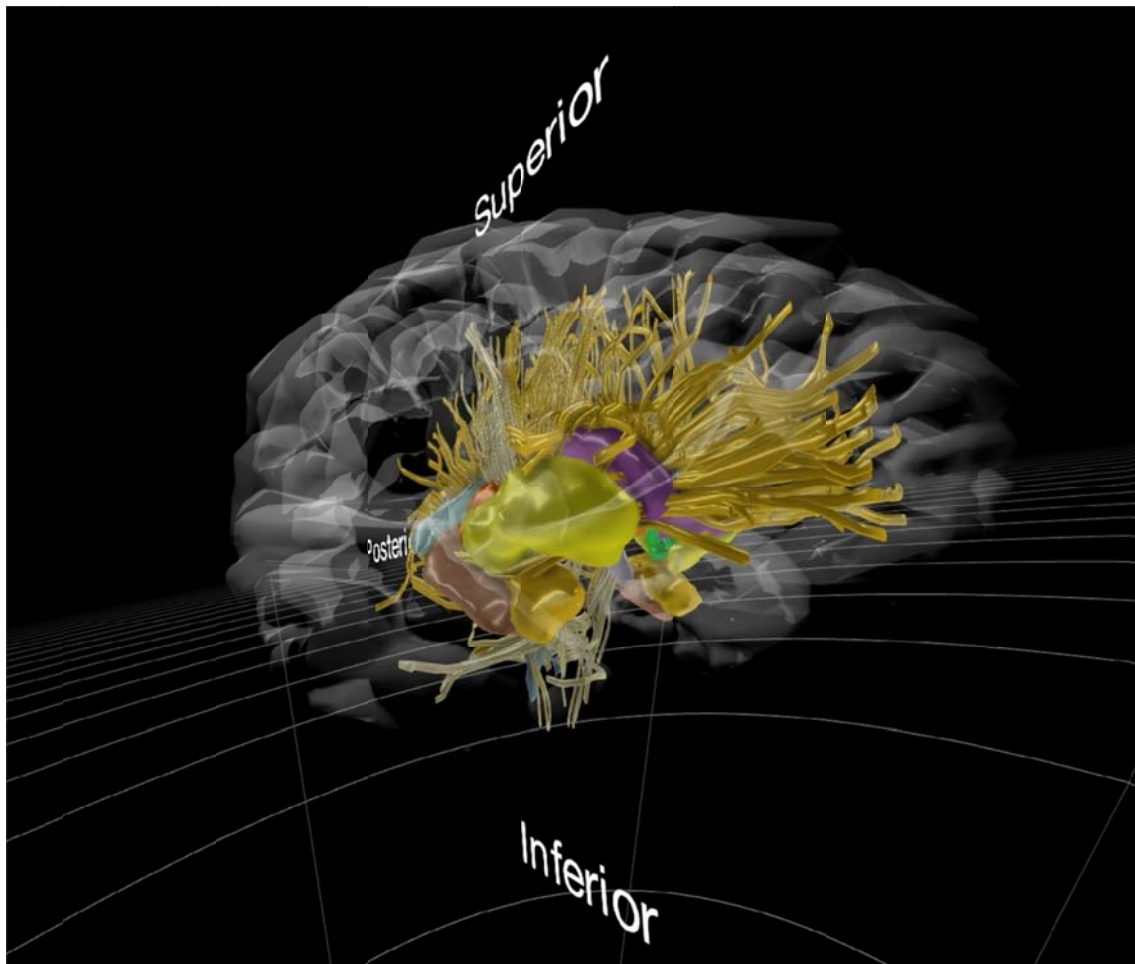


**Appendix 1 (as supplied by the authors):** Supplementary material



Representative depiction of the virtual-reality hardware. The participant was able to interact with the virtual-reality brain presented via the headset using two handheld remotes. Image taken by the Department of Surgery at the University of Saskatchewan, used with permission.



Example of the virtual-reality brain within the virtual-reality environment. Visibility of the structures and their identity could be toggled by the participant.

## Baseline-test 'Test' Questions

1. Which structure is most lateral?
  - a. Caudate
  - b. Putamen**
  - c. Globus pallidus internus
2. Which structure is most superior?
  - a. Thalamus
  - b. Globus pallidus
  - c. Putamen
  - d. Caudate**
3. The most lateral portion of the basal ganglia is called the \_\_\_\_\_.
  - a. Putamen**
  - b. Thalamus
  - c. Globus pallidus
  - d. Caudate
4. The globus pallidus is \_\_\_\_\_ the size of the thalamus.
  - a. larger than
  - b. smaller than**
  - c. equal to
5. The third ventricle is \_\_\_\_\_ to the thalamus.
  - a. medial**
  - b. lateral
  - c. superior
  - d. inferior
6. Select the most inferior structure from the list below.
  - a. Caudate
  - b. Putamen
  - c. Amygdala**
  - d. Globus pallidus
7. The globus pallidus is \_\_\_\_\_ to the amygdala
  - a. Superior**
  - b. Lateral
  - c. Inferior
  - d. Medial
8. Which structure is most inferior?
  - a. Third ventricle
  - b. Fourth ventricle**
  - c. Lateral ventricle

9. The amygdala is \_\_\_\_\_ to the hippocampus
- Anterior**
  - Posterior
  - Medial
  - Lateral
10. In Huntington's disease, the lateral ventricle will have an abnormal concave shape, which is due to the atrophy of the \_\_\_\_\_, which runs along the lateral ventricle?
- Thalamus
  - Caudate**
  - Subthalamic nucleus
  - Putamen
11. If a bullet pierced a patient's thalamus, you may be worried that it also injured the \_\_\_\_\_.
- Subthalamic nucleus
  - Putamen
  - Third ventricle**
  - Globus pallidus
12. If you know that a gunshot would entered the side of a patient's skull and pierced through their lateral ventricle, you may be relieved that the structure lying inferior and posteriorly, the \_\_\_\_\_, was spared.
- Putamen
  - Thalamus**
  - Caudate
  - Fourth ventricle

#### Baseline-test 'Control' Questions

- The cingulate gyrus is \_\_\_\_\_ to the third ventricle
  - Inferior
  - Lateral
  - Superior**
- The entorhinal cortex is \_\_\_\_\_ to the globus pallidus
  - Superior
  - Lateral
  - Inferior**
- Which structure is most medial?
  - Parahippocampal gyrus**
  - Inferior temporal gyrus

4. Which structure is located most superior?
  - a. Pons
  - b. Medulla
  - c. Midbrain**
  
5. The inferior olive is located \_\_\_\_\_ to the pyramid
  - a. Lateral**
  - b. Medial
  - c. Superior
  
6. Which structure is located superior to the lateral geniculate body?
  - a. Superior cerebellar peduncle
  - b. Pyramid
  - c. Thalamus**
  - d. Olive
  
7. The septum pellucidum divides which structures?
  - a. Mammillary bodies
  - b. Lateral ventricles**
  - c. Left and right cerebral cortex
  
8. The red nucleus is located \_\_\_\_\_ to the substantia nigra
  - a. Superior**
  - b. Inferior
  
9. Which structure is most medial?
  - a. Inferior frontal gyrus
  - b. Body of the fornix**
  - c. Uncus
  - d. Insula

#### Post-intervention 'Test' Questions

1. Which structure is most medial?
  - a. Globus pallidus
  - b. Putamen
  - c. Thalamus**
  - d. Caudate
  
2. Which structure is located medial to the globus pallidus?
  - a. Caudate
  - b. Putamen
  - c. Thalamus**
  
3. The C-shaped structure connected to the putamen via cellular bridges is the \_\_\_\_\_.
  - a. Caudate**

- b. Putamen
  - c. Thalamus
  - d. Globus pallidus
4. The corticospinal tracts are \_\_\_\_\_ to the spinothalamic tracts
    - a. Anterior**
    - b. Posterior
  5. The fourth ventricle is \_\_\_\_\_ to the third ventricle.
    - a. anterior
    - b. posterior
    - c. superior
    - d. inferior**
  6. The globus pallidus is \_\_\_\_\_ to the amygdala.
    - a. anterior
    - b. posterior
    - c. superior**
    - d. inferior
  7. The lateral ventricles are \_\_\_\_\_ to the head of the caudate.
    - a. Medial**
    - b. Lateral
    - c. Superior
    - d. Inferior
  8. If you were to swim from the third ventricle into a lateral ventricle, you would see which structures bulging inward into the ventricle and forming its lateral wall as you proceeded to swim posteriorly?
    - a. Amygdala and internal capsule
    - b. Thalamus and Caudate**
    - c. Subthalamic nucleus and putamen
    - d. Thalamus and globus pallidus
  9. The hippocampus is located \_\_\_\_\_ to the putamen
    - a. Superior
    - b. Inferior**
    - c. Anterior
    - d. Posterior
  10. An abscess located in the putamen may also affect which structure that lies immediately medial to the putamen?
    - a. Thalamus
    - b. Caudate
    - c. Globus pallidus**

11. If a patient received a gun shot wound to their frontal lobe and you knew that their lateral ventricle was injured, you might be worried that the bullet injured the \_\_\_\_\_ on the same side.
  - a. Fourth ventricle
  - b. Putamen
  - c. Caudate**
  - d. Amygdala
  
12. The posterior aspect of the hippocampus is \_\_\_\_\_ to the thalamus
  - a. Anterior
  - b. Posterior**
  - c. Medial
  - d. Lateral

#### Post-intervention Control Questions

1. The \_\_\_\_\_ connects the third and fourth ventricle
  - a. Interventricular foramen of Monroe
  - b. Central canal
  - c. Cerebral aqueduct**
  - d. Foramen of Magendie
  
2. The pineal body is \_\_\_\_\_ to the cerebellum
  - a. Superior**
  - b. Lateral
  - c. Inferior
  
3. The mammillary bodies are located \_\_\_\_\_ to the uncus
  - a. Lateral
  - b. Superior
  - c. Medial**
  - d. Inferior
  
4. The sylvian fissure runs inferior to the \_\_\_\_\_
  - a. Inferior frontal gyrus**
  - b. Superior temporal gyrus
  - c. Occipital gyri
  - d. Angular gyrus
  
5. The supraoptic nucleus is located \_\_\_\_\_ to the corpus callosum
  - a. Superior
  - b. Inferior**
  
6. Which structure is located lateral to the claustrum?
  - a. Optic tract
  - b. Third ventricle

- c. Insula**
  - d. Corpus callosum
  
- 7. The orbital gyri are located \_\_\_\_\_ to the gyrus rectus
  - a. Lateral**
  - b. Medial
  - c. Superior
  - d. Inferior
  
- 8. The falx cerebri separates which structures
  - a. Mammillary bodies
  - b. Lateral ventricles
  - c. Left and right cerebral cortex**
  
- 9. The corona radiata lies \_\_\_\_\_ to the Sylvian fissure
  - a. Lateral
  - b. Medial**



### Satisfaction survey

Question	Group	Neither Agree Nor Disagree				
		Strongly Agree	Agree	Disagree	Strongly Disagree	
<b>This method is useful at learning about spatial relations of the thalamus</b>	VR	23 (74.2%)	8 (25.8%)	0	0	0
	Paper-based	0	20 (60.6%)	6 (18.2%)	7 (21.2%)	0
<b>This method was efficient in teaching spatial understanding of the thalamus</b>	VR	20 (64.5%)	11 (35.5%)	0	0	0
	Paper-based	0	13 (39.4%)	6 (18.2%)	13 (39.4%)	1 (3%)
<b>This method should be used in the curriculum</b>	VR	19 (61.3%)	10 (32.3%)	2 (6.5%)	0	0
	Paper-based	0	11 (33.3%)	17 (51.5%)	4 (12.1%)	1 (3%)
<b>This method was easy to use and get used to</b>	VR	20 (64.5%)	10 (32.3%)	1 (3.2%)	0	0
	Paper-based	1 (3.0%)	22 (66.7%)	3 (9.1%)	5 (15.2%)	2 (6.1%)
<b>This method was fun</b>	VR	25 (80.6%)	5 (16.1%)	1 (3.2%)	0	0
	Paper-based	0	0	11 (33.3%)	16 (48.5%)	6 (18.2%)
<b>This method has the potential to replace in class lectures</b>	VR	4 (12.9%)	9 (29.0%)	9 (29.0%)	8 (25.8%)	1 (3.2%)
	Paper-based	0	3 (9.1%)	5 (15.2%)	14 (42.4%)	11 (33.3%)
<b>I feel I had enough time to learn about the neuroanatomical structures</b>	VR	2 (6.5%)	12 (38.7%)	8 (25.8%)	9 (29.0%)	0
	Paper-based	0	2 (6.1%)	3 (9.1%)	16 (48.5%)	12 (36.4%)
<b>I feel I have a better understanding of the spatial relationships of the neuroanatomical structures</b>	VR	20 (64.5%)	11 (35.5%)	0	0	0
	Paper-based	0	22 (66.7%)	7 (21.2%)	3 (9.1%)	1 (3%)
<b>I feel more confident in being able to engage in learning neuroanatomy</b>	VR	13 (41.9%)	16 (51.6%)	2 (6.5%)	0	0
	Paper-based	0	15 (45.5%)	10 (30.3%)	7 (21.2%)	1 (3%)
<b>I feel that I will be able to retain this information for the future</b>	VR	4 (12.9%)	16 (51.6%)	7 (22.6%)	4 (12.9%)	0
	Paper-based	1 (3.0%)	7 (21.2%)	11 (33.3%)	11 (33.3%)	3 (9.1%)
	VR	8 (25.8%)	17 (54.8%)	2 (6.5%)	4 (12.9%)	0

Question	Group	Strongly Agree	Agree	Neither Agree Nor Disagree	Disagree	Strongly Disagree
<b>I feel less afraid with the complexity of neuroanatomy</b>	Paper-based	0	4 (12.9%)	10 (30.3%)	16 (48.5%)	3 (9.1%)
<b>This method can promote and enhance self-directed learning</b>	VR	21 (67.7%)	10 (32.3%)	0	0	0
	Paper-based	0	11 (33.3%)	7 (21.2%)	12 (36.4%)	2 (6.1%)
<b>Being able to interact with and manipulate the neuroanatomical structures helped me to engage in learning the material</b>	VR	23 (74.2%)	8 (25.8%)	0	0	0
	Paper-based	0	3 (9.1%)	22 (66.7%)	1 (3.0%)	2 (6.1%)
<b>Being able to orient my body in relation to the structures helped me engage more with the neuroanatomical structures</b>	VR	20 (64.5%)	9 (29.0%)	1 (3.2%)	0	1 (3.2%)
	Paper-based	0	7 (21.2%)	19 (57.6%)	0	2 (6.1%)
<b>This method makes neuroanatomy more interesting to learn</b>	VR	23 (74.2%)	7 (22.2%)	1 (3.2%)	0	0
	Paper-based	0	2 (6.1%)	6 (18.2%)	18 (54.5%)	7 (21.2%)
<b>I don't feel overwhelmed by the material presented</b>	VR	12 (41.9%)	15 (48.4%)	3 (9.7%)	0	0
	Paper-based	1 (3.0%)	8 (24.2%)	6 (18.2%)	17 (51.5%)	1 (3%)
<b>I feel less anxious with the complexity of the material</b>	VR	8 (25.8%)	15 (48.4%)	5 (16.1%)	3 (9.7%)	0
	Paper-based	0	3 (9.1%)	8 (24.2%)	21 (63.6%)	1 (3%)
<b>I now want to learn more about neuroanatomy</b>	VR	7 (22.6%)	17 (54.8%)	6 (19.4%)	1 (3.2%)	0
	Paper-based	5 (15.2%)	13 (39.4%)	7 (21.2%)	6 (18.2%)	2 (6.1%)
<b>I feel that I could be able to apply this knowledge in a clinical situation</b>	VR	9 (29.0%)	12 (38.7%)	5 (16.1%)	5 (16.1%)	0
	Paper-based	1 (3.0%)	5 (15.2%)	6 (18.2%)	16 (48.5%)	5 (15.2%)
<b>I feel I could transfer this knowledge to interpret medical imaging</b>	VR	12 (38.7%)	15 (48.4%)	4 (12.9%)	0	0
	Paper-based	1 (3.0%)	16 (48.5%)	7 (21.2%)	7 (21.2%)	2 (6.1%)

Question	Group	Strongly Agree	Agree	Neither Agree Nor Disagree	Disagree	Strongly Disagree
<b>I now feel that the spatial relations between neuroanatomical structures is less complex</b>	VR	11 (35.5%)	16 (51.6%)	1 (3.2%)	3 (9.7%)	0
	Paper-based	0	5 (15.2%)	3 (9.1%)	21 (63.6%)	4 (12.1%)
<b>This method can be used repeatedly for learning</b>	VR	17 (54.8%)	13 (41.9%)	1 (3.2%)	0	0
	Paper-based	2 (6.1%)	19 (57.6%)	8 (24.2%)	2 (6.1%)	2 (6.1%)
<b>This method helped clear any misconceptions of the material</b>	VR	10 (32.3%)	10 (32.3%)	10 (32.3%)	1 (3.2%)	0
	Paper-based	0	7 (21.2%)	7 (21.2%)	15 (45.5%)	4 (12.1%)
<b>This method is an intuitive approach to learning</b>	VR	13 (41.9%)	15 (48.4%)	2 (6.5%)	1 (3.2%)	0
	Paper-based	0	8 (24.2%)	9 (27.3%)	10 (30.3%)	6 (18.2%)
<b>I can visualize in my mind the details and spatial relations of the structures</b>	VR	15 (48.4%)	16 (51.6%)	0	0	0
	Paper-based	3 (9.1%)	11 (33.3%)	9 (27.3%)	9 (27.3%)	1 (3%)

Average scores for the test and control questions

	<b>Virtual-reality Average Score</b>	<b>Paper-based Average Score</b>
<b>Baseline Test Questions</b>	5.61/12	5.45/12
<b>Post-intervention Test Questions</b>	8.74/12	8.58/12
<b>Baseline Test Questions 7-Days Post-intervention</b>	8.10/12	6.70/12
<b>Post-intervention questions 7-Days Post-intervention</b>	7.77/12	7.48/12
<b>Baseline Control Questions</b>	4.10/9	3.45/9
<b>Post-intervention Control Questions</b>	3.90/9	4.03/9
<b>Baseline Control Questions 7-days Post-intervention</b>	3.74/9	3.73/9
<b>Post-Intervention Control Questions 7-days Post-intervention</b>	4.1/9	3.82/9