The Relationship of Working Memory Span, Cognitive Reflection Test, and Compound Remote Associates Task Performance

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Introduction

- Insight may involve both automatic (Type 1) and controlled (Type 2) processes (Ash & Wiley, 2006; Gilhooly, Ball & Macchi, 2015)

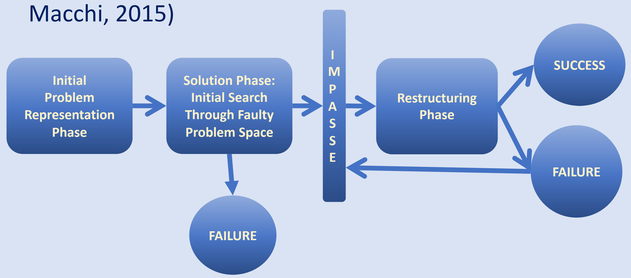

Figure 1. Information-Processing Framework for Insight Problem Solving

Insight as a solution after impasse
- Gestalt insight problems
- People with less appropriate initial problem representations are more likely to reach an impasse
- Problems solved after impasse take longer than problems solved without impasse (Ash, Jee, & Wiley, 2012)
- WM span predicts solution rate and solving time on problems with large initial problem spaces
- WM span does not predict solution rate or solving time on problems with small initial problem spaces (Ash & Wiley, 2006)
- Supports restructuring as an automatic (Type 1) process

Insight as Aha! Experience (Chein & Weisberg, 2014)
- Compound Remote Associates Task (RAT)
- WM span is correlated with the number of problems solved with Aha! Experience (r = .39, p < .05)
- Aha! solving times are faster than non-Aha! solving times, $t(51)$ = 8.0, p < .001
- Supports restructuring as controlled (Type 2) process

Cognitive Reflection Test
- Individual-differences measure of propensity for Type 1 vs. Type 2 processing (Frederick, 2005)
- CRT analytical solution rate is correlated with WM span (Cokely & Kelley, 2009; r = .31, p < .01) and with number of correctly solved RAT problems (Barr et al., 2005; r = .32, p < .05)

Method

Participants:
- 54 ODU undergraduate students participated for course credit
  - female = 28, male = 26; age M = 19.43, SD = 2.15

Measures:
- Compound Remote Associates Task (60 trials)
  - Think-Aloud protocols recorded during solving
  - Coded for instances of impasse

Insight Problems: Remote Associates Task (RAT)
Find a fourth word which creates a compound with each of the following words:
cross rain tie

- Working Memory Tasks (Composite score)
  - Operation Span (Unsworth et al., 2005)

OSPAN: Working Memory Span Task
is (8 ÷ 2) + 1 = 1? F
is (6 × 1) + 2 = 8? Y
??

- Reading Span (Redick et al., 2012)

RSPAN: Working Memory Span Task
As soon as I get done taking this envy I am going to go home. Q
Although Joe is sarcastic at times, he can also be very sweet. P
??

- Cognitive Reflection Test

Cognitive Reflection Test
A bat and a ball cost $1.10. The bat costs $1.00 more than the ball.
How much does the ball cost?

- Number of analytical solutions (e.g. $ .05)
- Number of intuitive solutions (e.g. $ .10)

Results

Table 1. *Relationships of WM, CRT(A), and CRT(I)*

	WM	CRT(A)	CRT(I)
WM	1	.36*	−.23
CRT(A)	.36*	1	−.74*
CRT(I)	−.23	−.74*	1

* p < .01

Table 2. *Linear Regression Models: Predicting Number of Correctly Solved Problems on RAT (with and without Impasse) from WM capacity and CRT*

R^2 = .02	Impasse (correctly solved, #)	R^2 = .13	No Impasse (correctly solved, #)
CRT(A)	$\beta_1 = -.10$, p = .51	CRT(A)	$\boldsymbol{\beta_1} = .38$, p < .05
WM	$\beta_2 = .12$, p = .42	WM	$\beta_2 = -.07$, p = .64

R^2 = .01	Impasse (correctly solved, #)	R^2 = .17	No Impasse (correctly solved, #)
CRT(I)	$\beta_1 = -.02$, p =.90	CRT(I)	$\boldsymbol{\beta_1} = -.41$, p < .05
WM	$\beta_2 = .08$, p = .57	WM	$\beta_2 = -.02$, p = .86

Table 3. *Linear Regression Models: Predicting Mean Successful Solving Time of RAT (with and without Impasse) from WM span and CRT*

R^2 = .08	Impasse (Solving Time)	R^2 = .08	No Impasse (Solving Time)
CRT(A)	$\beta_1 = .16$, p = .32	CRT(A)	$\beta_1 = .03$, p = .84
WM	$\beta_2 = -.29$, p = .07	WM	$\boldsymbol{\beta_2} = -.30$, p < .05

R^2 = .07	Impasse (Solving Time)	R^2 = .09	No Impasse (Solving Time)
CRT(I)	$\beta_1 = -.07$, p = .66	CRT(I)	$\beta_1 = .07$, p = .60
WM	$\beta_2 = -.26$, p = .11	WM	$\boldsymbol{\beta_2} = -.27$, p = .05

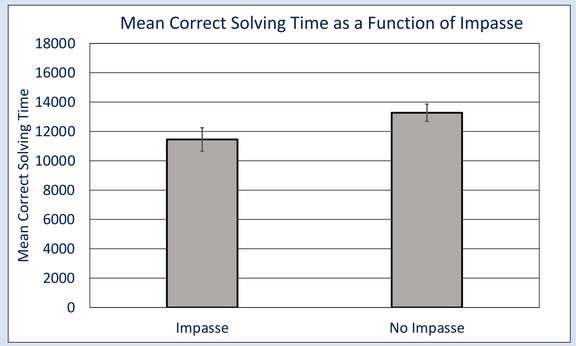

Figure 2. Mean solving time (RAT) in milliseconds: with impasse (M = 11449.98 ms, SD = 5266.74) and with no impasse (M = 13277.48 ms, SD = 3859.12,); $t(42)$ = -2.52, p < .05, d = .40.

Discussion

- When insight is operationalized as "Solution After Impasse" WM span does not predict number of insightful or non-insightful solutions
- CRT scores predict number of solutions without impasse (i.e. non-insightful solutions) but not number of solutions after impasse (supporting Type 2 theories)
- WM span shows similar relationship with RAT solving time on impasse and non-impasse solutions
- On Remote Associates Task, solutions that involve impasse are solved more quickly than those without (unlike in Gestalt insight problems)
- Differences in results among previous studies may be due to type of problems used as "insight problems" (Gestalt Problems vs. Remote Associates Task) and operational definition of Insight (Aha! Experience vs. Impasse)

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