



# LEARNING TO CONTROL DYNAMIC SYSTEMS IS SPARED IN HEALTHY AGING

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## Abstract

This study examines early and late learning of process control in healthy aging. We found age constancy both early and late in training, suggesting that implicit learning of this type, without the perceptual or motor components typical of most implicit tasks, is spared in normal aging.

## Theoretical Background

The two-stage theory of learning (Squire & Frambach, 1990) suggests that early on learning in the process control task is implicit, while later on it becomes explicit. We used healthy aging, with its known explicit learning deficits, as a test case to investigate this two-stage theory on one version of this task, the sugar production task.

In our previous study (Yankovich et al., 2003), as predicted by two-stage theory, we had found age constancy early in training, and age-related deficits later in training. However, no age differences were found on the specific situation task (given at the very end of training), which measured knowledge needed to perform well on the process control task. This suggests that the process control task might underestimate what older people know. Also, their lack of improvement in later training might have been due to older people getting discouraged and fatigued.

In the present study we aimed to test our interpretation of these previous results. To get a better picture of what people know about the control task at each point in training, we included the specific situations task and a questionnaire (adapted from Dienes & Fahey, 1995 and Buchner, Funke and Berry (1995), respectively) after both early and late training. Also, the tests given in the middle of training served the function of encouraging and helping the older people to reorient to the task.

## Participants

	Old	Young
Gender	14F, 16M	19F, 11M
Age	71.90 (6.71)	19.63 (1.25)
Education	15.39 (2.16)	13.40 (0.93)
Self-rated health	4.47 (0.73)	4.70 (0.47)

Note: Standard deviations in parentheses

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## Process Control (PC): Sugar Production Task

Task\*:

- Goal to reach 9,000 T of sugar
- Vary the workforce size
- 12 possible inputs (100 – 1,200 workers)
- 12 possible outputs (1,000- 12,000 T of sugar)

Goal: 9,000 T



Procedure: 2 X 40 trials

Other measures given after each set

Equation:

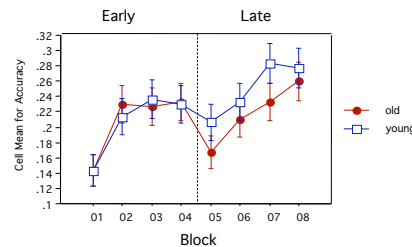
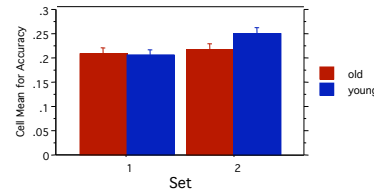
$$P = 2 \times W - P1 + r$$

- W = workforce,
- P1 = previous sugar output,
- P = current sugar output.
- r = random element, either 1, 0 or -1 (in thousands).

Trial	Workforce	Sugar Production
0	600	12,000
1	900	5,000
2	800	12,000
3	1,000	9,000
4	1,100	9,000

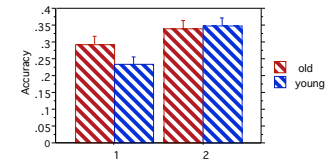
\*Adapted from Berry & Broadbent, 1984

## Learning on Process Control Task



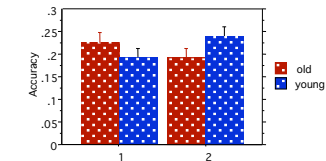
- Both young and old are learning early and late
- No significant age differences early nor late
- No ability to verbalize

## Explicit Memory: Questionnaire



➤ No age differences

## Implicit Memory: Specific Situations Task



➤ No age differences

## Conclusions

- Learning of process control spared in healthy aging
- Age constancy in learning both early and late
- Age constancy on other measures
- No support for two-stage theory

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