

Research Report

Benefits of a 12-Week Non-Drug “Brain Fitness Program” for Patients with Attention-Deficit/Hyperactive Disorder, Post-Concussion Syndrome, or Memory Loss

Supplementary Figure 1. Complete list and brief descriptions of brain games utilized in NeuroGrow’s Brain Fitness Program, categorized by NeuroGrow for use by patients with deficits in Verbal Memory, Reaction Time, Attention, Processing Speed, Working Memory, and/or Executive Functioning.

List of Brain Games Used at NeuroGrow

Bananagrams	Inverse	Set
Blink	Logic Links	Shell Game
Boggle	Pentago	Spot-It
Catchphrase	Q-Bitz	Swish
Chess	Qwirkle	Word Around
Chocolate Fix	Rummikub	Word Q
Colorku	Rush hour	

Descriptions of Brain Games Used at NeuroGrow

Bananagrams

- A word game, in which lettered tiles are used to spell words and create word grids.
- Variations: Players may play timed rounds with only 21 letters (allow individuals to return an unwanted letter in exchange for 3 more letters). Players may play collaboratively and work together to create 1 board. To increase difficulty, players can impose word-length limits (i.e., only 5-letter or longer words allowed), or compete against one another in Bananagram Wars (players play against each other, attempting to use all of their letters first).
- Cognitive domains: verbal memory, sustained/simple/complex attention, working memory, executive functioning, cognitive flexibility, and processing speed.

Blink

- To begin, players simultaneously turn over the card that they placed in the center of the table. Players then race to play cards from their hand on either of the piles. For a card to be played, it must match at least one of the characteristics (color, shape, or count) of the card on which it is being played. For instance, a card with four brown stars could be played on any card with brown (color), or on a card with stars (shape), or on a card with four symbols (count). Players may have up to three cards in their hand at a time and refill their hand by drawing from their draw pile. Play continues until one player is completely out of cards from their hand and draw pile. The first player that successfully plays all their cards wins BLINK.
- Variations: Players can play by themselves or challenge themselves by quickly sorting the deck by number, shape, or color.
- Cognitive Domains: processing speed, executive functioning, cognitive flexibility

Boggle

- The game is played using a plastic grid of lettered dice, in which players attempt to find words in sequences of adjacent letters. Each player searches for words that can be constructed from the letters of sequentially adjacent cubes, where "adjacent" cubes are those horizontally, vertically, and diagonally neighboring. Words must be at least three letters long, may include singular and plural (or other derived forms) separately, but may not use the same letter cube more than once per word. Each player records all the words he or she finds by writing on a private sheet of paper. If two or more players wrote the same word, it is removed from all players' lists. For all words remaining after duplicates have been eliminated, points are awarded based on the length of the word. The winner is the player whose point total is highest, with any ties typically broken by count of long words.
- Cognitive Domains: verbal memory, executive functioning, processing speed, cognitive flexibility

Catchphrase

- The game is played in two teams. The goal for each player is to get their team to say the word or word phrase displayed in the disc. One member of a team starts the timer and tries to get his or her team to guess the displayed word or phrase. A clue-giver can NOT make any physical gesture, and can give almost any verbal clue, but may not say a word that rhymes with any of the words, give the first letter of a word, say the number of syllables, or say part of any word in the clue (e.g., "worry" for "worry wart"). When the team guesses correctly, the other team takes its turn. Play continues until the timer runs out. The team not holding the disc when time runs out scores a point. They also have one chance to guess the word or phrase, with team members allowed to confer; a correct answer earns a bonus point. The first team to score 7 points wins.
- Cognitive Domains: cognitive flexibility, executive function, reasoning, processing speed

Chess

- This is a board game for two players. It is played in a square board, made of 64 smaller squares, with eight squares on each side. Each player starts with sixteen pieces: eight pawns, two knights, two bishops, two rooks, one queen, and one king. The goal of the game is for each player to try and checkmate the king of the opponent. Checkmate is a threat ('check') to the opposing king that no move can stop. It ends the game. During the game, the two opponents take turns to move one of their pieces to a different square of the board. One player ('White') has pieces of a light color; the other player ('Black') has pieces of a dark color. There are rules about how pieces move and about taking the opponent's pieces off the board. The player with white pieces always makes the first move. Because of this, White has a small advantage, and wins more often than Black in tournament games.
- Variations: Players can strengthen their attention and multitasking skills by listening to a podcast while competing against their brain coach.
- Cognitive Domains: working memory, short-term memory, visual processing, reasoning, deduction skills, sustained/simple/complex attention, processing speed, and executive functioning, planning

Chocolate Fix

- A sudoku-style logic game that comes with 60 challenges of increasing difficulty, from beginner to expert. Using the clues, fill the tray with all nine chocolate pieces in their correct positions. Like Sudoku, you will need to examine and consider all clues on the challenge card before making a move.
- Cognitive Domains: visual processing, reasoning, working memory, deduction skills, sustained/simple/complex attention, processing speed, and executive functioning

Colorku

- A fun variation of Sudoku using brightly colored wooden balls instead of numbers. The gameboard includes 81 balls in 9 different colors, 104 puzzle cards, solutions booklet. There are 5 levels of difficulty. This game plays by the same rules as Sudoku but uses 9 colors instead of 9 numbers. At Neurogrow, a brain coach will guide their patient to develop strategies to solve these complex puzzles more efficiently.
- Cognitive Domains: visual processing, reasoning, working memory, deduction skills, sustained/simple/complex attention, processing speed, and executive functioning.

Inverse

- A competitive game of obstruction and construction, this game challenges players to position all of their playing pieces on the playing field and to block their opponent from doing the same. The player who gets all their pieces onto the board first wins the game.
- Variations: play against self or against brain coach
- Cognitive Domains: spatial reasoning, executive functioning, cognitive flexibility

Mastermind

- Two players decide in advance how many games they will play, which must be an even number. One player becomes the codemaker, the other the codebreaker. The codemaker chooses a pattern of four code pegs. The chosen pattern is placed in the four holes covered by the shield, visible to the codemaker but not to the codebreaker. The codebreaker tries to guess the pattern, in both order and color, within twelve (or ten, or eight) turns. Each guess is made by placing a row of code pegs on the decoding board. Once placed, the codemaker provides feedback by placing from zero to four key pegs in the small holes of the row with the guess. A colored or black key peg is placed for each code peg from the guess that is correct in both color and position. A white key peg indicates the existence of a correct color code peg placed in the wrong position. Once feedback is provided, another guess is made; guesses and feedback continue to alternate until either the codebreaker guesses correctly, or twelve (or ten, or eight) incorrect guesses are made.
- Cognitive Domains: executive functioning, cognitive flexibility, deduction, and reasoning

Memory Match

- A memory game where you need to match pairs of tiles. Playing is very simple - you turn over one tile and then try to find a matching tile.
- Variations: timed rounds, taking turns
- Cognitive Domains: visual memory, processing speed, motor speed, deduction and reasoning, working memory, spatial reasoning

Outburst

- The game is played with two teams or two players. On each side of the cards, a topic heading is printed, followed by a list of 10 items that fall under the given topic. The object is to guess the items that were chosen for inclusion on the card, given the topic.
- Cognitive Domains: verbal memory, executive functioning, cognitive flexibility

Q-Bitz

- Players recreate the patterns provided on the game cards using a set of 16 cubes.
- Cognitive Domains: visual processing, working memory, visuoconstruction, spatial reasoning, executive functioning

Rummikub

- A tile-based game for two to four players, combining elements of the card games rummy and mahjong. There are 104 number tiles in the game (valued 1 to 13 in four different colors, two copies of each) and two jokers. Players have 14 or 16 tiles initially and take turns putting down tiles from their racks into sets (groups or runs) of at least three, drawing a tile if they cannot play. In the Sabra version (the most common and popular), the first player to use all their tiles scores a positive score based on the total of the other players' hands, while the losers get negative scores. An important feature of the game is that players can work with the tiles that have already been played.
- Cognitive Domains: visual processing, working memory, visuoconstruction, spatial reasoning, executive functioning

Rush Hour

- To solve this game of reasoning and strategy, continue to slide the pieces representing cars and trucks out of your way until the path is clear, then slide your red car through the exit. Cars and trucks must remain on their set tracks and cannot jump over any other cars or trucks.
- Variations: Patients can play individual timed rounds or play competitively against their brain coaches to see who finishes first.
- Cognitive Domains: spatial reasoning, executive functioning, sustained/simple/complex attention, processing speed, visual processing, cognitive flexibility

Scrabble

- This is a word game, in which two to four players score points by placing tiles bearing a single letter onto a board divided into a 15×15 grid of squares. The tiles must form words which, in crossword fashion, read left to right in rows or downwards in columns, and be defined in a standard dictionary or lexicon.
- Cognitive Domains: visual processing, sustained/simple/complex attention, working memory, executive functioning, verbal memory, processing speed

Shell Game

- A player will first arrange the crabs and stones to match the starting position on each challenge and then hide the crabs and stones under the shells. Swap the shells along the arcs until the crabs are in the end position. Shells must remain covered until the round is finished

and shells can only move on their given arcs. Patients must remember where each crab has moved to solve the puzzle correctly.

- Cognitive Domains: sustained/simple/complex attention, visual processing, visual memory, working memory, processing speed, executive functioning, cognitive flexibility

Solitaire Chess

- A player will first set up the chess pieces on the board according to instructions from one of the 60 challenge cards. Then they will proceed to capture and eliminate all but one piece, using only moves allowed in traditional chess. Players must capture a piece with every move.
- Variations: Patients can play against the clock during timed rounds, individually, or by taking turns with their brain coach.
- Cognitive Domains: working memory, deduction and reasoning skills, executive functioning

Brain Coaching Games Recommended for Specific Cognitive Deficit Categories					
Verbal Memory	Reaction Time	Attention	Processing Speed	Working Memory	Executive Functioning
Bananagrams	Blink	Bananagrams	Bananagrams	Bananagrams	Bananagrams
Boggle	Egyptian Rat Screw	Chess	Blink	Chess	Blink
Outburst	Face Card	Chocolate Fix	Boggle	Chocolate Fix	Boggle
Scattegories	Spit	Colorku	Catchphrase	Colorku	Catchphrase
Scrabble		Rush Hour	Chess	Memory Match	Chess
Story and Poem Memorization		Scrabble	Chocolate Fix	Q-Bitz	Chocolate Fix
Word List		Shell Game	Colorku	Rummikub	Colorku
			Memory Match	Scrabble	Inverse
			Rush Hour	Shell Game	Mastermind
			Scrabble	Solitaire Chess	Outburst
			Shell Game		Q-Bitz
					Rummikub
					Rush Hour
					Scrabble
					Shell Game
					Solitaire Chess