A basic guide to Psychomorph

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A basic guide to Psychomorph

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1. Introduction

I hope this will be a useful guide for people who haven't used Psychomorph before. I'm still learning myself, so any suggestions or tips are warmly received. Just email me at clare.am.sutherland@gmail.com.

All credits belong to the people who created Psychomorph (see references at the end or on the Psychomorph webpage) and made it freely available to the research community. You should repay this by citing them appropriately (see references at the end).

Thanks to Andy Young, Dave Perrett, Peter Hancock, Carmen Lefevre, Josh Spowage, Richard Vernon, Scott Brindley and Katrien Sutherland for thoughtful comments and suggestions on draft versions. Thanks also to Peter Hancock for encouraging me to publish this. Any remaining mistakes are mine. If you spot any, let me know!

Obtaining Psychomorph

All of the documentation here has been tested on a Mac running Psychomorph version 6. Psychomorph and example image, template and mask files are found here: http://users.aber.ac.uk/bpt/jpsychomorph/.

What this guide covers

Professor Andy Young was kind enough to write a general introduction to Psychomorph (section 2). The rest of the guide was written by me and will show you what Psychomorph looks like (section 3) and will offer a simple "how to" delineate images (section 4), create averages (section 5) and morph or transform images (section 6). I also included batch aligning eyes (section 7) and overlaying a face mask (section 8), since these are common tasks. It's aimed at first time users, including undergraduates or anyone unfamiliar with Psychomorph. I tried to make it as user-friendly as possible.

What this guide won't cover: Anything more advanced than that, basically. There are lots of other useful features of Psychomorph, such as video tracking, PCA analysis, or creation or analysis of facial symmetry or texture, to name a few things you can do. You can also extract information from it using code (e.g. template positions) and you can make your own plug-ins.

For more advanced features, or for other descriptions of delineating, averaging and transforming, there is a help site here: http://cherry.dcs.aber.ac.uk:8080/wiki/jpsychomorph/ or post a question to the face perception research list (face-research-list@lists.stir.ac.uk). If you wish there was something that this guide would cover, email me - if I get enough emails asking to cover a particular feature, I'll see what I can do to add this.

The help site especially is meant to be a wiki, so if you find bugs or useful hints or tips, please upload them there!

2. Background

Andy Young

Psychomorph (Tiddeman and Perrett, 2001) is an excellent resource for manipulating images of faces that has been used to create stimuli for many published studies. Like any software, though, there are things that need to be learnt to achieve the best results. This guide will take you through some of the key steps involved in using Psychomorph, and show you how to transform images in different ways.

In general, image manipulation software starts by positioning a number of points that mark the positions of features on an image - a step usually called **delineation**. In the case of a photograph of a face these points will delineate the eyes, nose, mouth, the outline of the hair, and so on. These feature points (often called **fiducial points:** see below, left hand side image) can then be used in two ways:

- their locations define the shape of the image
- they can be used to segment the surface of the image into a large number of smaller regions through a process of **tessellation** (essentially, positioning a mesh of imaginary lines joining the points together: see **Figure 1** below, the right hand side image)

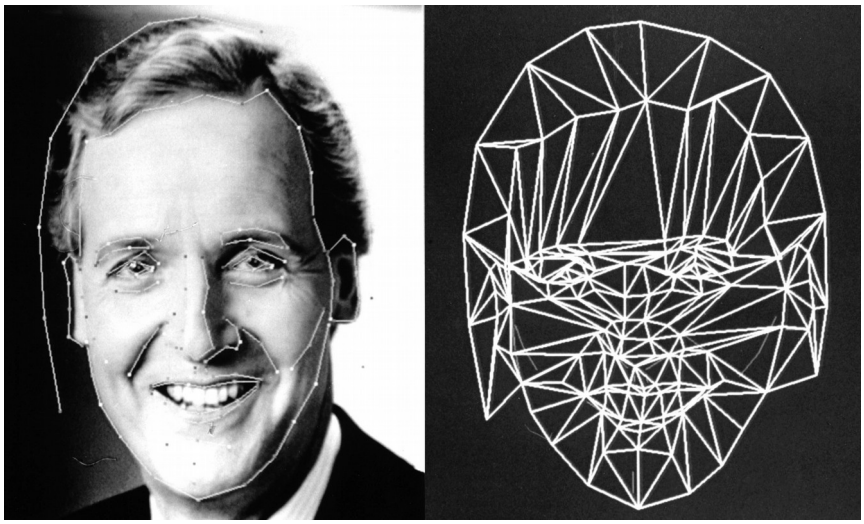


Figure 1. An example image with the fiducial points marked out (left hand side) and a diagram of the tessellations between the fiducial points (right hand side). Note that this example has less fiducial points than the rest of the examples used in this guide. Image used with permission from Professor David Perrett.

So, once an image has been delineated, computer graphics techniques can be used to change its shape or its surface characteristics:

- to change the shape, you treat the image as if it was set out on a rubber sheet which you can stretch or compress until the fiducial points fall in whatever new positions you would like
- to change the surface characteristics you can blend each of the small tessellated areas with a corresponding area from another image

Let's consider the case where we have delineated a photograph of Face A and a photograph of Face B. Even from this simple start, there are many things that can be done:

- we could change the shape of the image of Face A into the shape of the image of Face B, by moving all the fiducials on Face A into the positions of the fiducials in B
- we could make an average of the images of Face A and Face B by moving the fiducial points for A and B into the mid-point location across each image and then blending together the brightness and colour values of each pixel in the corresponding tessellated region
- we could exaggerate the differences between A and B by calculating the mid-point location for each fiducial and then reshaping the images to move the fiducials in each face further away from these mid-point locations

So it is possible to **average** images, to blend images in regular steps (**transforming or morphing**), and to exaggerate differences between images (**caricature**). Often, these can be done separately for shapes (fiducial positions) and surface characteristics (brightness and colour values of pixels in the tessellated regions). Psychomorph will let you do any of these.

Note that in essence Psychomorph is a program for manipulating **images** of faces. It takes as input the 2D representation found in a photograph or similar, and does not explicitly represent the face's 3D structure (although see below). At first, this seems counterintuitive - we all know that faces have a complex three-dimensional shape, and not explicitly inputting the depth information can feel like a limitation. Nonetheless, the results of image manipulation with Psychomorph are usually remarkably effective, and it is worth thinking about why this might be. There seem to be two contributory reasons. First, many of the cues we need to perceive faces are actually intrinsically two-dimensional. For example, moving the corners of the lips upwards and opening the mouth will convey a smile regardless of the relative locations in the depth plane of the parts of the mouth itself (i.e. regardless of the particular 3D shape of an individual's mouth). Second, in circumstances where depth cues are informative, some information about depth relationships is present in patterns of shading across the tessellated regions, and sometimes in the relative positioning of the fiducials themselves (especially if the image viewpoint is not one of directly facing the camera).

An equivalent program exists for working in 3D (http://cherry.dcs.aber.ac.uk/morphanalyser/version2.4/launch2.4.html). This requires both the 2D surface colour and information from depth/distance. Note also that while Psychomorph was developed for face image manipulation, it can be used with any type of objects that has corresponding landmarks (profile faces, bodies, hands, cars, aeroplanes, etc.)

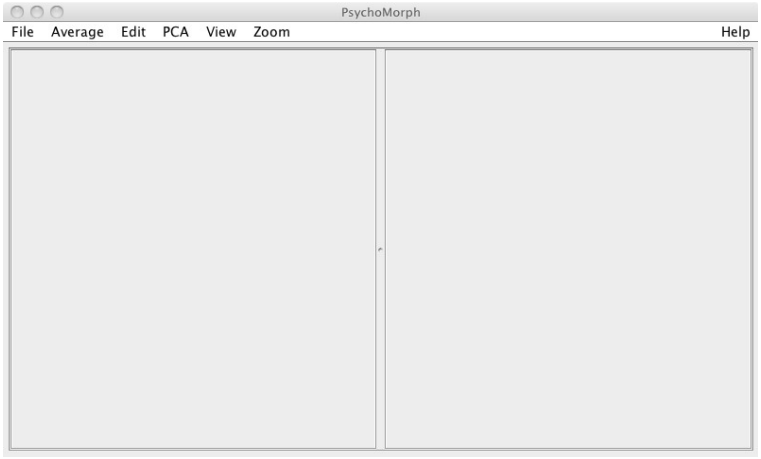
One of the many strong points of Psychomorph is that it offers a considerable degree of control over **how** you can tell it to manipulate the images you are working with. But with that degree of control comes the responsibility of choosing the manipulation best-suited to your needs. The types of consideration outlined above all need to be taken into account. The rest of this guide explains how to go about achieving different types of image change.

3. Getting started

3.1. Psychomorph Interface

Main Window

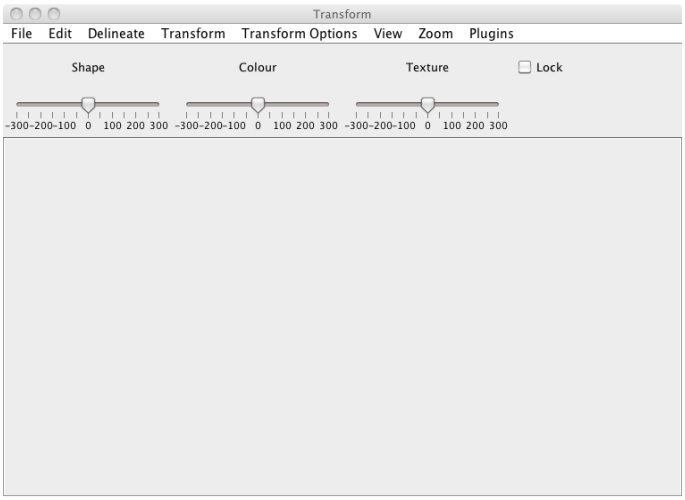
When you first open Psychomorph, you will see that there are **two windows**. The first window looks like this:



This window is the **main window** and you will use this for **averaging, transforming, morphing and caricaturing faces.**

Transform Window

The second window looks like this:



This window is the **transform window** and you will mainly use this for **delineating faces** (and setting up face morphing or transforms).

These windows might look more or less different, depending on your version of Psychomorph and the operating system you are using. But the basic idea of two windows and what they do, should be the same.

3.2. Template and Image files

You will be working with **Image files** and **Template files.**

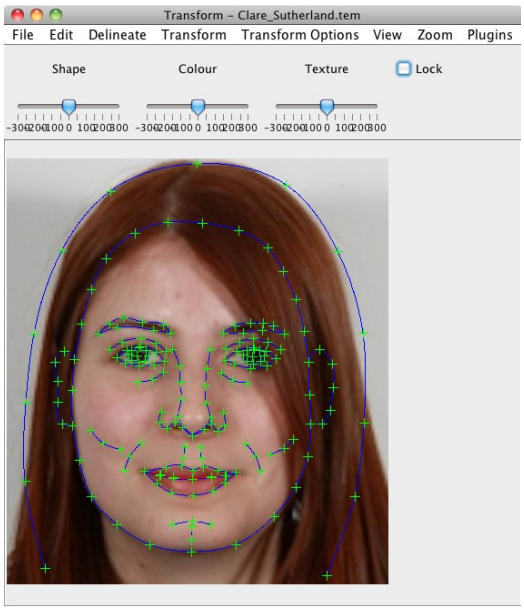
Image files are exactly like they sound i.e. pictures of (usually) someone's face. Image files can either be of real people, or averaged images and they can be any typical image file format (e.g. .png, .jpg, .bmp etc.). I usually work with **.png** files because they are usually better quality than jpegs and Psychomorph can work with this file format.

Image size: if you use really large images (around >1000 * 1000 pixels or larger) or many files, then Psychomorph might be too slow/crash. Either use smaller files or get advice on more efficient use of Java.

Template files are an overlay that shows the position of key features in an image file. They result from the positions of the fiducial points and are also used to split the face into lots of little triangles (tessellations) that Psychomorph then uses when it manipulates images. They are saved as .tem files which Psychomorph can open and create. (You can also open these in text processors like Word, or Excel, which is useful if you want to collect measurements such as the width of the eyes or to swap individual features between faces. Alternatively, Matlab or Python etc. can also open them too, if you are a programming whiz).

The process of fitting a template to an image to create a .tem file is called **delineation** (we'll come back to this in the Delineating Images section).

Below is a picture of an image file loaded together with a template file (the green points and blue lines) in the transform window of Psychomorph:



3.3. Loading Images

To load an image into the transform window select **'Load Image'** from the **File menu.** Similarly, you can load images into the left or right hand side of the main window using Load Left Image or Load Right Image from the File menu of the main window.

If the **'Autoload Templates'** option is specified in the transform window, then Psychomorph will search for a template file starting with the same name and automatically load it into along with the image. ***This is very useful but will only work if the .tem file is in the same folder as the image file, and if they have the same filename.(e.g. Clare_face.png and Clare_face.tem for corresponding image and template files).***

If the **'Autosave Templates'** option is specified in the transform window then when you save a new image file, Psychomorph will automatically also save a .tem file with the same name as the image you just created and saved (if you create the image within Psychomorph). ***This is also very useful and you will wish you had set this option when you keep finding you have to remake an image because you forgot to save a template file.***

But remember! If you reopen an old image and work on the template again, Psychomorph will not automatically save your new changes to the .tem file – you have to save the image again for the automatic template saving to work (so it's now simpler to just save the changes to the template file directly). **If in doubt, just save the image/template as a test file (named something different which you can remember).**

3.4. Saving images

To save an image you have created, go to the file menu (on either the main or transform window) and select **'Save image'.** If you have just created an average image in the right hand main window, then go to the file menu in the main window and select **'Save right image'.**

If you have ticked the 'autosave templates' option (see above) then saving the image will also save the template file too. If not, or if you just want to save the template file, go to the file menu (in either the main or transform window) and select **'Save template'.**

3.5. Other useful menu options

Transform Window

File Menu: Has the load and save file options, as well as auto load and auto save.

Edit Menu: This has options for editing the image files (e.g. cropping, rotating etc.).

Delineate Menu: This has all of the options for delineating images (see the Delineating Images section).

Transform Menu: This has options for transforming images (see the Transforming Images section).

Transform Options Menu: This has more options for transforming or morphing images (see the Transforming Images section).

View Menu: Has options to turn the picture of the template file on and off. 'Display off' lets you better see the actual image of the face; 'Display Template' lets you see the template. Hint - turn the template off and on to check the position of landmarks around faint features such as the border of the lips.

Zoom Menu: This is very useful when you need to tweak the template file to fit an image file better. You can zoom to 25%, 50%, 100%, 200% and 400% - 400% is good for delineating the eyes; otherwise 100% or 200% is probably OK. Note you may need to reposition the image for the face to be displayed after zooming in. Do this by left-clicking the mouse and holding it down and moving the entire image.

Plugins: If you install (or make) plugins, this is where they go.

Main Window

File Menu: Has the load file and save file options, as well as auto load and auto save. There is also an interesting option called video tracker (which I have not yet used).

Average Menu: This has options for averaging images (see the Averaging Images section).

Edit Menu: This has options for batch aligning the eyes, which can be useful if you have images that are not aligned.

PCA Menu: For carrying out shape or image PCAs (I have not used this but help files are available from the PerceptionLab at St Andrews).

Display Menu: Has options to turn the template file on (so that you can check that it is accurately positioned) and off (so that you can better see the actual image file). Mostly, I usually just have this on.

Zoom Menu: This is useful when you need to tweak the template file to fit an image file better. You can zoom to 25%, 50%, 100%, 200% and 400% - 400% is good for delineating the eyes; otherwise 100% or 200% is probably OK.

3.6. Error messages

The most common error in my experience is usually due to Java needing to be updated (Psychomorph is written in Java). The Java website has a test page where you can check if your Java is up to date (java test site); if not, try reinstalling Java here (download Java) and then check if Psychomorph works.

For Apple users, at the time of writing, Apple have stopped support for Java updates for their operating systems older than Lion and above (Java FAQ). So it might be worthwhile to upgrade your computer/laptop (the newest OS updates are free) if you think you'll use Psychomorph or other Java programs a lot on this system.

A second common error is to have your security settings blocking Java programs from running. Try searching for the Java settings on your computer, and adding Psychomorph as an exception to the security blocking. If this doesn't work or if it's difficult to work out what the problem is, get help to check your computer settings.

Finally, when you start Psychomorph in Windows, it can give scary warning messages about the security risk. There is no extra risk; it's just that you have to pay money to get an official security certificate that would make the message go away and the makers chose not to do this. If you press OK, it should run (you need to do this twice for some reason).

4. Delineating images

So, you have a bunch of images you want to average together, transform between or something. **What next?**

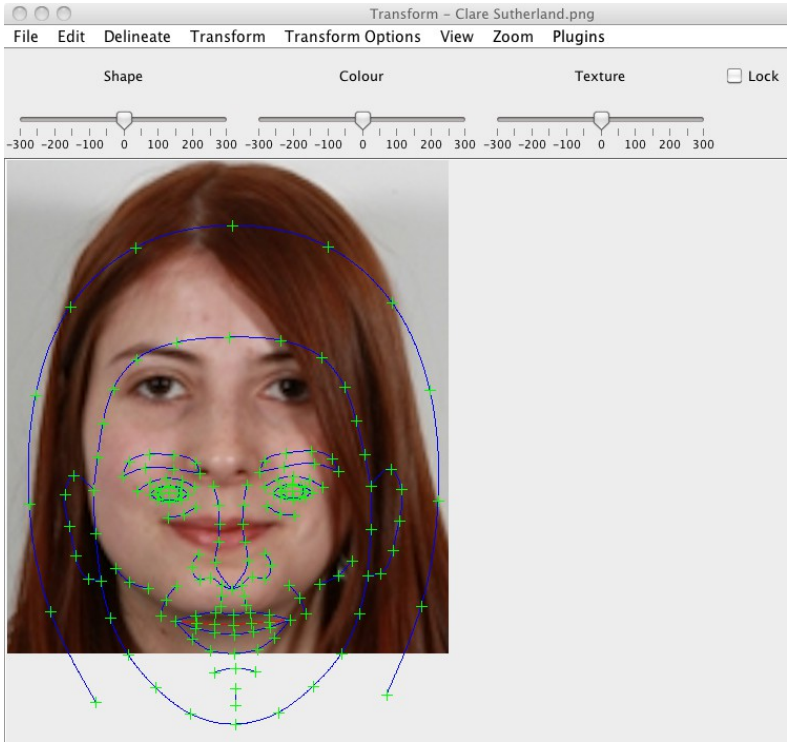
Before you do anything more fancy, you need to fit a template file to each of the images you have - this is called 'delineating the images'.

You can use the .tem files supplied in the "images.zip" file available at the Psychomorph site. There are more delineated images available at the PICS database at Stirling. Alternatively, you could manually construct a template file by adding and deleting points (these options are found in the **delineate menu** in the transform window). Otherwise, find out from your lab group which template file they are using.

All images should be roughly the same size for the rest of the techniques - such as averaging - to work properly. (You can run them with different sized images, but it may look weird).

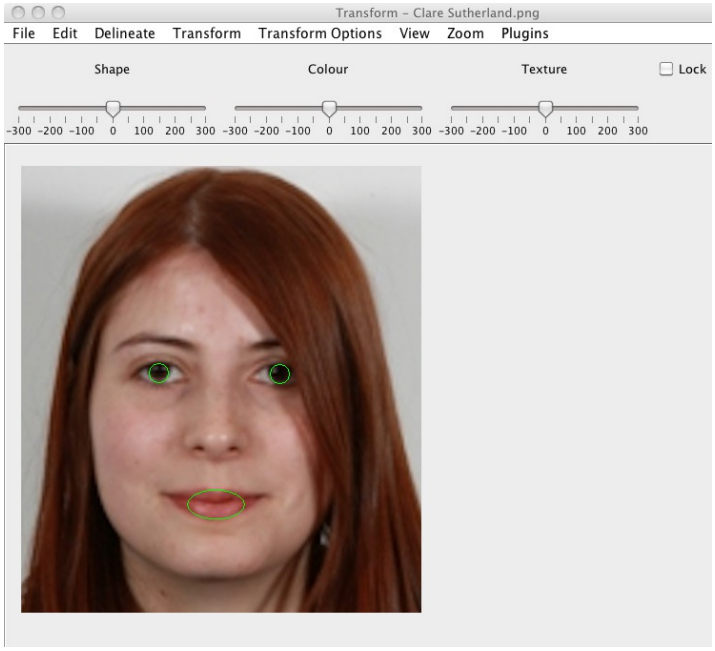
4.1. First steps

First you have to load the image you want to delineate into the **Transform Window**. Then load the default template (later, when you have created a template file which fits the image and is named after the image, Psychomorph should automatically load it in for you - see the **Autoload option** in the file menu).

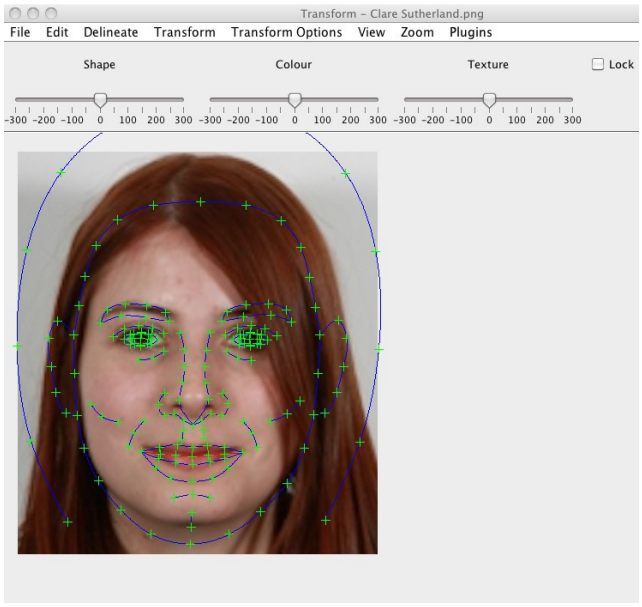


You will see that in all likelihood the template won't really fit the face at this point - in fact in this example, it's not actually on the face! (Also, apologies for the photograph, I don't like it much either and before the end of this guide we'll all be sick of it!) Before you do anything though, take a note of where the **'undo'** button is - under the **'Delineate Menu'. The undo button is also an essential feature for backtracking when you get something wrong.**

The next part is a little bit magic - go to the View Menu, and then Display Three Points. Move these three points (eye-eye-lips) over the eyes and the lips (see below). Note that the order of the points is critical: the left circle is for the left (of image) eye; the oval for the mouth.



Then go back to displaying the full template (View Menu > Display Template). Now it looks a lot more fitted to the face! (Well it's actually on the face now, which is a start).



It still doesn't fit amazingly well though - for example, the chin template is below the face's actual chin; the lip template is below the actual lip and the ears and eyebrows are probably too big for the face. This is when it gets a bit tricky because now you have to adjust the fiducial points in the template manually.

If you **click on a line**, you can drag and move that whole section. If you **click on a cross**, then you can drag and move only that point (cross). **Try it out!** (Remember you can 'undo' the last action if you don't like it – the 'undo' button is in the 'delineate' menu in the transform window).

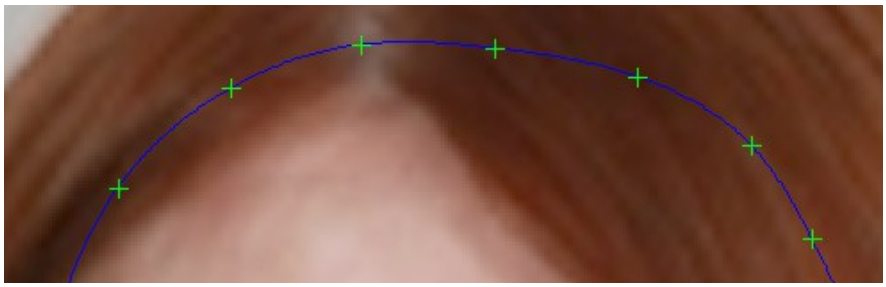
For the next part (step by step instructions) it helps to **zoom in** (Zoom Menu > 200% or even 400%). **And remember - when you are finished, you need to manually save the template file!** If you call it by the same name as the image you are working from, then Psychomorph will be able to open the tem file automatically next time you load that image file.

Remember to give it the ".tem" extension in the filename i.e. call your new file "some_face.tem" not just "some_face". Otherwise, it will save as a file that Psychomorph won't open (but you can always manually assign the .tem extension later by renaming the file).

4.2. Delineating the jaw and forehead

The important thing here is to make sure that the points are **spaced evenly** throughout the jaw and forehead. A good tip is to place the points where the ears meet the jaw/forehead first, since these are constrained by where the ears actually are, and then space the rest of the fiducial points in between these ear fiducial points. Another useful placement is to fix the second point down from each ear (numbers 126 and 132) at the place where the neck and the chin cross.

Strategy number 1: Follow the structure of the face, ignoring hair. On the forehead, the points should fall roughly along the path where the skin of the head meets the skin of the face (imagine you are fitting a swimming cap to the head of the person). Don't follow the hairstyle though - you're trying to follow the structure of their face, not the hair. This is useful if you want to see build average images which allow the hairstyle to contribute (so for example, you can see if more trustworthy looking faces have a fringe, or whatever), and if you want to measure the size of the head unconstrained by the hairstyle (or take other measurements from the spacing of the points).



Strategy number 2: Follow the line of the hairstyle, rather than the head. This is useful if you want to create a mask that removes all of the hair and just leaves the internal features, or if you want to transform the hair (e.g. making it grey with an ageing transform). Alternatively, for men's faces the receding hairline is diagnostic of identity and age so this is another reason for tracing the actual hair. For women too, hairstyle can be individually diagnostic, so if you're interested in these things you should probably include the hairstyle. Also, for colour or texture transforms (see Transforming Images) it's a bit tricky to stop the image from looking like it's got a colour mask on, but if you follow the hairline carefully then it's usually ok.

So your choice of strategy will depend on the research question you have: you need to decide whether you ignore or follow the hairstyle. Whatever you do, be consistent across all of the images you want to compare.

Finally, for bald people, you need to imagine where their hairline used to be when they had full hair (unless you are tracking receding hairline).

4.3. Delineating the outline of the head

This just needs to roughly follow the silhouette of their hair and you usually don't need to spend too long on this. Again, there are two commonly used options. In the first, the endpoints go where the shoulders are (where they meet the neck, like a halo). In this option, the hair is essentially ignored by averaging across different hairlines. The other strategy is to go around the hair from ear to ear, with the end points just by the top of the ears (like a cap). A mask (see later) can then be used to give everyone a similar, short hairstyle. Again, be consistent across images with which strategy you pick.

4.4. Lips, cheeks and chin

4.4.1 Lips

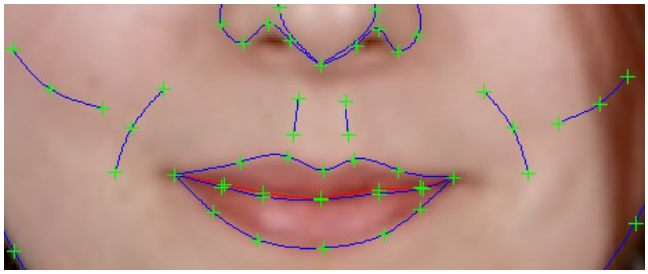
There are four lines to create the shape of the upper and lower lips: two inner ones and two outer ones. **Don't get these mixed up!** If you do, it's best just to start again because it will make really horrible errors in the manipulated image and it's difficult to spot what has gone wrong in the template file.

As with the jaw/forehead, the trick is to place the end points of the lips first, and then space the other points evenly (while still following the lines of the lips).

The triangular bit at the top of the lips (technically, "Cupid's bow", so we can stop calling it "the triangular bit") needs to be outlined carefully; incidentally Wikipedia actually has a good picture with Cupid's bow outlined. The middle-most point on the top lip goes in the bottom of Cupid's bow and the two points on either side go at the highest most points.

If the lips are open, the **red inner line of the lip always goes above the blue inner line** (think **b**ottom = **b**lue). If the lips are closed, get the blue middle lip line to lie as close to the red line as possible (but not above it[1]). Note that the aim is to get the green squares on the feature landmarks and not necessarily the blue line. Tessellations and shape changes in Psychomorph work off the green crosses and not the blue line – this is for illustration only. Note though that if you try and keep the blue lines tracing the feature points, then you can always use this information later (e.g. by using your own code to work out the size of the lips, or whatever).

It is best to space landmarks evenly (mid-distance) on contours defined only in one dimension (e.g. point between lip corner and Cupid's bow). The most important thing is to be consistent with points across face images. For example, place points on inner lip-lines vertically below points on the outer lip-lines, or evenly space them along the inner lip line, but don't switch strategy across images.



4.4.2 Cheeks

The slightly curvy (outermost) lines sit so that they underline the apple of the cheeks (i.e. the round bit where people smile, roughly over the cheekbones). Often there will be a colour change in the image so that the pink bit in the cheeks should be above this part.

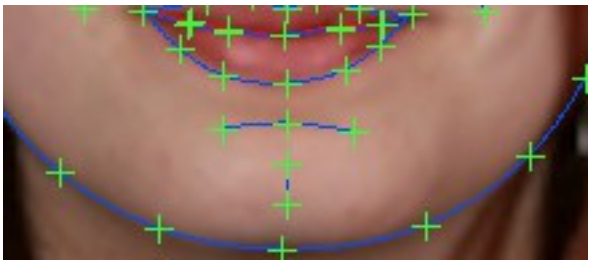
The middle lines roughly mark the limits of the lip region. If you were delineating a dog's face, then this bit would be where the muzzle of the dog is (sorry, that's the best description I can come up with). For humans, these lines are meant to capture the smile lines (naso-labial fold), for young faces such lines are faint, but they deepen with middle age. The (innermost) lines between the nose and lips sit over the two raised ridges that join the lips and nose (roughly above Cupid's bow in the lips, in a vertical orientation).

An advanced function is to use the **autodelineate processing option** under the ASM option in the delineate menu. This will 'suggest' where such cheek and smile lines go. If they are in reasonable positions then you can then leave them where they are. You might think: well, what is the function of points that are quite subjective and hard to define? The answer is that shape transformations works well when the tessellations are short fat triangles; the cheek points provide help to form such triangles (see Figure 1 in the Introduction).

[1] On some versions of Psychomorph, there is a "closed mouth" option in the delineate menu which will snap the inner lip lines together which is helpful.

4.4.3 Chin

There are two lines on the chin, one should lie roughly horizontally, in the dip under the lips. Make sure this is where this line is. The other line is roughly vertical – all you need to do is make sure that the length of this line corresponds to the length of the chin, and that the orientation of the line runs from the tip of the chin to the middle of the horizontal chin line.



Chin and neck shape are sexually dimorphic and contain a lot of information about weight and age (through sag). Tips: the chin line should trace the jawbone and not the lower double chin if present. Delineating the end of the chin is easy, delineating the rest of the chin is not, so just do your best and try and be even.

4.4.4 Neck

The delineation depicted here does not define the neck structure. A simple extension is to use two extra points (or the lowest two points of the outer hairline) to mark the width of the neck at the level of the shoulders (or the lowest point visible in the image). The top of the neck, where it intersects with the surface of the face (in the frontal view) then should also be defined. Here one can use the second points below the junction with the ear. Remaining points are then placed evenly over the chin surface between these landmarks. Necks are much thicker in men than women, so sex transforms are much more convincing when the neck is delineated.

4.5. Ears and Nose

4.5.1 Ears

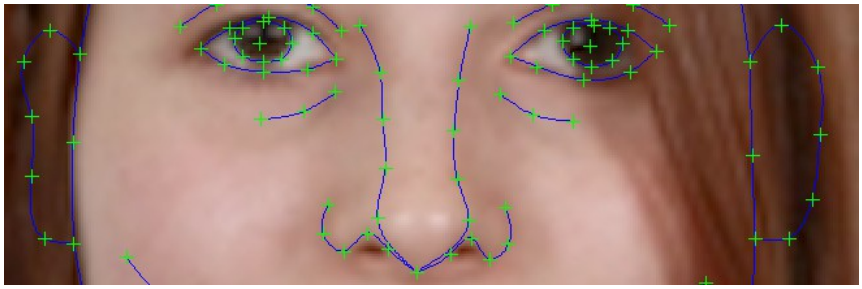
For the ears, follow their ears while trying to keep curves as smooth as possible, and keeping points spaced out. If you check the usual template structure and find a point at the top or base of the ear, then you can try and keep this point consistent between images.

You'll get the hang of it. If in doubt (like the image shown here, where the hair hangs over the ears) then just draw a rough ear shape. As a rough rule of thumb (ear?) the ear joins the face roughly parallel to the tip of the nose and ends approximately parallel to the middle of the eye. If the ear is in profile, then just make it as small as possible (i.e. flat against the side of the face) without overlapping into the face.

4.5.2 Nose

You are outlining around the top of the nostrils (rather than crossing them) and don't make them too pointy. Make sure the upper lines of the nose (which outline the bridge of the nose) and the lower lines (which outline the nostrils) don't overlap. Try and end the nose roughly level with the eyes. Switching the template lines on and off allows you to find the faint shadows around the nostril sides before moving the template points. Nostril appearance varies markedly between people and with head tilt, so nostrils are a major source of 'glitches' in shape transforms - your aim is to trace the lower margin of each nostril. Again, make sure to get the green points on the contours.

An updated template created by the FaceLab in Glasgow and now also used by the PerceptionLab at St Andrews has extra nostril points, which might be useful. You can also add points from the template window yourself (but remember you then need to use the extra points for all your faces). The sides of the nose are subjective as the shadows are subtle but try and be consistent with the nose width across faces.



4.6. Eyes and eyebrows

4.6.1 Eyes

The eyes are the hardest feature to delineate! Increasing the size of the image with the zoom function can help a lot – always double check images in this way.

The main thing to be careful with is not to mix up the outer and inner eye frames - **the inner eye frame (around the iris) needs to stay inside the outer eye frame (around the eyelids) without overlapping at all.** If you think you might have mixed up the inner and outer eye frames, just scrap that .tem file and start again (I know this is a pain, but if the eyes are wrong then it really scrambles up the image). You can check the numbering of landmarks to see if you have been consistent by turning on 'display labels' in the view menu of the template window.

I find it helps to start with the outer eye - shift the rightmost and leftmost points into the part of the face where the white of the eye meets the skin[2]. Then move the rest of the outer eye points until they frame (evenly) around the white of the eye. **It's important not to get the points rotated around** - otherwise when you come to averaging, for some templates you will be

[2]Some labs place the inner corner of the eye on the tear duct medial to the round fleshy bit. This can capture extra structure.

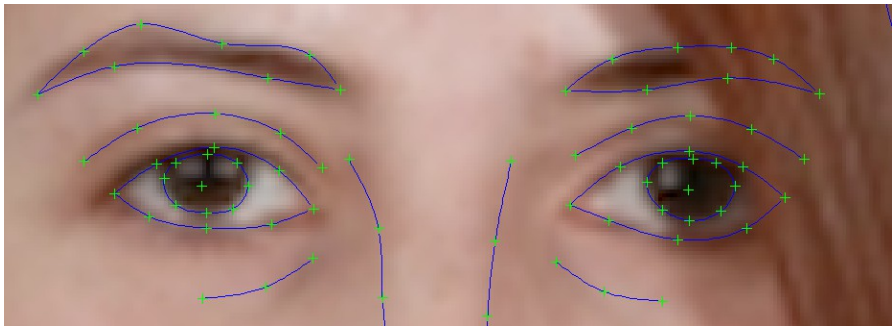
trying to average the topmost point of the eye with the rightmost point on other templates (and this will look really odd).

For the inner eye, move the left and rightmost points until they sit where the iris meets the white of the eye. If the eyes are wide open (in a fearful or young faces) you can delineate the iris fully. With many faces, particularly those with drooping or half-closed eyelids (e.g. due to a smiling expression), place the “iris” points next to the outer eye points but not outside them. With eyes and irises you are attempting to make an evenly spaced octagon with west, east landmarks horizontally aligned, and north and south landmarks vertically aligned.

The point in the middle goes in the middle of the pupil (not on a highlight).

4.6.2 The line between the eye and the eyebrow

The single line right above the eyes goes at the part where you would stop putting on eyeshadow (if you're into that). It usually appears as a kind of crease in the face (where the eye socket ends, if we have to think about that) but if in doubt, as long as it's between the eyebrow and the eye it will usually be fine. Some people have two folds or creases in the upper eyelids, some have none. The crease you want is usually the lower one. People also vary in the length of the crease, so you may need to vary the length you delineate.



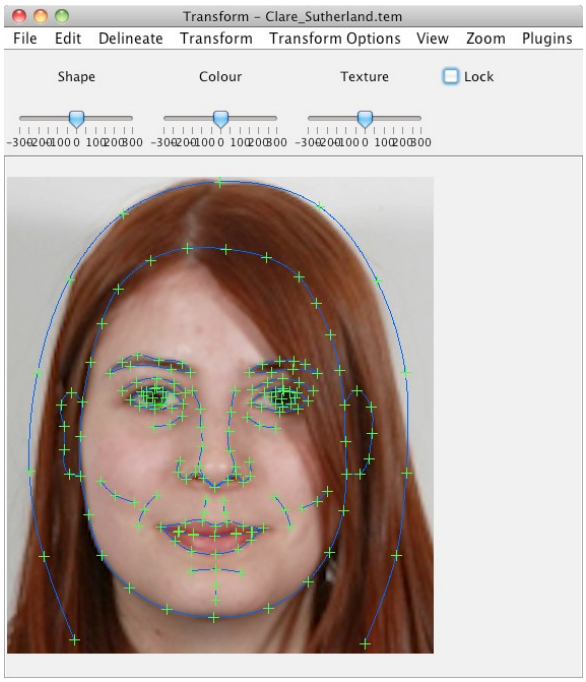
4.6.3 Eyebrows

Again start with the rightmost and leftmost points, and put them at the tips of the eyebrows. Then just try and follow the line of the eyebrows, with four points going above and two below. Female eyebrows are usually easier to do because they're more defined - but it's more fun when you get a really wild pair! There are many exceptions since people pluck their eyebrows and may mark a false brow. Turn the delineation lines off and on to see pale eyebrows. You may need to place the 2nd most medial point of the upper brow line quite medially (i.e. above the innermost margin points) to capture the structure of male brows which are thick. Eyebrows are incredibly distinctive and support individual recognition (see Sadr et al., 2003), so try and capture idiosyncratic structure if you are researching face identification. One tip is not to try and mark too close to the edge of the eyebrow; leave a pixel or two of skin. Odd things can happen when averaging if you just clip the edge of the actual hair.

Male brows protrude and can occlude the eyelid crease. If so, maintain the obscured (and hence partly imagined) eyelid crease line below the lower brow line but above the upper eyelid.

The two curves below the eyes go roughly where the eye socket ends - usually you can see a texture difference.

Done! Remember to save the new .tem file!



4.7. Some hints and tips

- **Names of files should be kept short** and avoid full stops or non-alphanumeric characters. You can use underscores instead of spaces e.g. Clare_Sutherland.png. This would be useful if you ever need to write code to refer to these names.

- **Remember that the new .tem file needs to have the same name as the image file** for Psychomorph to automatically associate them (e.g. person1.png, person1.tem).

- **Always start with the default template file.** This means if you mess up on one template file, it won't then systematically mess up the rest of them. Also it's more objective because it stops the previous face shape from influencing the next one.

- For people who use make-up, **a good way of thinking about positioning the template is to imagine applying makeup** - it's the same idea really, you are using the lines to define the points. For example, on the lips, usually the idea is to get the 'lipstick' (i.e. template lines) around the lines as neatly as possible (ignoring exceptions like eyebrow liners since you are trying to be accurate, not to enhance the facial beauty). If you don't use make up then a different analogy is that it’s like the reverse of colouring in a picture book - try and

get the lines to go around the differently coloured regions as neatly as possible. OK, now I will stop with the analogies!

- It's a good idea to always start with one section of the face (e.g. the jaw) and **work your way up or down the face systematically** so that you remember which features you have actually covered.

- When you think you've finished, **zoom out again** and do a quick overall scan of the face. If there are any sections that you missed, this helps pick that up.

- **Get someone else to check over your delineation** to double check it's OK. The quality of the images you can create with Psychomorph is obviously dependent on the quality of your delineations (as well as the quality of the images you start with).

- **Another good way to check your delineation** is to do a standard transformation (see Transforming Images). For example, keep average male and female faces in the two main Psychomorph windows and – after you have saved your template – try transforming the newly delineated image. Discrepancies in markup will usually show as distortions.

- **It's really important to be consistent.** Hence it's better to do all of a collection of images yourself. Different people place points differently on the facial features which can create problems in analysis, averaging etc.

- Your first face may take you up to half an hour but **with practice, delineation may take only 5-10 minutes.**

- Finally, **music really helps** during delineation because it can get really boring after a while (especially when you have hundreds of images to do). Alternatively, stick on the sort of TV that doesn't demand all of your attention. It helps to do a bunch of images at the same time though (one after the other) because you get into a routine.

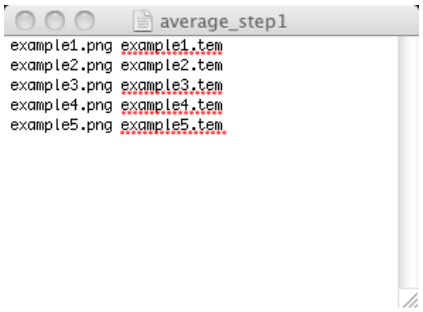
5. Averaging images

The good news is that once you have mastered delineating, the rest is more or less easy, much quicker and a lot more fun! Averaging is especially easy and fun.

Please note, although Psychomorph can cope with differently sized images, it's probably best if the images that go into the average are (at least roughly) the same size for this to work properly.

5.1. Build a text file

The first step doesn't actually have to happen in Psychomorph. Open up **Text Edit** (Mac) or **Notepad** (Windows) and make sure you are working with a **plain text file**. Then simply list the images you want to average (on the left hand side), along with their templates (on the right hand side). Each row should be one image and template. See below for an example:



Save this text file as something logical **in the same folder** as the **full set** of images (and their template files) that you want to average together. A common error is to have one image missing - Psychomorph will stop at that image if this happens.

Tip: You can use Excel to cut and paste lists of stimuli (after concatenating .png and .tem onto the end) into the text file.

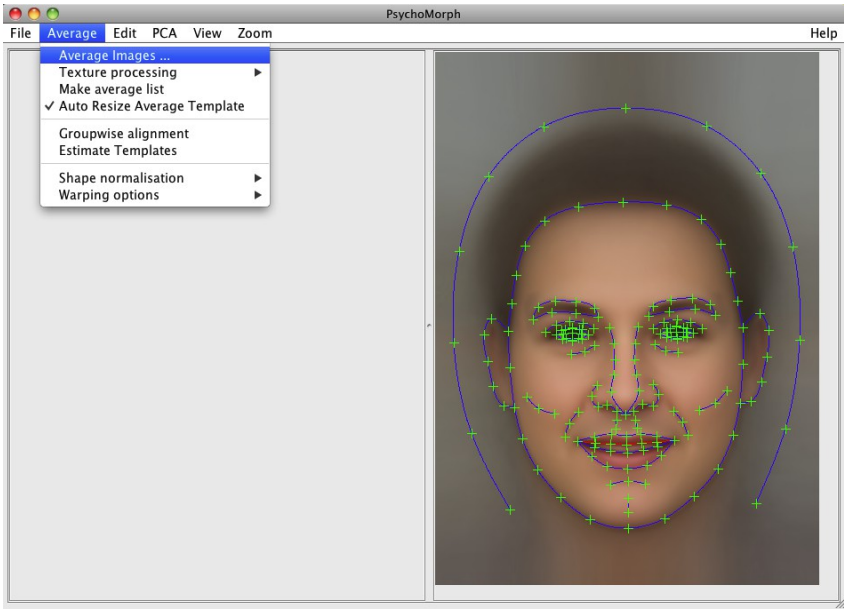
Alternatively, you can also use Psychomorph to make a list of all matching images and template name within a directory. Use the double window, and 'Average' menu select Make Average List; provide a name with a .txt extension (e.g. my_list.txt). If you have a folder with only some of the images delineated, then select *.tem as the pattern to match and it will only list the files that have templates. You can also edit this list in excel or a text editor.

5.2. Run the text file to create the average

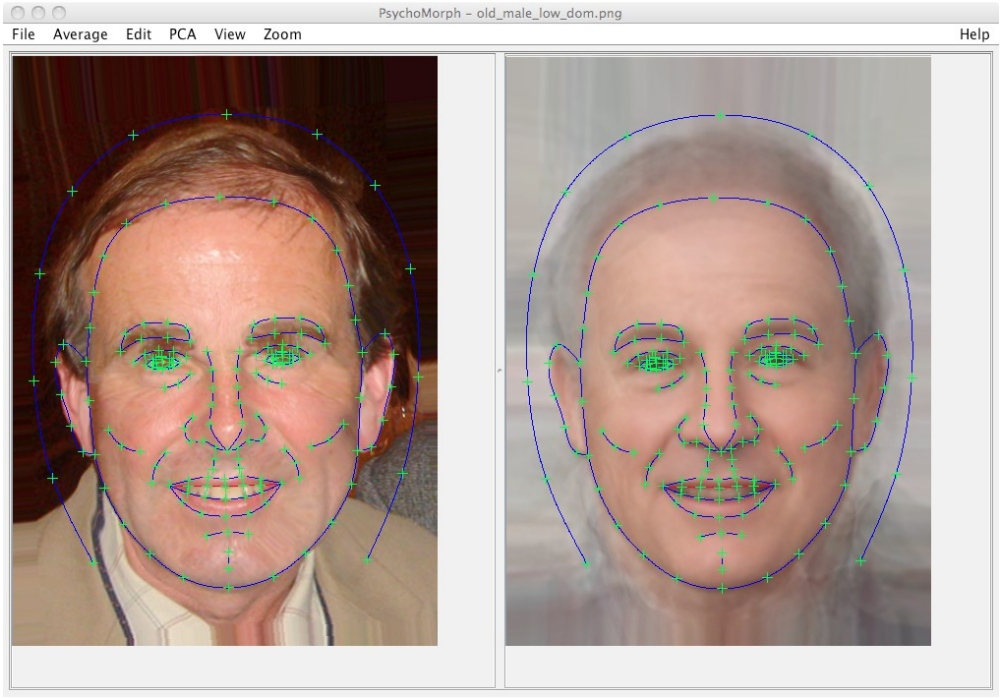
Now, return to Psychomorph. Go into the average menu, click "Average images" and select the text file with your list of images and their corresponding template files. Either then tell Psychomorph the width and size of the image (it will ask you) or just make sure an image of the right size is already loaded in the right hand side window. (Having a face already loaded is

also necessary in older versions of Psychomorph, where averaging won't work otherwise). You don't need to load anything on the left hand side.

Remember, the text list of images for averaging needs to be in the same folder as the images and templates.



Press OK. Psychomorph will now whiz through the individual images, adding them to the average! MAGIC! The **face on the right** (below) is an example of what you get in the end, your new average image!



5.3. Save the average image

Make sure you save this new image! When you save the new image (**the one on the right hand side** of the main window!), you will need to specify the image file type (i.e. save it as "new_image.png"). This is required and otherwise it doesn't save.

If you have auto-save templates set in the file menu, Psychomorph will then automatically save the template for the average image too (but check before you assume it's selected!). Otherwise, you need to separately save the right hand template (making sure you save it as a .tem file).

A good tip is to always save the template file for an average image you make, because later on you might think of something more you want to do with it.

5.4. Settings

The averaging procedure outlined above generates an image with the average shape (averaged fiducial positions) and average surface properties (colour and brightness of each tessellated region) of the set of images used. Often these are also called **prototype images** in the research literature. You can see that it is easy to create different kinds of prototypes by varying the properties of the images in the list. For example, you might create prototypes based on averaging just male faces (the average man), or just female faces (the average woman), or both male and female faces (the average person).

For the standard averaging we have described here, the Psychomorph help site suggests you select Texture processing > none; Shape normalisation > full; warping options > multiscale. For more realistic averages (i.e. less smoothed) turn texture processing on. This is important if you want to age transform images since ageing introduces wrinkles that are missing without additional texture processing (see Tiddeman et al., 2001).

There are other ways in which the images might be averaged. These are accessed via the average menu, and as you learn more about image manipulation you may find that you want to use some of them.

6. Transforming images

6.1. The transforming equation

In transforming, you move one image between 0% (a source image) and 100% (where 100% is some other image). You can do this with specific images, such as a photo of Person A and a photo of Person B, or you can do it with averaged (prototype) images. For example, you might transform a picture of person A to be 10% more like a picture of person B, or you might transform an averaged male face into being 10% more like an averaged female face.

When the image is being transformed, what is actually happening is:

New = Original + Percent_Transform*(Destination - Source)

- **New** is the image you want to create – its image and template will appear in the transform window at the end
- **Original** is the image you want to transform – you start off with this image and template in the transform window
- **Source** is the image at the beginning of the continuum you are transforming along – this image and template are loaded into the left hand side of the main window, and
- **Destination** is the image at the end of the continuum you are transforming along – this image and template are loaded into the right hand side of the main window.

For any image, you can either transform the shape (fiducial positions) or colour/texture (of the pixels in the tessellated regions) or both.

All images should probably be (at least roughly) the same size for this technique to work properly.

6.1.1 Transforming v. morphing

Transforming is sometimes also called “morphing” in the literature but it’s worth pointing out a distinction between transforming and morphing here. With **transforming** three images are required: image A (the original image, which we want to manipulate), and image B and C, two images that are prototypes of two extremes along a continuum (e.g. an average young person and an average old person). A transform allows you to maintain the identity of the original face while changing its appearance shifted in category. In this case, a 100% transform will retain the identity cues present in image A but shift its appearance by 100% of the shape (and colour and texture) difference between image B and image C towards image C.

So a 100% transform of Clare's face using a young and old prototype (source and destination images) will produce an older looking Clare, potentially looking like her mum or grandmother. A 100% transform of Dave's face with the same prototypes on the other hand will produce an older version of Dave who hopefully will not look like Clare's mum! See examples of ageing and the opposite (rejuvenation) below in **Figure 2**.

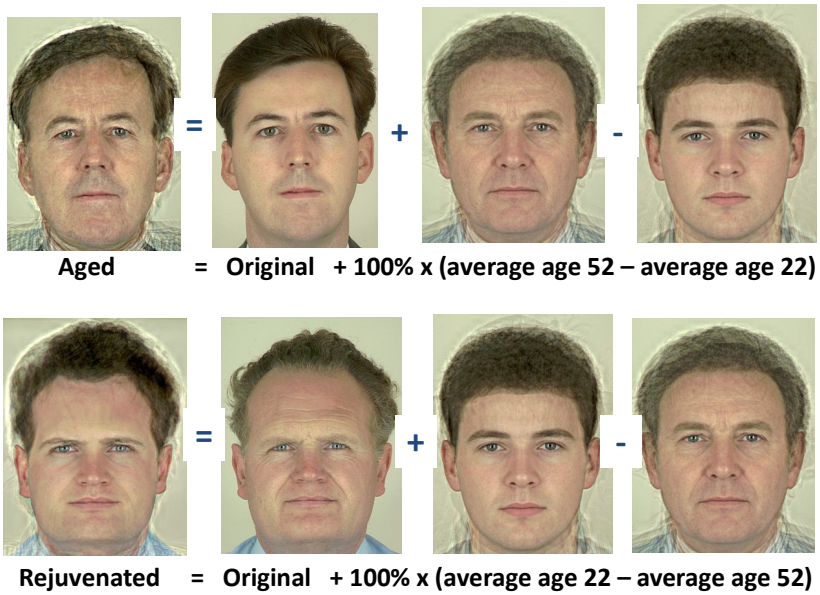


Figure 2. Illustration of ageing and rejuvenating a face using transforming (not morphing). Created by and displayed here with permission from Professor David Perrett.

With **morphing**, the image we want to manipulate (A, for example, a female face) is moved towards another image (B, for example, a male face), such that the endpoints of a morph are always 0% = A (female) and 100% = B (male). A 50% morph would be half-way between faces A and B (for example, gender androgynous). See **Figure 3** below for an example of morphing.

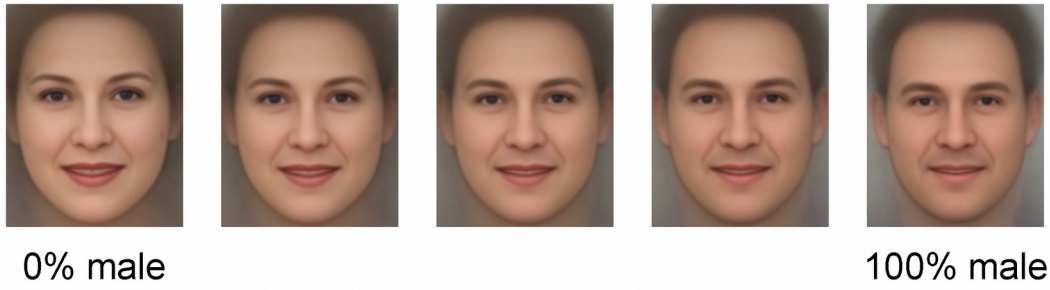


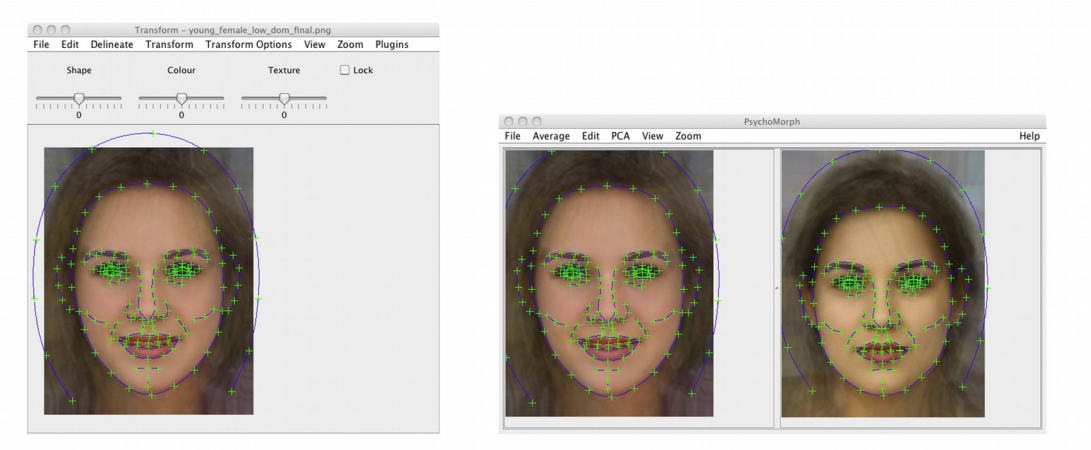
Figure 3. An example of a morph continuum, changing a female face (original and source images) into a male face (destination image).

A 'transform' becomes a 'morph' if the original image is also entered as the source image. This may sound pedantic but the key point is that transforms can change the category of an individual face: e.g. female to male, white to black, young to old, neutral to happy, while maintaining identity. Morphs by contrast change one image gradually into another.

6.2. Morphing

6.2.1 Set up the images

We will first describe how to morph in Psychomorph, then how to create a transform. When we morph, we put the **original image (the image to be morphed) in both the transform window and the left hand side of the main window.** We put the **image that is being used to create the morph into the right hand side of the main window**. Like this:



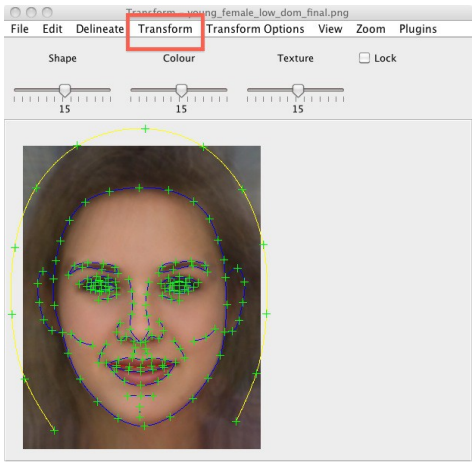
6.2.2 Set up the morph

Once the images and template files are in place, you can **change the slider** at the top of the transform window to X% where X% reflects the amount of morphing from the original image/template to the destination image/template that you want. So for example, if you want to morph it towards the other image by 10%, then drag the slider to 10%. If you wanted 11%, then move from 10% by 11% by dragging the slider forward by one percent with your mouse (or by using the arrow keys on your keyboard). And so forth.

Usually, you would do this simultaneously for all three options of shape, colour, and texture. To make this easier, you can “lock” these options together by ticking the lock button on the right hand side of the transform window (under the zoom menu in the image below). If you only want to alter shape OR colour/texture – then don’t “lock” the three together, and just pick the one you want to change.

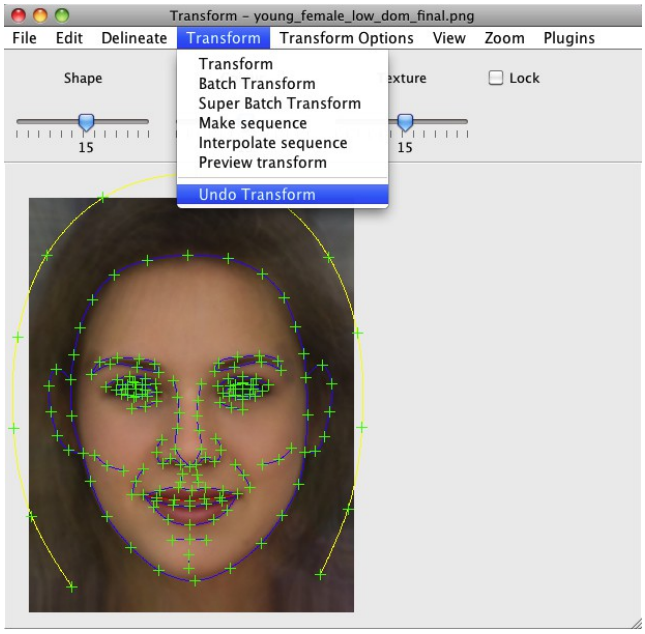
6.2.3 Go!

Now click the "transform image" button under the transform menu in the transform window. The morphed image will now appear in the transform window. Hooray!



6.2.4 Save and undo

Now here is a critical step: Once you have saved the new image (in the transform window) click undo transform!!



Why is this step critical? Well, remember that in morphing or transforming in Psychomorph, you have to begin with the original image you want to morph or transform in the transform window (see above). But often you will want to make a couple or a series of morphs or transforms of the same image – for example, moving it to 10%, 20%, 30% etc. to make a nice morphed/linear continuum. To do this, you need to make sure that the original image is back in the transform window, and the easiest way to do this is to undo the previous transform.

Otherwise, any morphing or transforming you do after the first manipulation will actually be carried out on top of whatever the image is in the transform window - so if it's the already-

altered image, you can get some pretty weird results (or pretty subtle results, **but either way you are unlikely to get what you want).**

If you get confused by whether or not you undid the previous transform, the best option is just to reload the original image in the transform window. That way, you're confident about the level of transform you've just applied.

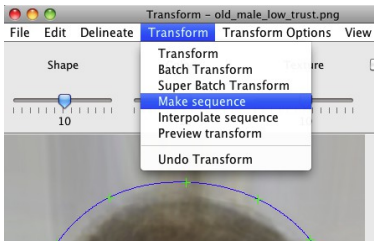
6.3. Linear or morphing continua

As we've just noted, quite often you won't just want to morph or transform an image one time, but rather to form a linear continuum between one extreme and another (sometimes also called a morphing continua). In this case, there is a more simple method.

First of all, set up the transform and main windows as described above.

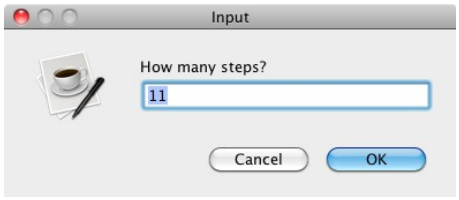
Then, go into the transform window under the transform menu and select "make sequence". Follow the rest of these steps (to create an 11-image sequence in steps of 10%):

6.3.1 Select sequence



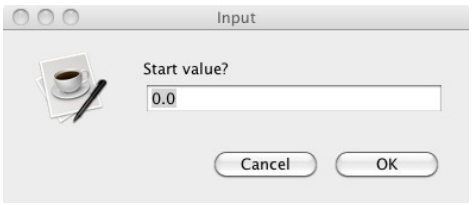
6.3.2 Set the number of steps

You need to allow for the beginning and end images in your continuum. So for example to make a continuum with images at 10% intervals, you need to tell Psychomorph to make 11 steps (images). For 5% intervals, you need to create 21 steps (images) and so on.



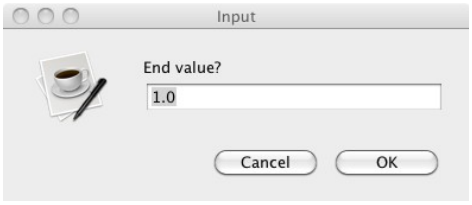
6.3.3 Select the start value

This is usually the original image, which would be 0.



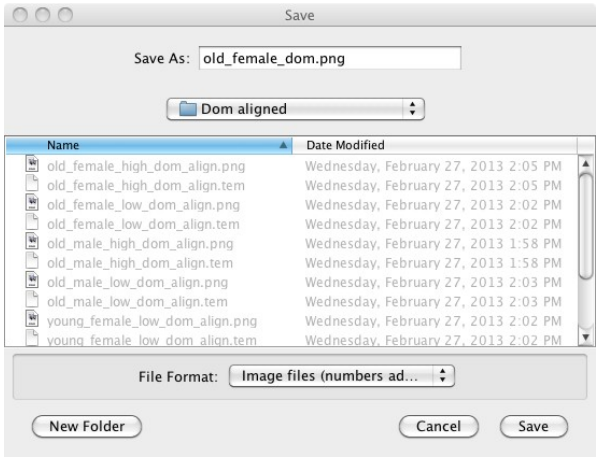
6.3.4 Select the end value

This is usually the destination image, which would be 1.



6.3.5 Save the new image!

Now remember to save it, and include a file extension! (e.g. example_image.png). If you don't give a file extension, it won't work, but Psychomorph won't tell you why.



6.4. Transforming rather than morphing

While the example images being transformed here were described in terms of one average image moving towards another average image (morphing); remember you can also use the transform manipulation described here to transform an individual (raw photograph) image to take on the appearance of a different category using two averages (one image usually being an average from the individual's own source category, like a young average face; the other being the average of the destination category, like an old average face: this is what we've described as 'transforming').

The way to do this is to put the average you want the individual face to be made *more* like in the right hand main window (e.g. use an old average face as the destination image), put the

average you want the face to be *less* like in the left hand main window (e.g. a young average face as the source image), and then put your original individual face in the transform window. Then you can set the shape and/or colour/texture to X% (depending on how much you want to add from one average versus another). Then follow the rest of the steps mentioned above, either for a single new image or a continuum of images.

Alternatively, you could also manipulate individual face images by placing one individual's face photograph in the transform and left hand main window, and another individual in the right hand side window. The possibilities are endless.

6.5. Caricatures

The examples of transforms and morphs discussed so far involve moving an image to be transformed (the original image) along a continuum that runs between the source image at 0% (the image you want to transform away from) and the destination image at 100% (the image you are transforming towards). In this scenario, you only ever make the original image a blend of the source image and destination images. But, you can also make a new image that is more extremely like the original image, and this is called caricaturing.

For example, in morphing, the original and source image are the same. However, if you flip this normal situation where the original and source image are the same, and instead, make the original and *destination* image the same, then you get a caricature in which the difference between one image and another will be increased because you are now making the original image a more extreme version of itself (we will talk through the steps below). Often, you will want to make the caricature transform on an individual person's face relative to some population norm, as defined by an average image of some sort (e.g. David Tennent's face caricatured relative to an average male face). This will caricature their identity, as in the classic example of a cartoon portrait.

How to caricature

One way to do this is to take an individual face image (Face A) and place this in the transform window **and** as the destination image in the right hand window, then take an average image (e.g. the average person's face) and place it in the left hand (source) window.

In this set up, if you then set the transform function to be 30%, the final new image you get (see below) will be a caricature of person A's face which emphasises their distinctiveness from the average by 30 (see **Figure 4** below for an example). This is good fun to try with celebrity faces or your own face! Moving in the opposite direction (e.g. -30%) will produce a morph between face A and the average which is sometimes referred to as an 'anti-caricature' (i.e. it's a version of the individual's face which is less distinctive than the original). Note that in these examples, you are transforming the *individual's* face image.

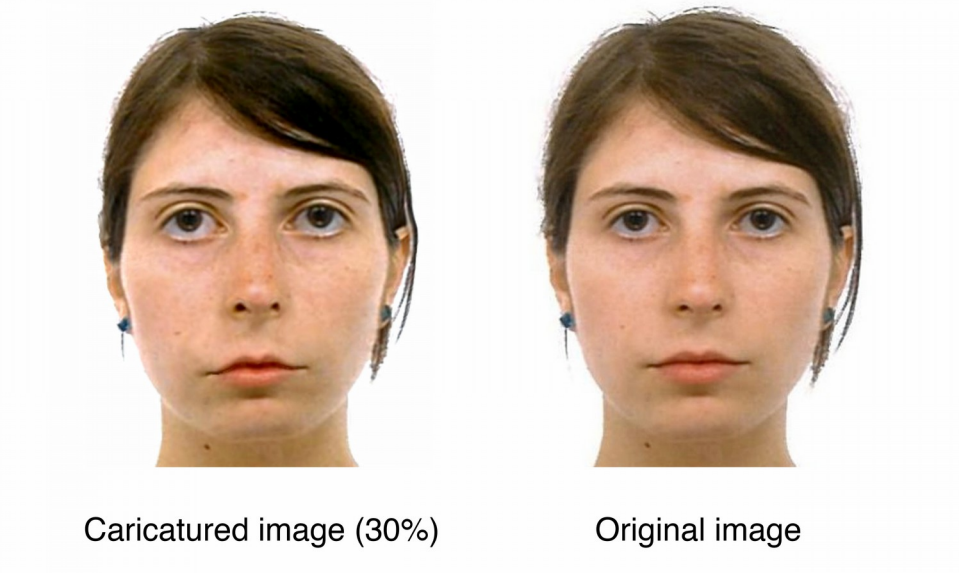


Figure 4. A caricatured version (left) of an original photograph (right) of the author.

In **Figure 4**, you can see that the caricatured image on the left appears slightly more saturated, because Psychomorph is emphasising the colour in my face and hair away from the average. Freckles and blemishes stand out on my face more too (thanks Psychomorph!) because it's comparing a real photograph against the unnaturally smooth average. My hair looks darker since the average face was a light brown; but if my hair was tinted a different colour, this would be emphasised instead. Finally, my expression is more unhappy/serious in the caricature because I'm following passport regulations and not smiling, whereas the average face has a slight smile. It also exaggerates sexually dimorphic characteristics, since I used an average image that was the average of both male and female faces for illustration. This highlights that you need to think carefully about what the best baseline average face is to base your caricature on!

One way to stop some of the problems of emphasising photographic characteristics like facial blemishes or the background or paraphernalia in an image, would be to use a face average for the individual face too rather than a single photograph of the individual, so you don't get as many image based artefacts. In this example, I would use an average of different photographs of me rather than one single photograph of me. You then caricature this 'individual average' away from an overall average face (made up of many identities) as usual. Alternatively, you can turn off the "colour" transform and just use shape, depending on your research question.

An alternative method of caricaturing

There is an alternative way to set this process up in Psychomorph, which is to place the average face photograph in the transform window and as the source image in the left hand window; and place the individual person's photograph in the right hand (destination) window. If you then transform the average face towards the individual's face by 130%, you will again create an image that emphasises the features of the individual's face against the average by 30% more.

Note that in this example, you are transforming the *average* face image. Either way should be fine but they differ on which image you are transforming, so be careful. One trick I've learnt is to try a really extreme caricature at the start to make sure it is actually caricaturing the image I think it is.

Non-identity caricatures

While 'caricaturing' strictly speaking refers to emphasising an individual's identity, we have also used caricaturing to refer to any process that emphases one image relative to another by using different average images. For example, by caricaturing a female face relative to a male face average you can make a hyper female face that looks more 'feminine' than the original. Or you can make an old face look even older. And so on.

7. Batch aligning eyes

If you want a set of faces to be more or less in the same orientation (for example, to standardise them before averaging them together, if you want to create a standardised average, or for use as experimental stimuli), you can use a little function called “Batch align eyes”. It’s under the edit menu in the main window.

Simply load a text file with the list of faces (and their templates) that you want to batch align – exactly as you would do for an average; in fact, you can use the same file as the text file you will later use for making an average (see Averaging Images section). Make sure that the baseline, standardised face you want to align the set of faces to is loaded in the right hand window of the main window (i.e. an image where you have controlled the eyes to be level, or an average face). Psychomorph will whiz through the set of face images named in the text file, aligning them to the face in the right hand side window.

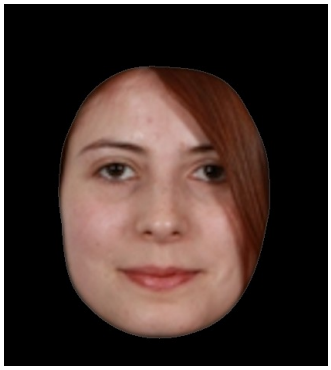
If you just want to align one face, you can select the “Align eyes” option in the edit menu, main window. This will now align the face image loaded in the left hand side of the main window, with the face image on the right hand side of the window (e.g. a standardised image you know is already aligned). The other options for aligning include “eyes and mouth” or “full” but align eyes is the default for most purposes.

8. Masking

Sometimes you might want a mask around the face so that all you can see is the face and not the background (a kind of reverse mask, actually, now I think about it)

You can find pre-made masks on the Psychomorph site (in the “extra.zip” downloadable file).

First, you need to load the mask, by going to the file menu in the transform window, and selecting “load mask”. Then, select the mask you want. Then, go to the edit menu (still in the transform window) and click “apply mask”. You can choose the colour of the mask, whether or not the mask is inverted (i.e. covering the face like an actual mask, which you probably usually don’t want, so click ‘no’) and the smoothness of the mask as it blends into the face.



There is also a batch option (“Batch Mask” under the edit menu again), which uses the same average list text file format, and applies the mask to all the images.

A snazzy mask (dat_no_ears.msk) downloaded from the Psychomorph site and applied to a face photograph.

9. Enjoy it!

Psychomorph is amazingly versatile, completely free, and once you are past the delineation stage, lots of fun to use!

10. References

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For more information, and to download Psychomorph, along with example image and template files look on this website: http://users.aber.ac.uk/bpt/jpsychomorph/. All credits to Psychomorph belong to the people referenced below, they work hard on this and **you should cite them if you use Psychomorph!** (whether or not you also cite this user guide).

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