

TWO BIG EARS

3DCEPTION UNITY

3Dception Unity.

vo.8.ob. 23rd December 2014.

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# 1

## *Introduction*

### **1.1 What did you download?**

Thanks for downloading 3Dception Unity. 3Dception extends the spatialisation functionality in Unity to include full binaural synthesis (including elevation effects) and room modelling. It is cross-platform (Windows, OSX, Linux, iOS and Android), supports multiple sample rates and is extremely efficient and power friendly. Do what you do best – designing great experiences – and let 3Dception tackle the heavy maths and science of binaural spatialisation. For any issues, help or bug reports, email [support@twobigears.com](mailto:support@twobigears.com).

### **1.2 Binaural Audio**

Real-time binaural audio works using HRTFs (or Head Related Transfer Functions). HRTFs work by filtering an audio signal to recreate the complex cues that help us, as humans, localise sounds. The cues are influenced by multiple factors, including the listening environment and the shape of your body, head and ears. In reality, we move our heads and reorient ourselves to localise sounds. We constantly try to bring sounds (or the objects that are creating such sounds) into our line of sight to overcome the ambiguity of spatialisation. Some of the long standing problems of binaural audio can be overcome with head tracking technology, as found on virtual reality devices.

### **1.3 Room Modelling**

A majority of the binaural solutions only take into account HRTF measurements made in an anechoic chamber. In reality, we listen to sounds in live environments that alter our sense of localisation. Real-time room modelling, with binaurally spatialised reflections can overcome this. A full real-time room modelling solution can be a CPU intensive process, but 3Dception takes the best of both worlds. The room modelling algorithms in 3Dception recreate only the reflections that are essential for a convincing 3D audio experience. This means

that it could be used with any other reverberation system, including Unity's reverb zones, without any problems. It is advisable to use it in conjunction with Unity's reverb zones for best results. Adding a small pre-delay to the reverb system (30-60ms) can greatly enhance the spatialisation effect.

## 1.4 Versions

3Dception is currently in beta. During this introductory period all desktop platforms (OSX, Windows, Linux, iOS and Android) are bundled together. Depending on the product you downloaded, you might have some limitations:

- Non-Commercial: For non-commercial use only, with a limitation of 10 active binaural sources.
- Basic: For commercial use, with a limitation of 5 active binaural sources
- Pro: For commercial use, with no limit on the number of binaural sources

## 1.5 License

Regardless of the product or version you downloaded, you should have been supplied with license keys in an email. Keep these safe as they are needed to activate 3Dception. Details on license activation are provided in [Activating Your License](#).

## 2

# Setup

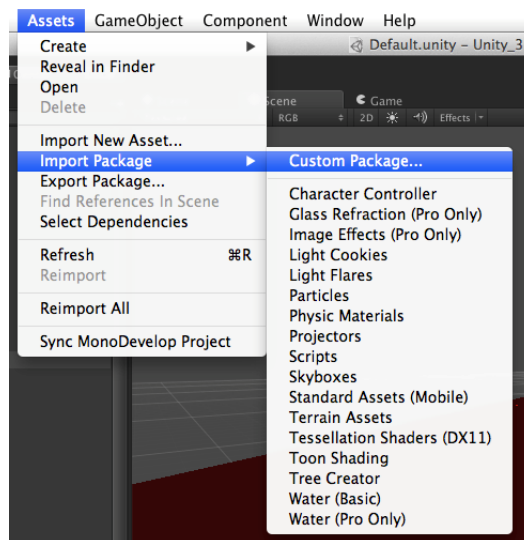
### 2.1 Requirements

- Unity 4.3 Pro or greater (including Unity 5)
- 3Dception unitypackage

### 2.2 Importing 3Dception

If you are using 3Dception in your project for the first time, follow the steps below.

1. Open Unity and load your project and scene
2. Go to the 'Assets' menu and choose *Import Package > Custom Package*



3. Choose 3Dception\_o.8.ob\_system.unitypackage, where 'system' would be OSX, Windows, Linux, Android or iOS. For example, if you use OSX it would be named 3Dception\_o.8.ob\_OSX.unitypackage. You would need to have either the Windows or OSX package imported for the Unity editor to work. You can import multiple platform packages into the same project if you are targeting multiple platforms.

## 2.3 Updating

If you have installed a previous version of 3Dception in a project or if you are upgrading to Unity 5, follow these steps to update your project:

1. Quit and reopen Unity, if you have already have it open
2. Open your Unity project
3. Go to the *Assets* menu and choose *Import Package/Custom Package*
4. Choose the new 3Dception Unity Package
5. Click on import. Once completed, quit Unity and re-open your project
6. Go to 3Dception/Setup And Diagnostics in the menu bar and click on *Run Diagnostics* from the window
7. Once complete, click on *Assets/Reimport All..* in the menu bar and select *Reimport* from the resulting window
8. Once your project has reloaded, go to 3Dception/Diagnostics in the menu bar again and click on *Run Diagnostics* again. You should see an image similar to the one below, depending on which of the 3Dception plugins you have installed.



9. If you are upgrading from version 0.6.1b of 3Dception or lower, follow the steps 1-2 in [Using 3Dception](#) to ensure your project is upgraded correctly. vo.6.2b and higher of 3Dception includes new initialisation and destruction components that will need to be added to your project.



## 2.4 Activating Your License

Import and setup the 3Dception Unity Package in your project (read [Importing 3Dception](#)).

1. Click on *3Dception* in the menu bar. You might need to click elsewhere in the menu bar for *3Dception* to appear
2. Click on *License..*
3. Enter your license keys in the license pop-up window and click on authorise. **You must be connected to the Internet for this first verification.** Once authorised, you won't need to authenticate your computer again unless you de-authorise your license or receive a new one. After authorisation, all builds will be pre-activated and your users would not need an Internet connection.
4. *For Pro/Basic users:* You will need to enter in all the license keys you have received. For example, if you plan to develop for OSX and Android, you will need to enter in the OSX and Android license keys. Linux doesn't require a license key.
5. *For Non-Commercial users:* If you plan to develop for both OSX and Windows, you will need to enter in both license keys. Android, iOS and Linux currently do not require a license key.

## 3

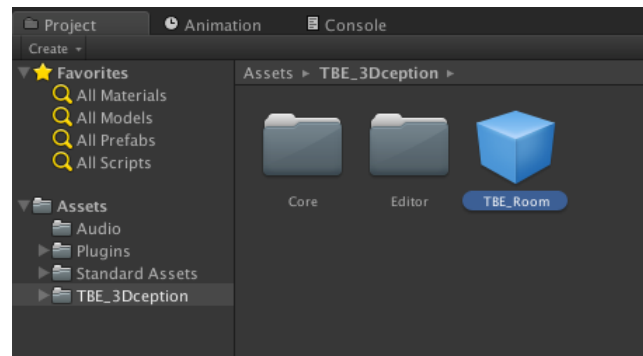
# Using 3Dception

In just a few steps you can have 3Dception integrated into your Unity scene:

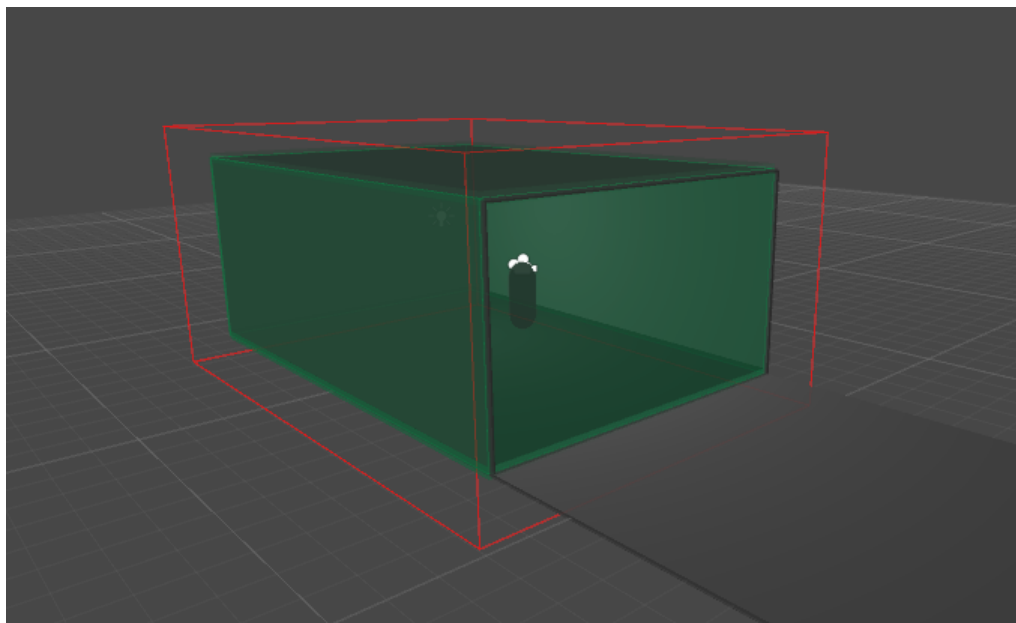
1. Go to *3Dception/Setup And Diagnostics* in the menu bar
2. Click on *Setup Scene*. This will automatically create an empty game object called *3Dception Global* with the *3Dception Initialisation* and *Destroy* scripts added as components and also the *3Dception Global Listener* to the Main camera in your scene. It important that you follow this step for every scene/level in your project. If you delete or create a new Main camera, you will need to manually add a *3Dception Listener* component to it.



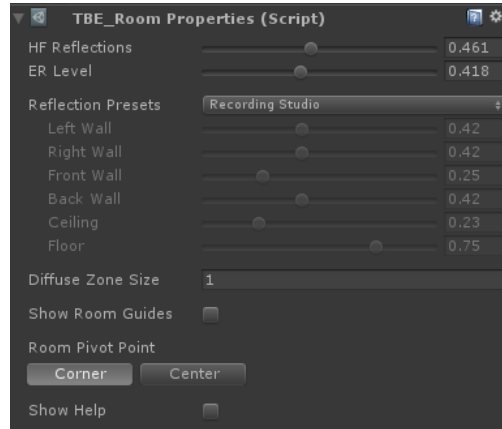
3. Select your game object and click on the *Add Component* button in the inspector. From the contextual menu, click on *3Dception* and choose *3Dception Source*. If you want to use 3Dception as a filter effect with a Unity Audio Source, choose *3Dception Filter* instead.
4. Under the *Project* tab in Unity, navigate to *Assets/TBE\_3Dception*. Drag the *TBE\_Room* prefab into your scene.



5. Scale this prefab around the room within your scene. If you have multiple rooms, add multiple instances of the prefab around each of the rooms. These prefab rooms do not get rendered, but act as detectors in 3Dception to setup the room modelling properties. Think of it as acoustic paint on the walls in the room. If you have a room that isn't a cube, you can still use *TBE\_Room* as an approximation of its dimensions.



6. Clicking on the *TBE\_Room* prefab will give you access to the room reflection properties.

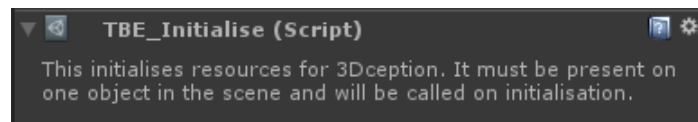


7. **Done!** If you have a Unity *Reverb Zone* setup in your scene, you can use it with 3Dception for an enhanced effect. Just enable *Reverb Zones* on the 3Dception *Source* properties.

## 4

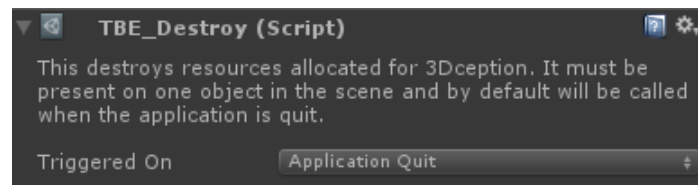
# 3Dception Components

### 4.1 3Dception Initialise



This is a component that must be placed within every scene in your project. It ensures that resources for 3Dception are initialised for your project. 3Dception sources or filters will not work without the *Initialise* component preset in your scene.

### 4.2 3Dception Destroy



This is a component that must be placed within every scene in your project. By default it is called when the game/application is quit. This is the recommended setting as the resources for 3Dception in most cases would only need to be destroyed on exit of the application.

### 4.3 3Dception Initialise Room Modelling

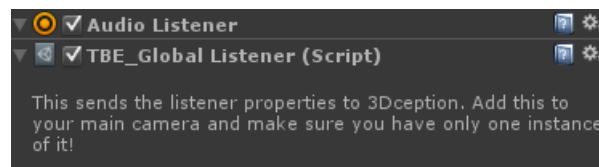
This is a component that ensures that resources for 3Dception's room modelling engine are initialised for your project. It also resets all objects within 3Dception's physics system (rooms and audio source references).



Depending on how your project is setup you might call it only once (on level 1 load for example), especially if you are loading levels using *LoadLevelAdditive* or if you want to retain rooms into the next level.

## 4.4 Global Listener

A single instance must be added to the main camera or the camera that controls the point of view of the player. If you are working with stereo visuals, you can place the *Global Listener* on either of the two cameras. Make sure you have only ONE version active in a scene. The *Global Listener* has no properties to set. If you are using a first person controller, make sure the *Global Listener* is added to the camera and not to the parent object in the hierarchy.

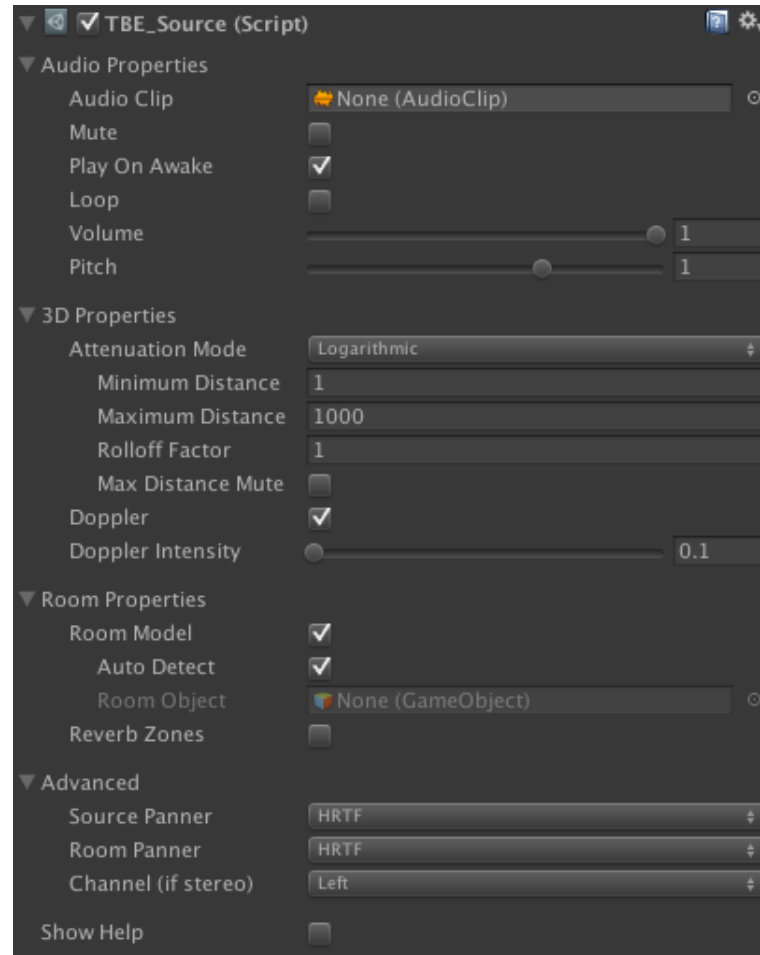


## 4.5 Source

The binaural audio source extends the functionality of Unity's *AudioSource* with binaural spatialisation options. The *Source* must be placed on any game object that needs a binaural audio source. You will be familiar with its functionality if you have previously used the default *AudioSource* in Unity.

### Audio Properties

- **AUDIO CLIP:** Specify the audio clip that needs to be played back
- **MUTE:** Mute the source
- **PLAY ON AWAKE:** Automatically play on game 'awake' or start.
- **VOLUME:** The volume of the source
- **PITCH:** The pitch of the source



### 3D Properties

These properties determine how the amplitude of the sound changes depending on the position of the object on the game map. The further away a sound is from the listener, the lower its amplitude will be.

- **ATTENUATION MODE:** Specify the attenuation curve type for the source
  - **LOGARITHMIC:** Follows a logarithmic curve. By default the volume is attenuated by 6dB when the distance is doubled. The **ROLLOFF FACTOR** has an effect on this curve.
  - **LINEAR:** Linear attenuated, where the maximum distance is the distance at which the source will no longer be audible.
  - **CUSTOM:** A custom attenuation value can be specified using a script. See [5](#).
- **MINIMUM DISTANCE:** The distance value after which the amplitude attenuation starts.

- **MAXIMUM DISTANCE:** If the **ATTENUATION MODE** is set to **EXPONENTIAL**, the distance value after which the amplitude attenuation stops. If the **ATTENUATION MODE** is set to **LINEAR**, the distance value at which the source is no longer audible.
- **ROLLOFF FACTOR:** [Only if **ATTENUATION MODE** is set to **LOGARITHMIC**] The distance attenuation curve. A value of 1 is a 6dB drop every time the distance is doubled (this is how most sounds work in the 'real' world). A value greater than 1 results in a steeper rolloff.
- **MAX DISTANCE MUTE:** [Only if **ATTENUATION MODE** is set to **LOGARITHMIC**] Mutes the audio source if the distance of object from the listener is greater than the maximum distance.
- **DOPPLER:** Toggle Doppler effect
- **DOPPLER INTENSITY:** Intensity of the doppler effect

### Room Properties

- **ROOM MODEL:** Enable or disable room modelling
- **AUTO DETECT:** Automatically detect which room prefab the source is in. This uses 3Dception's physics system.
- **ROOM OBJECT:** Manually specify the room prefab object
- **REVERB ZONES:** Use Unity reverb zones

### Advanced

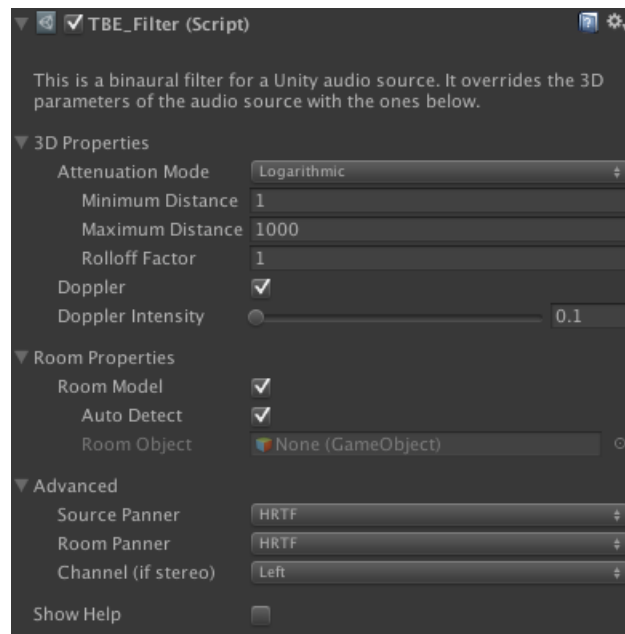
- **SOURCE PANNER:** Specify the type of spatialisation for the source.
  - **HRTF:** Full binaural spatialisation, including elevation
  - **APPROXIMATE:** An approximate binaural effect, without elevation cues
  - **STEREO:** Non-HRTF stereo panning
- **ROOM PANNER:** Specify the type of spatialisation for the room reflections.
  - **HRTF:** Full binaural spatialisation, including elevation
  - **APPROXIMATE:** An approximate binaural effect, without elevation cues
  - **STEREO:** Non-HRTF stereo panning
- **CHANNEL SELECTION:** Since binaural processing requires a mono audio source, if you are using a stereo *AudioClip* you can choose either of the stereo channels or a mix-down of both channels



- LEFT: Chooses the left channel from the stereo clip for spatialisation
- RIGHT: Chooses the left channel from the stereo clip for spatialisation
- MIXDOWN: Mixes down both left and right channels into a mono stream

## 4.6 Filter

A binaural filter, meant to be used with a regular Unity audio source, it must be placed after any Unity *AudioSource* in the inspector. The functionality is similar to the *Source* component documented above.



### 3D Properties

These properties determine how the amplitude of the sound changes depending on the position of the object on the game map. The further away a sound is from the listener, the lower its amplitude will be.

- ATTENUATION MODE: Specify the attenuation curve type for the source
  - LOGARITHMIC: Follows a logarithmic curve. By default the volume is attenuated by 6dB when the distance is doubled. The ROLLOFF FACTOR has an effect on this curve.
  - LINEAR: Linear attenuated, where the maximum distance is the distance at which the source will no longer be audible.
  - CUSTOM: A custom attenuation value can be specified using a script. See [5](#).

- **MINIMUM DISTANCE:** The distance value after which the amplitude attenuation starts.
- **MAXIMUM DISTANCE:** If the **ATTENUATION MODE** is set to **EXPONENTIAL**, the distance value after which the amplitude attenuation stops. If the **ATTENUATION MODE** is set to **LINEAR**, the distance value at which the source is no longer audible.
- **ROLLOFF FACTOR:** [Only if **ATTENUATION MODE** is set to **LOGARITHMIC**] The distance attenuation curve. A value of 1 is a 6dB drop every time the distance is doubled (this is how most sounds work in the 'real' world). A value greater than 1 results in a steeper rolloff.
- **DOPPLER:** Toggle Doppler effect
- **DOPPLER INTENSITY:** Intensity of the doppler effect

### Room Properties

- **ROOM MODEL:** Enable or disable room modelling
- **AUTO DETECT:** Automatically detect which room prefab the source is in. This uses 3Dception's physics system.
- **ROOM OBJECT:** Manually specify the room prefab object
- **REVERB ZONES:** Use Unity reverb zones

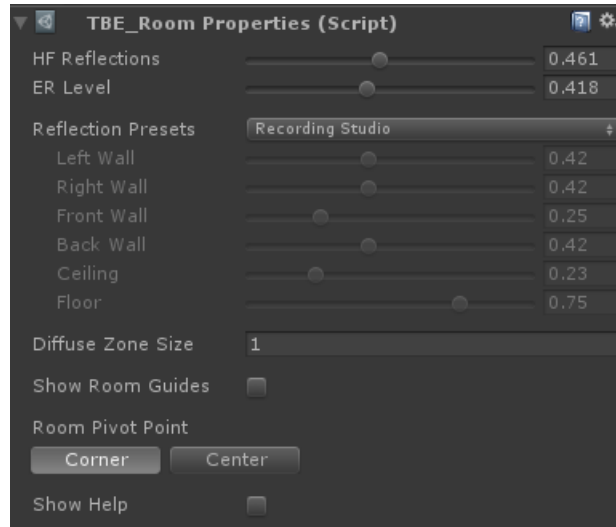
### Advanced

- **SOURCE PANNER:** Specify the type of spatialisation for the source.
  - **HRTF:** Full binaural spatialisation, including elevation
  - **APPROXIMATE:** An approximate binaural effect, without elevation cues
  - **STEREO:** Non-HRTF stereo panning
- **ROOM PANNER:** Specify the type of spatialisation for the room reflections.
  - **HRTF:** Full binaural spatialisation, including elevation
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  - **STEREO:** Non-HRTF stereo panning
- **CHANNEL SELECTION:** Since binaural processing requires a mono audio source, if you are using a stereo *AudioClip* you can choose either of the stereo channels or a mix-down of both channels
  - **LEFT:** Chooses the left channel from the stereo clip for spatialisation

- RIGHT: Chooses the left channel from the stereo clip for spatialisation
- MIXDOWN: Mixes down both left and right channels into a mono stream

## 4.7 Room

The room modelling properties are set using a prefab called 'TBE\_Room', found in the 'TBE\_3Dception' folder under 'Assets'. Instructions for setting this up are provided in [Using 3Dception](#).



- HF ABSORPTION: High frequency absorption within the room. 1 is maximum high frequencies.
- ER Level: Amplitude of early reflections in the room
- DIFFUSE ZONE: This specifies an area around the room where the reflections gradually die out. It is useful for creating seamless transitions between rooms.
- DIFFUSE ZONE: Choose a room reflection preset or alternatively choose *Custom* to specify your own
  - LEFT WALL: Amplitude of reflections from the left wall
  - RIGHT WALL: Amplitude of reflections from the right wall
  - FRONT WALL: Amplitude of reflections from the front wall
  - BACK WALL: Amplitude of reflections from the back wall
  - CEILING: Amplitude of reflections from the ceiling
  - FLOOR: Amplitude of reflections from the floor

- **SHOW ROOM GUIDES:** Show visual guides for the room dimensions and diffuse zone within the Unity editor.
- **ROOM PIVOT POINT:** The pivot point of the room (for setting the position, rotation and scale)

## 5

### 3Dception API

You can control or change any of the properties on a 3Dception binaural source using scripts. The methods are similar to Unity's Audio Component.

- To access any 3Dception specific APIs, specify the following before the class declaration:

```
1 // Use the 3Dception core library
2 using TBE_3DCore;
```

- A 3Dception source, room or filter on a Unity *Game Object* can be accessed using the *GetComponent* method:

```
1 TBE_Source tbeSource = GetComponent<TBE_Source> ();
2 TBE_RoomProperties tbeRoom = GetComponent<TBE_RoomProperties> ();
3 TBE_Filter tbeFilter = GetComponent<TBE_RoomProperties> ();
```

- Methods:

```
1 /** TBE_Source */
2
3 // Once you 'Get' the TBE_Source component using the above code, use the following methods to get or
  // set parameters for a TBE_Source component
4 tbeSource.erRoomObject // Get or set room object
5 tbeSource.isPlaying // check if source is playing
6 tbeSource.loop // Get or set loop status
7 tbeSource.maxDistanceMute // Get or set maximum distance mute status
8 tbeSource.maximumDistance // Get or set maximum distance
9 tbeSource.minimumDistance // Get or set minimum distance
10 tbeSource.mute // Get or set mute status
11 tbeSource.pitch // Get or set pitch
12 tbeSource.playOnAwake // Get or set play on awake status
13 tbeSource.reverbToggle // Get or set reverb zone status
14 tbeSource.rolloffFactor // Get or set rolloff factor
15 tbeSource.roomToggle // Get or set room toggle status
16 tbeSource.time // Get or set playback position in seconds
17 tbeSource.timeSamples // Get or set playback position in samples
```

```

tbeSource.volume           // Get or set volume
19 tbeSource.selectChannel   // Get or set channel selection for binaural playback (as type TBEChannel)
tbeSource.clip             // Get or set audio clip
21 tbeSource.detectRoomTrigger // Get or set auto room detection status
tbeSource.dopplerToggle    // Get or set doppler status
23 tbeSource.dopplerIntensity // Get or set doppler intensity
tbeSource.attenuationMode  // Get or set attenuation mode
25 tbeSource.customAttenuationGain // Set the custom attenuation gain if the custom attenuation mode is
    selected
tbeSource.sourcePannerType // Get or set source panner type (as type TBEPannerType)
27 tbeSource.roomPannerType // Get or set room reflections panner type for source (as type
    TBEPannerType)

29 // Functions for a TBE_Source component
tbeSource.Play();          // Playback audio source
31 tbeSource.PlayDelayed(float delay); // Playback audio source with a delay
tbeSource.PlayOneShot(AudioClip clip); // Playback a one shot audio clip
33 tbeSource.PlayOneShot(AudioClip clip, float gain); // Playback a one shot audio clip with a gain
    modifier
tbeSource.Stop();          // Stop playback

35 /** TBE_Filter */
37 // Once you 'Get' the TBE_Filter component using the above code, use the following methods to get or
    set parameters for a TBE_Source component
39 tbeFilter.erRoomObject    // Get or set room object
tbeFilter.maximumDistance  // Get or set maximum distance
41 tbeFilter.minimumDistance // Get or set minimum distance
tbeFilter.rollOffFactor    // Get or set rolloff factor
43 tbeFilter.roomToggle     // Get or set room toggle status
tbeFilter.selectChannel    // Get or set channel selection for binaural playback (as type TBEChannel)
45 tbeFilter.detectRoomTrigger // Get or set auto room detection status
tbeFilter.dopplerToggle    // Get or set doppler status
47 tbeSource.dopplerIntensity // Get or set doppler intensity
tbeSource.attenuationMode  // Get or set attenuation mode
49 tbeSource.customAttenuationGain // Set the custom attenuation gain if the custom attenuation mode is
    selected
tbeFilter.sourcePannerType // Get or set source panner type (as type TBEPannerType)
51 tbeFilter.roomPannerType // Get or set room reflections panner type for source (as type
    TBEPannerType)

53 /** TBE_RoomProperties */

55 // Once you 'Get' the TBE_Room component using the above code, use the following methods to get or set
    parameters for a TBE_Source component
tbeRoom.erLevel           // Get or set level of ER reflections
57 tbeRoom.hfReflections    // Get or set level of high frequency reflections
tbeRoom.diffuseZone       // Get or set diffuse zone size
59 tbeRoom.roomPreset       // Get or set room preset (as type TBRoomPresets)

```

```
61 tbeRoom.reflectionLWall // Get or set level of reflections for the left wall
62 tbeRoom.reflectionRWall // Get or set level of reflections for the right wall
63 tbeRoom.reflectionBWall // Get or set level of reflections for the back wall
64 tbeRoom.reflectionFWall // Get or set level of reflections for the front wall
65 tbeRoom.reflectionCeiling // Get or set level of reflections for the ceiling
66 tbeRoom.reflectionFloor // Get or set level of reflections for the floor
```

### *Troubleshooting*

**Error: 3Dception: TBE\_GlobalListener is not setup or inactive. Have you added it to the main camera and setup the script execution order?**

The error is triggered if your scene does not have an active instance of TBE\_GlobalListener. Alternatively, it might be because the script execution order for your project has changed. Go to *3Dception* in the menu bar and select *Setup And Diagnose*. Uncheck *Create 3Dception Global Object* and *Create 3Dception Listener*. Make sure *Set Execution Order* is checked. Click on *Setup Scene*. This will fix any errors in the script execution order.

**Error: 3Dception: License unavailable**

Make sure 3Dception has been authorised. See [2.4 on page 9](#).

**Error:DllNotFoundException: tbe\_3Dception**

Make sure you are using Unity Pro. Run the Diagnostics tool (*3Dception/Setup And Diagnostics* in the menu bar and click *Run Diagnostics*). The results of the diagnoses should show that the plugin for your platform is available and that the 3Dception version “is correct”. If you continue to have issues, email [support@twobigears.com](mailto:support@twobigears.com) with the information displayed in 3Dception support window (accessible from *3Dception/Support* in the menu bar).

**Error loading 3Dception on 'Object' (TBE\_E\_ENGINE\_NOT\_INIT. 3Dception isn't initialised. Have you added the 3Dception Initialise component?)**

The 3Dception *Initialise* component might be missing from your project or the script execution order might be incorrect. Go to *3Dception/Setup And Diagnostics* in the menu bar. Uncheck *Create 3Dception Listener*. Make sure *Set Execution Order* and *Create 3Dception Global Object* are checked. Click on *Setup Scene*. This will the 3Dception initialisation and destruction components and fix any errors in the script execution order.

**iOS: Undefined symbols when building Xcode project**

1. In your Xcode project, click on the target build (should be named 'Unity-iPhone') in most cases
2. Click on the 'Build Phases' tab

3. Under 'Link Binary With Libraries', click on the '+' button Add 'libc++.dylib' from the window that opens up
4. Rebuild your project