



IMPLICIT SEQUENCE LEARNING AND SPATIAL CONTEXTUAL CUEING IN EXPERIENCED COLLEGE-AGE MUSICIANS AND VIDEO GAMERS

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Background

Expertise results from learning domain-specific cognitive and perceptual skills that often do not transfer to different tasks and situations. However, recent studies have shown that experienced action video-game players display enhanced ability on a range of basic visual skills compared to non-gamers (Green & Bavelier, 2003; Greenfield et al., 1994). Similarly, musicians have revealed superior visuo-spatial perception, imagery and mental speed compared to non-musicians (Brochard et al., 2004). The present study compared two groups of college student experts (musicians and video-gamers) to controls in two implicit learning tasks— an alternating serial reaction time task (SRTT) and a spatial contextual cueing task. In the alternating SRTT sequential dependencies exist across non-adjacent spatio-temporal events (Howard et al., 2004) whereas in the contextual cueing task some global configurations of display elements cue the location of a search target (Chun & Jiang, 1998).

Participants

	Musicians	Gamers	Controls
Sex			
Female (30)	15	1	14
Male (24)	3	17	4
Age (in years) [*]	19.43 (18-22)	19.65 (18-24)	19.02 (18-21)
Education (in years) [*]	12.66 (12-15)	12.61 (12-14)	12.56 (12-14)
Self-rated health ¹	4.28 (3-5)	4.50 (3-5)	4.50 (3-5)
WAIS-III Digit-Symbol Coding [*]	86.06 (47-111)	78.81 (67-98)	85.22 (71-104)
WAIS-III Digit Span test [*]	17.50 (13-23)	19.11 (11-26)	16.11 (11-25)
WAIS-III Spatial Span test [*]	16.72 (11-28)	17.83 (11-30)	16.33 (12-21)
WAIS-III Vocabulary test [*]	35.44 (26-50)	32.67 (20-46)	30.83 (17-35)

^{*} No group differences. ¹ Responses ranged from 1 (poor) to 5 (excellent).

Interpretation and Conclusions

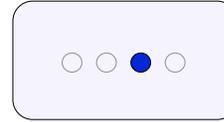
Results revealed implicit learning of these relationships in all three groups (music, gamer and control) on both tasks in that there was clear evidence of learning in the absence of declarative knowledge of what was learned. Musicians and gamers responded more quickly than controls on both tasks and, more importantly, the two expert groups revealed greater implicit learning than controls on sequence learning, but not on contextual cueing. These findings are consistent with evidence that the two tasks depend on different underlying brain systems and suggest that the component skills they entail transfer better to temporal sequencing than to spatial cueing.

Cognitive Neuroscience Society Annual Meeting
April 10-12, 2005, New York, NY
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Supported by NIA Grant R37AG15450

Alternating Serial Reaction Time Task

Learning

- Repeating sequence
- Alternates with random events (e.g. 1r2r3r4r...)
- 8 epochs of 20 blocks each
- Push key under stimulus



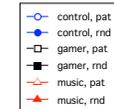
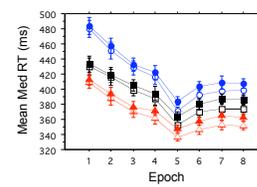
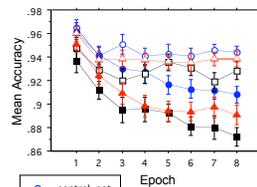
Response

Explicit Tests

- Recognition test
- Card sorting
- Interview

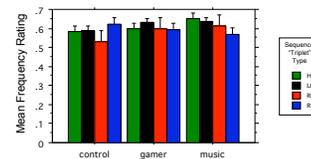
Learning:

- Learning Measure = Difference between pattern and random trials
- All groups learn regularly.
- But more learning occurs in expert groups.



- On both accuracy and reaction time, pattern and random trials diverge across epochs for all groups.
- Pattern trials are faster and more accurate than random for all groups.
- On accuracy, both expert groups show a greater pattern vs random separation than controls (group x trial-type interaction).

Explicit Recognition:

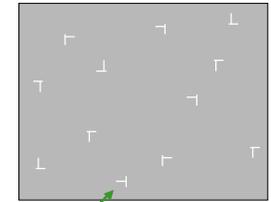


- Learning is implicit.
- Participants are unable to differentiate sequences that occurred rarely versus often.

Contextual Cueing Task

Learning

- Fixation dot
- Visual array of 12 items
 - 11 distractors (L's--orientation varies)
 - 1 target (horizontal T)
- Task to find T, respond to **direction**
- Auditory feedback
- 24 trials over 30 blocks over 6 epochs
 - 12 repeated, **familiar** configurations
 - 12 new, **novel** configurations



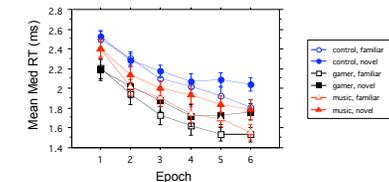
- On familiar trials
 - Configuration predicts **location** of T
 - NOT direction of T

Explicit Test: Identify quadrant where target is most likely to occur.

- 12 old, **familiar** configurations
- 12 new, **novel** configurations
- Interview

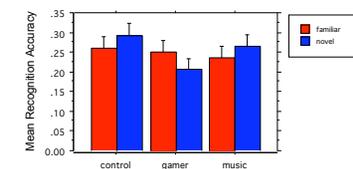
Learning:

- Learning measure = Difference between familiar and novel trials
- All groups learn regularly.
- No group differences in learning.



- On reaction time, familiar and novel trials diverge across epochs for all groups.
- Familiar configurations are faster than novel for all groups.
- No group x trial type interaction for reaction time or accuracy.

Explicit Recognition:



- Learning is implicit.
- Participants are unable to identify quadrants in which the target occurred on familiar trials.