

Threatening Impairment: The Effects of Diagnosis Threat on Computerized Concussion Screening Tests

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Introduction

- Can expectations of being diagnosed with cognitive impairment actually result in poorer cognitive performance—a concept referred to as diagnosis threat?
- For example, following a head injury, might expectations of cognitive effects in and of themselves lead to poorer performance on tests used to diagnose and manage concussions?

Introduction (cont.)

- Prior research on the effects of expectations in this context has largely relied on participants' self-report of post-concussion symptoms (Mittenberg, DiGiulio, Perrin, & Bass, 1992; Panayiotou, Crowe, & Jackson, 2011).

Introduction (cont.)

The few studies examining actual cognitive performance yield varied results:

- Suhr and Gunstad (2002) found that participants performed significantly worse on cognitive tasks when attention was drawn to a previous head injury.
- Ozen and Fernandes (2011) found that a similar but more subtle manipulation affected self-reported symptoms but not cognitive performance per se.

Introduction (cont.)

- We extend the investigation of diagnosis threat to athletes' performance on a short battery of computerized cognitive tests increasingly used in concussion diagnosis and management
- In this context, expectations of impaired performance are likely to be rather high, thus highlighting the importance of determining whether expectations influence performance on these tests.

Method

Participants

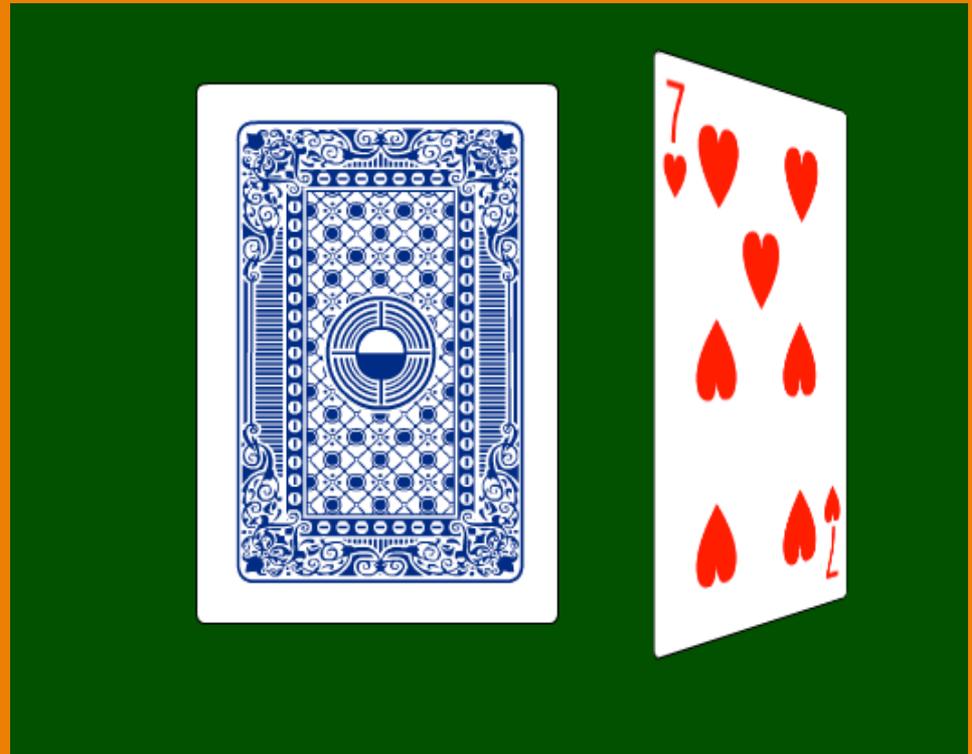
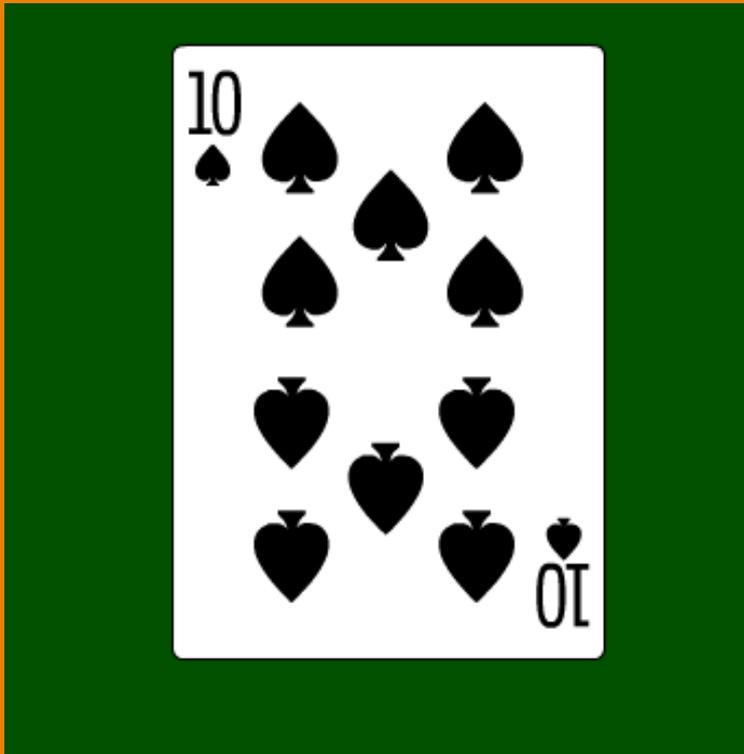
- 23 NCAA Division III athletes
- 9 soccer players: 7 females, 2 males
- 14 field hockey players: 14 females
- Quasi-random assignment to Negative Expectation or Neutral Expectation condition

Materials

- Printed excerpts from a *MedPage Today* article (Neal, 2012), selectively abridged to induce either negative or neutral expectations about future cognitive performance
- Post-test questionnaire, including manipulation check, demographic information, anxiety and mood inventories, powered by Survey Monkey

Materials (cont.)

- Axon Sports Computerized Cognitive Assessment Tool (CCAT)
 - 4 tasks using computerized playing cards
 - Participants press the appropriate key on the keyboard as quickly and accurately as possible.
 - Detection: Indicate when a card flips over
 - Identification: Indicate whether the card is red
 - One Card Learning: Indicate whether the card has appeared among the cards presented earlier within the same task
 - One Back: Indicate whether the current card is the same as the previous card



Figures 1 and 2. Screenshots from the CCAT's One Card Learning Task.

Procedure

- Conducted in a computer laboratory at individual computer terminals with headphones
- Participants entered the laboratory, signed an informed consent form, and were told to follow instructions from individual written packets:
 - Read *MedPage Today* excerpt (Neutral or Negative Expectation manipulation)
 - Completed a shortened practice CCAT test
 - Completed a full CCAT test
 - Completed the post-test questionnaire
- Participants were read a debriefing statement that revealed the full purpose of the study and the presented the full results reported in the *MedPage Today* article.

Neutral Manipulation

- “Most head impacts during sports do not result in concussion or mild traumatic brain injury, but concerns have been raised about the cumulative effects of repetitive impacts....McAllister and colleagues evaluated the cognitive effects of repetitive head impacts over a single season...at three National Collegiate Athletic Association (NCAA) programs....On one of the tests included in the neuropsychological battery, the contact athletes were more likely to fall short of the expected performance after the season. In addition, poor performance on two of the postseason cognitive measures...was associated with greater exposure to various head impact metrics.”
The cognitive tests you are about to take are similar to those used in the aforementioned study that found poorer post-season performance on some cognitive tasks.

Negative Manipulation

- “Most head impacts during sports do not result in concussion or mild traumatic brain injury....McAllister and colleagues evaluated the cognitive effects of repetitive head impacts over a single season...at three Division I National Collegiate Athletic Association (NCAA) programs....There were few cognitive differences between the contact and noncontact athletes in the preseason and postseason assessments, ‘suggesting that accumulated impacts over multiple previous seasons (i.e., prior to the index season) are not associated with reduced cognitive performance....,’ according to the authors.” The cognitive tests you are about to take are similar to those used in the aforementioned study that overall found no reductions in cognitive performance over multiple seasons.

Results

Manipulation Check

Table 1 Responses to manipulation check items and condition

Manipulation check item (See Appendix A)	Neutral expectation	Negative expectation	F	<i>p</i> -value
Perceived personal relevance of excerpt (8-point likert scale)	M=6.18 SD=1.250	M=5.75 SD=1.288	.162	.692
Perceived truth of excerpt (6-point likert scale)	M=3.73 SD=.905	M=4.17 SD=.389	.429	.521
Performance expectations (8-point likert scale)	M=5.55 SD=1.128	M=5.17 SD=1.029	4.549	.048*
Likelihood of cognitive impairment (8-point likert scale)	M=4.18 SD=1.537	M=4.17 SD=1.115	.015	.904

Note. M=mean; SD=standard deviation; F=multivariate analysis of variance result

*Denotes a significant univariate effect at the alpha level $p < .05$.

Manipulation Check (cont.)

- No significant difference was found between the two excerpts' perceived personal relevance or truth.
- Participants in the Negative Expectation condition had significantly lower performance expectations compared to those in those in the Neutral Expectation condition.
- However, performance expectations of participants in the Negative Expectation condition were still fairly high, corresponding to a rating of “above average.”
- Participants in the two conditions did not differ in their belief in the likelihood that they were experiencing cognitive impairment.

Condition and CCAT Response Speed

Table 2 Transformed speed scores for each CCAT task and condition

	Neutral expectation	Negative expectation	F	<i>p</i> -value
Detection task	M=2.479 SD=.054	M=2.504 SD=.065	.835	.382
Identification task	M=2.619 SD=.057	M=2.655 SD=.057	5.555	.040*
One Card Learning task	M=2.881 SD=.070	M=2.922 SD=.049	8.040	.018*
One Back task	M=2.755 SD=.076	M=2.822 SD=.078	6.368	.030*

Note. M=mean; SD=standard deviation; F=multivariate analysis of variance result

*Denotes a significant univariate effect at the alpha level $p < .05$.

Condition and CCAT Response Speed

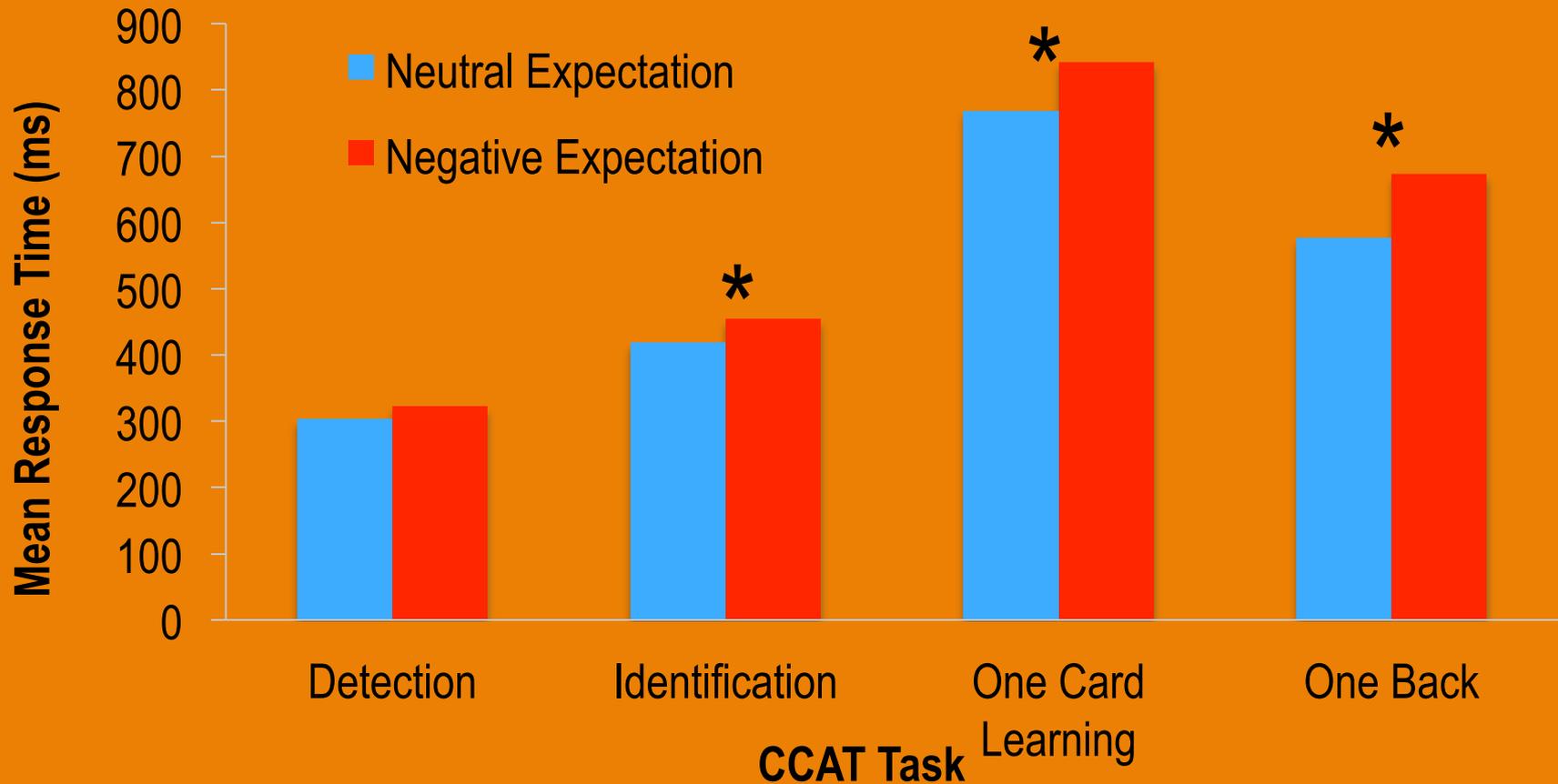


Figure 3. Mean response time (ms) for each CCAT task and condition
*Denotes a significant univariate effect, $\alpha = .05$

Condition and CCAT Response Accuracy

Table 3 Transformed accuracy scores for each CCAT task and condition

	Neutral expectation	Negative expectation	F	<i>p</i> -value
Detection task	M=1.487 SD=.123	M=1.538 SD=.078	5.974	.035*
Identification task	M=1.416 SD=.142	M=1.424 SD=.119	.371	.556
One Card Learning task	M=.942 SD=.039	M=1.010 SD=.074	6.561	.028*
One Back task	M=1.341 SD=.133	M=1.434 SD=.160	3.173	.105

Note. M=mean; SD=standard deviation; F=multivariate analysis of variance result

*Denotes a significant univariate effect at the alpha level $p < .05$.

Condition and CCAT Response Accuracy

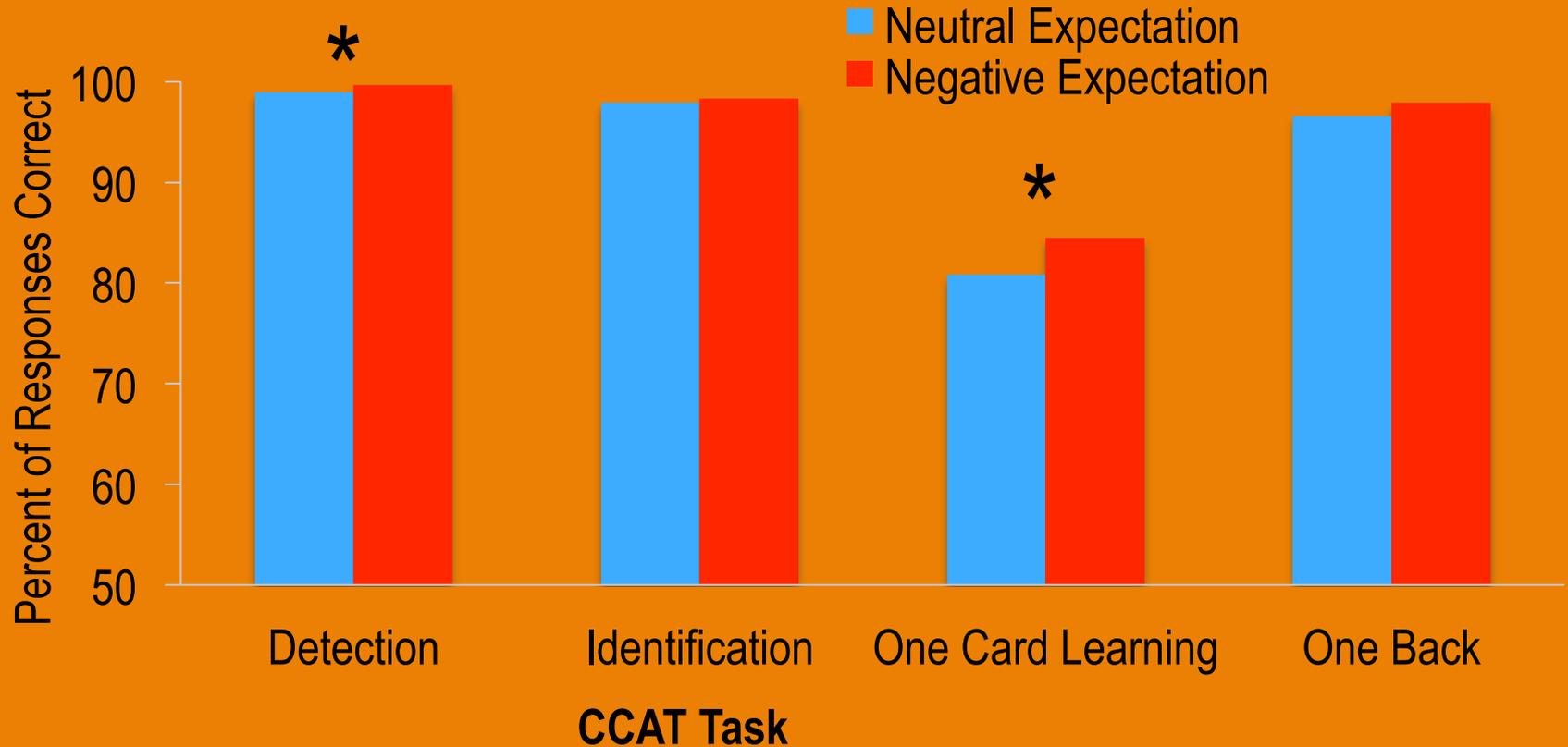


Figure 4. Mean response accuracy for each CCAT task and condition
*Denotes a significant univariate effect, $\alpha = .05$

Discussion

- Participants who were primed with negative expectations responded more slowly but more accurately on CCAT tasks compared to participants who were primed with neutral expectations.

Discussion (cont.)

- Participants who expected to perform worse might have hesitated during CCAT tasks to verify their responses, leading to slower but more accurate performance.
- Because the manipulation did not induce strong negative performance expectations as assessed by self-report, the effects might have occurred at a subconscious level or through a mechanism of the than expectation.
- Due to differences in the nature of the tasks, subjective expectations of performance can have a unique effect on each task.

Discussion (cont.)

- Diagnosis threat can differentially affect response speed and accuracy, which should be evaluated separately when interpreting results of concussion tests, as opposed to using a composite score that includes both speed and accuracy.
- In a real world setting, the act of taking a concussion screening test following head trauma might induce stronger expectations of cognitive impairment than we were able to produce in an experimental setting, which in turn might produce even greater performance differences.
- By making cognitive screening more regular and routine, we might decrease the association between testing and injury and diagnosis threat.

References

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