



THINKING ABOUT WASON´S THOG PROBLEM*

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This work is based on one of the main experimental tasks that has served as a primary focus of reasoning research: Wason´s THOG problem (Wason, 1977, 1978; Wason & Brooks, 1979).

The fundamental objectives are to present the main lines of empirical investigation, the most relevant theoretical explanations developed around this task and the repercussion which the research with the THOG problem has had for the general study of human reasoning.

The original version of this metainference task is as follows:

In front of you are 4 designs: blue diamond, red diamond, blue circle and red circle:



You are to assume that I have written down one of the colours (blue or red) and one of the shapes (diamond or circle). Now read the following rule carefully: **“If, and only if, any of the designs includes either the colour I have written down or the shape I have written down, but not both, then it is called a THOG”**. I will tell you that the blue diamond is a THOG. Each of the designs can now be classified into one of the following categories: (a) definitely is a THOG; (b) insufficient information to decide; (c) definitely is not a THOG.

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Participants often failed to discover the right answer, which was: “the red circle is a THOG and the other two designs are not”. The most commonly made biases are the intuitive errors: “Type A” (mirrors the correct response and leads to the answer “the red circle is not a THOG and the other two designs are THOGs”), and “Type B” (“the red circle is not a THOG and there is insufficient information to decide about the other two designs”) (Griggs & Newstead, 1983).

¿How reasoning with this task has been investigated?

THE THOG PROBLEM: SOME EXPERIMENTAL RESEARCH

What kind of variables might make it easier the THOG problem? Next table presents some of the main empirical studies that analysed different factors, such as the content of the task, the structure, the instructions, the scenario, the empirical knowledge and so on (Martín & Valiña, 2003).

Some empirical research with the THOG problem, by chronological order.

Authors	Version	Results-Explanation
<i>Griggs & Newstead (1982)</i>	<i>DRUG Problem</i>	Facilitation: make the structure of the problem highly explicit
<i>Newstead, Griggs & Warner (1982)</i>	<i>GASTRONOMIC Problem</i>	Facilitation: when realistic material cues in the correct answer from the memory
<i>Smyth & Clark (1986)</i>	<i>HALF-SISTER Problem</i>	Realistic content it is not sufficient to induce correct performance
<i>Giroto & Legrenzi (1989)</i>	<i>MIB-THOG Problem</i> <i>SOVIET SPIES Problem</i> <i>PUB Problem</i>	Context separating levels produce facilitation even using abstract material. Confusion Theory
<i>O'Briem, Noveck, Davidson, Fisch, Lea & Freitag (1990)</i>	<i>TRUMP Problem</i> <i>ONE-OTHER THOG Problem</i> <i>BLACKBOARD Problem</i>	Facilitation: when the version separates positive instance from the hypotheses and when subjects are required to generate hypotheses
<i>Newstead & Griggs (1992)</i>	<i>PUB Problem - reply</i>	Facilitation: separation positive instance from hypotheses and instructions
<i>Giroto & Legrenzi (1993)</i>	<i>SARS Problem</i>	Sources of error: Non-consequential reasoning and confusion theory
<i>Needham & Amado (1995)</i>	<i>PYTHAGORAS Problem</i>	Narrative thematic versions are easier to solve than the classic version.
<i>Griggs, Platt, Newstead & Jackson (1998)</i>	<i>THOG Problem</i> <i>SARS Problem - Reply</i>	Facilitation: attentional factors (via experimental instructions)

<i>Martín, Seoane, Valiña & Ferraces (1998)</i>	<i>THOG Problem DRUG Problem</i>	Performance is modulated by individual differences
<i>Marek, Griggs & Koenig (2000)</i>	<i>THOG Problem “modified”</i>	Correct performance increased reducing cognitive complexity of the problem and the possibility of non-consequential thinking
<i>Valiña, Seoane, Martín, Rodríguez & Ferraces (2003)</i>	<i>THOG Problem DRUG Problem PUB Problem SPIES Problem REPRIEVE Problem</i>	Better performance with thematic content than with abstract content Better performance with one-other instructions than with standard instructions. Individual differences
<i>Seoane, Valiña, Rodríguez, Martín & Ferraces (2007)</i>	<i>THOG Problem ONE-OTHER THOG Prob. DRUG & PUB Problems</i>	Keys: Individual differences in flexibility and cognitive abilities
<i>Koenig & Griggs (2011)</i>	<i>PYTHAGORAS Problem BLACKBOARD & SARS Problems</i>	Performance with the THOG problem is explained by the dual process theory
<i>Schreiber (2014)</i>	<i>THOG Problem “modified”</i>	Subjects rely on visual symmetry when solving the THOG problem

THINKING ABOUT THOG: THEORETICAL EXPLANATIONS

Several explanations on THOG reasoning have been proposed. Some of these are more specific, such as the “Confusion Theory” (Giroto & Legrenzi, 1989) or the “Non-consequential reasoning” (Giroto & Legrenzi, 1993). From a general perspective, two theories of human inference that have explained the reasoning

with this task are the Mental Models Theory (Johnson-Laird, 1983; 2000; 2012; 2013; 2021; Johnson-Laird & Byrne, 1991; Khemlani & Johnson-Laird, 2009, 2017; Quelhas, Rasga & Johnson-Laird, 2019) and the Dual Process Theory (Evans, 2003, 2007, 2017, 2018, 2019, 2021; Evans & Over, 1996; Evans & Stanovich, 2013). The Mental Models Theory proposes that subjects reason elaborating semantic representations or mental models from the meaning of the premises. The contents of clauses and general knowledge can *modulate* this meaning (Johnson-Laird & Byrne, 2002; Quelhas & Johnson-Laird, 2017; Quelhas, Johnson-Laird, & Juhos 2010). Initially, subjects contemplate only models that express true situations (principle of true). This may be an added difficulty in disjunctive reasoning, where subjects need to “think what is false”. Any manipulation that makes a counterexample to a hypothesis more salient, should increase corresponding selections in tests of the hypothesis. According to Khemlani & Johnson-Laird (2019) subjects use strategies and fallible shortcuts when they reason.

Focussing on the THOG problem, Mark Jones proposed an account of this task, which is based on the elaboration of mental models (Johnson-Laird, 2000). Concretely, from the initial information “Blue diamond is a THOG” subjects construct the mental models that represent only true models:

Diamond

Blue

They incorrectly inferred that “the red diamond and the blue circle may be a THOG” because it has one of these characteristics, but they cannot be certain because the other characteristic (blue) could be the critical one. They infer that “the red circle cannot be a THOG” because it shares neither of these two

features. The correct answer depends on fleshing out the initial models above in order to make explicit what is false:

Blue	\neg Diamond
\neg Blue	Diamond

The false cases in these two models can be replaced by their corresponding positive features:

Blue	Circle
Red	Diamond

The Dual Process Theory defends the existence of two cognitive processes. “Type 1”: quick, implicit and automatic processes, and “Type 2”: slow and explicit processes which require effort. Type 1 processes are responsible of heuristic strategies that may led to intuitive error in the Thog problem. Likewise, subjects can automatically activate pragmatic keys which contextualise the problem from beliefs or empirical knowledge. Type 2 processes are responsible for abstract, analytic and hypothetico-deductive reasoning, required by the formal solution to the THOG.

THE THOG TASK AND BEYOND: SOME OPEN QUESTIONS

Some key questions around the THOG task are the following: (1) **Better performance is modulated by the activation of hypothetical thinking, related to the System 2 (Giroto y Legrenzi, 1993) or, on the contrary, is related to the attentional heuristics related to System 1?** (Griggs, Platt, Newstead & Jackson, 1998; Koenig, Platt & Griggs, 2007); (2) **How can**

participants' cognitive capacity modulate reasoning with the THOG task? (Martín, Valiña, Seoane & Ferraces 1998; Seoane, Valiña, Rodríguez, Martín & Ferraces, 2007, Valiña, Seoane, Martín, Rodríguez & Ferraces, 2003); (3) **What kind of variables might make it easier the THOG problem?**; (4) **Is thematic facilitation a good criteria for evaluating the comprehension of the task?** (Koenig & Griggs 2004a, b, 2011; Koenig, Platt & Griggs, 2007); (5) **What are the mental processes underlying the responses on the THOG task: reasoning, decision making, hypothesis testing or all?** (Evans, 2007; Tversky & Shafir, 1992; Shafir & Tversky, 1992).

CONCLUSIONS

An important part of empirical researches on the THOG task, seem to emphasize the plasticity of the reasoning towards factors related to the content, the context and the empirical knowledge. To theoretical level, some of the main approaches that have explained the reasoning with this task are the Mental Models Theory and the Dual Process Theory.

Researchers' interest in studying the THOG is not limited to understanding the problem per se. Empirical studies on this task has also contributed to "illuminate the nature of human rationality" (Khemlani & Johnson-Laird, 2017) and to go deeper into "the nature of thought" (Evans & Johnson-Laird, 2003).

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