Where's Waldo?
What-to-Where and Where-to-What Cortical Interactions
Enable Brain Categorization and Search for Desired Objects in a Scene

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The Where's Waldo problem concerns how individuals can rapidly scan a scene to detect a desired target object in it. The ARTSCAN Search neural model has been developed to clarify how brain mechanisms that govern spatial and object attention, spatially-invariant object learning and recognition, reinforcement learning, and eye movement search are coordinated to enable learning and directed search for desired objects at specific locations in a cluttered scene. In the model, interactions from the Where cortical processing stream to the What cortical processing stream can modulate invariant category learning of a desired object, whereas interactions from the What cortical processing stream to the Where cortical processing stream can support search, attention, and movement to such an object. In particular, when an invariant object category representation is activated top-down by a cognitive plan or by an active motivational source in the model's What stream, it can shift spatial attention in the Where stream and thereby selectively activate the locations of sought-after object exemplars. These combined What-to-Where and Where-to-What interactions clarify how the brain's solution of the Where's Waldo problem overcomes the complementary deficiencies of What and Where stream processes taken individually by using inter-stream interactions that allow both invariant object recognition and spatially selective attention and action to occur.