EME6646 Summer B 2026
A02: Explanations of Human Senses and Perception
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Reflecting on Sense and Perception: How Neuroscience Deepened My Understanding of Learners, Learning, and Instructional Design

Introduction

Entering Unit 2, I expected to learn primarily about the brain's sensory systems and how humans perceive the world around them. Although my undergraduate studies in psychology introduced me to concepts such as sensation, perception, and attention, I had largely viewed these topics as separate cognitive processes rather than interconnected mechanisms that influence how learning begins. As both a veteran mathematics teacher and an aspiring instructional designer, I was particularly interested in understanding how neuroscience could deepen my existing knowledge of learner-centered instruction and explain why different learners often experience the same instructional event in very different ways.

Throughout Unit 2, I came to appreciate that sensing and perceiving are not the same process. While our sensory systems collect information from the environment, the brain actively predicts, organizes, and interprets that information by integrating sensory input with prior knowledge, expectations, and attentional processes (Byrne, 2025a; Grossberg, 2018). Rather than functioning as a passive recorder of reality, the brain continuously constructs meaningful experiences from incomplete sensory information. The assigned readings, videos, and multimedia resources demonstrated that learners actively perceive, interpret, and selectively attend to information long before it reaches long-term memory. This realization shifted my perspective from asking how clearly instruction is presented to considering how learners are likely to perceive, interpret, and attend to instruction before meaningful learning can occur.

Based on my reflection of Unit 2, this paper focuses on three lessons that most influenced my thinking professionally: (1) perception is an active construction rather than passive reception, (2) prior knowledge and expectations shape perception before learning begins, and (3) attention determines what ultimately becomes learning. Together, these lessons deepened my understanding of how neuroscience complements instructional design by explaining not only how the brain processes information, but also why learners experience the same instruction in different ways.

Lesson 1: Perception Is an Active Construction Rather Than Passive Reception

One of the most meaningful lessons I learned from Unit 2 was that perception is not a passive recording of the external world. Before this unit, I generally assumed that perception functioned much like a camera, accurately capturing information from the environment before passing it to higher cognitive processes. The neuroscience presented throughout Unit 2 challenged that assumption by demonstrating that perception is an active process of interpretation. Byrne (2025b) explains that visual information travels from the retina through the lateral geniculate nucleus of the thalamus before reaching the primary visual cortex, where specialized neural pathways simultaneously process features such as color, motion, depth, and form. These parallel processing systems ultimately integrate individual features into the unified visual experiences we consciously perceive. Rather than providing a direct representation of reality, the visual system continuously predicts, organizes, and interprets incomplete sensory information to construct meaningful experiences.

The *NOVA* documentary *Your Brain: Perception Deception* reinforced this concept by demonstrating that only a small portion of our visual field is processed with high acuity while the brain continuously fills in the remaining details using contextual information and prior experience (*Your Brain: Perception Deception*, 2015). At first, I viewed these demonstrations as fascinating examples of visual illusions. As I continued exploring the assigned resources, however, I realized they illustrated something much more significant: perception reflects the brain's interpretation of reality rather than reality itself. Al Seckel's visual illusions and Iain McGilchrist's discussion of attentional styles further demonstrated that what we consciously experience depends as much on interpretation and context as it does on sensation (McGilchrist, 2009; Seckel, 2010). Because perception reflects interpretation rather than direct sensory recording, learners may construct different understandings even when they receive identical instructional experiences. This helps explain why simply presenting accurate information does not guarantee that every learner develops the same understanding.

As I reflected on these ideas, I realized how often I had assumed that students experienced instruction in essentially the same way simply because they were exposed to the same lesson. Unit 2 fundamentally challenged that assumption. If perception itself is an active process of interpretation, then effective instruction cannot begin with the expectation that every learner experiences the same instructional event in the same way. Instead, each learner constructs meaning through unique combinations of prior knowledge, experience, and attentional processes. As an educator transitioning into instructional design, this lesson strengthened my appreciation that effective instruction begins not by asking, *"How clearly did I present the information?"* but rather, *"How are different learners likely to perceive and interpret this experience?"* That subtle shift in perspective has already begun changing the way I think about designing instruction. Rather than assuming instruction is experienced uniformly, I now recognize that learner variability begins with perception itself. In the end, understanding that perception is an active construction reminds instructional designers that effective instruction begins by designing for how learners interpret information, not simply how instructors present it.

Lesson 2: Prior Knowledge and Expectations Shape Perception Before Learning Begins

Another significant lesson I learned from Unit 2 was that perception is strongly influenced by what learners already know before encountering new information. Prior to this unit, I viewed prior knowledge primarily as an instructional design principle that supported comprehension and memory after instruction had begun. Unit 2 expanded that understanding by demonstrating that previous experiences, expectations, and existing knowledge influence perception itself rather than simply affecting learning after information has already been received. Grossberg (2018) explains that top-down expectations continuously interact with incoming sensory information, allowing the brain to interpret incomplete or ambiguous stimuli by drawing upon existing knowledge and previous experience. Rather than waiting until after sensory information has been processed, these top-down signals influence perception in real time through distributed cortical networks, demonstrating that learners actively construct meaning from the very beginning of an instructional experience.

Several of the Unit 2 resources illustrated this concept from different perspectives. Al Seckel's discussion of the dolphin illusion demonstrated how identical visual information can produce entirely different perceptions depending on an individual's previous experiences, while *Your Brain: Perception Deception* similarly emphasized that perception reflects the brain's ongoing predictions rather than a literal recording of reality (Seckel, 2010; *Your Brain: Perception Deception*, 2015). Together, these resources helped me realize that learners never approach instruction as blank slates. Instead, every new learning experience is interpreted through existing mental models that influence how information is perceived from the very beginning. Learning therefore begins with the knowledge learners already possess rather than solely with the information instructors present. This lesson helped me recognize that effective instruction is not simply about presenting accurate information, it is about helping learners connect new ideas to the mental models they already have.

Reflecting on this lesson helped me synthesize that neuroscience provides a biological explanation for many instructional design principles I have encountered throughout my graduate studies. Before studying neuroscience, I learned that effective instructional design begins with learner analysis, activating prior knowledge, and connecting new information to existing understanding. Looking back, I realize I had been applying these principles throughout my teaching career without fully understanding the biological processes that made them so effective. Until completing Unit 2 I viewed these practices primarily as sound instructional strategies. Understanding that prior knowledge actually influences perception itself (not simply comprehension after information is presented) fundamentally reshaped how I think about preparing learners for new instruction. Instead of viewing learner analysis as an important first step in the instructional design process, I now recognize it as an essential consideration because learners perceive instructional experiences differently based on what they already know. This lesson will continue to influence how I analyze learners before designing instruction and reinforces the importance of building upon existing knowledge rather than assuming every learner begins in the same place. This lesson reinforced that analyzing learners' prior knowledge is not simply good instructional design practice, it reflects how the brain naturally constructs perception and meaning.

Lesson 3: Attention Determines What Ultimately Becomes Learning

One of the most significant lessons I learned from Unit 2 was that attention is far more than simply "paying attention." Before this unit, I tended to think of attention primarily as a learner characteristic or, at times, a classroom management concern. Unit 2 fundamentally changed that perspective by demonstrating that attention is a limited cognitive resource that determines which information receives further processing and could become learning. Posner and Petersen (1990) describe attention as a system of interacting neural networks consisting of alerting, orienting, and executive control. Together, these attentional systems prepare the brain to respond, direct cognitive resources toward relevant information, and resolve competition among multiple sources of information. Sarter and Lustig (2020) further explain that attention, learning, and memory function as highly integrated processes rather than independent cognitive systems. Combined, these findings reinforced that attention is not simply a prerequisite for learning, it is an essential component of the learning process itself.

Several Unit 2 resources challenged common misconceptions about attention. The BrainFacts article explaining why people struggle with multitasking demonstrated that the brain cannot effectively perform multiple demanding cognitive tasks simultaneously because those tasks compete for the same limited attentional resources (BrainFacts.org, 2023). Rather than processing every stimulus equally, attentional networks continuously select, prioritize, and suppress competing information so that limited cognitive resources can be allocated where they are needed most (Posner & Petersen, 1990; Sarter &

Lustig, 2020). As a mathematics teacher, this explanation immediately resonated with experiences I have observed in the classroom. Students frequently believe they can divide their attention among instruction, conversations, and digital devices without affecting learning. Unit 2 provided a neuroscientific explanation for why those assumptions are often incorrect. Because attentional resources are limited, not all information receives equal cognitive processing. Learning therefore depends not only on what instructors present but also on what learners are able to attend to and process deeply enough to construct meaningful understanding.

During my reflection on this lesson, I realized that my role as an instructional designer extends beyond presenting accurate content. Effective instructional design also involves intentionally designing learning experiences that guide and sustain learner attention toward the information that matters most. Throughout my graduate studies, I have learned about instructional strategies such as signaling, reducing unnecessary cognitive load, and designing clear visual layouts. Unit 2 deepened that understanding by explaining why those strategies are effective from a neuroscientific perspective. I no longer think of learner attention as something instructors simply hope for during a lesson. Instead, I now see attention as something instructional designers intentionally earn, guide, and sustain through thoughtfully designed learning experiences that minimize distractions and emphasize what matters most. More than anything, this lesson reminded me that effective instructional design is not simply about presenting information clearly. It is about intentionally creating learning experiences that help learners focus their limited cognitive resources on the ideas that matter most for truly meaningful learning. Ultimately, neuroscience helped me realize that effective instruction depends as much on intentionally designing for attention as it does on presenting accurate content.

Conclusion

Reflecting on Unit 2 significantly expanded my understanding of how perception, prior knowledge, and attention influence learning. The assigned readings, textbook chapters, videos, and multimedia resources demonstrated that learners do not passively receive information from their environment. Instead, the brain continuously predicts, interprets, and selectively attends to sensory information before meaningful learning can occur (Byrne, 2025a; Grossberg, 2018; Posner & Petersen, 1990). Collectively, these resources reinforced that learning begins long before information reaches long-term memory because learners actively construct meaning from every instructional experience.

Most importantly, these lessons fundamentally changed how I think about learners. Prior to this unit, I generally focused on designing instruction that presented information clearly and logically. While those goals remain important, I now better appreciate that effective instructional design begins by understanding how learners are likely to perceive, interpret, and attend to instructional experiences before they are expected to remember, apply, or transfer new knowledge. Instead of viewing perception, prior knowledge, and attention as separate concepts, I now see them as connected processes that shape every learning experience. This perspective strengthened my appreciation that neuroscience complements learning theory and instructional design by providing biological explanations for many learner-centered practices that educators have long recognized as effective.

Unit 1 helped me understand how neuroscience supports instructional design, while Unit 2 helped me better understand the learners for whom instruction is designed. That shift in perspective may be the most meaningful lesson I use as I continue developing as both an educator and an instructional designer. Looking back on this unit, I realize that instructional designers are not simply designing information or learning activities. They are designing experiences that influence how learners perceive, interpret, and attend to information before meaningful learning can occur. Understanding those differences provides a stronger neuroscientific foundation for designing instruction that is not only effective, but also responsive to the diverse ways people experience and construct learning.

References

BrainFacts.org. (2023). Why can't we multitask? Society for Neuroscience. https://www.brainfacts.org/thinking-sensing-and-behaving/learning-and-memory/2023/why-cant-we-multitask

Byrne, J. H. (Ed.). (2025a). Central visual pathways. *Neuroscience Online: An Electronic Textbook for the Neurosciences*. McGovern Medical School at UTHealth Houston.

Byrne, J. H. (Ed.). (2025b). Visual processing. *Neuroscience Online: An Electronic Textbook for the Neurosciences*. McGovern Medical School at UTHealth Houston.

Grossberg, S. (2018). Desirability, availability, credit assignment, category learning, and attention: Cognitive-emotional and cortical dynamics. In J. T. Wixted (Ed.), *Stevens' Handbook of Experimental Psychology and Cognitive Neuroscience* (4th ed.).

McGilchrist, I. (2009, October). *The divided brain* [Video]. TED Conferences. https://www.ted.com/talks/iain_mcgilchrist_the_divided_brain

Posner, M. I., & Petersen, S. E. (1990). The attention system of the human brain. *Annual Review of Neuroscience, 13*, 25–42.

Sarter, M., & Lustig, C. (2020). Attention and the neurobiology of learning. *Perspectives on Psychological Science*.

Seckel, A. (2010, February). *Visual illusions that reveal how we think* [Video]. TED Conferences. https://www.ted.com/talks/al_seckel_visual_illusions_that_reveal_how_we_think

Your Brain: Perception Deception. (2015). PBS NOVA.

Disclosure of AI Usage to Identify, Explore, Synthesize

AI Tools Used and Purpose

Artificial intelligence (AI) tools were used throughout this assignment to support learning, organization, scholarly writing, and reflection. The primary AI tool used was ChatGPT (OpenAI), which served as a collaborative thought partner during the planning, development, and revision of this paper. AI assisted with organizing course resources, comparing concepts across assigned readings and multimedia resources, evaluating potential themes for reflection, reviewing alignment with the assignment rubric, and strengthening the organization and clarity of the final manuscript. NotebookLM was also used to generate an audio synthesis of Unit 2 materials after I completed the readings. Comparing its summary with ChatGPT's synthesis highlighted differences in emphasis, reinforcing the importance of verifying AI-generated summaries against the original course resources.

AI supported my learning process rather than replacing it. I independently completed all assigned readings, textbook chapters, videos, and multimedia resources before using AI to discuss ideas and explore relationships among perception, prior knowledge, attention, learning, and instructional design. Throughout the assignment, I directed every stage of the process by selecting the lessons to analyze, determining the organization of the paper, choosing to support scholarly sources, and evaluating every recommendation before deciding whether to incorporate it.

Critical and Effective Use of AI

AI primarily supported the planning, organization, and refinement of this reflection rather than generating its content. After completing the assigned readings, textbook chapters, videos, and multimedia resources, I used AI as a collaborative thought partner to help synthesize information across all of the Unit 2 resources and identify common themes that aligned with my professional interests and experiences.

One of AI's most valuable contributions involved synthesizing the assigned materials to identify where concepts overlapped across multiple readings and media. Rather than reviewing each resource in isolation, I directed AI to compare the textbook chapters, journal articles, TED Talks, documentary, BrainFacts article, and module overview to identify recurring neuroscience concepts that connected most naturally to my background as a veteran mathematics teacher and my transition into instructional design. This process helped me evaluate numerous possible reflection topics before selecting perception, prior knowledge, and attention because together they represented the strongest synthesis of the course materials while also reflecting the concepts that most influenced my own thinking.

After selecting the three lessons, I used AI to help locate relevant discussions within the assigned resources that supported each topic. For example, once I decided to focus on top-down processing, AI identified portions of Grossberg's work and related course resources discussing prediction, expectation, and perception. Likewise, after choosing attention as my third lesson, AI helped identify supporting discussions from Posner and Petersen, Sarter and Lustig, and the assigned BrainFacts article. I independently returned to each original source to verify that the recommended sections accurately reflected the authors' intended meaning before incorporating them into the paper.

AI also supported the revision process by reviewing the organization of the paper, strengthening transitions between lessons, identifying opportunities to explain underlying neuroscientific mechanisms more clearly, and evaluating whether each reflection demonstrated meaningful professional growth rather than simply summarizing course content. Throughout this process, I directed every revision and accepted only those recommendations that strengthened the paper while accurately representing the assigned materials and my own perspective.

Table 1
Examples of Critical Evaluation During AI-Assisted Writing

Original Prompt to AI	AI Synthesis / Recommendation	My Evaluation and Final Decision
"Synthesize all Unit 2 resources (module overview, textbook chapters, journal articles, TED Talks, NOVA documentary, and supplemental readings). Identify concepts that consistently overlap across the resources and align with my professional experience as a mathematics teacher transitioning into instructional design."	AI identified several recurring themes across the course materials, including active perception, top-down processing, prior knowledge, attention, predictive processing, learner variability, and multitasking limitations. It also ranked the themes based on how naturally they connected to my instructional design background.	After reviewing the synthesis and returning to the original sources, I selected **perception**, **prior knowledge**, and **attention** because they represented the strongest overlap across the assigned materials while also reflecting the greatest change in my own thinking as an educator and instructional designer.
"Review my draft using Dr. Hirumi's evaluation rubric and previous A01 feedback. Identify places where additional neuroscience mechanisms or stronger instructional design implications would improve the paper without adding unnecessary content."	AI identified opportunities to strengthen the biological explanations supporting each lesson and recommended ending each lesson with a clearer instructional design implication rather than simply summarizing the neuroscience concepts.	I reviewed each recommendation individually and incorporated only those that accurately reflected the assigned resources and aligned with Dr. Hirumi's previous feedback. Suggestions that added unnecessary complexity or shifted the paper away from reflective writing were intentionally omitted.
"Review my draft and identify areas where the writing could be clearer, more concise, or better organized. Suggest revisions that improve readability while preserving my voice, intended meaning, and adherence to APA conventions."	AI revised wording to improve clarity, reduce repetitive phrasing, strengthen transitions, and better reflect my conversational yet professional writing style. It also identified places where explanations sounded overly technical or overly formal.	I accepted revisions only when they improved readability while preserving my own voice. Every paragraph was manually reviewed and edited before inclusion, ensuring that the final manuscript reflected my own understanding, writing style, and professional experiences rather than AI-generated language alone.

I evaluated AI recommendations using the following questions:

- Did the recommendation accurately reflect the assigned Unit 2 resources?
- Did it identify meaningful connections across multiple course resources rather than relying on a single source?
- Did it strengthen the relationship between neuroscience and instructional design?
- Did it deepen my reflection rather than simply add more information?
- Did it reflect my own professional experience and growth?
- Did it maintain my authentic writing style?
- Was every claim supported by an assigned course resource or credible scholarly source?

Ethical Use, Privacy, and Responsibility

Throughout this assignment, I remained responsible for all learning, interpretation, writing, reflection, and final decision-making. I personally completed all assigned readings and multimedia resources, verified AI-supported suggestions against the course materials, selected every scholarly source, and revised each section to reflect my own understanding of Unit 2. AI supported exploration, organization, and revision, but it did not replace my analysis, academic judgment, or professional reflection.

I also recognize that AI systems can occasionally oversimplify complex neuroscience concepts or generate inaccurate interpretations of scholarly literature. For that reason, every substantive recommendation was verified against the original course materials before being incorporated into this paper. AI occasionally proposed wording that sounded more formal than my natural writing style. Those revisions were either rewritten or rejected to preserve my authentic voice. No confidential, proprietary, or personally identifiable information was entered into any AI system during completion of this assignment. AI was used in a manner consistent with the expectations established for this course while maintaining academic integrity, transparency, and responsible human oversight.