will result in lowered self-esteem. There is bound to be a bewildering sense to a world that others appear to understand but which I cannot.

## Conclusions and Discussion

Students with Central Auditory Processing difficulties tend to learn at a different pace and often in a different style or manner than they would if they did not manifest the syndrome. For example, it is not uncommon to find students testing as strongly holistic, or simultaneous, learners on instruments such as the Kaufman Assessment Battery for Children (K-ABC) or on the Detroit Tests of Learning Aptitude versions 2 and/or 3 (DTLA3, DTLA2). One might then conclude that the student prefers open-ended tasks and is capable of learning in this manner. If that student has a CAD this is not likely to be the case. Students with CAD often require a structured program that is sequential rather than simultaneous, in order to ensure that they have heard, understood and integrated the concepts being taught. Indeed, this student may have the capacity to become an open-ended holistic learner who is capable of advanced inference, is a well organized and adventuresome student, but often intervention and coaching are necessary to bring him/her to that point.

The important issue for the assessor is to be aware of the possibilities of CAD. Unless CAD has been considered in the process of assessment. the overall findings, correct as they may be, will still be subject to yet one more dynamic force--the force of the student's auditory perceptual signature. This force can work against the most subtly crafted program and delay growth and success!

In a subsequent work I will be presenting a series of screens and checklists that will help the examiner to better identify students at risk, presently I suggest that the examiner consider all verbal tests and subtests in the light of CAD. For example, if the examiner were using the DTLA-2 or 3 and noticed that the student was successful on the auditory test of rote memory (Word Sequences) but did **less** well on the auditory test of memory in a more complex auditory environment (Sentence Imitation), consideration should be given to why this is so. When the task

became more complex, as it does in the Sentence Imitation subtest, the student was less successful. This might be the first clue that more than attention or anxiety was involved. Consideration of CAD is then appropriate.

Gathering a full anecdotal case history from the parent with information comparing the child's behaviour in crowded restaurants, theatres and shopping malls to his/her behaviour at home or in a similar quiet environment would then not only be important, but would give the examiner a new context in which to examine the information from the more formal test instruments (DTLA, WISC, KABE, etc.).

If dynamic identification is the first stage, instruction is the second and tying them together will become another dynamic process. Using an older more traditional approach to CAD, one might expect the examiner to test, write an report and oversee the modification of the student's program. This essentially parodies the process at that point and can lock the child into a series of expectations and behaviours that reinforce, and may even shape, behaviour and success. The teacher has been excluded from the testing element and the tester excluded from the growth process. If the examiner uses a dynamic process that takes the whole child into account (feelings and behaviour during testing, classroom reports from the teacher, parent's anecdotal information, etc.), considers this information in the light of test findings, and considers the child's ability to learn and conceptualize (information obtained from testing by using instruments such as Ravens Progressive Matrices, Gamlin's Similarity Reasoning Instrument, Proverbs Test, Test of Nonverbal Intelligence, etc.), it will then be possible to develop suggestions for instruction that include information on how the child learns and in what manner.

CAD is a syndrome that requires patience and support on the part of instructors. Knowledge relating to the child's cognitive potential is essential in building programs. Merely providing parents and teachers with checklists, such as the ones I have prepared for this article, may not be the most appropriate means of assisting. Considering these suggestions in the light of a dynamic assessment findings and using only those items that 'fit' the child's profile, will undoubtedly bring more success.

Teachers and parents can be instructed on the process of Test-Teach-Test in relation to all the skill development activities herein included. By testing to obtain the student's ceiling and basal level in auditory functions, as well as his/her ability to generalize, the assessor can provide entry points for instruction. As the skills are presented in drills and games, the parent or teacher can then retest on a regular basis in order to determine growth.

Initially the student will have to learn these skills in isolation because they represent primary perceptual, rather than cognitive skills, and cannot be efficiently developed in the context of curricula. The practice of generalizing and transferring them to curriculum subjects is also a skill that can, and must be taught. Recent work with the ST1 (Gamlin and Whitehead, 1992) indicates that generalization skills are coachable. The instructor then will teach, test, teach the transfer and retest.

The process can then be completed by performing an informal skill level academic assessment. If the student has learned new auditory concentration, understanding and integration skills in isolation, has been tested and coached on the appropriate use of these skills in the context of the curriculum and is applying them to academic subjects, there should begin to be an observable change in the quality of the student's product in school.

The entire cycle can now be presented as a test for the skill, coach the student in the development of the skill in isolation, test the skill gain and modify the program accordingly, retest as you teach, teach the transfer and test the academic skill base.

It is important to note that students with a **CAD** may be limited only in the manner in which they accumulate sensory data. Their internal cognitive functions are not hampered, shaped or limited

by their CAD. Identification of the deficit is valuable only in that it allows the instructor to coach the student in a manner that is most appropriate and provides the student with an opportunity to gain a deeper understanding of his/her own metacognitive processes. As the CAD student learns to deal with, and overcome the deficit, the personal gain will not just be evidenced in marks, it will be in the mind of the student who better understands how (s)he learns.

In the exhibits that follow, the reader will find numerous suggestions that fit the 'teach' portion of the model. While it will certainly be valuable for CAD students to develop these skills in isolation, more value will be gained if the reader follows the test-teach-test model. Use these exhibits as the basis for an at-home or in-class program.

**Exhibit A**

Guidelines for Parents

1. Remember, often your child did not ignore you intentionally. Repeat instructions using different words when necessary. Simplify the grammar and complexity of the instruction.
2. Check with your child to see if (s)he has really understood what you said – especially when your directions or instructions are important - asking for a simple "no" or "yes" to this question will not do. Ask your child to repeat or explain what was said.
3. Attract his/her attention before you speak--this may be by using his name first "John, please come here" instead of "Please come here, John". You may also wish to develop a special signal so (s)he will know when YOU wish to communicate.
4. Always be supportive if your child does not understand! Usualy there is no disobedience intended--merely improperly processed signals.
5. Try to keep the background sounds to a minimum when you are talking with your child. Turn off stereo, T.V., etc. Remember that (s)he may have trouble staying focused when you go out to eat in a noisy restaurant or take a trip to the mall. Allow for this and give instructions appropriately.
6. Help your child to develop the habit of always looking at the person who is speaking. This will allow him to process both verbal and visual clues at the same time. Make sure that your (or the speaker's) face is clearly visible while you are doing this training.
7. Encourage your child to tell you when (s)he doesn't understand and make sure that you attach NO guilt or anger to these interruptions. Unless (s)he feels totally safe, (s)he may not tell you and merely pretend to understand.
8. When speaking: speak slowly so as to allow time to process the information; use short sentences and simple grammar; speak clearly; and. accent key words (stretch them out or emphasize them).
9. The more aware your child becomes of his/her own mental processes, the more control (s)he will be able to exert over them. This is called the process of metacognition and it is very important. Too often students take their thinking and learning processes for granted. "I just read it." or "I just study." The truth is that we can be aware of what our brain is doing if we focus. If you work with your child in order to encourage an awareness of when a thing has been completely heard, when (s)he is tuning out, etc., you will help him/her to develop this awareness. Don't forget that awareness is necessary for understanding.
10. Encourage discussions about what has and has not been understood -- keep the concept of ***"RIGHT*** or "***WRONG***" out of these discussions!!! Remember, your child did not actually do anything wrong! (S)he heard what was said in the only way (s)he can! It will take time and patience to **overcome** this tendency and you will have to work as a team. If you consider that this is merely a skill that your son or daughter can develop, it need not be a disability**!**

**Exhibit B**

Instructing Students with CAD

1. Children with **CAD** often have trouble staying on task, paying attention, listening, processing (understanding) what has been said, sorting out all the competing sounds in your classroom and monitoring his/her environment. As a result, this student may seem to be disobedient, non-compliant, distractible, disorganized, unable to get work copied from the board in the same time as the others, unable to get assignments in on time or generally just not interested. Remember that this processing problem was not chosen by the student, it is not their fault. YOU must try to learn as much as you CM about the particular difficulties of each of your students who have CAD. This will help you to better understand what his/her needs are and how you can best meet them.

2. Make sure the child is seated so (s)he can best see the board while the correct, or strongest, ear is facing the teacher. The audiologist's report will indicate which ear has the lowest Selective Attention, Closure or Auditory Figure/Ground skills. Treat the other ear as the strongest. If (s)he is distractible in one particular ear, face that ear away from the busiest activities.

3. Cueing response is necessary. Many students cannot stay on task without it. Watch closely for signs that (s)he is not paying attention. Encourage concentration and self-monitoring but be willing to cue whenever necessary. Names or the use of personal codes, worked out independently with each student always make the best cues. As long as you ensure that you attach no blame or guilt when your CAP students arr off task, they will be more willing to tell you when they have not been attending. You can use this to help them develop a greater sense of what they are doing and how to become a more effective listener/learner.

4. If the student does not understand, REPEAT if that doesn't work, REPHRASE!

5. Experiment with various seating placements until you find the best 'chemistry where the student is nicely settled, attending and not distracted. Make sure to move these students away from other students who will spend too much time 'visiting' or who will distract your student with an auditory problem.

6. Various ways of speaking and presenting material orally will help you to communicate more effectively. These include:

i) When trying to make a point, speak at a different rate than you normally would, change your pitch and/or volume when you come across an important word or phrase.
ii) Emphasize key words and phrases, whenever possible use visual aids and hand gestures to enable the student to better understand.
iii) Avoid multiple commands and ask short simple questions.
iv) When you are teaching reading, emphasize the differences in the phonemes of the language and ask your student to say these new sounds back to you, this will also help him/her to listen and hear
v) Speak clearly and without great facial distortion or movement which might distract the student and confuse meaning. Use visual aids and gestures to empahsize a point or to attract attention.
vi) Above all, make sure the child understands your verbal instructionsl

7. Encourage your student to repeat instructions to him/herself as (s)he works. Allow subvocalization while reading and some quiet vocal summary while instructing. This will help your student stay on-task and understand the lessons.
8. Explain WHAT is being taught as you are teaching itl Use the blackboard, pictures, videos and any other visual aids you have available. Vary colours and underline key words and phrases.
9. Move into new arenas of instruction gradually, always summarizing what you have already covered and why and where you now going.
10. Rhyming games, clustering activities, auditory discrimination activities, memorygames and activities, repetition of discriminate sounds and singing are all activities which should be stressed in the student's program.
11. Be generous with your praise and support for small gains. You are trying to help develop new patterns of success and encouragement can help overcome fear and anxiety while your student learns that succcss is possible!
12. Students remember verbal information best when it is related, or connected to real life experiences or emotions. Help your students understand the relevance of what you are teaching and how it fits into real life. Use examples from their own lives when possible.

## Exhibit C

## Program Planning and Classroom Management

1. Sound attenuating earmuffs and earplugs often help eliminate background noise while children are trying to do seatwork or concentrate in an auditorily complex situation. It often helps to have a number of earmuffs around so other children can use them to assist with concentration. This will also stop the CAD problem students from being singled out and you may find that your average students will benefit greatly from these aids.
2. FM auditory training units have been successful in helping some CAD deficit students. They tend to enhance reception of classroom instruction.
3. Seating: Listen to your classroom. Are there echoes? Reverberations? What are the acoustics like? Take these factors into consideration when assigning seating. Try and keep CAD problem students away from the hall, street or window noises and within a ten to twelve foot radius of the teacher. Remember, children with an auditory deficit process information more effectively and remember it better when they can both look and listen.
4. Instruction:

i) Gain the child's attention first before explaining anything by using his/her name, a sound or a prearranged gesture.

ii) Check comprehension by asking questions or asking the student to repeat what you have said. Rephrase and restate, empharize key words, alter your inflection and volume and substitute and simplify your grammar and use brief instructions to overcome memory weakness.

iii) Pre-tutor child; encourage the student to read ahead so as to be more able to follow the lessons in class.

iv) When beginning a new unit, list key words and concepts on blackboard and define and explain them.

v) Write instructions and assignments on board or on handout sheets and ensure that your students have copied them down.

5. Provide quiet study areas with minimal visual or verbal distractions.
6. Monitor and evaluate the effects these program changes are having and communicate this growth to both the parents and the student. If modifcations are necessary do not be afraid to experiment.

Exhibit D

Skill Development: Auditory Memory and Sequencing

1. Show a child 5 or 6 objects then call out the names of the objects and ask the student to point to them in the order in which you called. Increase the difficulty from 3 to 6 items when you can. Switch from objects to numbers and ask for verbal recall as well.
2. Clap out rhythms wirh your fingers, hands or an object and ask the student to repeat.
3. Perform a series of tasks, such as stamping your feet, clapping, open door, etc., and ask the student to repeat the in sequence.
4. Show a series of pictures from books or magazines and ask for a recall of the order in which they wcrc presented.
5. Give a series of complex but often silly instructions and ask the student to perform them in order, e.g.:hop backwards - sit on the table - open the door - and walk out backwards - dial the phone number with your nose etc.
6. Say, in sequence, a series of words that have the same sounds in them or that have a common basis or theme. – e.g:
    i) far--jar and other words with common sounds;
    ii) Name as many birds as you can--use other categories.
7. Teach memory strategies such as chunking, grouping, acronyms, silly sentences, asociation, etc. Use chunking exercises (telephone numbers) to produce the rhythm and order of long sequences. Clapping and rhythm exercises will also work with these tasks.
8. Use sentence completion games when more than one student is involved. For example: “On the way to the store I _____“. Each student adds one more thing which must then be repeated by the next student and the next, etc.
9. Memorize songs, poems and stories. Start with the easy ones and get harder. Encourage art to go with these tasks.
10. Read stories or sing songs then ask questions regarding sequence, cause and effect; and possible outcomes.

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