[Tutorial: From *3-Lights* to Mental Ray]

Content:

1. Introduction

Lightning is one of the most important things in CG-art. Ever since CG exists, artists wanted to create perfect copies of real life. One big problem was lighting up the scene.
Where to put the different spots to get a half-decent result?

In this short article we want to explain the 3 basic methods of lightning. This tutorial is focused on bloody beginners and should help them to choose the right lightning technic for their projects.

The three lightning techniques are: The **three lights scene**, the **sphere of lights** and lightning with **mental ray.**

The **three lights scene** is very easy to handle: Just place 3 different spot-lights around the scene. Although the results look quite good for CG-art, real "freaks" can't be satisified with this kind of lightning, me included. Therefore another solution exists. The "**Sphere of Lights**", which is a a dome of lights that give nice soft shadows.

The results are quite amazing but the script creates hundreds of spotlights around the scene which make the handling a bit complicated.
The last solution is **Mental Ray** a Renderer that comes with 3dsmax6. With the help of this renderer you can create photorealistc effects that are not feasible with the normal scanline renderer

2. Three Lights Scene

It is true that there are absolulty no lightning rules and that every scene has its own lightning positions although there exist three types of basic-lights which can be found again and again.

It's the basic lightning technic used in 3dsmax.

The three different lights are:

- the **Key**-Light
- the **Fill**-Light and
- the **Back**-Light

The picture seen above was found in the book: **3d Studio Max R3 – Professional 3d Effects** from Jon A. Bell and describes the three different light positions very well.

2.1. The Key – Light

The **Key-Light** is responsible for the main illumination of the scene and defines the angle where the basic light comes from.
In the picture on the right, the Key light is placed on the right hand side of the camera. It is the strongest light in the scene and therefore creates the darkest shadows.
Here you can use a **multiplier**-amount of **1** and a bright **white** color. Key-Lights have to create shadows, therefore you have to activate them.

In real life, (in most cases) the **Key–Light** comes from top (the sun or the lamp in your living room) so you can take it as a rule of thumb to place the **Key–Light** always above the object.
You can easily remember to place it in an angle of 45° from the objects front and height.

For example: if your object is placed 0/0/0 and your camera is placed 0/100/0, it's a good idea to place the Key-light at
100/100/100 or
–100/100/100
so: either left- or right hand side of the camera and a bit above.

The **Key-Light** is always the first light to be created, although using only the **Key-Light** will result in a very flat looking image. Just take a look at the picture of the teapot on the previous page where I only used a simple Spot representing the Key-Light.

You can see that the shadows are very strong and parts of the pot are completely black. So: using only the **Key-Light** makes your scene look really dark. To get rid of this effect, we have to create the Fill-light.

2.2. The Fill – Light

The **Fill–Light** supplements the Key-Light. It creates a smooth atmosphere and brings out the details of the objects. By doing so, it dimly lits the dark parts created by the Key-Light.
Just take a look at the picture on the right. With the help of a second Spotlight I was able to light up the scene.

In real life every object immits and emmits parts of the light. The emmited light lights up other objects and gets immited and emmited again. This effect is called "radiosity"

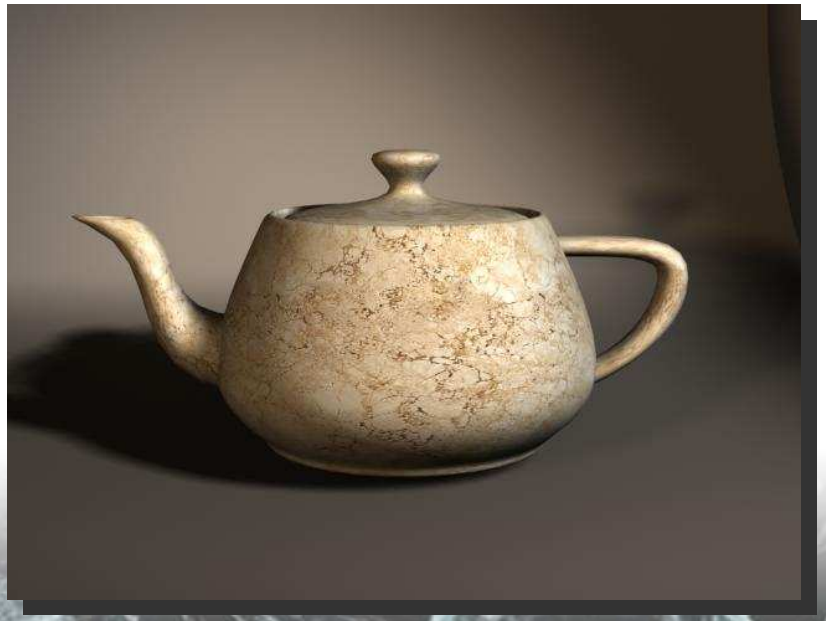
As a matter of fact this kind of effect is rather complicated to simulate within a 3d software.

To simulate "radiosity", **Fill–Lights** are used.

They illuminate only parts of the object that are not directly effected by the Key-Light, but would be effected with the help of other objects in real life.
With the help of the **Fill-Light** you can also fake reflections or a second light source.

Fill-Lights are NOT as strong as Key-Lights. Use a Multiplier-amount of 0.5 (or lower) for Fill-Lights, but that really depends on your scene settings.

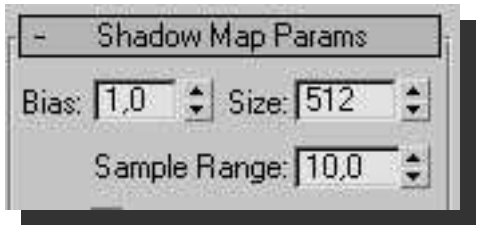
Fill-Lights have no fix place and no fix amount as **Fill-Lights** simulate the light that is reflected from other objects. The first pic on the previous page shows the Fill-Light on the left hand side of the camera.
You can use eihter **Spots** or **Omnis** for **Fill-Lights** and you should change the bright white color into a soft tone.



Normally **Fill-Lights** are too weak to produce shadows so you do not have to activate them. If you really want to use shadows you should change the shadow parameters. Lower the "**object shadow density**" to 0.5 or even lower. At the same time you have to raise the "**Sample Range**" to 10 (again: those values strongly depend on your scene)

With those settings the **Fill-Light** will produce very soft shadows.

Higher **sample range** causes soft-edged shadows



2.3. The Back – Light

The **Back-Light** illuminates the boarders of an object to highlight it from the background.
Thus, **Back-Lights** help to define an object.

Back-Lights are placed diagonally opposite the Key-Light and a bit above. You can use the same settings similar to the Fill-Light.
Again, the **Back-Light** creates only very soft shadows so keep in mind to raise the "Sample Rage".

Contrary to the Fill-Lights, you should always use **Back-Lights** as they increase the realism of your scene.

The picture on the right shows the final result of my small sample scene with all three lights activated.

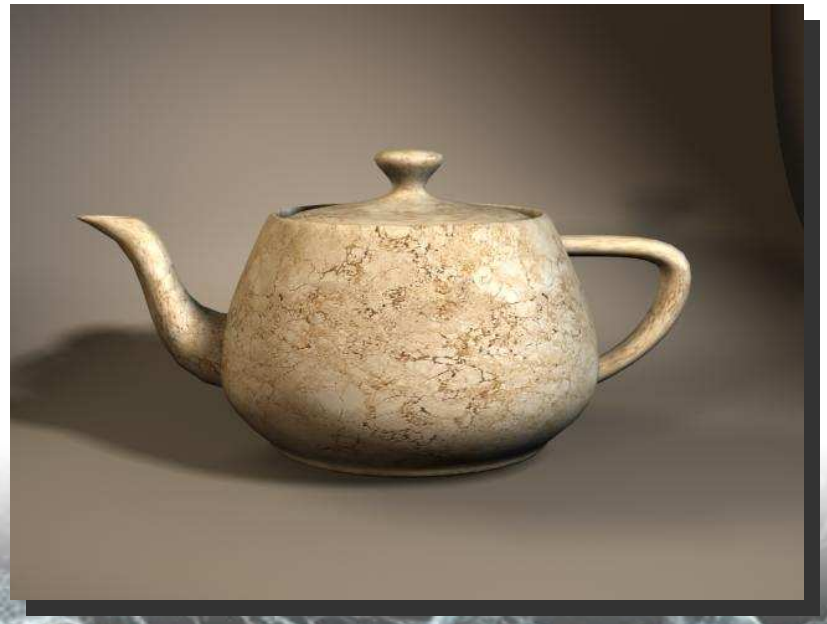
With the help of those settings you should be able to create the basic lightning of your scene.

The **Key-Light** always represents the main lightsource and creates the darkest shadows.

The **Fill-Light** helps to light up the whole scene, especially the areas that are not illuminated by the Key-Light. It can only create very soft shadows and should have some light coloring.

The **Back-Light** defines the back of your objects by illuminating the boarders.
Like the Fill-Light it is used as an indirect light-source and can only create soft shadows.

Beside those three main *Light-Types*, there exist a lot of others as well.



Other types are artificial light sources like desk-lamps, headlights, flashlights or open fire. To simulate these kinds of light-sources you should use Lens-Effect-Glow or other Video-Post-Stuff to illuminate the object (ex.: a bulb)

If you do not know how to work with Video-Post please use the online help of 3dsmax ("F1")

In summary it can be ascertained that the three-point-lightning is basically used to display 3-dimensional objects in a 2d picture. In an illuminated scene, every lightsource serves a purpose (Key-Light, Fill-Light or Back-Light).

The problem is that those guidelines are very flexible as there exist no rules in art.

BUT there exists at least ONE rule you must take care of:

NEVER ever place a light directly behind the camera!! Although the light would be very consistant it would ruin the 3rd dimension. By placing a lightsource behind the camera you would create the effect of a flattened image.

Keep in mind that lights have the aim to create a dimension either by lighting up only parts of the objects or by creating real shadows.

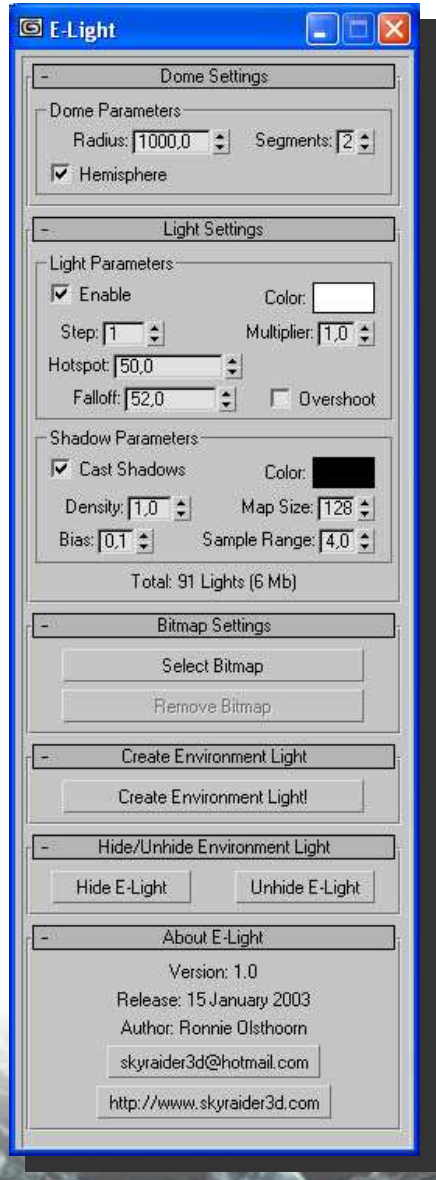
Well, that's it from the simpliest form of lighting up a scene in 3dsmax. You can use this form of lightning if you have created just one model and want to present it like a photographer in his studio. By creating more complicated scenes, the lightning gets more complicated as well.

In this short article I do not want to differ between indoor and outdoor lightning as this topic could fill libraries.
All I can do is to give you a short overview and some rules of thumb you should take care of when working with 3dsmax and lights.

As I told you before:
In real life every object immits and emits parts of the light. The emited light lights up other objects and gets immited and emited again. This effect is called "radiosity"

It is hard to create a "radiosity-like-effect" with just Fill-Lights.

To get the effect of radiosity a little script exists which can create a "**sphere of lights**".
The "**sphere of lights**" is the next step towards reality.



3. The sphere of lights

Before we begin, let's remember that while Discreet has taken MAX to historically industry leading limits, there are still other folks out there who live to take MAX still farther. They create new pieces of programming that MAX can execute to further your modeling and rendering. These extra goodies are written for MAX in "maxscript."

The file extension for such a treat is *.ms and such a file goes in the following directory:
3DsMAX>Scripts>Plugins

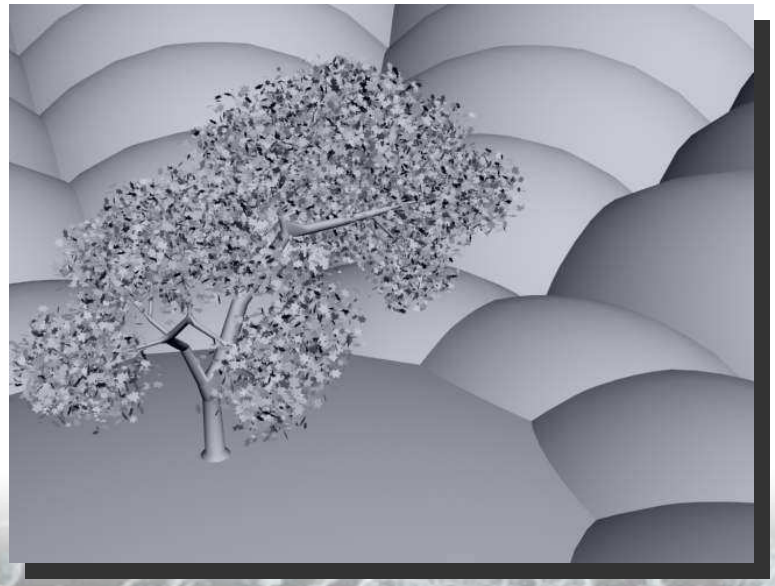
With the script in place, you can access it from MAX's top-most toolbar by "running" a script. Now that this is all said, go grab yourself E-Light by visiting

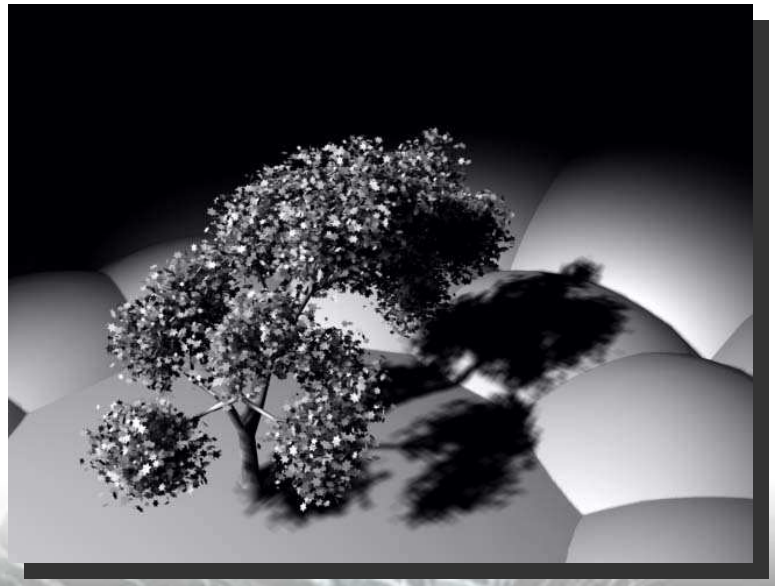
http://home.wanadoo.nl/r.j.o/skyraider/e-light.htm

Unzip it and stick the approporiate .ms file as mentioned above. This script is verified by 3D Kingdom Admin to work in Mr6 with no trouble.

Get yourself a ground and a simple subject. Here, I have a tree from another maxscript that I'll share with you later and I arrayed some spheres to illustrate the range and effect of E-Light on convex areas (those that bend OUTWARD). You can see that one Target Direct on the tree is less than exciting. As a matter of fact, it's just boring.

Once I position the camera and objects, I then want to play with lighting since I know how I'll be viewing the subject. This is something you should try to do too. A simple rule of lighting composition that someone once taught me was that your picture obeys common rules of goodness if you can remove all color and still see goodness with just the values in the picture. Below we have worse vs. better; better resulting from the higher contrast in the shadows generating a bit of depth.



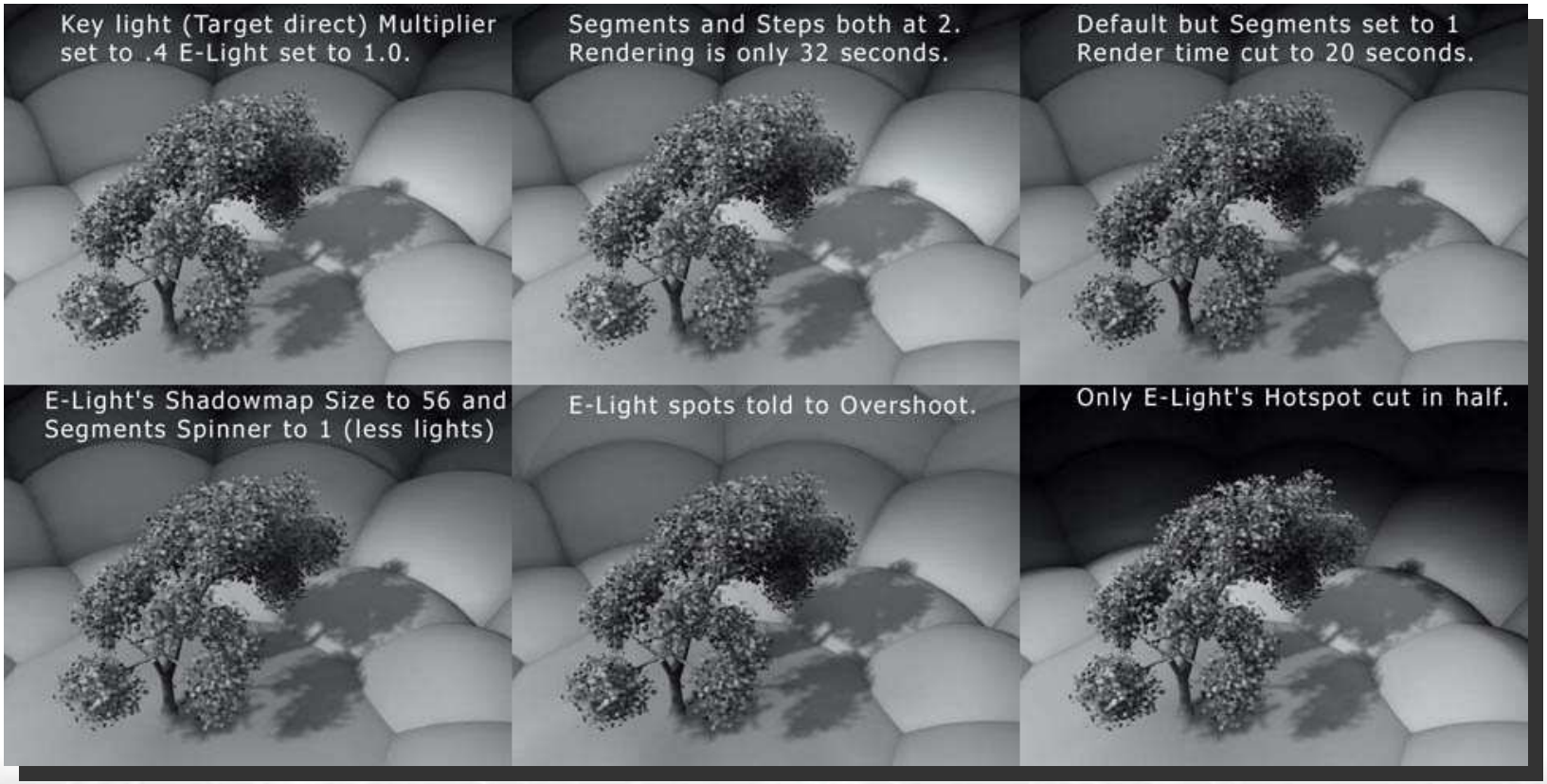


ANYTHING in 3D can be complex. Even the most mundane plugin scripts can offer various settings that bring you overly-done results. In this case of lighting with E-Light, E-Light's own settings bring in a geosphere in half with 91 spot lights aimed at Origin, 0,0,0 (Global). The TOTAL multiplier is default of 1.0 If your subject is only visible to half of the lights, it will only receive a combined multiplier of 0.5 Combining 0.5 with the default Target Direct multiplier of 1.0 is far too much light. Lower your key light settings (discussed in the previous chapter).

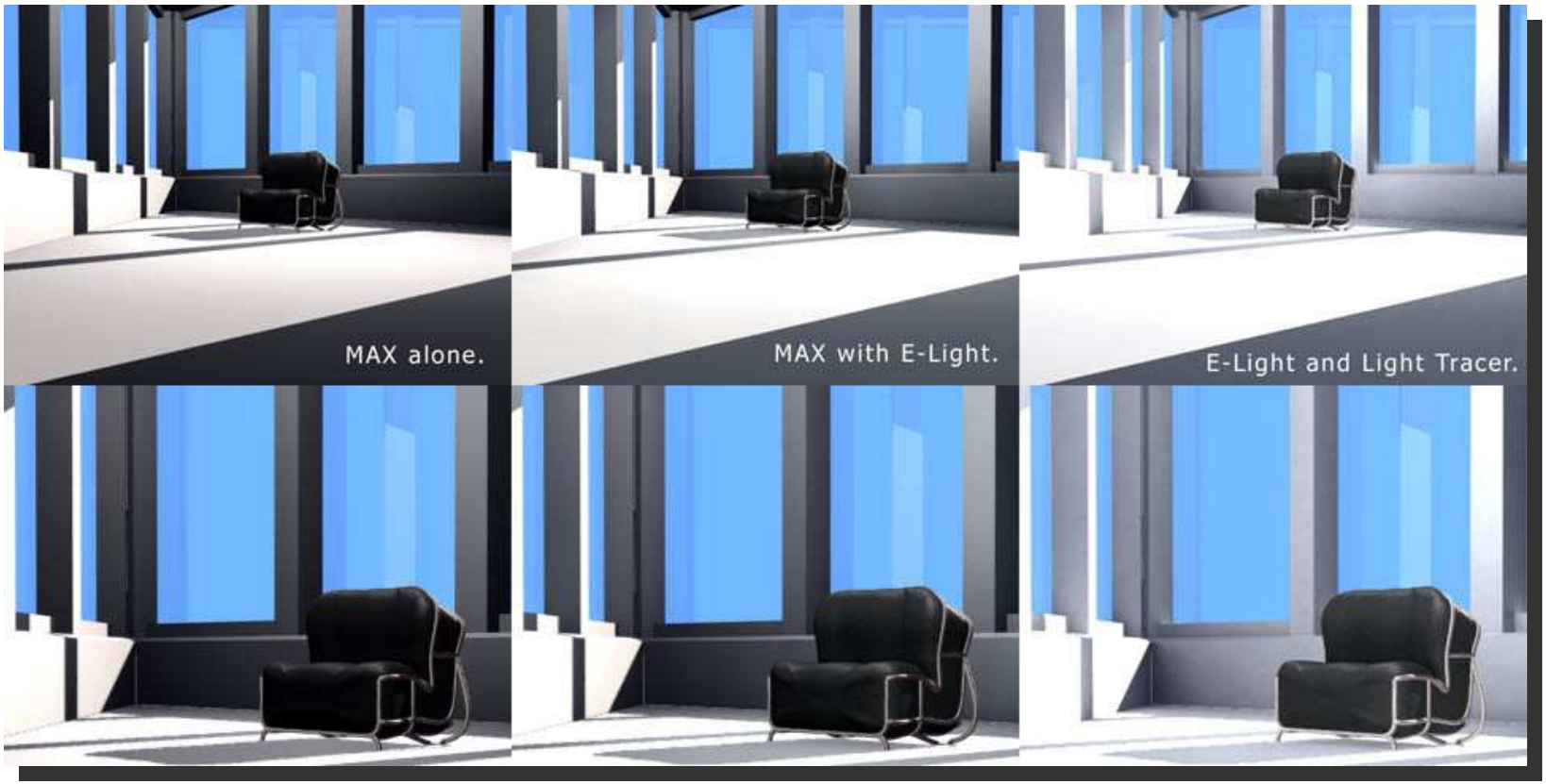
There's a great variety of things to play with in E-Light. It doesn't offer the same exact control as MAX's own light that are created straight from the panel, but the results are definitely altered by a few simple switches from default levels to streamlined, custom levels.

These lights must be thought of as an Array that was set to Instance when created.

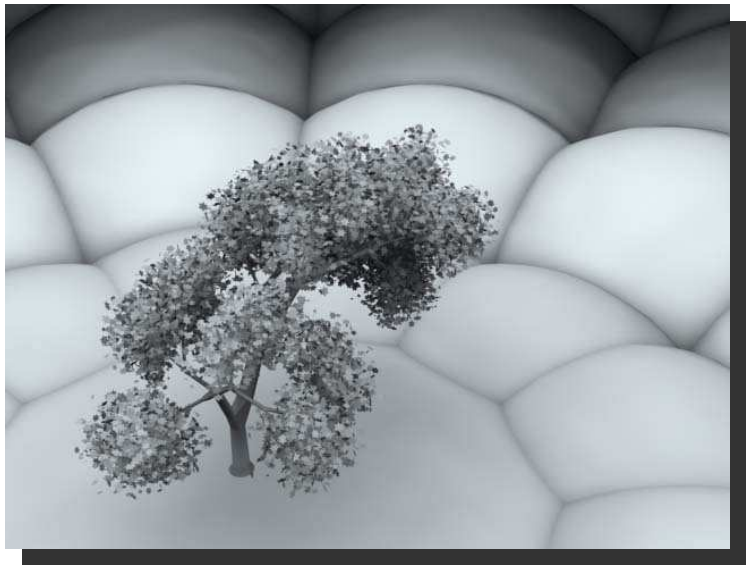
They operate as a whole and the Multiplier, cleverly, is *cumulative* meaning it's the WHOLE, not just an individual light.



The dome of lights created by E-Light has edges. Objects can be too far away from Origin, hence, not lighted correctly. E-Lights Modifier panel is lost for good once you close it, so minimizing is preferable. **MAX's Modifier panel will not control the E-Light dome in the same way.** Only E-Light's Multiplier is animatable. These down-sides are far outweighed IMO by E-Light's excellent internal control for simple scenes that could be modeled far more complexly than I've done here. Rich shadows remain where they should remain and for the more industrious students, E-Light provides a DirtMap-like effect in crevices – conceivably, one could 'paint with light.' Most thankfully, E-Light's controls allow for marvelous optimization for rendering time! Attractive previews can be popped out in half the time as a 91 light scene (full E-Light default) can be with little loss of effect.



Pic of default E-Light settings
without Target Direct



Pic of Too much E-Light multiplier

Pic with more balanced settings

4. Mental Ray

The last solution that we want to discuss here is the usage of **Mental Ray**.
To quote the „F1-Help" of 3dsmax: "The mental ray renderer is a general purpose renderer that can generate physically correct simulations of lightning effects, including raytraced reflections and refractions, caustics and global illumination."

Befor the times of mental ray creating caustics was just a dream and the "e-light script" was the only key to create "global illumination" (the effect of radiosity). Although the results looked good, all those spotlights where not very handsome.
Good luck, mental ray was integrated in 3dsmax 6, as it relieves you of the need to simulate complex lighting effects "by hand".

There is no need to explain the differences between the mental ray Renderer and the Default Scanline Renderer as you can find that in great detail in the online-help of 3dsmax.

I want to give you a few information of the most important settings of Mental Ray and how it can be used to give your pictures more realism. As mental ray is a very complex renderer and has so many things that can be changed, I was not able to discuss all those things on just a few pages. Therefore I have attached a link-list at the end of this article to very interesting tutorials about mental ray. People who want to learn more about it, should really read those.
But lets get started: On the right you can see two pictures of the same scene. The first was rendered with the standard scanline renderer using the **3 – lights – technique** I explained befor. The second picture was rendered with **Mental Ray** with activated "Caustics" and "global illumination"
The most visible difference is that the glasses in the second pic create a "caustic" effect, which is only possible using mental ray.
Beside that, the background is much brighter than in the first picture. This effect is called global illumination.

With the help of Mental Ray you can create such effects within seconds; apart from the render-times ;) …. Just to think about: The first picture took me about 20 seconds to render, the second pic took 5 mins 40 sec !!

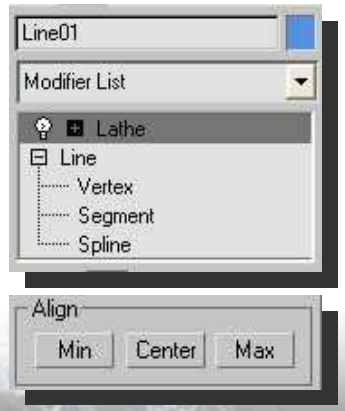
On the next few pages I want to explain how to use some of the special features of Mental Ray and what you should take care of when using them.

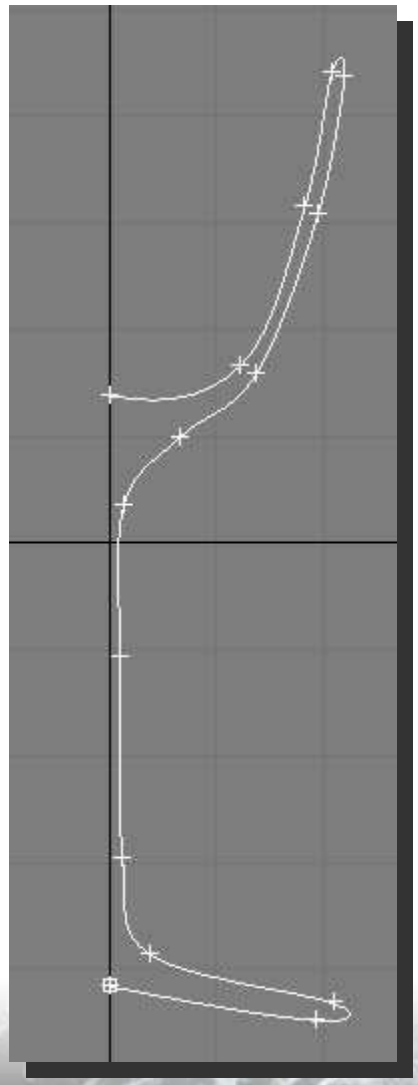
Therefor we will create a small scene, set up the lightning, select Mental Ray as renderer and be astonished ;)

5. Mental Ray – Sample Scene

Open your copy of 3dsmax6, select line (activate smooth (Initial and Drag Type)) and create a line like in the picture on the right.
(we select smooth to avoid corners!) It does not matter if you create it in the front or right view, but please do not create it in the top-view!!)

When done add the **Lathe–Modifer** to the stack and **align** it to "**min**" (or **max**… that depends)

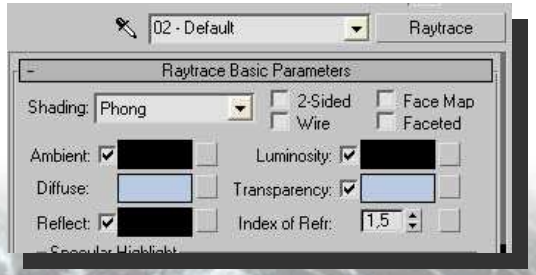




You should now have a kind of "wine-glass".

As everyone should know how to create a glass-like material I will explain that in just a few sentences.

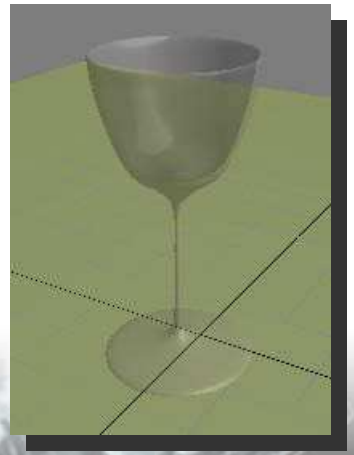
Click "m" to open the material editor and select a new slot.
As our aim is to create a glass, we have to create a corresponding material.
Click on the standard-button and select "raytrace" from the pop-up.
Change **diffuse** and **transparency** - color to some light blue.
When done apply the material to the glass.



To finish the modelling part, create a box which should represent the floor lateron.
Move the "glass" so that it stands on the box.

Open the material editor again, select a new slot (standard), change the diffuse color to some brown (or whatever you like) and apply this material to the box.

Ok, that's it from the modelling part. We do not want to loose time on some complicated models but learn something of Mental Ray.



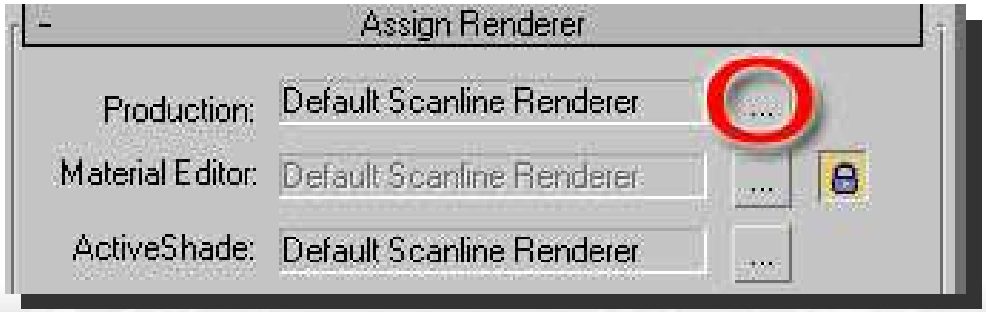
5. Mental Ray – Sample Scene

By now we have created the glass and the floor.
Now we want to render that scene with the **Mental Ray** renderer.
On the main menu-bar go to "rendering" – "render…" (shortcut = F10). A window should pop up (You all know what it is ;)).
Scroll down to the "**assign renderer**" section and click on the "**…**"-button to change the **production** – renderer.

In the pop-up, select **mental ray Renderer**.
That's it, you have changed the renderer and can render your pic using Mental Ray. Easy, wasn't it?

Render your scene! – What? You cannot see any difference compared to the normal Scanline Renderer? – Well, it seams that it is NOT that easy ;)

Why can't we see caustics or global illumination?
Right: There are no lights in our scene.



Changing only the renderer is not the solution to perfect looking pictures. But **Mental Ray** supports things that are not supported by the Scanline Renderer. All we have to do is to activate them.
Jeremy Birn (the link to his tutorial and to lots of others can be found at the end of this article) explained very well the difference between mental ray and scanline.

"..Ordinary scanline rendering and raytracing works "backwards" - the rays start at the camera (…) Caustics are an addition to your rendering that calculates photons of light starting at a light source (like real light)."

So to see caustics in our scene, we have to create a light – source.

To do so, go to **create** – **lights** and select **mrAreaOmni**

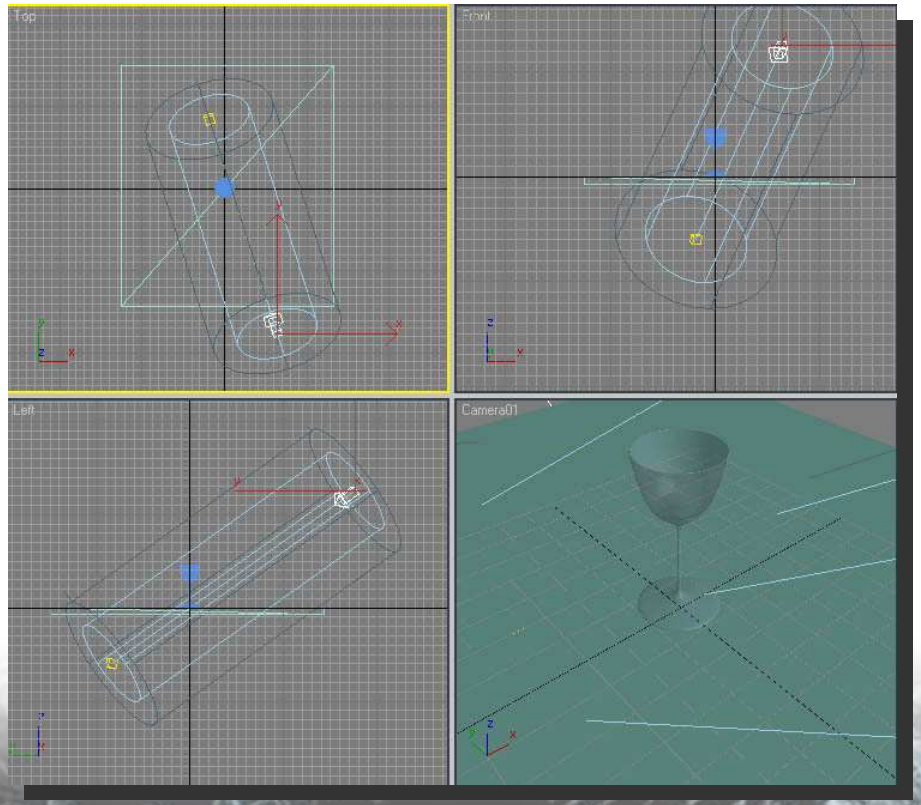
MrAreaOmni and MrAreaSpot are two lights that come with Mental Ray.

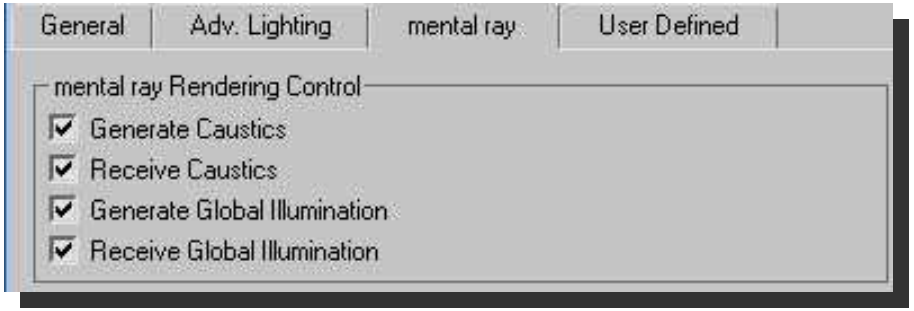
Place the Omni somewhere in your scene. When done go to its modify-menu and change the **light type** to **directional**. Like that we get a light source that can be targeted on our glass. Move and rotate that light till it lights out the scene.
In the **directional parameters** you can change the size of Hotspot and Falloff.

5. Mental Ray – Sample Scene

Make shure that **ray traced shadows** will be generated.
By now, we have created all needed objects and the light source.

Your scene should look like the one below:
What we have to do now is to tell 3dsmax which objects can create caustics and which objects can receive caustics.
Select the glass, right-click on it and select **properties**.





Find **mental ray** and activate **Generate Caustics**

As all the other stuff is activated by default we do not have to change the settings for the floor which should only receive caustics, but should not generate them.

As caustics are the effects of light cast onto an object via reflection off or refraction through another object you have to assign a Raytrace or other map as either a Reflection map or Refraction map before you can render them.
So: The glass has a raytrace material and can generate caustics.

The floor has just a standard material, and cannot create caustics, even if you activate them in the mental ray rendering control.

Press "F10" to open the Render-Menu. Find the **Indirect Illumination** Tab and enable **Caustics**. You are now able to render the scene with caustics.

Lets summarize:
To use Caustics in your pictures you have to:

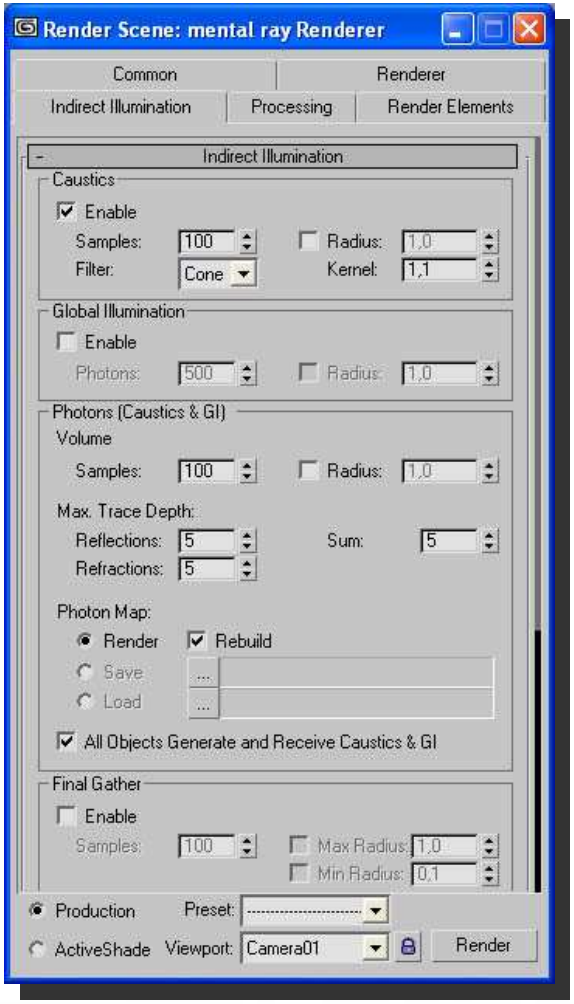
1. Create all the objects
2. Select the objects that should create caustics and activate it in the Rendering Control

5. Mental Ray – Sample Scene

3. Create a light-source that can create caustics (either mrAreaOmni or mrAreaSpot)
4. Select mental ray as renderer and enable caustics in the indirect illumination tab.

Like this you can create very fast very well looking results. The MAX – standard settings should fit all kind of scenes.
You can also activate Global Illumination and Final Gather but for our small scene that will only increase the rendering – time and wont have much influence on the final result

Mental Ray is a very complex renderer and there are a lot of things you can change and that have great influence on the result of your pictures.



There is no use of explaining every button as you can find all those things in the 3dsmax online help (just search for: **Indirect Illumination Rollout**)

With the help of this article you should now be able to use the appropriate lightning technique for your scenes:

Use the **3 – lights – technique** if you want to show some WIPs of your projects (for example on the forums of 3dkingdom.org). The 3 – lights – technic is fast and easy to use and can give good results.

The "**Sphere of Lights**" can be used to present single objects.
For example: If you have modelled a car and do not have an environement just create a plane and put the car on that plane. Create a "Sphere of Lights" and you get a "showcase – effect"

If you want to create photorealistic pictures with physical correct lightning you should use **Mental Ray**. Although rendering time can be very long it gives the best results.

I hope that this article helps Newbies to light up their scenes and that I do not have to look at WIPs using just one spot-light in future!!

I am sorry that this time, there was nothing to learn for all the intermediate Maxers.
To calm you down I have searched some good articles about mental ray which can be found on the next page. Beside those, please read the online – help of 3dsmax for further informations.
If someone knows any other good tutorials about Mental Ray or other Lightning-technics, please post a comment below the article at www.3dkingdom.org

6. Link List

A Look At Caustics, by Jeremy Birn
http://www.3drender.com/light/caustics.html

3dsmax: mental ray, by _mistle_
http://www.evermotion.org/tutorials/rendering/max_rendering_mr/

Realistic Table Tutorial for 3dsmax 6, by 3drigger
http://www.3dkingdom.org/modules.php?op=modload&name=News&file=article&sid=579

Mental Ray - Ambient Occlusion Shader, by Chris Thomas
http://www.christopher-thomas.net/pages/free_tutorials/tut_ambient_occlusion_shader/ct_tut_mentalray_ambientocclusion_shader.htm

Occlusion in 3dsmax 7, by Ozgur Ustundag
http://67.15.36.49/team/Tutorials/occlusion_ozgur/occlusion01.asp

Car Paint Rendering with Max 6.0 & Mental Ray, by veXal
http://www.3dkingdom.org/modules.php?op=modload&name=News&file=article&sid=541

Mental Ray
http://www.cgtalk.com/showthread.php?t=104578

3ds max : rendering mit dem mental ray (german!!)
ah-datentechnik.de/down/3dsmax_workshop.pdf

and dozens more ;)

Any Questions?

Eumel3d@3dkingdom.org or

BryanA@3dkingdom.org

Acknowledgement

Special thanks to

- **C** for correcting my (Eumels) bad english
- **necksmasher** for allowing me to use one of his pics as background
  http://www.necksmasher3d.tk/

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