



# Feedback about previous action improves executive functioning in schizophrenia: an analysis of maze solving behavior



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Executive functioning (EF) is regarded as one of the primarily disturbed cognitive domains in schizophrenic illness.

Executive functions can be defined as a set of cognitive processes whose primary purpose is to facilitate adaptation to novel situations by modulating and controlling of more fundamental or routine cognitive skills (Burgess 1997). Therefore, they are highly important for adaptive human behavior. They include functional domains such as self-regulation, sequencing of behavior, flexibility, response inhibition, planning and organization of behavior.

Are impairments of schizophrenic patients seen in executive tasks (e.g. WCST, maze test) linked to impairments of  
- executive functions themselves or  
- other cognitive functions additionally involved in task solving ?

The present study investigates whether the maintenance of previous processing, i.e. of previous action, influences the performance of schizophrenic patients in maze task.

## Experimental Paradigm: Maze Tasks

### Procedure:

Subjects were seated in front of a computer screen (17", 800x600 Pixel) on which two-dimensional maze displays were presented. Whenever a maze-stimulus appeared on the screen, subjects had to guide a cursor as fast as possible from a starting point to a color-coded target array. This was achieved using a graphic tablet. The movements of a pen on the graphic tablet were echoed by a cursor on the screen. During the task X-, Y-positions of graph-pad pen and cursor were measured every 5 ms and stored for evaluation.



In the main trial, mazes had to be solved with and without visualization of the route already taken, i.e. the white cursor (size 9x9 pixel) either left a trace (1 pixel width) within the paths of the maze (black, width 20 pixel) or not. In order to minimize effects of stimulus sequence, the feedback conditions were presented in balanced order. To control the complexity of the maze tasks regarding perceptual and decision-making processes as well as motor actions required, the same maze topography was presented twice in two parallel forms, one maze reflecting the mirror image of the other. Each maze involved 16 decision points, thus resulting in 32 items per experimental condition.

### Instruction:

Please, solve the mazes as fast as possible using the shortest possible route. Avoid wall touching, i.e. contacts between the "walls" of the maze and the cursor.

### Sample:

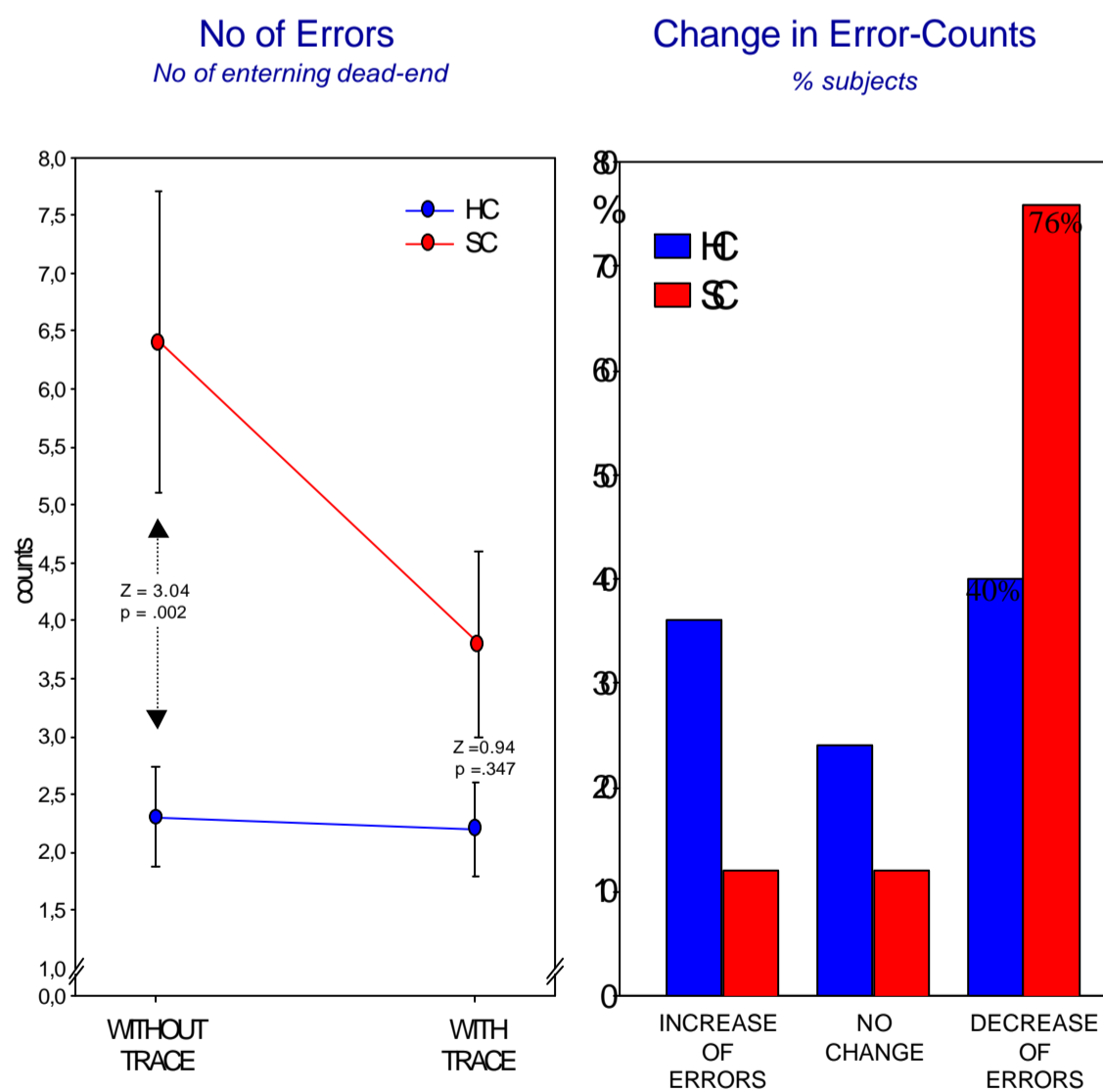
	SCHIZOPHRENIC PATIENTS	HEALTHY CONTROLS
N	25	25
Sex	12 males 13 females	12 males 13 females
Age	31.3 years SD 8.7	30.9 years SD 8.7
PANSS:		
Total	72.3 SD 23.1	
positive	14.7 SD 5.8	
negative	20.0 SD 7.9	
general	37.6 SD 11.8	
Duration of illness	6.3 SD 7.4	
No previous hospitalisations	4.0 SD 5.1	
medication	Clozapine N:12 Risperidone N:10 Amisulpride N: 1 Olanzapin: N: 1 Zotepin N: 1	

WITHOUT FEEDBACK OF PREVIOUS ACTION

WITH FEEDBACK OF PREVIOUS ACTION

## Results:

### QUALITY OF TASK SOLVING

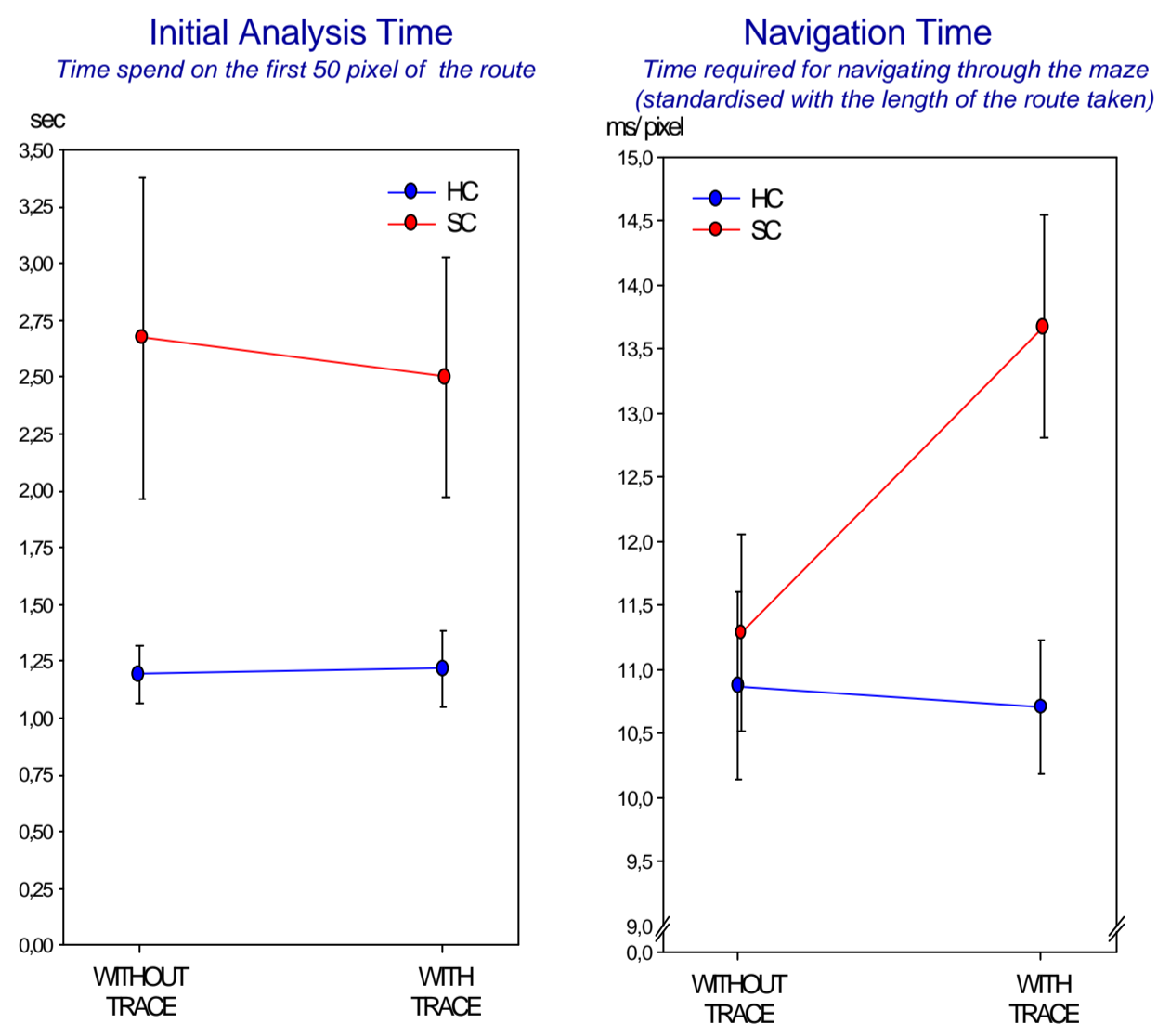


The effect of the visualisation of previous movements differs between groups:  
• no effect in HC  
• **improvement in SC**

The rate of subjects whose number of errors decreases, increases or does not change with feedback of movements, differs between groups ( $\chi^2=6.79, p=.033$ ).

NO TRACE SC enter more often dead ends than HC  
TRACE: No significant differences between groups

### TIMING OF TASK SOLVING

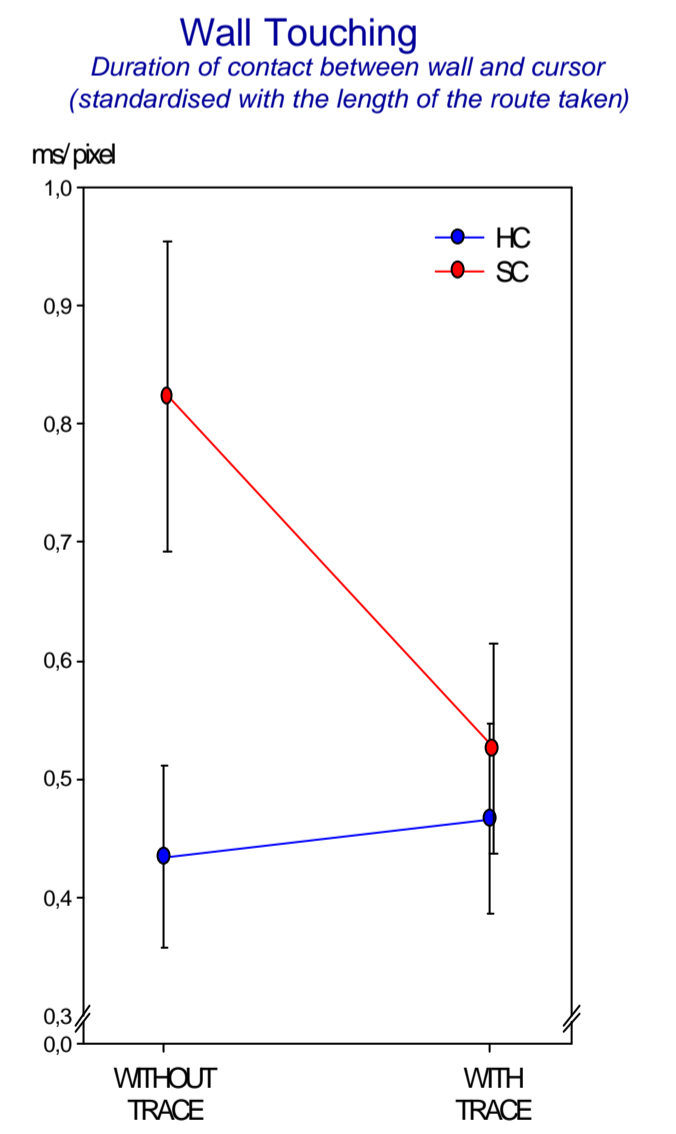


No effect of the visualisation of previous movements in both groups but, SC spend more time in the start area than HC. (main effect group:  $F(1,48)=0.27, p=.029$ )

The effect of the visualisation of previous movements differs between groups (interaction:  $F(1,48)=17.07, p<.001$ ):  
• no effect in HC  
• **increase in processing times in SC**

NO TRACE No significant differences between groups  
TRACE: SC need more time to steer the cursor through the system of paths than HC.

### PRECISION OF MOVEMENTS



The effect of the visualisation of previous movements differs between groups (interaction:  $F(1,48)=16.07, p<.001$ ):  
• no effect in HC  
• **improvement in the accuracy of movements in SC**

NO TRACE SC touch more often the walls than HC  
TRACE: No significant differences between groups

## Summary:

- Without feedback of previous movements the task solution was less successful and the control of motor action was deficient in schizophrenic patients.
- With feedback both domains of behavior improved up to the level of healthy controls at the cost of higher time demands.
- Lower demands on the maintenance of previous action seem to enable schizophrenic patients to perform executive functions successfully.
- But data suggest that task solving of schizophrenic patients is characterized by alterations in the coordination of executive functions with other cognitive processes.