Task protocols from Last et al., Childhood socioeconomic status and executive function in childhood and beyond

Briana Last,Gwen M. Lawson,Kaitlyn Breiner,Laurence Steinberg,Martha J. Farah

Abstract

Socioeconomic status (SES) predicts health, wellbeing, and cognitive ability, including executive function (EF). A body of recent work has shown that childhood SES is positively related to EF, but it is not known whether this disparity grows, diminishes or holds steady over development, from childhood through adulthood. We examined the association between childhood SES and EF in a sample ranging from 9-25 years of age, with six canonical EF tasks. Analyzing all of the tasks together and in functionally defined groups, we found positive relations between SES and EF, and the relations did not vary by age. Analyzing the tasks separately, SES was positively associated with performance in some but not all EF measures, depending on the covariates used, again without varying by age. These results add to a growing body of evidence that childhood SES is associated with EF abilities, and contribute novel evidence concerning the persistence of this association into early adulthood.

Citation: Briana Last,Gwen M. Lawson,Kaitlyn Breiner,Laurence Steinberg,Martha J. Farah Task protocols from Last et al., Childhood socioeconomic status and executive function in childhood and beyond. **protocols.io**
dx.doi.org/10.17504/protocols.io.ri9d4h6
Published: 07 Jul 2018

Document

Task protocols from Last et al., *PLOS One*
Childhood socioeconomic status and executive function in childhood and beyond

Digit Span – Working Memory
"Remember the Numbers"

Overview:

The digit-span memory test was similar to that in the Wechsler Scales. Participants heard a series of 14 sequences of digits (beginning with 2 digits and increasing to 8) that they were asked to recall forwards, and 12 sequences (beginning with 2 digits and increasing to 7) that they were asked to recall backwards. A *memory score* ("DigitSpan") was computed by averaging the total number of forward trials and backward trials recalled correctly.

Instructions to Participant:

FORWARD Condition:

For this task, you are going to need to listen very carefully because I am going to turn the computer screen away from you. I am going to say some numbers out loud and you should try to remember them. You will need to tell me the numbers after I finish.

For example, if I said 7 3 0, you would repeat back 7 3 0.

Any questions?

Here is the first series. Ready?

BACKWARD Condition:
Now I am going to tell you some more numbers, but this time it will be a little different.
Now you have to tell me the numbers backwards.
So if I said 9 7, you would say 7 9.
Any questions?
Ready?

Letter Working Memory (“Remember the Letters”)

Overview:
The test battery included a test of resistance to interference in *working memory*. In this task, participants see four probe letters on the screen, followed by a screen displaying a target letter. They are then asked whether the target was among the four probes. On test trials, two of the four letters presented had appeared in the previous trial, providing interference with recall on the present trial. An overall accuracy of working memory score is computed by averaging the number of correct responses across four trial-types (yes and no, interference and no interference).

Instructions to Participant:
You will see 4 letters on the screen. It is your job to remember them. The screen will go blank for a while. After a short delay, a single letter will appear. You must decide if that letter was one of the 4 letters you just saw.
If it is, press the YES button.
If it isn't, press the NO button.
(EXAMPLE)
First, you will see a cross appear on the screen. You should just look at the cross. Press Enter to continue.
+
Then, you will see 4 letters like the ones below. You should remember the letters. Press Enter to continue.

f
c m
b

Then, you will see a blank screen. You should still be remembering the letters that were shown on the last screen! Press Enter to continue.
Finally, you will see a letter appear on the screen. You should decide if the letter was one of the letters you saw two screens ago. Capital letters count as being the same if the name of the letter is the same. For example, if "a" was presented earlier and now you see "A", then you would press YES. If the letter you see here does not match one of the letters you saw earlier, press NO. If it does match, press YES. Press your answer.
(PRACTICE)
Before we start the real test, you will get some practice trials.
Remember, if you have just seen the letter, press YES.
If you haven't seen the letter, press NO.
You should press YES or NO as fast as you can when you know the answer.

Ready for the practice?
Press Enter to continue
FeedbackDisplay1: (Correct!) (Incorrect) (No response detected)
The practice is over.
Now we are going to begin the real test.
From now on, you will not be told if you are right or wrong.
When you are ready to start the task press enter.

Stroop Task (Inhibitory Control)
"Color Identification"

Overview:

A computerized version of the classic Stroop color-word task was administered to assess prepotent *response inhibition*. On each trial, the participant was presented either a **color-word** (e.g., "blue", "yellow") or a **neutral** (i.e., non-color) word (e.g., "Math", "Add") and instructed to identify the color in which the word was printed (while ignoring the semantic meaning of the word) by pressing a corresponding key as quickly as possible. All color-word trials are **incongruent** such that the color of the ink in which the word was printed does *not* match the semantic meaning of the word (e.g., the word "blue" printed in yellow). In this version of the task, there are no color-word congruent trials in which the color-word matched the color of the ink in which it is printed.

Participants completed two 48-trial experimental blocks. The **first block** included an equal mix of neutral and incongruent trials, and the **second block** included a greater number of neutral than incongruent trials.

Instructions to Participant:
In this task, you will press the button that matches the color of a word, while ignoring what the word says.
The possible color responses are:
7 Red
4 Yellow
1 Green
0 Blue

Press Enter when you are ready to begin.
To get you started, we will give you some practice with crosses.
Your job is to press the button that matches the color of the crosses.
The color that goes with each button is shown below
Hit Enter to Begin

4 Practice Trials

Now you will practice identifying the colors at normal speed.
Remember, the responses are: Red Yellow Green Blue

Press Enter to continue.

You are finished with the practice trials. Now you will begin the task. Remember, you should base your response of the color of the ink in which the word is printed, while ignoring the meaning of the printed word. From left to right, the responses are Red, Yellow, Green, Blue.

Hit Enter when you are ready to begin.

Spatial Working Memory
“Remember the Boxes”

Overview:

This task examines both the ability to maintain information in spatial working memory as well as to retrieve it. Subjects are presented with a series of red squares on a grid, one at a time. They must then recall the order in which the red squares appeared on the grid. Thus, individuals must not only remember a sequence, but the location of the items. This task is computer adaptive; when the subject responds correctly, the task becomes increasingly more difficult, offering an additional square to remember. The number of test items increased until participants failed to correctly recall two successive trials at a given list length. A participant’s *spatial working memory* was defined as the maximum list length for which all items were recalled in the correct serial order.

Notes:
- The minimum starting sequence is **3** red squares
- If a participant is given an additional square to remember, but does not remember the entire sequence, the number of squares remains the same (i.e. does not *decrease* based on incorrect responses)
- Task is discontinued when participants fail to recall 2 successive trials at given length

Instructions to Participant
In this game, you will see a grid with 16 boxes. The boxes in the grid will turn red.
Your task is to remember the order the boxes turned red.
You will use the mouse to click on a blank grid and indicate the order that the boxes turned red.
Let’s do a few for practice.

Practice Feedback:
You remembered #items correctly
You got __/__ correct

Now, I'm going to let you do the task by yourself. Keep in mind that the goal is to remember as much as you can.
First, you will be asked to remember the order of 3 boxes. The better you do, the more boxes you will have to remember.
If you miss once, you'll be given a chance to remember the same number of boxes as before.

“Tower of London” (Inhibitory control)

Overview:

A computerized version of the Tower of London task can be used to generate behavioral indices of *impulsivity* and *strategic planning*. As a measure of impulsivity, it measures the degree to which one inhibits acting before a plan is fully formed.

The subject is presented with pictures of two sets of three colored balls distributed across three rods, one of which can hold three balls, one two balls, and the last, only one ball. The first picture shows the starting positioning of the three balls, and the second depicts the goal position. The subject is asked to move the balls in the starting arrangement to match the goal arrangement in as few moves as necessary, using the computer cursor to “drag” and “drop” each ball.

Five sets of four problems are presented, beginning with four that can be solved in a minimum of 3 moves, and progressing to trials that can be solved in a minimum of 4, 5, 6, and 7 moves. In the administration of the task, the starting and goal positions are displayed, and the subject takes as much (or as little) time as necessary before making each move. The task is scored with regard to the proportion of problems correctly solved at each level of difficulty, the proportion correctly solved with the minimum number of moves, and the amount of time that elapses (in milliseconds) between the presentation of each problem and the subject’s first move, with shorter latencies to first move indicating greater impulsivity.

Instructions to Participant:

In this game, you will be solving puzzles like this one. Your goal is to rearrange the balls in the picture on the left so that they match the picture on the right, using the fewest number of moves possible. To move a ball, put the black bar under the peg and click the mouse. Then, slide the bar under the peg where you want to move the ball, and click the mouse again. The ball will drop onto the peg. After you have finished a puzzle, the next puzzle will appear. I will demonstrate the first puzzle for you, then you will have two practice puzzles before beginning the game.
Do you have any questions?

Each puzzle will have a game board and a goal board.
The three balls on the game board are in the starting position and they can be moved.
The three balls on the goal board are in the ending position and they cannot be moved.
To solve the puzzle, you need to move the balls on the game board so they match the balls on the goal board.
You should try to do this in the fewest number of moves.
When you are sure the Game balls match the Goal balls, left click on the ‘Done’ button.
1. Lifting a ball off of one peg and putting it down on another peg counts as one move.
2. The tallest peg only holds 1 ball. You can’t stack more than that number on each peg.
3. If you ‘drop’ a ball anywhere except on a peg, the computer will put it on the nearest peg with space for another ball.
4. The puzzles get harder as you keep going because it will take more moves to match the goal board.
5. Try to solve each puzzle in the fewest possible moves, but also try to solve each one as soon as you can.
Now the researcher will show you how a puzzle works, then give you two practice puzzles before you start the game.

Verbal Fluency
3 Letter Trials, 3 Category Trials
“Word Game”

Overview:
A measure of verbal fluency asked participants to generate, in one minute, as many words as possible which either began with a specific letter (3 trials) or were members of a category (e.g., fruits) (3 trials). A *verbal fluency* score (“Fluency.Total”) was computed by adding the total number of words generated for all six trials.

Instructions to Participant:
In this task, you will be given a letter and asked to come up with as many words as you can that begin with the letter.
Names of people and places do not count, so you should not say any of these.
Also, words that are different versions of the same word do not count. For example, don't say run, runs, and running. All three of these words just count as one answer.
When I tell you the letter, you will have 1 minute to come up with as many words as you can.

The first letter is F.
The next letter is A.
The next letter is S.

1 legal word
2 repeat
3 unknown
(NOT INCLUDED IN DATASET)

Now we are going to do something a little different. I am going to give you a category and you should try to name as many members of the category as possible.
For example, if the category was vehicles, you could say car, bicycle, truck, bus, scooter, and so on. You can't say different types of cars such as Ford, Chevy, Honda, and so on.
Do you have any questions?

The category is ANIMALS.
The category is FRUITS.
The category is VEGETABLES.

1 legal word
2 repeat
3 unknown
(NOT INCLUDED IN DATASET)

That is the end of this task.