Prosopagnosia: face blindness after brain injury

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Introduction

Some people with a brain injury acquire a condition known as prosopagnosia (pronounced pro-so-pag-no-sia), or 'face blindness'. People with the condition cannot tell the difference between faces, an ability most of us take for granted. They may not even recognise the faces of their closest friends and family, or their own face in the mirror. This can be a cause of great distress, social isolation and loss of opportunities in careers and relationships.

The pure form of the condition does not result from generalised difficulties in memory or visual perception and is not associated with mental confusion. Instead, people appear to have selective difficulties in face recognition alone. Indeed, they can still access all their stored knowledge about a person once they know their name, and they can still recognise other types of objects. However, the pure form of prosopagnosia is very rare, and most people who acquire face recognition difficulties after brain injury experience other cognitive and visual difficulties alongside the condition. This occurs because brain injury tends to affect a number of brain regions, causing multiple difficulties.

How does face blindness affect people?

As face recognition comes so naturally to most people, it can be very difficult for those with normal face processing abilities to understand. A good way to understand it is to think about our ability to distinguish individual animals, such as chimpanzees. Humans find it very difficult to identify chimpanzees unless they have a lot of practise looking at particular individuals. The chimps themselves, however, have no problem telling each other apart but have great difficulty doing the same with humans. It seems we have evolved an ability to expertly identify faces of our own species.

The particular pattern of face processing and other cognitive and visual difficulties varies greatly among individuals with prosopagnosia. Many people have problems extracting information other than identity from a face, and may struggle to interpret a person's gender, age or emotional expression. Most people with prosopagnosia also have difficulties recognising other classes of objects, such as cars, household utensils or garden tools.

Many people also experience navigational difficulties alongside prosopagnosia. This can result from visual difficulties in processing angle or distance, or may be caused by poor memory for places and landmarks. Finally, more general visual impairments are frequently observed in people with prosopagnosia, such as the perception of luminance, colour, curvature, line orientation or contrast.

What causes face blindness?

Whether experienced alongside other difficulties or in isolation, prosopagnosia generally results from damage to specific brain areas. Typically it is parts of the occipital lobes and temporal lobes involved with perception and memory that are affected, especially a specific region within each temporal lobe known as the fusiform gyrus. The importance of this region for face recognition has led to it being commonly known as the fusiform face area (FFA) (see diagram on the following page). There is a fusiform gyrus in both sides of the brain, but it is the one in the right hemisphere that is usually associated with face processing.

Some evidence suggests that fusiform gyrus damage tends to bring about difficulties in face perception and recognition, whereas damage to other areas of the temporal lobes is associated with difficulties accessing memories of faces. It has therefore been suggested that there are two subtypes of prosopagnosia, one affecting the way we perceive faces (apperceptive prosopagnosia), and the other affecting our memory for faces (associative prosopagnosia).

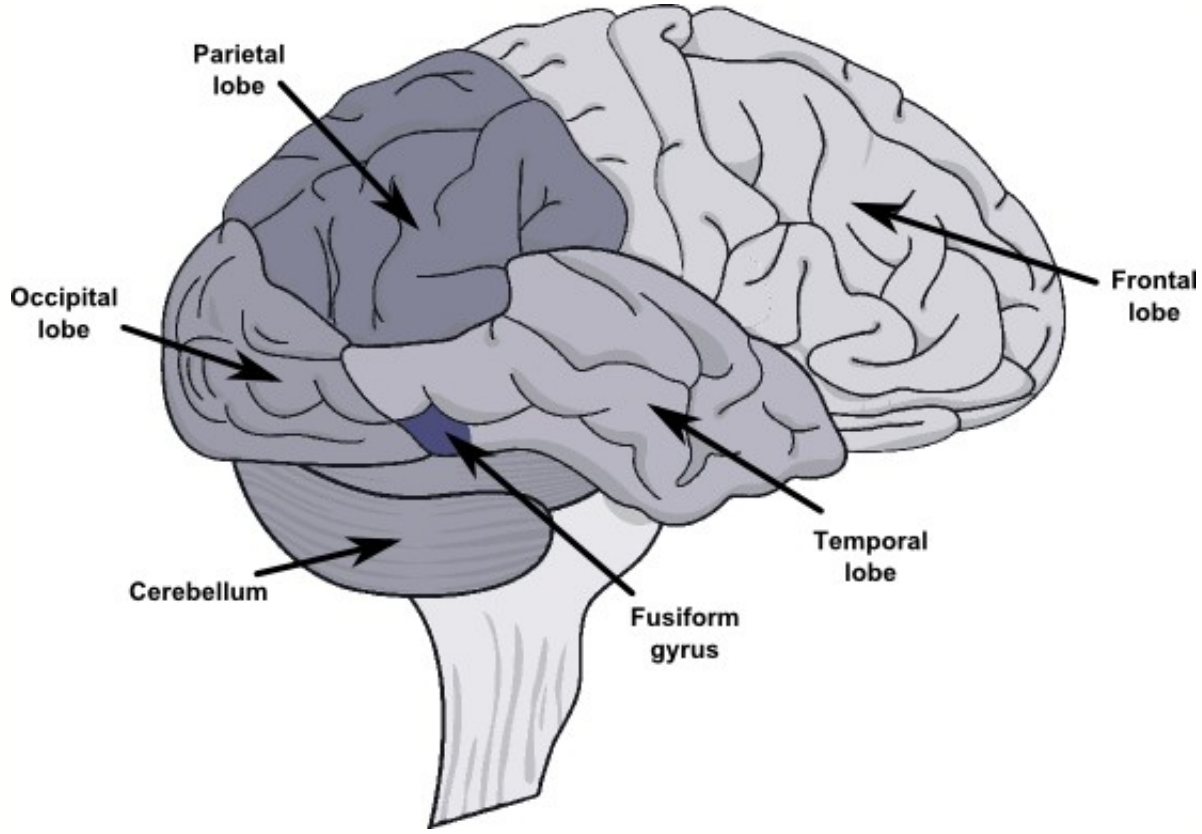


Figure 1: Human brain with fusiform face area (FFA) in right temporal lobe highlighted

These conditions may be caused by the precise location of the brain injury. However, as noted above, it is rare that damage is confined to just one brain area, and prosopagnosia is often accompanied by a range of other cognitive and visual difficulties. This can sometimes make it difficult to interpret the nature of a person's face processing difficulties according to the two subtypes.

Developmental prosopagnosia

Interestingly, there also appears to be a developmental form of the condition that has been estimated to affect approximately 2% of the population (approx. 1.2 million UK residents) and occurs in the absence of brain injury. Instead, people with developmental prosopagnosia seem to fail to develop the visual mechanisms necessary for successful face recognition.

There have been reports of families in which multiple members have the condition, suggesting a genetic link in some cases. Studies of identical and non-identical twins have also provided more evidence of a genetic basis. A recent study has shown that in face recognition tests the correlation of scores between identical twins was more than double that of non-identical twins. However, a specific gene for developmental prosopagnosia has not yet been found.

It has been suggested that the developmental form of the condition could be related to other conditions. For example, case reports have documented that some people with developmental prosopagnosia experienced uncorrected visual problems for sustained periods of their childhood. This may have resulted in visual areas of the brain failing to develop properly. It is also known that many people with autistic spectrum disorders (ASD) have difficulties recognising faces. This may be related to impaired social functioning, poor memory and inability to interpret the emotional and mental state of other people. However, not all people with ASD have impaired face recognition skills.

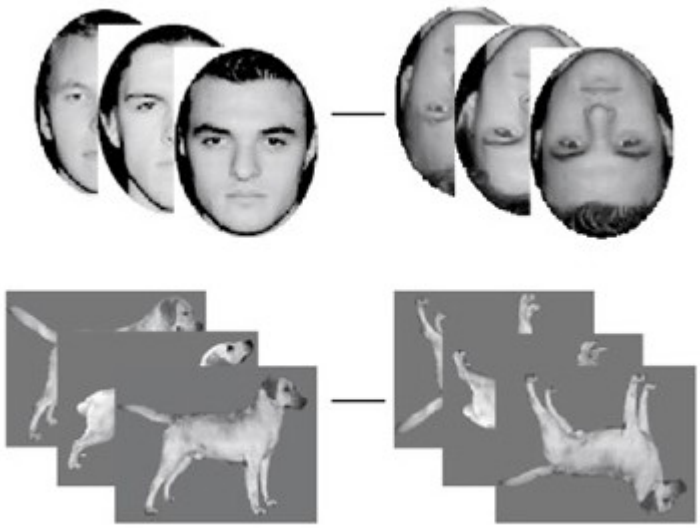
The study of developmental prosopagnosia is still relatively young. While developmental prosopagnosia shares the same key characteristics as prosopagnosia acquired after brain injury (i.e. a severe and permanent difficulty in face recognition), other similarities between the two conditions are still being investigated.

How does the brain usually process faces?

Research suggests that faces are processed in a unique way, differently to other types of objects. People with normal face recognition abilities appear to process faces 'holistically'. This means that the face is processed as a whole, taking account of the relationship between features rather than focusing on the features themselves. This is demonstrated by the following three phenomena unique to the perception of faces rather than other objects.

The inversion effect - Faces are very difficult to recognise when upside down, whereas other objects tend to still be recognisable.

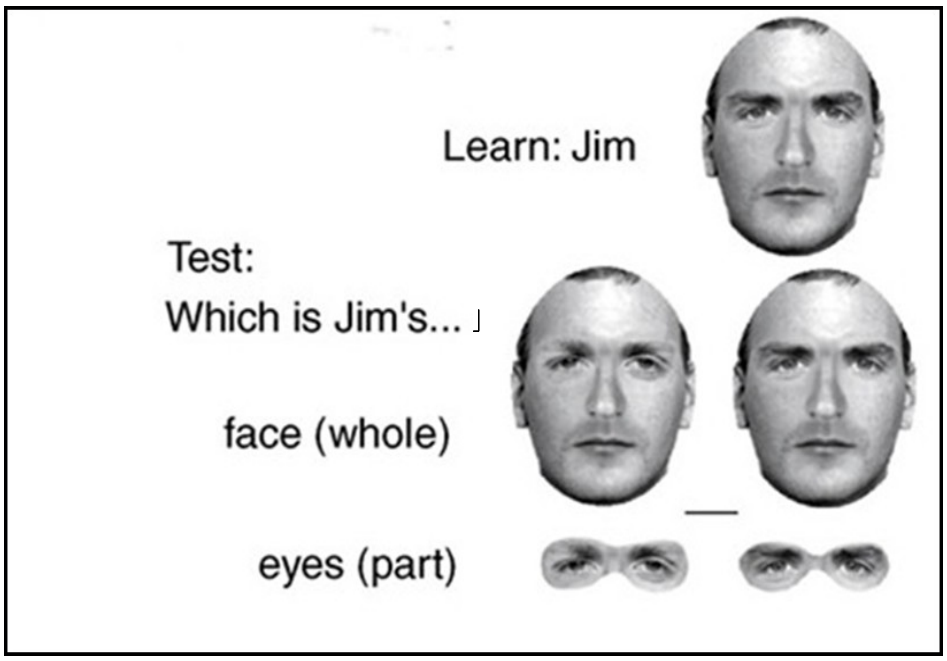
Figure 2: The inversion effect



The figure above shows human faces and dogs in upright and inverted positions. Research has shown that dogs are much easier to identify when inverted than human faces.

The part/whole effect - Facial features are also remembered much better when viewed in the context of the whole face than when viewed separately. This is a lot less of a problem when identifying features of other objects, such as the doors of a house.

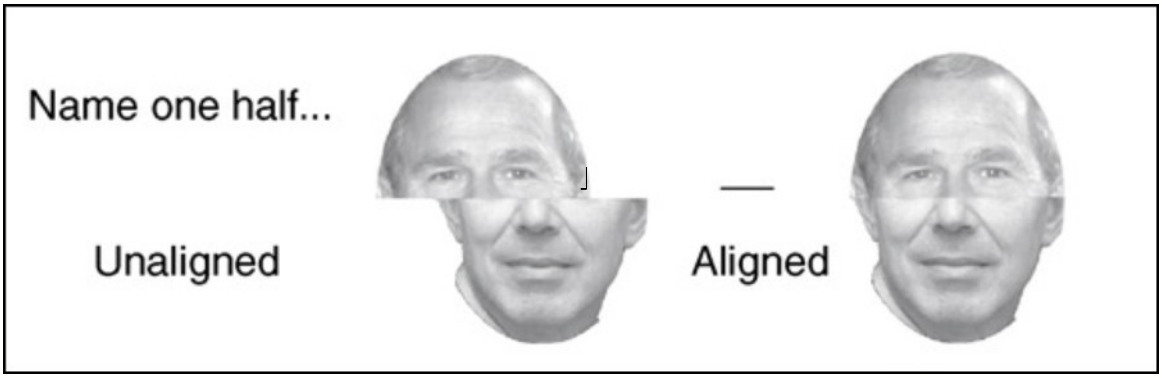
Figure 3: The part/whole effect



The diagram above shows a typical test of whole-face and part-face identification. It is much easier to identify Jim's eyes when shown in the context of the whole face than when shown separately.

The composite effect - When faces are divided into top and bottom halves, it is much easier to identify one half if it isn't aligned to the other half of a different face. This is because when the halves are aligned the brain automatically tries to process the image as a whole face and can no longer identify a specific half.

Figure 4: The composite effect



Can you identify the two faces depicted above? It should be much easier to identify George W. Bush (top half) and Tony Blair (bottom half) in the unaligned condition than when they are aligned.

So it appears that face processing works uniquely in the human perceptual system. Further evidence for this has come from studies of young children, who seem to have an innate bias towards faces over other objects.

Infants as young as a few days old have been shown to have a preference for looking at faces and face-like images, such as patterns resembling two eyes, a nose and a mouth. The children spend far longer looking at these images than other non-face like patterns. Babies a few days old have been demonstrated to prefer looking at their mother's face over those of strangers. Two-month olds even show a preference for faces rated as attractive by adults.

Early experience of faces appears to be important. One fascinating study showed that infants between six and nine months old can actually identify the faces of individual monkeys, an ability which is lost after nine months of age if not practised. Exposure to human faces in this period may therefore be critical to development of normal adult face processing ability.

How do people with prosopagnosia perceive faces?

People with prosopagnosia do not see faces in a distorted manner – they still see two eyes above a nose that is above a mouth, etc. However, they find it very difficult to use this information to recognise familiar faces. This may result from a problem with the holistic processing described above.

Rather than processing faces as a whole, individuals with prosopagnosia seem to adopt a feature-by-feature strategy, in which faces are processed in a piecemeal manner and each feature is looked at in turn. Not only does this make face recognition a longer and more difficult process, but it also ignores the spatial relations between features – information that is critical for successful recognition.

This unusual processing strategy has been demonstrated using eye tracking technology. Sensitive equipment monitors a participant's eye movements while they look at faces on a computer screen and tells researchers the precise areas of the face that participants view during recognition. While typical participants tend to only look at the inner features of the face (i.e. the eyes, nose and mouth) with a particular focus on the eyes, participants with prosopagnosia tend to spend more time looking at the external features of the face (i.e. the hair and ears) and specifically avoid the eye region.

Diagnosis and treatment

Prosopagnosia is typically confirmed following participation in a cognitive assessment session. People with face recognition difficulties may be referred to a clinical neuropsychologist working within the NHS or private practice. Alternatively, they may be referred to a researcher who specialises in the field and is based at a nearby university. Researchers often accept self-referrals when the person with prosopagnosia or a parent/ guardian contacts them directly.

A typical assessment session consists of a range of tests that assess a person's face recognition ability and also their more general cognitive and visual skills. The battery of face processing assessments is likely to include tests examining the ability to:

- Memorise and later recognise a set of faces that have never been seen before
- Recognise very famous faces
- Spot similarities and differences between faces that are presented side-by-side
- Judge age, gender or emotional expression from a set of faces

Some tests will be presented on a computer, while flip-charts, vision charts and other materials may also be used.

More generalised tests are carried out to examine whether any accompanying difficulties in memory, attention or vision may be contributing to the face recognition difficulty or affecting performance on the face recognition assessments. These tests may include an evaluation of IQ to be compared to appropriate control data.

Prosopagnosia is permanent in most cases, although some people experience isolated episodes of the condition (for instance following migraine), after which their face recognition skills return to normal. Most people's face recognition skills do not spontaneously improve, and there is currently no known cure for the condition.

Some researchers are developing training programmes that attempt to improve face recognition skills. While these are unlikely to offer an actual cure, some published findings suggest regular training with faces may improve recognition abilities. It is often possible for a person with prosopagnosia to directly contact a researcher to find out if they are eligible to take part in a research programme. For contact details of researchers see 'Further information and support' at the end of the factsheet.

Living with face blindness

Prosopagnosia can have a significant effect on a person's everyday life, particularly when the condition is acquired after years of living with normal face recognition skills. It can be very distressing and isolating to lack such a fundamental ability. Many people cope very well, however, some worry that they appear rude, aloof or simply disinterested in others when they fail to recognise a person. The condition can force people to actively avoid social situations and experience social anxiety and reduced self-confidence. Relationships and career opportunities can also be affected.

Face blindness can be difficult for those without the condition to understand. Face recognition appears to be such an automatic process that many people cannot imagine that face blindness is even possible. Therefore, prosopagnosics often experience a lack of empathy and understanding for their difficulties.

Other than the obvious problems of failing to recognise people, the following everyday difficulties often affect people with face blindness:

- It can be very difficult to identify the characters in films and TV programmes, especially when they change their clothes. This makes understanding the plot extremely difficult. Films in which people look similar or have very similar clothing or hairstyles can be particularly confusing, such as war films or Ocean's Eleven, for example.
- Men can be particularly difficult to tell apart because they tend to have similar short hairstyles and casual dress.
- Many people with prosopagnosia have difficulty navigating and can be prone to getting lost.
- It can be very difficult to recognise signs of emotion in people's faces.
- Some people have difficulty telling left from right.
- Failure to recognise public figures such as celebrities and politicians means it can be very difficult to keep up with news and current affairs. This can hinder people when entering into conversations.
- Even people's race and colour aren't always easily identifiable.
- Reading books can be difficult because prosopagnosics cannot imagine characters' faces.
- Strategies for recognising people can be disrupted if familiar individuals change their appearance (a new haircut, teeth whitening, tan, etc) or their voice changes due to a sore throat.

Many people use compensatory strategies that help them either to identify people, or to disguise their failures of recognition. Often, people with prosopagnosia are able to identify familiar individuals when they expect to encounter them, by putting together cues from a person's non-facial appearance with contextual information. For instance, they might be able to infer that the person operating the till at the local shop is Penny, the woman with very long hair that works in the shop every Saturday.

Sadly, compensatory strategies based on appearance and contextual cues do not always work, and may break down when a familiar person is met in an unexpected location or changes something about their appearance. For example, if unexpectedly bumping into Penny when walking in the park, it may be much more difficult to identify her, even when her hair is styled as normal.

Some people with prosopagnosia describe more elaborate compensatory strategies, and may recognise others using accessories such as shoes, jewellery or handbags. Others try to avoid embarrassing situations where they fail to recognise people by ensuring that they are always the first person to arrive for a meeting (so the other person has to find them and not vice versa).

There are no easy ways of overcoming face blindness and probably the most effective technique is to be open and honest about the condition with friends and work colleagues so they will not expect you to recognise them in unexpected environments.

Tips and coping strategies

The following tips and strategies have been suggested by people with prosopagnosia. If you are prosopagnosic yourself then some of the suggestions may work for you, while others won't. Everyone is different and you will need to work out the right strategies for you. It can be a good idea to get someone to help you with this, such as a psychologist, occupational therapist, or even a partner, family member or friend.

Social strategies

- Avoid referring to people by name or saying anything specific until you are sure you have identified them correctly.
- At gatherings where there are some people you know, treat everyone in a friendly way. Smile and say hello to people in passing and this will prevent people thinking you are ignoring them.
- When entering into conversation with people you can often work out their identity from what they say.
- Look for signs of recognition in people's body language.
- Try to avoid meeting too many people at once.
- Ask others to use people's names when addressing them in your company.
- When looking for someone in a group, ask someone you are sure is not the person you're looking for, such as a person of the opposite sex.
- Ask people to introduce themselves every time they see you with their names and how you know each other.
- Be careful when visitors come to the door and don't let people in until you are certain who they are. Other situations may also require caution.
- Try to take an interest in people and remember personal details from previous conversations. This can make up for an initial lack of recognition and ensures people don't think you just aren't paying attention. This is very difficult if you have memory problems as well, in which case keeping notes on people can help.

- Go to parties, meetings or other gatherings with a friend or colleague. Ask the other person to help you identify people before you talk to them.
- Get people to wear name tags if appropriate.

Observational strategies

- Look at the rings on people's fingers. A lot of people wear their rings all the time so it can be a reliable way of identifying people in some circumstances, especially if the rings are distinctive.
- Look for other jewellery (such as necklaces and bracelets) and distinctive shoes.
- Hairstyles are one way of identifying people. This can work well when people have distinctive haircuts, but is less effective for conventional styles. Men are particularly difficult to tell apart by this method.
- Walking gaits are very individual, so some people can learn to recognise them effectively.
- With practise, people can be easily identifiable by the unique aspects of their accent, speech patterns and turns of phrase.
- Look out for distinctive mannerisms, nervous ticks, etc.
- Look at body shape and height.
- Regular acquaintances can be recognised by their car, bags, or pushchair, etc.

Memory strategies

- Invent a mnemonic for remembering someone's distinctive features, e.g., Dave's dimples; Pam's perm. You could even invent ways of remembering people by really mentally exaggerating particular features in the style of a caricature.
- Make diagrams and notes of where people are sitting in meetings.
- At meetings or parties write down what clothes people are wearing.
- Keep a notebook and make notes of people's identifiable characteristics and features.

Preparation strategies

- School teachers can create a seating plan for their classes so they know exactly where everybody is.
- You could ask if you can take pictures of people you know so you can study them. Alternatively, facebook and twitter profiles can be very useful. You could add people as friends on facebook and study their profile pictures.
- Some photography programmes and computer applications have face recognition technology which can suggest other pictures a person appears in. This can actually help to train you to notice things about a person's face.

Navigation strategies

- Smartphone applications, such as Google Maps, can be invaluable for avoiding getting lost.
- Purchase a satellite navigation aid for car journeys.
- Learn how to read maps effectively for occasions when Google Maps and satellite navigation aids aren't available.

Watching films and TV

- Watch TV shows and movies with a friend who can help you identify characters. This also enhances the viewing experience by making it more of a social activity.
- Watch films with small casts of characters or one distinctive central character.

Issues facing children with face blindness

Prosopagnosia can be particularly difficult to diagnose and manage in children. Unfortunately, public and professional awareness of prosopagnosia is low, and educational professionals may not even have heard of the condition. Also, if a child was born face blind then they may consider it to be normal and not mention it to anyone. It could be years before the nature of the problem is properly noticed by adults. Children may even be misdiagnosed with other conditions, such as autistic spectrum disorder.

Signs to look out for include:

- Persistent failure to recognise family members and friends, particularly in unusual contexts and environments.
- Reliance on external features, such as hair and clothes, to identify people.
- Inability to keep track of the identity of characters on television or in films.
- Social isolation and difficulty making friends. This may be in contrast to more confident behaviour at home when recognition is not a problem.
- Excessive 'clinginess' to a parent or guardian in public places where they may get lost
- Waiting for a parent to wave before approaching them.
- Mistakenly approaching strangers.

The situation is made particularly difficult in the UK because most schools require children to wear uniforms and have strict rules about personal appearance, providing children with few external cues to identify their peers. These factors may make it difficult for prosopagnosic children to make friends. Some parents have found that use of a 'buddy' system at school can be effective, where the friend of a child with prosopagnosia

is allowed to wear a distinctive badge or marker in the playground. It can also help if other children understand that they need to identify themselves to a classmate before beginning a conversation.

Finally, parents of children with prosopagnosia also stress the need for schools to be aware of safety issues when their child leaves the premises at the end of the day or when the class goes on a trip. It is easier for children with prosopagnosia to become separated from a group and to be unaware of who is a stranger to be avoided and who is a teacher or classmate.

It is very important to identify the problem as soon as possible so it can be managed. A GP should be able to refer a child to an appropriate professional, such as a neuropsychologist or specialist researcher. Some university face processing laboratories also offer screening sessions for children. For example, to register a child for testing at the Centre for Face Processing Disorders at Bournemouth University, visit www.prosopagnosiaresearch.org.

Conclusion

Face blindness can have a profound impact on everyday life. While some people cope well with prosopagnosia, others may withdraw from social situations and encounter significant problems at work. There are also issues of safety to consider. It is very important that people receive as much support, understanding and information as possible in order to overcome these problems.

While prosopagnosia can present as a ‘pure’ disorder where a person only experiences difficulties with face recognition, following brain injury it occurs much more frequently alongside other cognitive and visual symptoms. It is very important when possible to work with rehabilitation specialists, such as neuropsychologists, who can help with the full range of problems.

Complex issues are often associated with childhood prosopagnosia and specific support and safety issues may need to be addressed. It can be very difficult to identify the problem in children and difficulties are sometimes attributed to other conditions, such as autistic spectrum disorder. If a child is suspected of having prosopagnosia it is very important to have them assessed by a professional as soon as possible.

Further information and support

Processing Disorders on their website at www.prosopagnosiaresearch.org. The website also provides further information about prosopagnosia, and has discussion forums where you can read about the experiences of other people who are affected.

You can also register to participate in research run by the Universities of Harvard and Dartmouth in the USA and University College London, by visiting www.faceblind.org.

Some memory clinics and other groups for people with brain injuries may provide support and advice about the condition. You can speak to your GP about any such services in your area. You could also ask your GP about referral to a clinical neuropsychologist. A directory of chartered psychologists in private practice is available at www.bps.org.uk.

Headway groups and branches provide a range of support services for anyone affected by brain injury. Details are available at www.headway.org.uk/in-your-area.aspx.

The London Faceblind Group was set up specifically for people with prosopagnosia and meets several times a year. The group is run by Monica Zenonos, a qualified counsellor who has the developmental form of prosopagnosia. More information can be found on her website at www.monicazenonos.counselling.co.uk.

Further reading

The following books provide detailed, academic accounts of the neurological and psychological aspects of face processing and its disorders. All titles are available from the Headway Amazon shop at www.headway.org.uk/headway-amazon-shop.aspx.

- Bate, S. (2012) *Face Recognition and its Disorders*. London: Palgrave Macmillan.
- Bruce, V. & Young, A. (1998) *In the Eye of the Beholder: The science of face perception*. Oxford: Oxford University Press.
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- Johnson, M. & Morton, J. (1991) *Biology and Cognitive Development: The Case of Face Recognition*. Oxford: Blackwell.

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McKone, E., Kanwisher, N., & Duchaine, B. (2007). Can generic expertise explain special processing for faces? *Trends in Cognitive Sciences*, 11: 8-15.

To discuss any issues raised in this factsheet, or to find details of our local groups and branches, please contact the Headway helpline free of charge on 0808 800 2244 (Monday - Friday, 9am-5pm) or by email at helpline@headway.org.uk.

You can also find more information and contact details of groups and branches on our website at www.headway.org.uk/supporting-you.

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