Mackey, Hill, Stone, & Bunge, *Developmental Science*, 2011
Supplementary Material: Games used in after-school program

Please note: The authors cannot vouch for the effectiveness of any one of the products listed below. We selected them based on the types of cognitive skills we believe they tax, and we used them in combination (rather than separately) in the context of a small initial study involving 2nd-3rd-graders from an underserved community. We provide this information in the hopes that it will be useful to parents, educators, clinicians and/or other researchers.

Reasoning Training Games

Individual Games

Rush Hour: This game gives cue cards that arrange cars in a specific pattern on the board. The player then has to manipulate the cars forwards and backwards or up and down (depending on how the car is placed) to move a specific car out of the board through an exit. To complete a puzzle efficiently, it is necessary to plan several moves in advance.

Chocolate Fix: The game consists of 9 plastic chocolate pieces of 3 different shapes and 3 different colors. Children need to place these pieces according to a set of rules given by a cue card. For example, one clue might show that the top row must all pink pieces and the left column must be all square, so the child must integrate these clues to deduce that the upper left piece is a pink square.

Towers: This game is modeled after a classic test of planning skills known as the Tower of London or the Tower of Hanoi. This game consists of 3 posts and anywhere from 3 to 7 rings. Children use two rules (only one ring can be moved at a time, and larger rings cannot be placed on smaller rings) to move a stack of rings from one post to another.

Tangoes: The objective of this game is to recreate a two dimensional figure using seven smaller pieces. This game requires children need to change the scale of an object and map the location of the smaller components.

Group Games

Quirkle: This game comes with tiles of different shapes and colors. The goal for each turn is to align as many tiles as possible that match along one dimension (i.e. color, shape). As the game progresses, the existing grid of tiles becomes more complicated, and it becomes more difficult to place multiple pieces in a turn.

Set: The goal of this game is to find a "set" in which three cards are either the same of different on each of four dimensions: shape, number, pattern, and color. Twelve cards are laid out on the table, and children try to find the sets as quickly as possible. To find the sets, children must flexibly switch between searching for matches along each of the four dimensions.

Nintendo DS Games

Picross: In this game, children are shown a grid with numbers along the rows and columns. The goal is to fill in squares to create a picture. It is necessary to integrate the information provided for the columns and rows to determine which squares should be filled in.

Big Brain Academy: Children played the three games in the "Thinking" category of this Nintendo DS game: **Heavier**, **Pathfinder**, and **Boneyard**.

a) **Heavier:** One or more cartoons is presented on each side of a balance scale, and multiple balance scales are presented simultaneously. It is necessary to examine the relationships between cartoons within and across balance scales to determine which of the cartoons is heaviest. For example, if one balance scale shows that the pear is heavier than the apple, and another scale shows that the apple is heavier than the pineapple, then the player should indicate that the pear is the heaviest item.
b) **Pathfinder:** This game requires the player to draw a horizontal line to complete a path that allows an animal at the top of the screen to reach a specific animal at the bottom. Once the player has drawn a line, the animal moves along the specified path. It is necessary to plan ahead, following the turns that the animal will make to get to the destination, to ensure that the animal lands in the correct spot.
c) **Boneyard:** This game gives the player a series of directions to follow to move a dog to his bone. For example, the game would tell the player that the dog will move 2 squares up, 3 squares left and 1 square down, and the player must integrate this information to determine his final destination.

Brain Teasers: Mind Benders. Four slots are presented on the screen, and the player must place a colored ball in each slot. The player must deduce the correct series by integrating feedback in response to each guess about the appropriate color and position of a ball.

Neves is the DS version of **Tangoes**.

Pipe Mania: In this game, the player must create a pipeline from a set of differently shaped pipe segments. To direct the flow of water from a start point to a specified end point, it is necessary to place and rotate each segment correctly, considering how the water will flow along the path.

Computer Games

Azada:

a) **Chemicals** is similar to **Mind Benders**, except that the player must place drops of colors on a paper in the correct sequence.
b) **Towers** is a computerized version of the wooden **Towers** game described above.
c) **Sliders** is a computerized analogue of **Rush Hour**, except that the items that need to be moved are wooden blocks rather than cars.
d) **Runes** is like **Set** with 3 features per item rather than 4.
e) **Shapes** is the computerized analogue of Tangoes and Neves.
f) **Round and Round** is a grid with several colored squares that need to be moved in a circular fashion so that they end up in boxes outlined in the matching color. Because the blocks can only be moved in a specific manner, it is necessary to plan a series of moves to get the objects to the correct locations.

Azada II:

a) **Connections** is a game with hexagonal tiles that have numbers that represent how many other tiles they need to touch. The goal of the game is to arrange the tiles on the board to meet these conditions.
b) **Dominos** is a game in which 2-part tiles must be arranged along a circle such that each tile matches its neighbor in one characteristic (color or shape).

Speed Training Games

Individual Games:

Perfection is a game in which the player must place different shaped pieces in their matching holes within the shortest amount of time possible.

Group Games:

Pictureka is a multiplayer visual search game. Cue cards instruct players to find certain objects on the board in a limited amount of time. The boards are periodically shuffled to prevent the player from learning the location of the items on the board.

Blink is a two-player card game. Each player is dealt half of the card deck and is required to match the cards in their hands along several dimensions (color, number, shape) as quickly as possible to two starter cards that are placed in the center of the table. The first player to get rid of all their cards wins.

Speed is a two-player card game in which two cards are placed on the table and each player starts with half of the deck. Each player can hold 5 cards at a time, and can pick up a new card each time they put a card down. The goal is to get rid of one's cards as quickly as possible by placing them on cards that are one higher or lower (e. g. a 3 can be placed on a 2 or a 4).

Spoons is a multiplayer card game in which players aim to collect all 4 of a card (ex: all Queens). Each player is dealt 4 cards and spoons are placed in the middle of the table (one fewer than the number of players). Cards are then passed around in a circle one at a time. If a player needs a card, he or she picks up the card and discards one from his or her hand. When one player has all 4 of one type of card, he or she reaches for a spoon. Every other player then reaches for a spoon, and the player who doesn't get one sits out the next round.

Nintendo DS Games:

Nervous Brickdown is a computerized brick buster game. The player must move a platform back and forth quickly to catch a bouncing ball that breaks a set of bricks.

Super Monkey Ball is a game in which the player navigates through various courses, adjusting speed and turning so as not to fall off the course.

Mario Kart and **Diddy Kong Racing** are games in which the player drives on a racecourse and must respond rapidly to curves in the road or potential roadblocks. The objective of this game is to cross the race line first by quickly responding to the various challenges within the game.

Computer Games:

Feeding Frenzy is a game in which the player guides a fish to eat smaller fish without being eaten by bigger fish. The player needs to move rapidly to avoid bigger fish and other hazards while still eating all of the smaller fish and collecting other objects for extra points.

Atlantis is similar to **Nervous Brickdown.**

Super Cow is a sidescroller game in which the player is a cow who must navigate through a space as quickly as possible, responding to a variety of obstacles.

Child-researcher interactions during training

Researchers in both groups asked children to verbally describe why they were stuck when they asked for help, rather than providing hints (e.g. the next correct move). The exact instructions that children varied across games, but in both groups, researchers would ask children to describe the most difficult parts of the game, and the easiest. They would ask children to try to change the order of the steps they were taking, and to try the easier parts of the games first.

For example, while playing Chocolate Fix (FR game), if a child couldn't solve a problem, they would be asked to explain which clues they had used successfully, and which they could not place. We would ask them whether they could try the clues in a different order, and to distinguish between the moves they were sure about from the moves they had guessed. While children were playing Perfection (PS game), if a child couldn't place all of the pieces in the time limit, we would ask them which pieces were more difficult to place than others, and whether they should change the order in which they attempt to place the pieces.