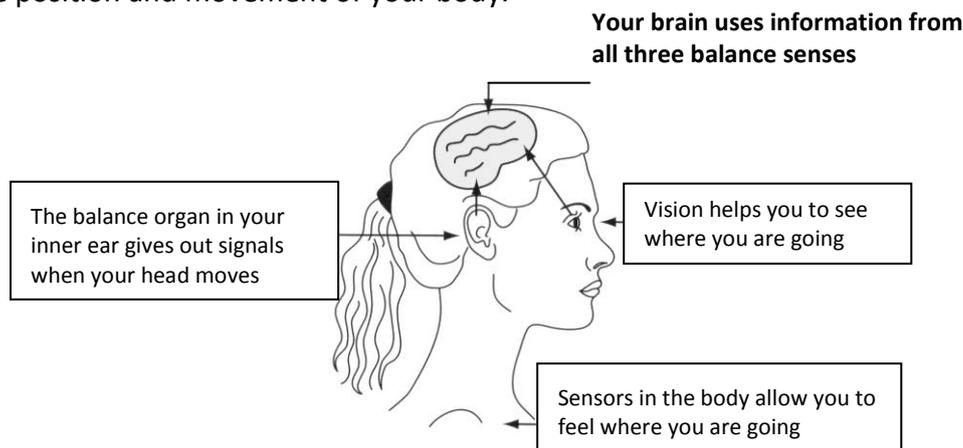


## The Balance System

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### How does the balance system work?

The balance system works by coordinating information in your brain from the three senses used for balance. These balance senses are the balance organ in your inner ear, your eyes, and your internal sense of the position and movement of your body.



If you feel dizzy, it means that your brain has not been able to coordinate the information from all the balance senses properly. This could be due to a problem in the brain, or with any of the three balance senses. In Ménière's disease and many other balance disorders, the disease affects the balance organ in the inner ear. But because your balance organ is faulty your brain becomes more dependent on information coming from your eyes and the sensors in your body. This makes you much more sensitive to situations which can cause dizziness in even healthy people, such as disorienting environments and times when you are under stress. Therefore, not all the symptoms of dizziness you experience will be due to your balance organ – some of the symptoms will be caused because your balance system cannot cope with the situation you are in. The good news is that you can often do something about these other causes of dizziness.

### How is my brain involved in balance?

When any of the information from your three balance senses changes or is incomplete, your brain has to adjust to the different information it is receiving and coordinate it to maintain balance (or as good a sense of balance as is possible). This is a gradual process and can take up to several weeks or even months for your brain to do, depending on how big the change in the information was, and how easy it is for your brain to coordinate the new and remaining information. Until this adjustment and re-

coordination has happened, you may feel dizzy, disoriented or unsteady. Your brain can only adjust to and coordinate the information it is regularly receiving from the balance senses. If your brain does not receive enough information from the balance senses (i.e. if you avoid the activities or places that make you dizzy), the things that make you dizzy will continue to make you dizzy because your brain has not had a chance to get used to them. Your brain also cannot cope with inputs that are much more extreme than you are used to (such as a fast spinning fairground ride) - or the sudden change in inputs from one balance organ that occurs when you have a severe attack of vertigo. But during the days and weeks after a severe attack your brain adjusts to the change in input (if there is no further change) and you gradually feel less dizzy. Gently practicing all kinds of movements helps your brain to adjust (see the booklet on balance retraining† for examples of helpful movements).

## **What processes in my brain can affect balance?**

### **Conflicting information from the balance senses**

Dizziness can be due to conflicting information coming from the three balance senses. An example of this is when you are sitting on a train and the train next you starts to move, creating the feeling that you are moving. The senses in your body and your balance organ are telling your brain that you are not moving, but your eyes are telling your brain that you are moving. This conflict of information results in dizziness, even in people who do not have any problems with their balance senses. Motion sickness is another example of conflicting information from the balance senses. When you are travelling in a car, boat, escalator or lift, the signals in your body (and your eyes if you cannot see through a window in a car, boat or lift) tell your brain you are not moving, but your balance organ in your ear is telling your brain that you are moving.

### **Emotions and thoughts**

When you feel particularly stressed, anxious, angry or fearful, you may be more likely to experience dizziness. This is because some of your body's automatic reflexes are linked to your emotions and thoughts through a process called the "fight or flight" response. Your brain interprets any strong emotions or frightening thoughts as a signal that you are in danger, and automatically prepares your body to either fight or run away. This means that your heart rate increases and your breathing gets faster as blood is pumped to your muscles. A side effect of this is that you may feel sick or dizzy, since breathing too fast causes you to take in too much oxygen, which can make you dizzy.

Your emotions can also be directly influenced by your thoughts. If you think that dizziness will lead to further problems this can make you feel even more stressed or anxious when you become dizzy. This can make your dizziness worse by setting off your fight or flight response. The types of thoughts that have been found to lead to distress include:

- Dizziness will result in me being physically harmed
- Dizziness means I am going to have a severe vertigo attack
- If I get dizzy, it means I will let people down
- I will be embarrassed if I become dizzy in a public place

Obviously, dizziness can cause problems of this kind, but it is important to keep the risks in perspective and not let yourself become too overwhelmed by these concerns (the techniques in the controlling your symptoms booklet† can help you control your emotions and thoughts).

### **Tiredness and concentration**

When you are tired or doing things you have to think about, this can affect your balance. This is because your brain has a limited capacity for what it can attend to at any one time. If you are concentrating on a mental task, your brain has less capacity spare for other tasks, such as maintaining your balance. This is why you may be asked to carry out a mental task (such as counting backwards) during some balance tests. Doing the tasks limits the capacity of your brain to correct any problems with the signals it is receiving from your inner ear and allows health professionals to get a better idea of how well your balance organ is working. Because it takes mental effort and capacity for your brain to cope with conflicting information about balance, you may become tired and unable to concentrate when you are dizzy, and while your brain is adjusting after an attack of vertigo.

### **Medications and alcohol**

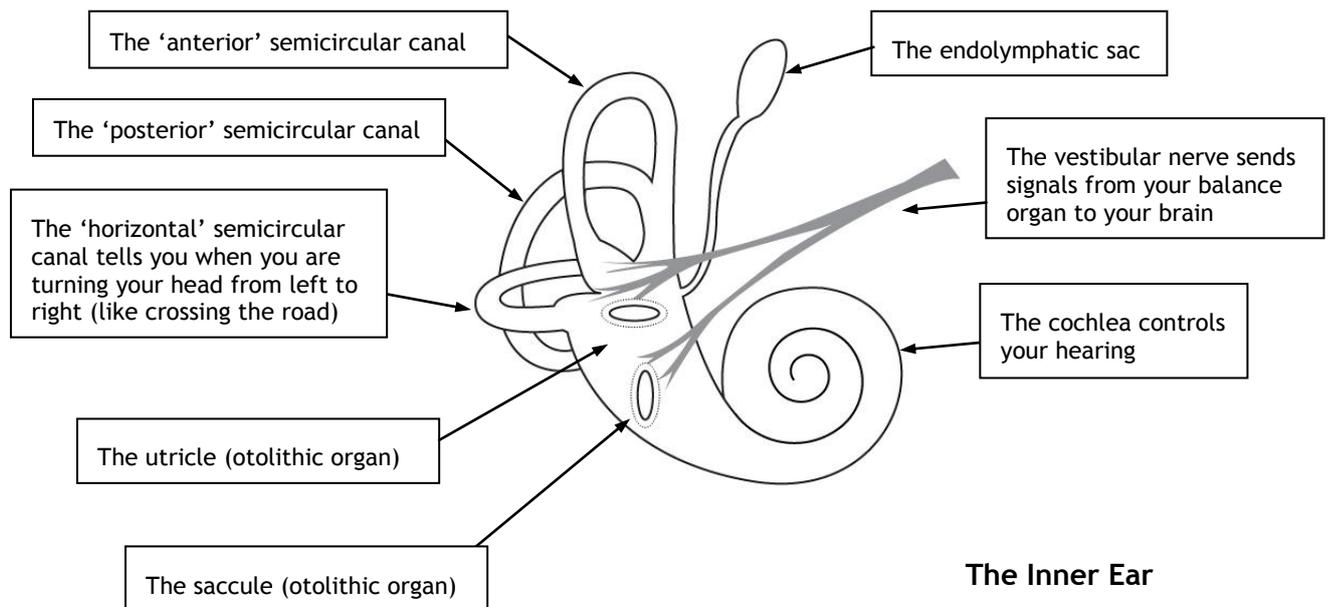
Some medications list dizziness as a side effect. If you take more than four different types of medication, this may also cause dizziness and increase your risk of falling. You should talk to your GP if you are taking more than four different types of medication and think this could be making you dizzy. Alcohol is also known to cause dizziness. This is because alcohol suppresses certain processes within the brain, including those responsible for balance.

### **Other medical conditions**

Dizziness and imbalance can also be the result of damage to the areas of the brain that coordinate balance; often the cause of dizziness in people who have MS, Stroke, or Parkinson's disease.

### **How does my inner ear affect my balance?**

The balance organ in your inner ear is responsible for sensing gravity and movement. It is made up of three loops called semicircular canals and two otolithic organs. Your hearing organ (called your cochlea) is also in your inner ear.



### What do the different parts of my balance organ do?

The three semicircular canals (called the 'horizontal', 'posterior', and 'anterior' canals) are all at right angles to each other so that together they can detect movement across all the different angles you can move through. The 'horizontal' semicircular canal detects movements such as turning your head from left to right (e.g. when you are crossing the road). The 'posterior' and 'anterior' semicircular canals often work together and detect movements such as nodding your head up and down (e.g. when you are looking up at a high shelf), and tilting your head sideways (e.g. holding a phone between your ear and your shoulder). The two otolith organs are called the utricle and the saccule. The otolith organs detect whether you are upright or lying down (using gravity) and whether you are moving forwards and backwards (e.g. in a car).

### How can they tell when I am moving?

Each of your semicircular canals and the two otoliths are covered in tiny sensory hair cells. It is these hair cells that send balance signals back to your brain (via your vestibular nerve). Your whole inner ear is filled with a special fluid (called endolymphatic fluid). This fluid moves around your inner ear when you move. The hair cells in your balance organ are activated to send signals to your brain when they are moved by this fluid.

### How do health professionals tell what is going on in my inner ear?

Health professionals cannot see inside your inner ear, but your inner ear is connected to your eyes by a reflex process (called nystagmus). Different eye movements relate to different parts of your balance organ and brain. This is why some balance tests involve looking at how your eyes move. As your brain coordinates information from all three balance senses (balance organ, eyes, and sensors in the body)

health professionals can also tell if your balance organ is not working properly by limiting the signals that can be sent from your eyes and sensors in your body. This is why some balance tests need you to close your eyes whilst standing on a wobbly surface or marching on the spot.

## **How is my inner ear affected by Ménière's disease?**

### **How are my semicircular canals affected?**

Attacks of Ménière's disease change the signals being sent from the semicircular canals in your balance organ. Experts do not know exactly how or why this happens, but several processes have been suggested that may or may not be involved. These include injury/physical changes within the inner ear, changes to the inner ear fluid (the endolymphatic fluid), or the result of the result of an immune disorder. Other suggestions have been that it could be genetic and runs partly in families, or that it could be the result of a virus. Some experts think that there might even be different causes for different people, rather than one single cause for everyone who has the disease.

### **How are my otoliths affected?**

Some, but not all, people with Ménière's disease experience drop attacks (also called 'otolithic crisis of Tumarkin'). A drop attack feels as if you are being pushed violently and suddenly, causing you to fall. The symptoms are usually gone as quickly as they appear, and you can get up straight away and carry on with whatever you were doing (unless you get a drop attack at the same time as an acute attack of vertigo). During these attacks, the hair cells on your otoliths are suddenly activated, causing your balance to be severely disrupted. Experts do not know how or why this happens.

### **How is my hearing organ affected?**

Your hearing organ (called your cochlea) is also in your inner ear (it looks a bit like a snail because it is curled round and round). Like your balance organ, the hearing organ is also covered in tiny sensory hair cells, and is filled with the same (endolymphatic) fluid. Different pitches of sounds are detected by different parts of your hearing organ. High pitched sounds are detected at the open end of your hearing organ, nearest your balance organ. Low pitched sounds are detected at the centre of your hearing organ (the part curled up most tightly). In Ménière's disease, the sensory hair cells at the centre of your hearing organ are damaged first, causing tinnitus and hearing loss for low pitched sounds first. As the disease progresses, the hair cells on the rest of your hearing organ can also become damaged, eventually affecting your ability to hear all sounds.

### ***Do loud sounds have an effect on my balance?***

The damage to the hearing organ may cause some people with Ménière's disease to become over-sensitive to certain sounds. Sounds which don't seem to bother other people may seem unpleasantly

loud to you, and difficult for you to tolerate (The medical term for this is called hyperacusis). Sounds do not normally affect the balance organ, however, excessively loud sounds experienced over a long period of time (such as in industrial work) may cause damage to the balance organ as well as the hearing organ. Rarely, some people with Ménière's disease may also experience dizziness or vertigo symptoms when they hear loud noises (This is known as the Tullio phenomenon). This is thought to occur because Ménière's disease makes the balance organ more sensitive to the effects of loud noises. The hearing loss that results from Ménière's disease means that you have to concentrate to make sense of the sounds you can hear. Having to concentrate to make sense of noise in busy environments can also limit the capacity of your brain to co-ordinate your balance.

### **Can I have more than one vestibular disorder at the same time?**

Yes you can. The most common type of vestibular disorder is benign paroxysmal positional vertigo and the second most common type is migrainous vertigo. Both of these disorders are more common in people with Ménière's disease than they are in the general population, which has led experts to suggest that there may be a link between these disorders.

### **Benign paroxysmal positional vertigo (BPPV)**

People with BPPV have short spells of strong vertigo (lasting only one or two minutes) when they move the position of their head. The kind of movements that trigger vertigo in BPPV can include getting in or out of bed, turning over in bed, bending down (e.g. when gardening), or looking up at something (e.g. when reaching up to a high shelf). BPPV is caused by small particles from one part of your balance organ becoming detached from where they belong and moving to another part of your balance organ. Small particles become detached from your utricle and roll into your semicircular canals (see the diagram on page 4), interfering with how the semicircular canals work. This causes short spells of dizziness when you change position. Ménière's disease attacks are believed to weaken the balance organ, including the utricle, which is why people with Ménière's disease have a greater risk of getting BPPV. One of the most effective treatments for BPPV is for a health professional to simply roll these particles back to where they belong using a special head movement. This treatment takes only a few minutes and is easy to do. It is also highly effective, with only one treatment session being needed in most cases.

### **Migrainous vertigo**

A migraine is made up of several symptoms. The main symptom is a headache that lasts between 4 and 72 hours. The headache is usually moderate or severe and is often just on one side of the head and a throbbing pain. It can also be made worse by physical activity. Other symptoms include nausea and sickness, and sensitivity to light or sound. Approximately 10% of people with migraine experience

unusual symptoms (called an aura) that affect vision, physical sensations, or speech. Visual symptoms might include blurred vision, blind spots, seeing patterns or flashing lights. Physical sensations might include pins and needles or numbness. As well as these symptoms, the aura part of a migraine can also include similar symptoms to Ménière's disease, symptoms of dizziness or vertigo, tinnitus and hearing loss. These aura symptoms usually last between 5 and 60 minutes before the headache starts (although there is also a type of migraine where these symptoms can happen without a headache). Although experts do not know what processes are involved in migraine, it is thought that the inner ear may be damaged by ongoing migraine attacks (also increasing the risk of BPPV). Approximately half of people with Ménière's disease experience at least one migraine symptom during a Ménière's attack.

### **How does my sense of vision affect my balance?**

In Ménière's disease (and many other balance disorders of the inner ear), your brain must rely more on your sense of vision to balance than people who do not have a balance disorder. As a result of this, your balance system can be more sensitive to confusing or disorienting information about your balance coming from your eyes. Dizziness can therefore be triggered by complex or moving visual environments (this is sometimes called visual vertigo). These include busy places such as busy roads, moving crowds, or walking down the aisle of a supermarket where the shelves provide repetitive complex visual patterns. Other disorienting environments include travelling in a car or going up or down in a lift or an escalator. These sorts of environments quite commonly cause dizziness in people with inner ear problems, due to different reasons:

### **What visual environments can affect my balance?**

#### ***Not enough visual information***

Your eyes get their information about which way up you are from the environment. This information is taken from vertical structures (such as buildings, trees and lamp posts). These vertical structures need to be quite close to you to be useful for your balance system. Several types of environments do not provide enough visual information for your brain to be able to use for balance, and so can result in dizziness and unsteadiness. The most obvious of these is night time when it is dark, or when you are somewhere that only has dim lighting. There is also not enough visual information nearby when you are in large flat and open spaces (such as a field or park), or looking down from heights.

Inaccurate visual information can also result in dizziness and unsteadiness. For example, when you are travelling in a lift or on a boat without a view, you do not have accurate visual information about how you are moving, because your visual environment is moving with you. The balance organ in your inner ear can tell you are moving and sends conflicting information to your brain.

### ***Too much visual information***

The balance system can also become overloaded when you take in more visual information than you are used to dealing with. This visual information can also conflict with information coming from your other balance senses. The types of environments that can provide too much visual information are environments that involve motion (in the environment), complex patterns, and flickering lights.

#### ***Motion***

Standing next to a busy road, watching a car chase on TV, or being in a crowded place can cause dizziness and unsteadiness. This is because the continuous movement of cars or people across your line of sight keeps sending new signals to your brain about your visual environment. These signals are an unreliable source of information for your balance system, as it can become confused as to whether it is you or your environment that is moving. It is not only fast moving environments that can trigger dizziness and unsteadiness. Slow moving environments such as being on an escalator or looking at the clouds, flowing water, or a scrolling computer screen can also have the same effect.

#### ***Patterns***

Environments where there are repetitive or complex visual patterns can also overload the balance system with too much visual information, causing dizziness and unsteadiness. The most common environment like this is a supermarket. Supermarkets have long narrow aisles that are stacked high with many shapes and colours, providing a very complex visual environment. Other environments include anywhere that has a patterned floor or carpet, or looking at stripy surfaces (such as some garden fencing or shirts with a stripy pattern).

#### ***Flickering lights***

Just as darkness or dim lighting prevents your eyes from getting enough information about your environment, lighting that flickers also means that your eyes are not getting reliable information about your visual environment. In addition, because your brain has a limited capacity for what it can attend to at any one time, attending to the change in lighting means that your brain has less capacity to coordinate your balance. This can result in dizziness and unsteadiness. Environments that involve flickering lighting include travelling in a car when the sun is shining through the trees or at night when the oncoming car headlights are flickering, and shops or other places that use fluorescent lighting. Programmes on television and older types of computer screens can also flicker (but so fast that you may not be aware of it).

## How does the rest of my body affect my balance?

Sensors in your skin, muscles and joints around your body send signals to the balance system about where all the parts of your body are, if they are moving, and whether they are touching anything. Your balance will be better when you are sitting than when you are standing, and standing on two feet will give you a better balance than when you are standing on one foot, as more parts of your body will be sending signals to your balance system. In addition to this, your balance is also affected by the type of surface you are walking on. The types of surfaces that can affect your balance include:

- Moving or wobbly surfaces (escalator)
- Uneven surfaces (stony path)
- Slippery surfaces (wet or icy path)
- Narrow surfaces (walking on a balance beam)
- Sloping surfaces (hill)
- Soft surfaces (thick springy carpet or a sandy beach)

When fewer signals are being sent from your body, your balance system is more reliant on the signals from your eyes and balance organ. An example of this is riding a bicycle. The signals from your body are dramatically reduced because you are not in direct contact with the ground, the bicycle and the pedals move, and you are reliant on a narrow surface (two thin wheels one in front of the other).

Regular exercise is important for maintaining flexibility and strength, which can help you to balance. The stronger and more flexible your muscles and joints are, the better your body will be able to deal with different surfaces.

<sup>†</sup> To receive the balance booklets referred to on page 2, please contact the Ménière's Society.

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**Disclaimer:** The Ménière's Society recommends that you always consult your GP, consultant or therapist for professional guidance before you begin, change, temporarily suspend or discontinue any treatment, medication, exercise or diet. The Society cannot advise on individual cases nor accept any liability resulting from the use of any treatments referred to in this information sheet.