6.2.3 Painting and Sculpting - Painting - Weight Paint

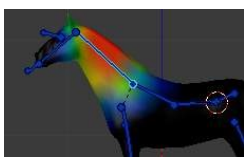
Weight Paint

Introduction

Vertex Groups can potentially have a very large number of associated vertices and thus a large number of weights (one weight per assigned vertex). *Weight Painting* is a method to maintain large amounts of weight information in a very intuitive way. It is primarily used for rigging meshes, where the vertex groups are used to define the relative bone influences on the mesh. But we use it also for controlling particle emission, hair density, many modifiers, shape keys, etc.

The basic principle of the method is: the weight information is literally *painted* on top of the Mesh body by using a set of Weight brushes. And since painting is always associated with color, we also need to define ...

Weight Paint in a nutshell



Weight Painted Vertex Group

- You enter *Weight Paint* mode from the Mode Menu (`Ctrl-Tab`). The selected Mesh Object is displayed slightly shaded with a rainbow color spectrum.
- The color visualizes the weights associated to each vertex in the active Vertex Group. Blue means unweighted; Red means fully weighted.
- You can customize the colors in the weight gradient by enabling *Custom Weight Paint Range* in the *System* tab of the *User Preferences*.
- You assign weights to the vertices of the Object by painting on it with weight brushes. Starting to paint on a mesh automatically adds weights to the active Vertex Group (a new Vertex Group is created if needed).

Tip

Useful Keyboard Shortcuts

The shortcuts can speed up your weight painting:

Weight color picker
`Ctrl-LMB` change current weight value to the weight value of clicked vertex
Resize the brush
`F` then drag to new brush size
Create linear gradient
`Alt-LMB` then drag
Create radial gradient
`Alt-Ctrl-LMB` then drag
Draw a *Clipping Border*
`Alt-B` then drag the clipping border to select the part of the 3D window which shall be kept visible. You can then draw only in this part. Press `Alt-B` again to remove the *clipping border.*

The weighting Color Code

Weights are visualized by using a cold/hot color system, such that areas of low influence (with weights close to 0.0) are drawn in blue (cold) and areas of high influence (with weights close to 1.0) are drawn in red (hot). And all in-between influences are drawn in rainbow colors, depending on their value (blue, green, yellow, orange, red)

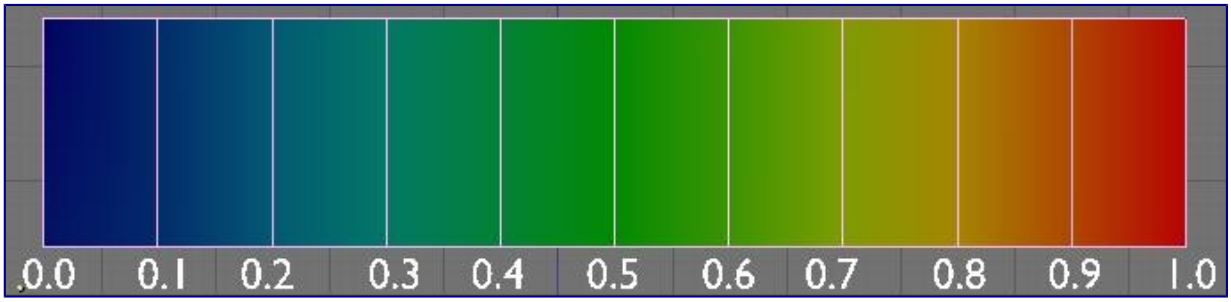
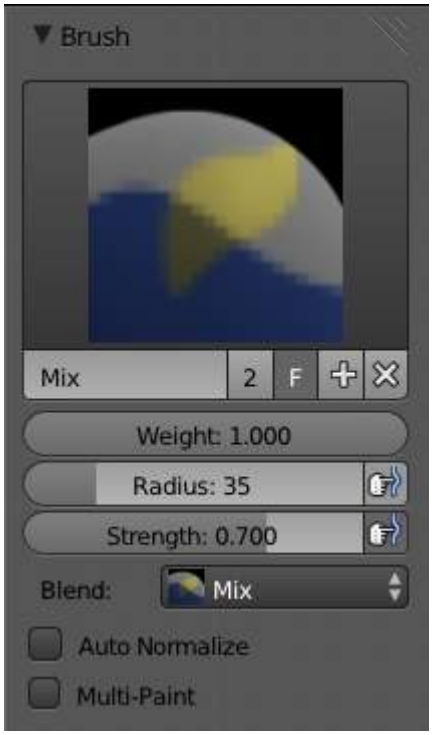


Image 3: The color spectrum and their respective weights.

In addition to the above described color code, Blender has added (as an option) a special visual notation for unreferenced vertices: They are drawn in black. Thus you can see the referenced areas (drawn in cold/hot

colors) and the unreferenced areas (in black) at the same time. This is most practical when you look for weighting errors (we will get back to this later).

Brushes



The Brush panel in the Tool Shelf

Painting needs paint brushes and Blender provides a Brush Panel within the Tool Shelf when it operates in *Weight Paint Mode*. You find predefined Brush Presets when you click on the large Brush Icon at the top of the brush Panel. And you can make your own presets as needed. See below for the available brush presets and to create custom presets.

The main brush properties

The most important and frequently modified properties are:

Weight
: The weight (color) to be used by the brush. However, the weight value is applied to the Vertex Group in different ways depending on the selected Brush Blending mode (see below).

Strength
: This is the amount of paint to be applied per brush stroke. What that means exactly also depends on the Brush Blending mode.

Radius

: The radius defines the area of influence of the brush.

> **Note**
>
> You can also change the Brush radius with a keyboard shortcut while painting. Just press `F` at any time, then drag the mouse to increase/reduce the brush radius. Finally click `LMB` to use the new setting. Or press the `Esc` key at any time to return to the current settings.

Blend mode

The brush Blending mode defines in which way the weight value is applied to the Vertex Group while painting.

Mix
In this Blend mode the Weight value defines the *target weight* that will eventually be reached when you paint long enough on the same location of the mesh. And the strength determines how many strokes you need to arrive at the target weight. Note that for strength = 1.0 the target weight is painted immediately, and for Weight = 0.0 the brush just does nothing.

Add
In this blend mode the specified weight value is *added* to the vertex weights. The strength determines which fraction of the weight gets added per stroke. However, the brush will not paint weight values above 1.0.

Subtract
In this blend mode the specified weight is *subtracted* from the vertex weights. The strength determines which fraction of the weight gets removed per stroke. However the brush will not paint weight values below 0.0.

Lighten
In this blend mode the specified weight value is interpreted as the target weight very similar to the Mix Blend mode. But only weights below the target weight are affected. Weights above the target weight remain unchanged.

Darken
This Blend mode is very similar to the Lighten Blend mode. But only weights above the target weight are affected. Weights below the target weight remain unchanged.

Multiply
Multiplies the vertex weights with the specified weight value. This is somewhat like subtract, but the amount of removed weight is now dependent on the Weight value itself.

Blur
tries to smooth out the weighting of adjacent vertices. In this mode the Weight Value is ignored. The strength defines how effectively the blur is applied.

Normalize Options

Blender also provides Options regarding the automatic normalizing of all affected Vertex groups:

Auto Normalize

Ensures that all deforming vertex groups add up to 1 while painting. When this option is turned off, then all weights of a vertex can have any value between 0.0 and 1.0. However, when Vertex Groups are used as Deform Groups for character animation then Blender always interprets the weight values relative to each other. That is, Blender always does a normalization over all deform bones. Hence in practice it is not necessary to maintain a strict normalization and further normalizing weights should not affect animation at all.

This option works most intuitively when used to maintain normalization while painting on top of weights that are already normalized with some other tool.

Multi-Paint

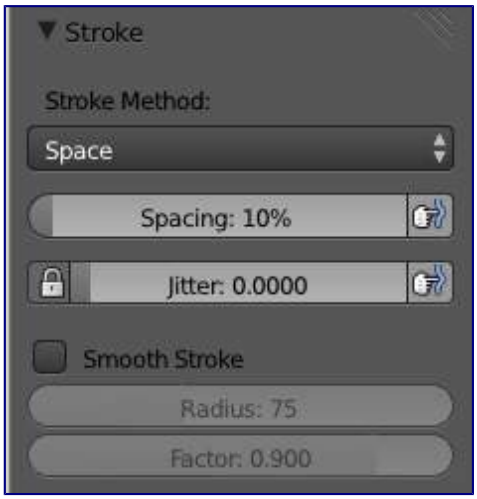
Paint on all selected Vertex Groups simultaneously, in a way that preserves their relative influence. This

can be useful when tweaking weights in an area that is affected by more than 3 bones at once, e.g. certain areas on a character's face.

This option is only useful in the context of Armatures, where you can select multiple Vertex Groups by selecting multiple Pose bones. Once at least two Vertex Groups are selected, viewport colors and paint logic switch to Multi-Paint mode, using the sum of the selected groups' weights if Auto Normalize is enabled, and the average otherwise. Any paint operations aimed at this collective weight are applied to individual Vertex Group weights in such way that their ratio stays the same.

Since the ratio is undefined if all weights are zero, Multi-Paint can't operate on vertices that don't have any weight assigned to the relevant Vertex Groups. For this reason it also doesn't allow reducing the weight all the way to zero. When used with X-Mirror, it only guarantees completely symmetrical result if weights are initially symmetrical.

The Brush stroke definition



Stroke Panel

Stroke Method
: **Airbrush**
: Keep applying paint effect while holding mouse down (spray)
: **Space**
: Limit brush application to the distance specified by spacing (see below)
: **Dots**
: Apply paint on each mouse move step

Rate (only for Airbrush)
: Interval between paints for airbrush

Spacing (only for Space)
: Limit brush application to the distance specified by spacing

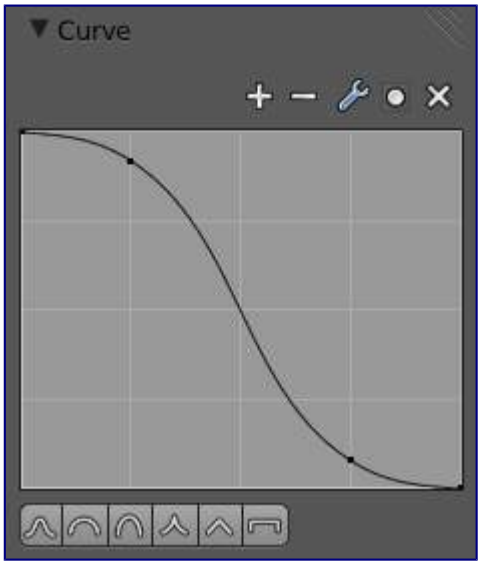
Jitter
: Jitter the position of the brush while painting

Smooth Stroke
: Brush lags behind mouse and follows a smoother path

Radius
: Minimum distance from last point before stroke continues

Factor
: Higher values give a smoother stroke

The brush Falloff curve



Curve Panel

The brush falloff editor allows you to specify the characteristics of your brushes to a large extent. The usage should be obvious and intuitive.

The brush appearance

Brush appearance

Show Brush
: makes the brush visible as a circle (on by default)

Color setter
: To define the color of the brush circle

Custom icon
: Allows definition of a custom brush icon

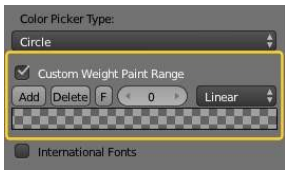
Brush presets

Blender provides several Brush presets:

- **Mix, Draw, Brush** : uses the Mix Blending mode to draw the brush weight with varying strength and brush falloff
- **Add** : uses the Add Blending mode
- **Subtract** : uses the Subtract Blending mode
- **Lighten** : uses the Lighten Blending mode
- **Darken** : uses the Darken Blending mode
- **Multiply** :uses the Multiply Blending mode

- **Blur** : uses the Blur Blending mode

Customizing brush color space



Customizing the Color Band

Blender allows customization of the color range used for the Weight Paint colors. You can define the color band as you like; for example, you can make it purely black/white if you prefer, you can even use alpha values here.

You find the customizer in the User Properties section, in the System Tab.

Selection Masking

If you have a complex mesh, it is sometimes not easy to paint on all vertices in Weight Paint mode. Suppose you only want to paint on a small area of the Mesh and keep the rest untouched. This is where *selection masking* comes into play. When this mode is enabled, a brush will only paint on the selected verts or faces. The option is available from the footer menu bar of the 3D viewport (see icons surrounded by the yellow frame):

You can choose between *Face Selection masking* (left icon) and *Vertex selection masking* (right icon).

Select mode has some advantages over the default *Weight Paint* mode:

- The original mesh edges are drawn, even when modifiers are active.
- You can select faces to restrict painting to the vertices of the selected faces.
- Selecting tools include:

Details about selecting

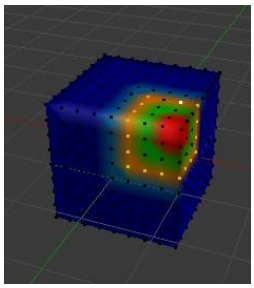
The following standard selection operations are supported:

- `RMB` - Single faces. Use `Shift-RMB` to select multiple.
- `A` - All faces, also to de-select.
- `B` - Block/Box selection.
- `C` - Select with brush.
- `L` - Pick linked (under the mouse cursor).
- `Ctrl-L` - Select linked.
- `Ctrl-I` - Invert selection (*Inverse*).

Tip
Selecting Deform Groups When you are doing weight painting for deform bones (with an Armature), you can select a deform group by

selecting the corresponding bone. However, this Vertex Group selection mode is disabled when Selection Masking is active!

Vertex Selection Masking



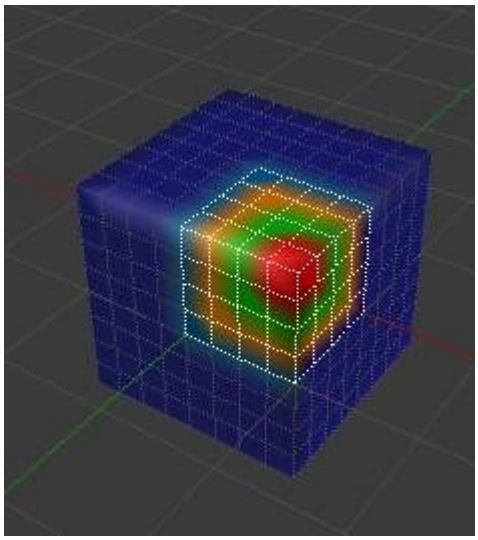
Vertex Selection masking

In this mode you can select one or more vertices and then paint only on the selection. All unselected vertices are protected from unintentional changes.

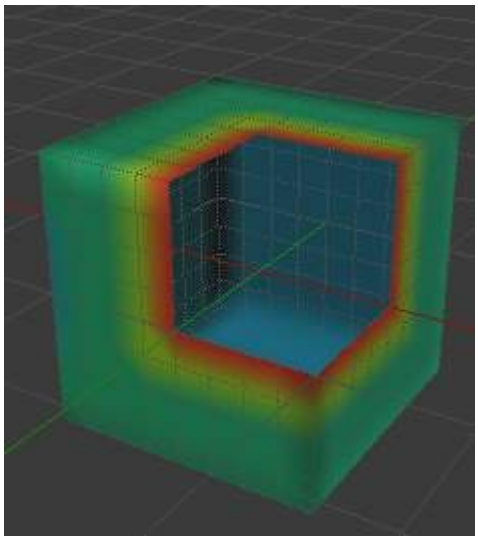
Note

This option can also be toggled with the V key:

Face Selection Masking



Face Selection masking



hidden faces

The *Face Selection masking* allows you to select faces and limit the weight paint tool to those faces, very similar to Vertex selection masking.

Hide/Unhide Faces

You also can hide selected faces as in Edit Mode with the keyboard Shortcut `H`, then paint on the remaining visible faces and finally unhide the hidden faces again by using `Alt-H`

Hide/Unhide Vertices

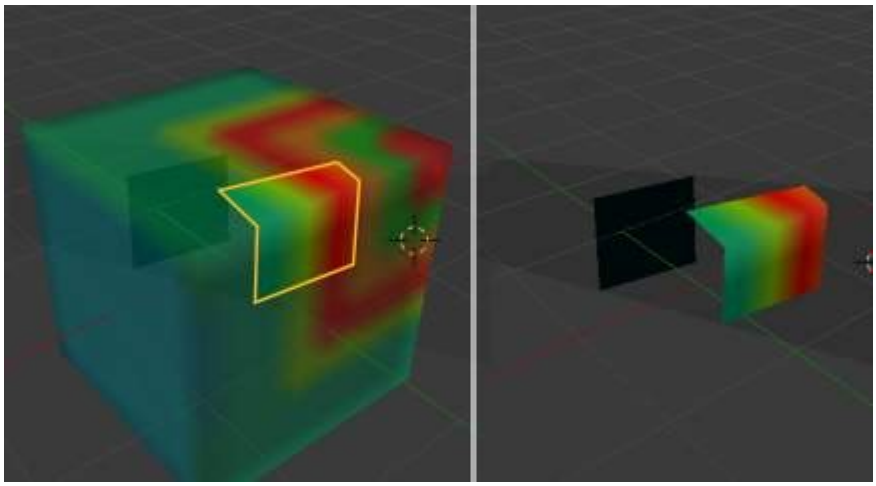
You cannot directly hide selected faces in vertex mask selection mode. However you can use a trick:

- First go to Face selection mask mode
- Select the areas you want to hide and then hide the faces (as explained above)
- Switch back to Vertex Selection mask mode

Now the verts belonging to the hidden Faces will remain hidden.

The Clipping Border

To constrain the paint area further you can use the *Clipping Border*. Press `Alt-B` and `LMB` -drag a rectangular area. The selected area will be “cut out” as the area of interest. The rest of the 3D window gets hidden.

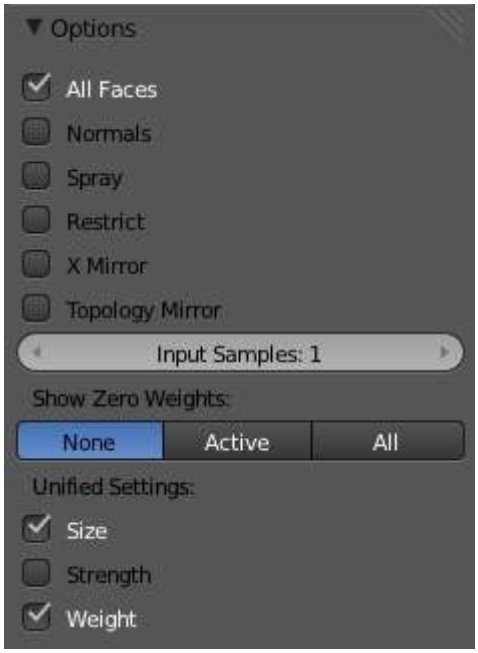


The Clipping Border is used to select interesting parts for local painting

You make the entire mesh visible again by pressing `Alt-B` a second time.

All weight paint tools that use the view respect this clipping, including border select, weight gradient and of course brush strokes.

Weight Paint Options



Weight Paint Options

The Weight Paint Options modify the overall brush behavior:

Normals
: The vertex normal (helps) determine the extent of painting. This causes an effect as if painting with light.

Spray
: This option accumulates weights on every mouse move.

Restrict
: This option limits the influence of painting to vertices belonging (even with weight 0) to the selected vertex group.

X-mirror
: Use the X-mirror option for mirrored painting on groups that have symmetrical names, like with extension `.R` / `.L`, or `_R` / `_L`. If a group has no mirrored counterpart, it will paint symmetrically on the active group itself. You can read more about the naming convention in *Editing Armatures: Naming conventions*. The convention for armatures/bones apply here as well.

Topology Mirror
: Use topology-based mirroring, for when both side of a mesh have matching mirrored topology.

Input Samples
: not so sure

Show Zero Weights
- None
- Active
- All

Unified Settings: The *Size*, *Strength* and *Weight* of the brush can be set to be shared across different brushes, as

opposed to per-brush.

- Spray: to constantly draw (opposed to drawing one stroke per mouse click).
- Restrict: to only paint on vertices which already are weighted in the active weight group. (No new weights are created; only existing weights are modified.)
- x-mirror: to draw symmetrically. Note the this only works when the character symmetry plane is z-y (character looks into y direction).
- Show Zero weights: To display unreferenced and zero weighted areas in black (by default).

Weight Paint Tools

Weight Paint Tools

Blender provides a set of helper tools for Weight Painting. The tools are located in the weight tools panel.

The weight paint tools are full described in the *Weight Paint Tools* page

Weight Painting for Bones

This is one of the main uses of weight painting. When a bone moves, vertices around the joint should move as well, but just a little, to mimic the stretching of the skin around the joint. Use a “light” weight (10-40%) paint on the vertices around the joint so that they move a little when the bone rotates. While there are ways to automatically assign weights to an armature (see the *Armature section*), you can do this manually. To do this from scratch, refer to the process below. To modify automatically assigned weights, jump into the middle of the process where noted:

- Create an armature.
- Create a mesh that will be deformed when the armature’s bone(s) move.
- With the mesh selected, create an *Armature* modifier for your mesh (located in the *Editing* context, *Modifiers* panel). Enter the name of the armature.

Pick up here for modifying automatically assigned weights.

- Select the armature in 3D View, and bring the armature to *Pose* **mode** (`Ctrl-Tab`, or the 3D View window header mode selector).

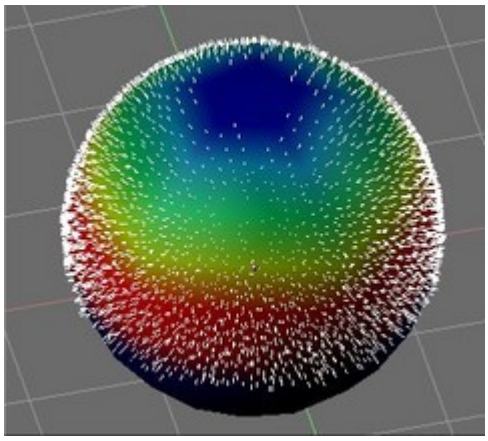
- Select a desired bone in the armature.
- Select your mesh (using RMB) and change immediately to *Weight Paint* mode. The mesh will be colored according to the weight (degree) that the selected bone movement affects the mesh. Initially, it will be all blue (no effect).
- Weight paint to your heart's content. The mesh around the bone itself should be red (generally) and fade out through the rainbow to blue for vertices farther away from the bone.

You may select a different bone with RMB while weight painting, provided the armature was left in *Pose* mode as described above. This will activate the vertex group sharing the name with the selected bone, and display related weights. If the mesh skins the bones, you will not be able to see the bones because the mesh is painted. If so, turn on *X-Ray* view (*Buttons* window, *Editing* context, *Armature* panel).

If you paint on the mesh, a vertex group is created for the bone. If you paint on vertices outside the group, the painted vertices are automatically added to the vertex group.

If you have a symmetrical mesh and a symmetrical armature you can use the option *X-Mirror.* Then the mirrored groups with the mirrored weights are automatically created.

Weight Painting for Particles



Weight painted particle emission.

Faces or vertices with zero weight generate no particles. A weight of 0. 1 will result in 10% of the amounts of particles. This option "conserves" the total indicated number of particles, adjusting the distributions so that the proper weights are achieved while using the actual number of particles called for. Use this to make portions of your mesh hairier than others by weight painting a vertex group, and then calling out the name of the vertex group in the *VGroup:* field (*Particles* panel, *Object* context).

Weight Tools

Weight Paint Tools

Blender provides a set of helper tools for Weight Painting. The tools are accessible from the Tool Shelf in Weight Paint mode. And they are located in the weight tools panel.

The Subset Option

Some of the tools also provide a Subset parameter (in the Operator panel, displayed after the tool is called) with following options:

- Active Group
- Selected Pose Bones
- Deform pose Bones
- All Groups

All tools also work with Vertex Selection Masking and Face Selection masking. In these modes the tools operate only on selected verts or faces.

Tip

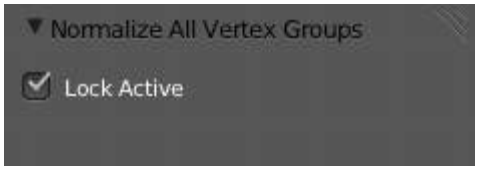
About the Blend tool

The Blend tool only works when “Vertex selection masking for painting” is enabled. Otherwise the tool button is grayed out.

Normalize All

For each vertex, this tool makes sure that the sum of the weights across all Vertex Groups is equal to 1. This tool normalizes all of the vertex groups, except for locked groups, which keep their weight values untouched.

Operator Parameters

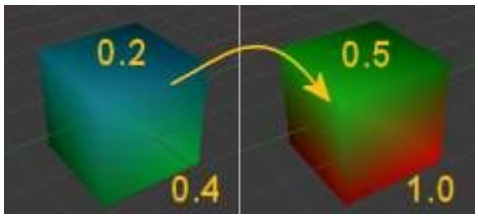


Normalize All Options

Lock Active
Keep the values of the active group while normalizing all the others.

Note
Currently this tool normalizes ALL vertex groups except the locked vertex groups.

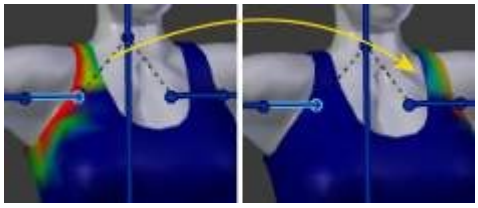
Normalize



Normalize All Options

This tool only works on the active Vertex Group. All vertices keep their relative weights, but the entire set of weights is scaled up such that the highest weight value is 1.0

Mirror



Normalize All Options

This tool mirrors the weights from one side of the mesh to the opposite side (only mirroring along x-axis is supported). But note, the weights are not transferred to the corresponding opposite bone weight group. The mirror only takes place within the selected Vertex Group.

Operator Parameters

Mirror Options

Mirror Weights
Mirrors the weights of the active group to the other side. Note, this only affects the active weight group.
Flip Group Names
Exchange the names of left and right side. This option only renames the groups.
All Groups
Operate on all selected bones.
Topology Mirror
Mirror for meshes which are not 100% symmetric (approximate mirror).

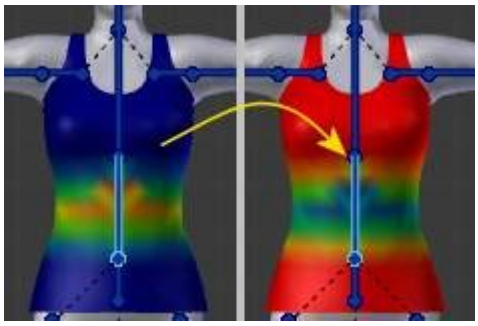
Tip

Mirror to opposite bone

If you want to create a mirrored weight group for the opposite bone (of a symmetric character), then you can do this:

- Delete the target Vertex Group (where the mirrored weights will be placed)
- Create a copy of the source bone Vertex Group (the group containing the weights which you want to copy)
- Rename the new Vertex Group to the name of the target Vertex Group (the group you deleted above)
- Select the Target Vertex Group and call the Mirror tool (use only the Mirror weights option and optionally Topology Mirror if your mesh is not symmetric)

Invert



Invert

Replaces each Weight of the selected weight group by 1.0 - weight.

Examples:

- original 1.0 converts to 0.0
- original 0.5 remains 0.5
- original 0.0 converts to 1.0

Operator Parameters

Mirror Options

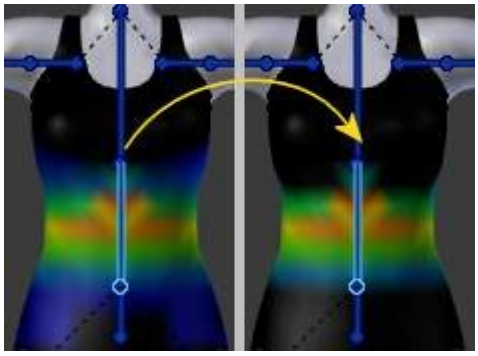
Subset
Restrict the tool to a subset. See above (*The Subset Option*) about how subsets are defined.

Add Weights
Add verts that have no weight before inverting (these weights will all be set to 1.0)

Remove Weights
Remove verts from the Vertex Group if they are 0.0 after inverting.

Note
Locked vertex Groups are not affected.

Clean



Invert

Removes weights below a given threshold. This tool is useful for clearing your weight groups of very low (or zero-) weights.

In the example shown, I used a cutoff value of 0.139 (see operator options below) so all blue parts (left side) are cleaned out (right side).

Note, the images use the *Show Zero weights* =Active option so that unreferenced Weights are shown in Black.

Operator Parameters

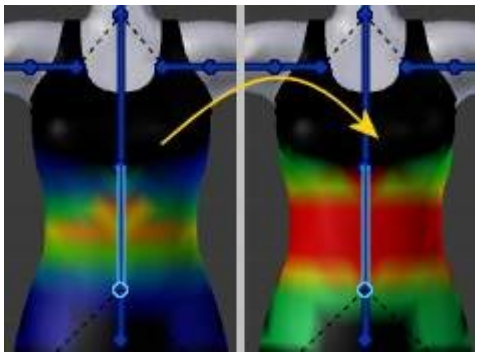
Mirror Options

Subset
Restrict the tool to a subset. See above (*The Subset Option*) for how subsets are defined.

Limit
This is the minimum weight value that will be kept in the Group. Weights below this value will be removed from the group.

Keep Single
Ensure that the Clean tool will not create completely unreferenced verts (verts which are not assigned to any Vertex Group), so each vertex will keep at least one weight, even if it is below the limit value!

Levels



Invert

Adds an offset and a scale to all weights of the selected Weight Groups. with this tool you can raise or lower the overall “heat” of the weight group.

Note
No weight will ever be set to values above 1.0 or below 0.0 regardless of the settings.

Operator Parameters

Mirror Options

Subset
Restrict the tool to a subset. See above (*The Subset Option*) for how subsets are defined.

Offset
A value from the range [-1.0,1.0]) to be added to all weights in the Vertex Group.

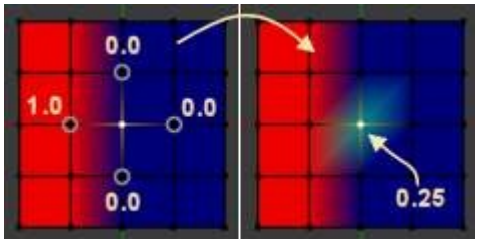
Gain
All weights in the Subset are multiplied with the gain. The drag sliders of this value allow only a range of [-10.0, 10.0]. However, you can enter any factor you like here by typing from the keyboard.

Note

Whichever Gain and Offset you choose, in all cases the final value of each weight will be clamped to the range [0.0, 1.0]. So you will never get negative weights or overheated areas (weight > 1.0) with this tool.

Blend

Blends the weights of selected vertices with adjacent unselected vertices. This tool only works in vertex select mode.



Blending

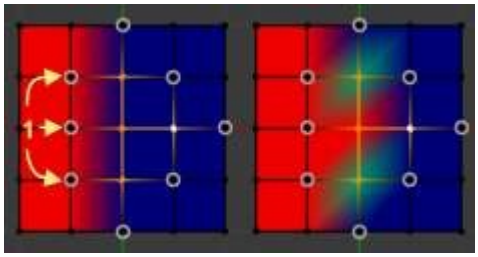
To understand what the tool really does, let's take a look at a simple example. The selected vertex is connected to 4 adjacent vertices (marked with a gray circle in the image). All adjacent vertices are unselected. Now the tool calculates the average weight of all connected **and** unselected verts. In the example this is:

```
(1 + 0 + 0 + 0) / 4 = 0.25
```

This value is multiplied by the factor given in the Operator parameters (see below).

- If the factor is 0.0 then actually nothing happens at all and the vertex just keeps its value.
- If the factor is 1.0 then the calculated average weight is taken (0.25 here).

- Dragging the factor from 0 to 1 gradually changes from the old value to the calculated average.



Blending

Now let’s see what happens when we select all but one of the neighbors of the selected vert as well. Again all connected and unselected verts are marked with a gray circle. When we call the Blend tool now and set the Factor to 1.0, then we see different results for each of the selected verts:

- The topmost and bottommost selected verts:

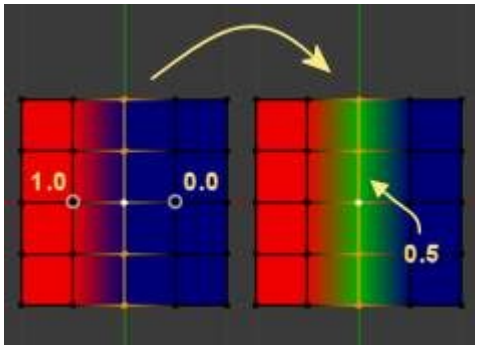
  are surrounded by 3 unselected verts, with an average weight of `(1 + 0 + 0) / 3 = 0.333` So their color has changed to light green.

- The middle vertex:

  is connected to one unselected vert with `weight = 1`. So the average weight is `1.0` in this case, thus the selected vert color has changed to red.

- The right vert:

  is surrounded by 3 unselected verts with average weight = `(0 + 0 + 0) / 3 = 0.0` So the average weight is 0, thus the selected vert color has not changed at all (it was already blue before blend was applied).



Blending

Finally let’s look at a practical example (and explain why this tool is named Blend). In this example I have selected the middle edge loop. And I want to use this edge loop for blending the left side to the right side of the area.

- All selected vertices have 2 unselected adjacent verts.
- The average weight of the unselected verts is (1 + 0) / 2 = 0.5
- Thus when the Blend Factor is set to 1.0 then the edge loop turns to green and finally does blend the cold side (right) to the hot side (left).

Operator Parameters

Blend Options

Factor
The effective amount of blending (range [0.0, 1.0]). When Factor is set to 0.0 then the Blend tool does not do anything. For Factor > 0 the weights of the affected vertices gradually shift from their original value towards the average weight of all connected **and** unselected verts (see examples above).

Transfer Weights

Copy weights from other objects to the vertex groups of the active Object. By default this tool copies all vertex groups contained in the selected objects to the target object. However you can change the tool's behavior in the operator redo panel (see below).

Prepare the Copy

Blending | Blending

You first select all source objects, and finally the target object (the target object must be the active object).

It is important that the source objects and the target object are at the same location. If they are placed side by side, then the weight transfer won't work. You can place the objects on different layers, but you have to ensure that all objects are visible when you call the tool.

Now ensure that the Target Object is in Weight Paint mode.

Call the Tool

Open the Tool Shelf and locate the Weight Tools panel. From there call the "Transfer weights" tool. The tool will initially copy all vertex groups from the source objects. However the tool also has an operator redo panel (which appears at the bottom of the tool shelf). From the redo panel you can change the parameters to meet your needs. (The available Operator parameters are documented below.)

Redo Panel Confusion

You may notice that the Operator Redo Panel (see below) stays available after the weight transfer is done. The panel only disappears when you call another Operator that has its own redo Panel. This can lead to confusion when you use Transfer weights repeatedly after you changed your vertex groups. If you then use the still-visible redo panel, then Blender will reset your work to its state right before you initially called the Transfer Weights tool.

Workaround

When you want to call the Transfer Weights tool again after you made some changes to your vertex groups, then always use the “Transfer Weights” Button, even if the operator panel is still available. Unless you really want to reset your changes to the initial call of the tool.

Operator Parameters

Note
This tool now uses the generic ‘data transfer’ one. Please refer to the *Data Transfer Modifier* for options details and explanations.

Limit Total

Reduce the number of weight groups per vertex to the specified Limit. The tool removes lowest weights first until the limit is reached.

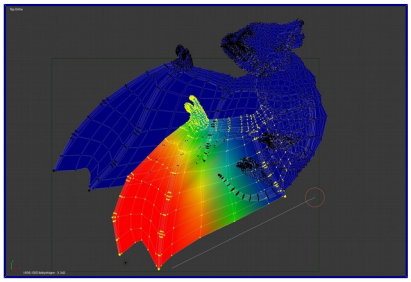
Hint: The tool can only work reasonably when more than one weight group is selected.

Operator Parameters

Subset
: Restrict the tool to a subset. See above (*The Subset Option*) for how subsets are defined.

Limit
: Maximum number of weights allowed on each vertex (default:4)

Weight Gradient



example of the gradient tool being used with selected vertices.

This is an interactive tool for applying a linear/radial weight gradient; this is useful at times when painting gradual changes in weight becomes difficult.

The gradient tool can be accessed from the Toolbar as a key shortcut:

- Linear: `Alt-LMB` and drag
- Radial: `Alt-Ctrl-LMB` and drag

The following weight paint options are used to control the gradient:

- Weight - The gradient starts at the current selected weight value, blending out to nothing.
- Strength - Lower values can be used so the gradient mixes in with the existing weights (just like with the brush).
- Curve - The brush falloff curve applies to the gradient too, so you can use this to adjust the blending.

Blends the weights of selected vertices with unselected vertices.

Hint
This tool only works in vertex select mode.

Operator Parameters

Type:

- Linear
- Radial

X Start: X End: Y Start: Y End: