

in relational reasoning – A psychological perspective

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Abstract

- Relational reasoning operations have different complexity and utilize different cognitive processing
- This research describes two relational problem solving experiments where we looked at human performance in relational problems, involving elementary relational operations and combination of such operations
- Main findings: Operation complexity impacted performance
- Other finding: Familiarity of the presentation doesn't play a significant role in performance

Background

- Relational reasoning problems have only been studied from the perspective of computer science; here we are taking a psychological perspective
- In this research, we aim to find the role of relational problem complexity and domain familiarity of subjects psychology in resolving relational problems
- Approach to problem is a factor of resolutions

Experiments

- Two studies explore subject ability to carry out the most basic forms of relational inference: projection, union, difference and join
- Participants were recruited on Amazon Mechanical Turk (mTurk): \$0.5 for participation with no bonus for performance
- One of four condition/problems randomly assigned to subjects
- Provided set of tables with sample data and list of 8 randomized steps.
- Only 4 out of 8 were correct
- Select 4 correct steps out of 8 and organize in correct logical order [1-4]
- Discrimination and accuracy are performance measures

Experiment 1

- Experiment 1 run with basic relational operations

Experiment 2

- Run with combination of relational operations (projection, union, difference and join)

After the experiment

- Participants were asked to report the difficulty level of their problem and their confidence in the solution
 - 1 being "Not Difficult/Not Confident"
 - 7 being "Very Difficult/Very Confident"
- Given questionnaire with 10 question to gauge their familiarity with spreadsheets, computer program, mathematics, logical reasoning and problem solving
 - 1 being no familiarity
 - 7 being high familiarity

Some future investigations

- Do people utilize strategies from everyday reasoning for solving relational problems?
- What particular type of error people make while solving relational problems?
- What are the general error patterns and how can we rectify it?

Acknowledgements

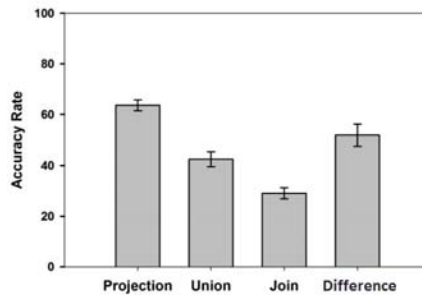
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Experiment Results

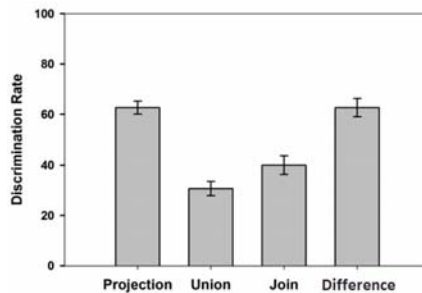
Experiment 1

- N = 398(57.25%=F, M age = 33.57)
- Experiment run with elementary relational operations

Comparison of Accuracy Rates across different Problems



Comparison of Discrimination Rates across different Problems



Correlations of Familiarity Score on Accuracy and Discrimination Rates.

	Total Score		Excel Score		Rest Score	
	Accuracy	Discriminatio n	Accuracy	Discriminatio n	Accuracy	Discriminatio n
	r_s	N	r_s	N	r_s	N
P	-.04	115	.05	115	-.09	115
U	-.10	92	-.10	92	-.02	92
J	-.10	98	.23*	98	-.08	98
N	-.23	93	.03	93	.02	93

Note: *** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$.

Correlations of Difficulty and confidence on Accuracy and Discrimination Rates.

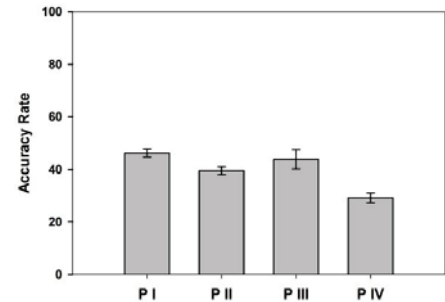
	Accuracy		Discrimination	
	Difficulty	Confidence	Difficulty	Confidence
	r_s	N	r_s	N
P	-.25**	115	.40***	115
U	.18	92	-.06	92
J	-.35***	98	.33**	98
N	.12	93	.36***	93

Note: *** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$.

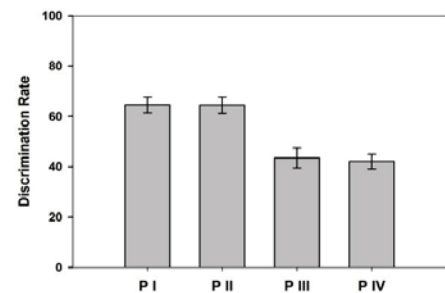
Experiment 2

- N = 403(42%=F, M age = 34.45)
- Experiment 2 Run with combination of relational operations like projection, union, difference and join.

Comparison of Accuracy Rates across different Problems



Comparison of Discrimination Rates across different Problems



Correlations of Familiarity Score on Accuracy and Discrimination Rates.

	Total Score		Excel Score		Rest Score	
	Accuracy	Discriminatio n	Accuracy	Discriminatio n	Accuracy	Discriminatio n
	r_s	N	r_s	N	r_s	N
P I	.01	111	.005	111	.09	111
P II	.05	107	-.07	107	.07	107
P III	-.01	92	-.05	92	-.01	92
P IV	.19	92	-.04	92	.25*	92

Note: *** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$.

Correlations of Difficulty and confidence on Accuracy and Discrimination Rates.

	Accuracy		Discrimination	
	Difficulty	Confidence	Difficulty	Confidence
	r_s	N	r_s	N
P I	-.19*	111	.13	111
P II	-.45***	107	.40***	107
P III	.10	92	-.20	92
P IV	.17	92	-.25*	92

Note: *** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$.

Conclusion

- Two studies that looked at human performances in solving relational problems composed of basic relational operations
- Basic relational operations differed in complexity and led to different accuracy and discrimination across problems.
- Problem with high accuracy have high discrimination
- Discrimination rate is positively correlated with subject familiarity only for join operation