# NPC Populator for Unity
# User Manual

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## Changes for Version 2.0 (June 2021)

This manual accompanies the first major update to the NPC Populator since its initial release in 2017. The NPC Populator has been reviewed, updated, and new features added, including:

- The NPC Populator has been tested and found to work with versions of Unity through 2021. This manual has been updated to reflect recent changes in Unity.
- A new, easier-to-use NPC Factory implementation creates many NPCs even more easily than before.
- NPCs can pause when they reach a waypoint.
- A small set of sample NPCs are included.
- A new Urban Waypoint Assistant tool is included.
- The NPC Populator is more flexible to allow using alternate animation clips. Instructions are included here.


## Introduction

Non-player characters (NPCs), especially free-roaming ones, add a lot of ambiance to your game environment. However, for many developers, it may not be a priority to add NPCs as compared with game elements that are more central to theme and action of the game, especially because adding NPCs may require significant developer effort.

The NPC Populator for Unity makes it easy and quick to add many free-roaming NPCs to your environment, without writing any code. Only some configuration is necessary.

The approach for the NPC Populator has been not to reinvent the wheel. Critical, complex capabilities including animation and navigation are already built into Unity. What is required are scripts that make these capabilities work smoothly together. This is what the NPC Populator provides. By using the NPC Populator, you do not need to write any code to add NPCs to your game.

Each game will have its own unique combination of environment and characters, whether created specifically for the game or obtained through the Asset Store. As long as these follow some straightforward guidelines, they will work well with the NPC Populator. In particular, humanoid characters need to be compatible with Unity's humanoid animation type, so that humanoid animation clips can be used.

There are two options for using the NPC Populator: The supplied NPC Factory creates many NPCs at once, having a variety of models (appearances), speeds, and locations. Alternately, you can create one NPC at a time.

## Mass producing NPCs using the NPC Factory

These steps will guide you through creating many NPCs using the supplied NPC Factory. A video tutorial is available at NPC Populator for Unity - YouTube, but please also see the updated video at NPC Populator 2.0 - YouTube.

### Step 1: Download and Install the NPC Populator.

This is done in the same way as any asset that you would obtain from the Unity Asset Store. Assuming you have received this Manual as part of the NPC Populator, you have probably done this step already!

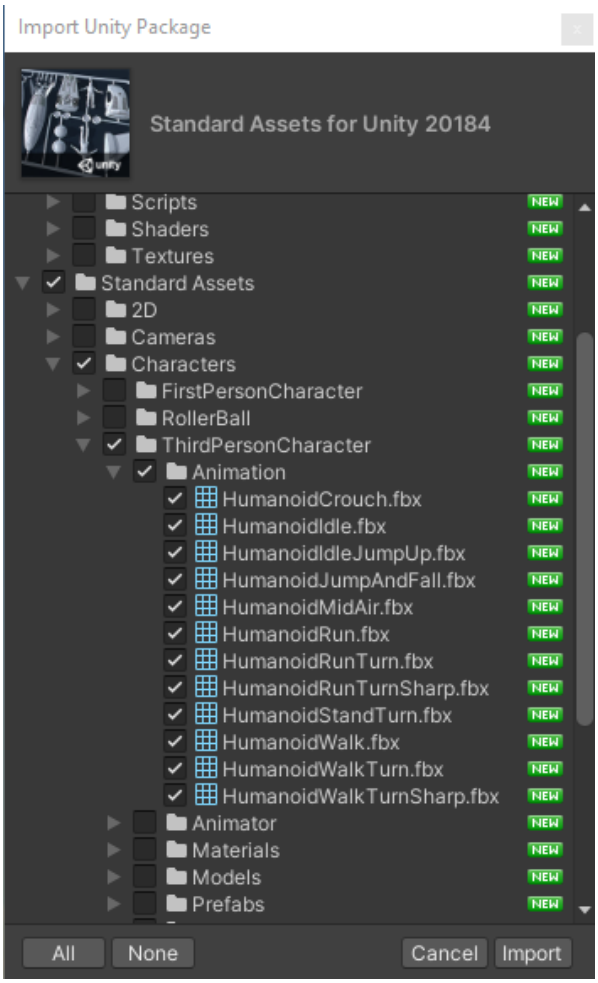
NOTE: Do not open the included Sample Scene yet!

### Step 2: Download and Install Animation Clips from Unity's Standard Assets.

Install the animation clips available for free in the "Standard Assets (for Unity 2018.4)."
Standard Assets (for Unity 2018.4) | Asset Packs | Unity Asset Store

(For versions of Unity up to 2019, this can be done in the Asset Store window. For versions of Unity starting with 2019, this is done using the Package Manager. For Unity 2019, either approach can be used.)

When importing the Standard Assets, there are some errors in Unity versions later than 2018. This can be avoided by only importing the animation clips themselves as shown below:




The Characters package includes animation clips for humanoid walking, running, turning, and idle that are used by the NPC Populator.

At this point you can verify that the NPC Populator is installed properly by running the Sample Scene.

- Under the File menu, choose Open Scene.
- Navigate into the NPCPopulator folder, then the SampleScene folder, then select and open the SampleScene Unity scene file. This opens a scene with a number of humanoid NPCs and a variety of obstacles to walk around.
- Click on the play button, and the NPCs should all walk around the scene.

## Step 3: Open or Create Your Scene

You can use any environment of your choosing. The Unity Asset Store contains over 4000 environment assets, or you may create one of your own.

You must do Step 2 above (importing animation clips) before opening or creating your scene, because of the way Unity handles packages and dependencies. If you have an issue with this, see the Troubleshooting section below.

## Step 4: Configure your environment with a navigation mesh (NavMesh).

The Navigation Basics videos from Unity teach much of what you need to know for setting up the NavMesh: Navigation Basics - Unity Learn

Of course, the Unity Manual has more details:
Unity - Manual: Navigation and Pathfinding (unity3d.com)

You may also benefit from this Clockworks Games video with practical tips on setting up the NavMesh:
Unity NavMesh on an Asset Store Environment - YouTube

You will get more lifelike results if you choose an asset in which easily walkable areas (such as sidewalks) and less desirable walkable areas (such as roads) are modeled as separate objects, so that the less desirable areas can be assigned a higher navigation cost. Otherwise, the NPCs will have no preference between walking on, for example, sidewalks vs. roads.

## Step 5: Place Waypoints

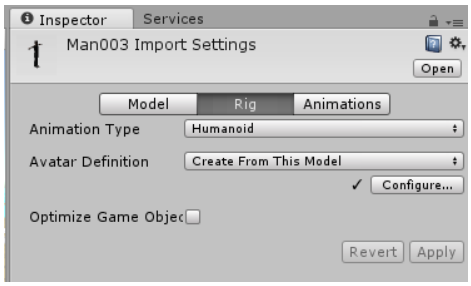
The NPC Populator includes a waypoint prefab. Drag this into your scene and duplicate as many times as you would like, so that you place a waypoint at key junctions for the travels of your NPCs, for example at intersections, entrances to buildings, etc. All of your waypoint objects should be under an empty object called Waypoints in the hierarchy. When roaming, NPCs will head for a waypoint. When reaching the destination, the NPC randomly chooses another waypoint as the next destination, with a preference for choosing a waypoint in the direction already facing if possible, to avoid more drastic changes in direction.

For some environments, especially urban street scenes having rectangular city blocks, the included Urban Waypoint Assistant tool can facilitate placing many waypoints automatically. (See below.)

## Step 6: Import Humanoid Models

The Unity Asset Store contains over 1500 humanoid model assets. Many of these will be compatible with NPC Populator. The key is that they must use or be compatible with the humanoid animation type.

Usually, the humanoid models will come as prefabs within your Project window. Click on the prefab to bring up the Import Settings dialog in the Inspector window. Then check on the Rig tab.




If the Animation Type is already Humanoid, this model should be ready to use.

If the Animation Type is not Humanoid, for example it may be Generic, try changing the Animation Type to Humanoid, setting Avatar Definition to “Create from this Model,” and click Apply. If that is successful, a checkmark will appear next to the Configure button.

Feel free to contact Clockworks Games if you have trouble with a specific humanoid model. It may be helpful to check out this Clockworks Games video that reviews several humanoid models from the Unity Asset Store: Unity Asset Reviews: Human Models - YouTube

Version 2.0 of the NPC Populator includes six example humanoid models to get you started.

## Step 7: Create and Configure an NPC Factory.

The NPC Factory automatically generates an arbitrary number of NPCs based on parameters that you set. Each generated NPC will be a clone of one of a set of NPC models that you specify.

For NPC Populator version 2.0, the NPC Factory has been entirely reworked, and is more automated than before, requiring fewer parameters for you to specify. Its custom editor provides red and green cues as to whether required information is complete.

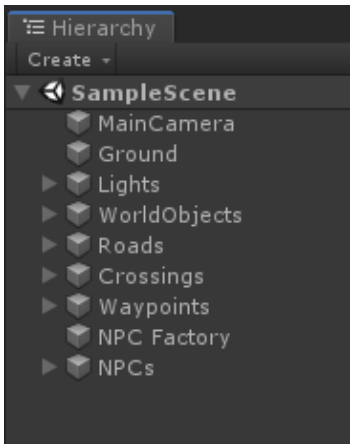
Create an empty game object in your Hierarchy, reset its transform, and rename the game object to "NPC Factory." Drag the npcFactory script to this game object.[1] In the Inspector the new NPC Factory should look like this:


The NPC Factory allows the rapid creation of as many NPCs as you want. As settings are adjusted, the red items should turn green. When no red remains, NPCs can be generated.

[1] An alternate approach would have been for the NPC Populator to provide an NPC Factory prefab but saving changes to a prefab is more complex so the approach described here was taken instead.

In the Hierarchy, create another empty game object called something like “NPCs.” Your generated NPCs will be placed under this object. You may want to reset its transform so that the positions of the NPCs will have absolute world values.

Depending on your environment, your Hierarchy may look something like this, and should have objects for the NPC Factory, Waypoints (created above in Step 5), and NPCs:




Now set up the NPC Factory:

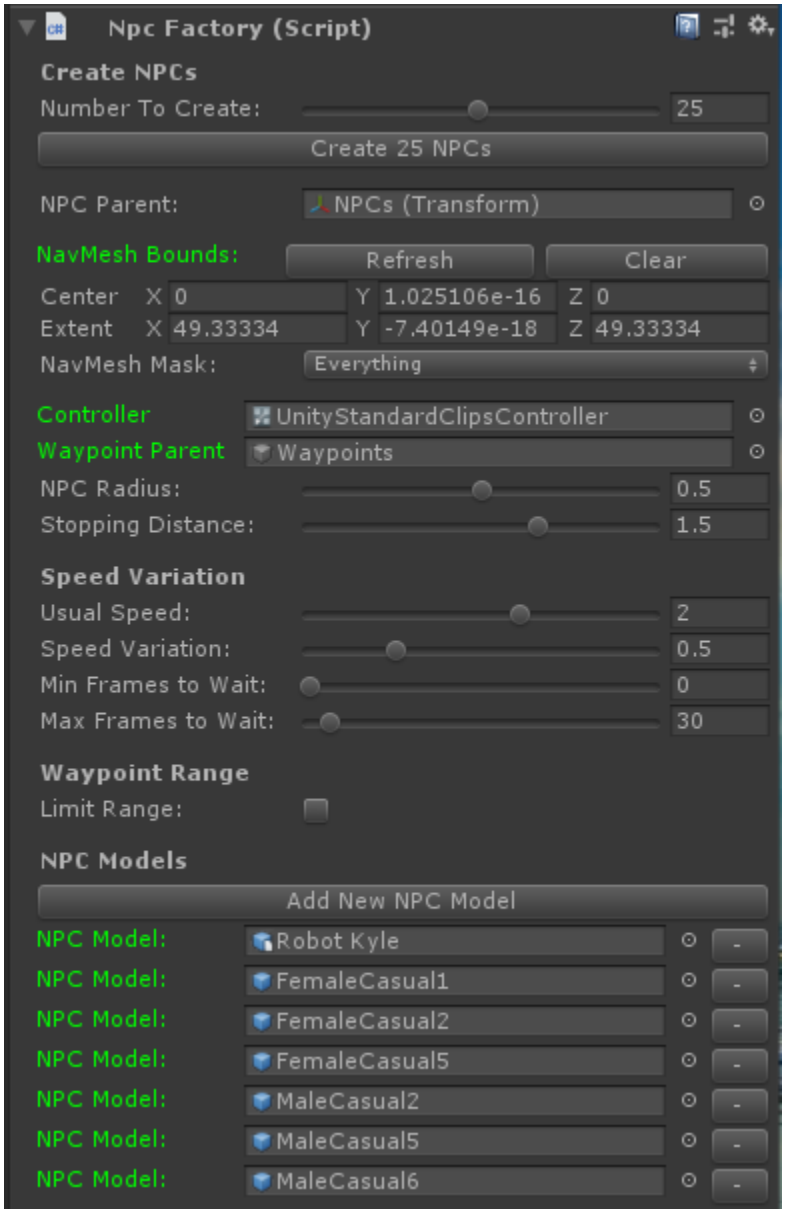
- Drag your NPCs object to “NPC Parent.” (This step is optional. If left out, all your generated NPCs will be placed at the top level of your Hierarchy.)
- Drag your Waypoints object to “Waypoint Parent.”
- Drag UnityStandardClipsController (provided with the NPC Populator in the Resources folder) to “Controller.” (See below for how to use a different Animator Controller.)
- You should have created a NavMesh above in Step 3. With that done, click the “Refresh” button next to “NavMesh Bounds.” Values should be automatically populated for the NavMesh Bounds Center and Extent. If you ever re-bake your NavMesh, you should click the Refresh button again.
- Set the NavMesh Mask to include the NavMesh areas where your NPCs are allowed to move. The default value of “Everything” may be OK depending on how you have set up your own NavMesh.
- Add some NPC Models, for example using the included sample models. (The “Add New NPC Model” button adds more slots, while each “-“ button removes a slot.)

Other parameters that can be set in the NPC Factory:

- NPC Radius: May typically be 0.5 but can be adjusted depending on your NPC models.
- Stopping Distance: The distance from a waypoint that will count as reaching that waypoint. If you have many NPCs, it may be best to use a larger value to avoid the NPCs getting bunched and stuck near waypoints.
- Usual Speed and Speed Variation: Generated NPCs will be assigned a speed of the average that you specify plus a random value between minus and plus the variation. This avoids the effect where all the NPCs seem to be marching at exactly the same speed. 2 and 0.5 may be reasonable values for the NPCs to move at a brisk walk.

- Min and Max Frames to Wait: How long an NPC should pause when reaching a waypoint.
- Waypoint Range and Limit Range: Can optionally limit how far the next waypoint can be.

When all of this has been set, all the red items should have turned green, and your NPC Factory should look something like the picture below:



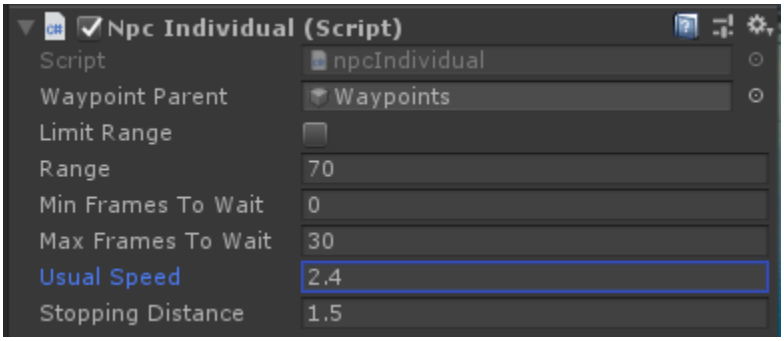

## Step 8: Generate the NPCs!

Continuing to use the NPC Factory above, adjust the Number to Create, and click on Create n NPCs. This will randomly generate the specific number of NPCs from the variety of models and range of speed that you specified, and also with a random avoidance priority so that one NPC will tend to have priority over another when they approach each other.

## Create a Single NPC

As an alternate to using the NPC Factory, you can create NPCs individually.

- Perform steps 1-6 from the instructions above.
- Drag your humanoid character model or prefab to your scene or hierarchy.
- Drag the UnityStandardClipsController from the NPCPopulator / Resources folder in your project to the Controller slot in your character's Animator component.
- Drag the npcIndividual script onto your character in the Hierarchy. This will automatically also add a NavMeshAgent component.
- In the Inspector, you have the following fields that you can adjust:




- The Waypoint Parent will be set automatically if all of your waypoints are children of an empty object called Waypoints as specified above.
- You can optionally set a range limit for how far away each scan for waypoints will look.
- You can optionally set the minimum and maximum frames the NPC will pause when reaching a waypoint. The length of time that the NPC pauses will be a random value between the minimum and maximum values.
- You can set the Usual Speed. 1 is a slow walk; 5 is a fast run.

## Performance Note

There is a practical limit to the number of NPCs, waypoints, and environment complexity the NPC Populator system will be able to handle with good performance. 100 NPCs in a moderate-sized environment seems to work well, even on an average laptop computer. Of course, you should keep in mind your target platform if you will be creating a game for a small device. There is a performance penalty for a large number of NPCs in a very large environment with hundreds of waypoints, although this mostly seems to be on startup. In this case, some NPCs will be idle for a couple of minutes until all the NPCs start moving. This is likely due to the NavMesh system being required to compute many complex paths all at once on startup.

## Troubleshooting

### NPCs Cannot Find their Animation Clips.

Some users have encountered a situation where NPCs do not properly animate, and the NPCs move without animating, sometimes sunk into the ground rather than being on top of it.

This is caused by performing the steps above in the wrong order and a limitation of Unity.[2] Referring to the steps above, Step 2 (importing animation clips) must be performed before Step 3 (opening or creating your scene). When the scene is opened, if the animation clips referenced by the Animator Controller are not yet in the project, Unity will not be able to find the clips later.

If you have performed these steps in the wrong sequence (Step 3 before Step 2), there is a workaround that usually works. In many cases, just exiting Unity and restarting may resolve the problem. If this does not work, please try "Reimport All" under the Unity Assets menu. One of these approaches should resolve the problem. If not, please email info@clockworks-games.com.

## The Urban Waypoint Assistant Tool

NPC Populator 2.0 contains a new tool: The Urban Waypoint Assistant, that can automatically place many waypoints if your environment is a city scene having a rectangular layout with straight streets and right angles.

To understand how to use this Tool, please see the tutorial on YouTube:
Urban Waypoint Assistant Tool for Unity - YouTube

Here is a summary of steps for using the tool, which are demonstrated in the video:

- Start with your scene (Step 3) and its generated NavMesh (Step 4). The Urban Waypoint Assistant provides a semi-automated way to place waypoints (Step 5).
- Add an empty GameObject to your scene. Drag the Waypoint Assistant script onto it.
- Also in your hierarchy, create an empty Waypoint Parent object and reset its transform.
- In the Inspector for the Waypoint Assistant:
    - Adjust the Agent Radius if appropriate.
    - Click Create Waypoint Grid button.
    - Drag in a Waypoint Object, using the Waypoint prefab.
    - Drag in the Waypoint Parent that you created above.
    - Specify your NavMesh Mask to be the NavMesh areas where your NPCs can travel.
    - Specify whether your environment uses a Unity terrain object. If it does not, enter the height of your ground.
    - You can adjust how high off the ground waypoints should be placed. The default value of 1 is probably fine.
    - Check the boxes for Draw Gizmos and Automate Scene View Change.
    - Adjust the sliders for NavMesh Probe, Corridor Distance, and Min Square Size as explained in the video.
    - Click the Generate Waypoints button to generate waypoints.
    - Disable the Waypoint Assistant object when you are done generating waypoints.

More details are explained in the video, including some important performance considerations while using the Tool.

[2] The limitation has been reported to the Unity development team. They acknowledge it, but also do not plan to fix it. See: https://issuetracker.unity3d.com/issues/animations-will-not-work-and-opening-the-animator-will-cause-a-crash-when-importing-animations-after-a-scene-is-loaded

## How to Use Alternate Animation Clips

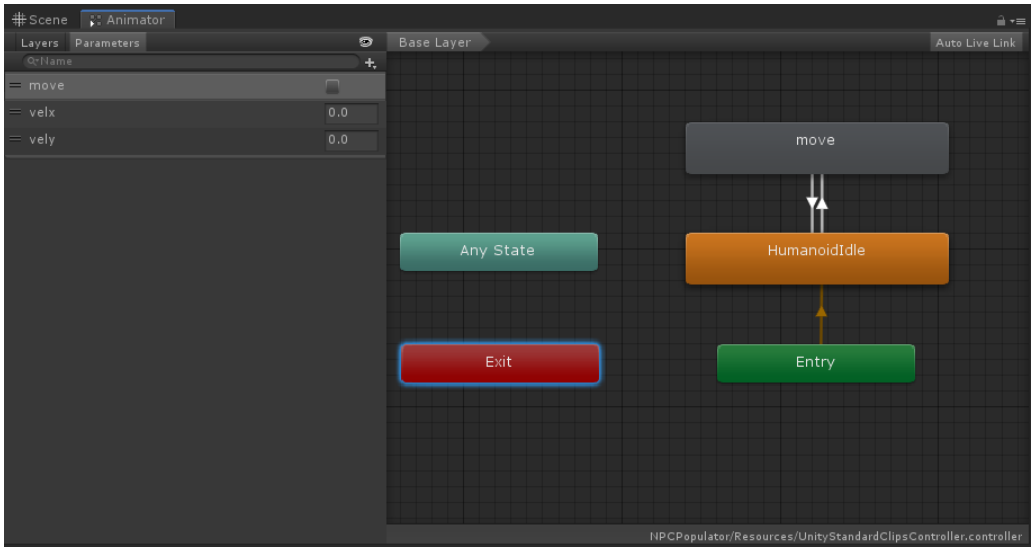
With version 2.0 of the NPC Populator, you can use different animation clips than those available from the Unity Standard Assets, but you will need to create an Animator Controller for your animation clips.

To be compatible with the NPC Populator scripts, your Animator Controller needs to respond to these three parameters:

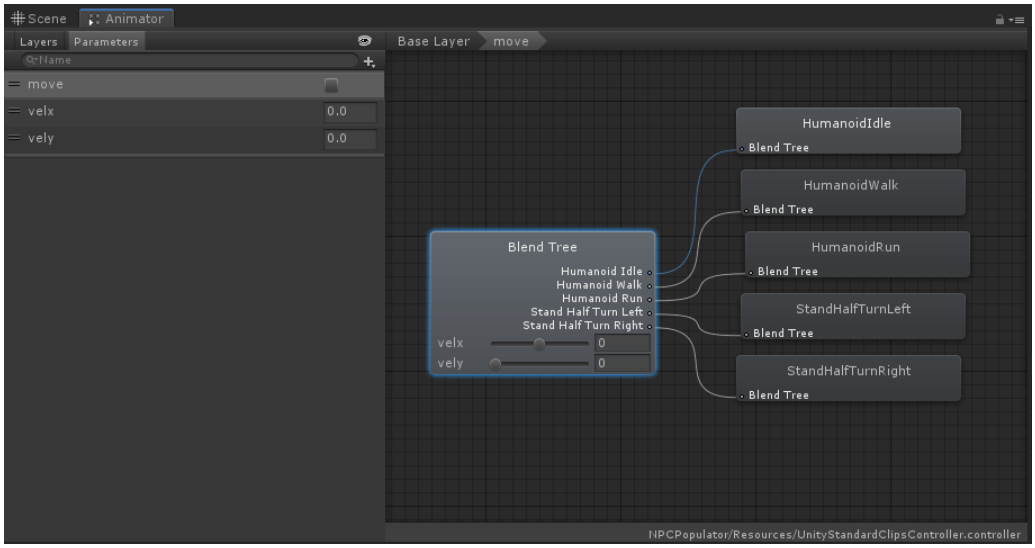
- move – a Boolean indicating whether or not the NPC should be traveling rather than being idle
- velx – a float indicating the degree of turning movement
- vely – a float indicating the degree of forward / backward movement

The simple UnityStandardClipsController provided with the NPC Populator is shown below. You would need to create a similar controller to use with alternate animation clips.

Top level:




"move" blend tree:



After you have created your Animator Controller, you need to reference it in your NPC Factory, rather than the provided UnityStandardClipsController. If you are not using the NPC Factory and are creating NPCs individually, then you need to reference your Animator Controller within the Npc Individual component.

## Acknowledgements

Space Robot Kyle is a free asset from Unity Technologies and is included here only as part of the sample scene.

The other included humanoid models were created using Autodesk Character Generator. Autodesk's licensing permits the redistribution of these models without restrictions as long as the "DNA data file" is not redistributed, which it is not.

Thanks to the many Asset Store creators whose humanoid character models will work with the NPC Populator. There are hundreds of such models in the Asset Store, so it is not feasible to test them all. Please contact Clockworks Games if you have problems with any particular humanoid model.