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The Role of Cognitive Effort in Framing Effects[2]

Abstract
Framing effects are a common bias in people making risky decisions. The account for this bias is found in the loss aversion derived from Prospect Theory. Most often in the decision making literature this is the effortful processes that are claimed to reduce framing effects in risky choice tasks i.e. investing of mental effort should de-bias the decision makers. However, in goal framing studies, effortful mental processes may produce those effects. In our experiment participants were primed with either effortful or effortless modes of processing before a classical Asian Disease scenario. As hypothesised, framing effects were obtained only through effortful processing. This suggests the effortful and reflective nature of framing effects.
Keywords: framing effects, effortful processing; effortless processing.

1. Framing Effects

Since 1981 the phenomenon of framing effects (Tversky & Kahneman,1981, 1986) has been extensively studied in various domains. In a typical scenario of this kind, people are to choose between two alternative options, either sure or risky. The options are equal in expected value as compared to the reference point, but described as gain or loss. People violate the invariance principle by choosing risky options when the descriptors are negative (i.e. in loss domain) and sure options when the descriptors are positive (i.e. in gain domain). The classic example is the *Asian Disease* problem: the scenario in which a deadly disease endangers the lives of 600 inhabitants of the USA. The task is the choice between two alternative rescue programmes, either sure or risky which are framed either positively or negatively but equal in value. Positively framed subjects choose between (A) saving 200 people for sure and (B) saving 600 people with a one-third probability and a two-thirds probability that no people will be saved. Negatively framed ones choose between (C) sure death of 400 people and (D) one third probability that nobody will die and two-thirds probability that all 600 people will die. The framing effect manifests in violation of the invariance principle by choosing the

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risky gamble (D) when the descriptors are negative (i.e. in loss domain) and sure thing (A) when the descriptors are positive (i.e. in gain domain).

The account for this bias is found in Prospect Theory (Kahneman & Tversky, 1979) which states that most people have the s-shaped value-function, concave for gains (which makes people risk averse) and convex for losses (which makes people risk seeking). Each prospect is evaluated (i.e. moved up or down around reference point) as gain or loss and choices are made correspondingly. Support for this is found in many experiments where the same prospects were framed (Kühberger, 2002).

Levin, Schneider and Gaeth (1998) provided the taxonomy of three separate types of framing: (i) risky choice framing, when risk preference is affected by gain/loss framing of prospects in problems of Asian Disease type, (ii) attribute framing, when object evaluation is affected due to the positive or negative framing of attributes and the object described in positive or negative terms obtains different frame-dependent evaluations, and, (iii) goal framing, when a positively framed message describes the advantages of acting while a negatively framed one stresses the disadvantages of non-acting to achieve a particular goal.

Prospect Theory is limited to the description of the phenomenon, however, despite numerous attempts including neuro-imaging (De Martino, Kumaran, Seymour & Dolan, 2006), the mechanisms underlying framing effects have not yet been fully described. Especially intriguing is the question of whether the deeper thoughts are able to prevent the occurrence of the effect.

2. The Effects of Effortful Processing in Framing Studies

The findings of risky choice research seem to indicate that the cognitive effort reduces framing effect (Kühberger, Schulte-Mecklenbeck & Perner, 1999; Mandel, 2001; Maule, 1989; Maule & Villejoubert, 2007). It has been proved that framing manipulation may not influence the decision when participants re-framed the problems (either spontaneously or following the instruction), drew cause maps before the decision, had to justify their choices afterwards and scored higher on scales measuring cognitive abilities or need for cognition (Arkes, 1991, Frederick, 2005; Maule, 1989; Maule, Hodgkinson & Bown, 2003; Smith & Levin, 1996; Stanovich & West, 2008).

2.1. De-biasing procedures

Researchers made numerous attempts to discover a reliable and replicable way to de-bias the decision makers, which was based upon the assumption mentioned above. However, only a few of the procedures were effective in removal of the influence of the framing. The effects appeared less frequently when the within-subjects

design was applied: when people were presented with the sequence of both gain and loss frames in a sequence, they tended to follow their first choice of risk or certainty, which was made under the frame shown first (LeBoeuf & Shafir, 2003; Stanovich & West, 2000). In Takemura's (1994) studies the framing effect was reduced for the participants in accountability condition i.e. those who were told that they would have to prepare an account of their choice after the decision. A similar results may be found in Sieck and Yates (1997) who obtained a reduction of framing effects in participants instructed to write an analysis of the decision (exposition manipulation). Surprisingly, considering the bulk of replications of the framing inspired experiments, the studies with successful de-biasing procedures that involve cognitively effortful processes are quite scarce.

2.2. Differences in individual qualities of decision makers

Some researchers, on the other hand, tested the role of individual differences in the cognitive abilities and motivation to reflect upon the problems and avoid framing effects. In the studies carried out with the Cognitive Reflection Test Frederick (2005) showed that high-score participants were more willing to accept the sure loss instead of gambling, which indicates the reduction of framing effects. McElroy and Seta (2003) found that the participants who adopt a primarily holistic style of thinking were sensitive to the frames whereas the framing manipulation had only marginal impact on those who preferred a predominantly analytic style. Smith and Levin (1996) used framing tasks in participants with different levels of the need for cognition. In this case framing effects were restricted to low-NC participants.

Apart from the need for cognition Simon, Fagley and Halleran (2004) decided to measure an additional variable, i.e. the level of mathematical skill (with a single question of self-evaluation). The results of their study show that the high need for cognition reduces the framing effect only in those participants, who scored highly in mathematical skill. The result, however, occurred to be difficult to replicate. In follow-up studies with different operationalisations of skill in mathematics (the assessment of self-efficacy, the results of the examinations and the anxiety experienced in relation to mathematics) revealed no significant reduction of the effect. It seems that the key to the phenomenon is the declaration of mathematical skill which preceded the experimental task which possibly induced a more logical/normative approach to the problem.

2.3. Controversies

On the basis of the results reviewed above it could be assumed that cognitive abilities and the readiness for effortful, systematic and rule-based processing re-

duces the influence of frames on decisions in most cases. However, there are also some findings which shed a different light on the problem. In the experiment by Svenson and Benson (1993) participants made decisions with or without a time limit. The greater impact of the frames was observed with no time restrictions than with the time-limit, which implies that it is the deep thought which is responsible for the bias.

Similar results were obtained by Igou and Bless (2007; see also Bless, Tilmann & Franzen, 1998) in a series of experiments in which the *Asian Disease* task was labeled either as a *statistical* or a *medical* problem. When the task was cued as *statistical*, the framing effects were reduced regardless of the effort put by the participants, however in the condition of medical reasoning, the more effort that was put in to the problem solving the stronger the impact of the frames. In the follow-up studies combining verbal protocols and time measures the authors found that framing effects were more likely in participants with a more effortful mode of processing, spending more time and generating more thoughts.

Thus although most of the findings of risky choice research seem to indicate that the cognitive effort reduces framing effect, this may be the result of the procedures which led to the removal of the frame or encouraged participants to elaborate the problem correctly. High cognitive capabilities and high motivation to use it may lead to the reduction of framing effects due to the fact that both features may result in a more correct understanding of the problem. Nevertheless, it may be stated that under some circumstances all people are able to engage in analytical processing, although those with higher cognitive abilities are more successful in finding normatively correct solutions (e.g. De Neys, 2006; De Neys & Schaeken, 2007; Klaczynski, 2009). Comparing the results of experiments on risky choice and goal framing shows different patterns of results. Goal framing effects are reduced or reversed in the case of low cognitive effort or low involvement of participants and tend to be more frequent under negative framing condition (Levin et al. 1998; Maheswaran & Meyers-Levy, 1990; Meyers-Levy & Maheswaran, 2004). In the goal research the focus was, however, on manipulating the participants' general mindset, i.e. the amount of effort involved in the processing of the problem with no stress put on normative correctness of thinking. The effortful mindset resulted in framing effects corresponding with those obtained in risky choices: people were more willing to act, including risk taking in the negative frame. Therefore we assume that it was just the enhanced correctness of understanding of the specific problems and high individual mental abilities that reduced the framing effects rather than the effortful processing itself. In other words, we think that although some specific cognitive efforts limit the framing effects, it does not mean that the effects are produced with effortless processing. The key question in our study was to test whether the activation

of effortful vs. effortless modes of thinking facilitates the occurrence of framing effects. We posed a hypothesis that framing effects will be produced by an effortful mode of thinking [H1] and the effortless mode of thinking will reduce the effects which the frames have on decisions [H2].

3. Method

3.1. Participants

One hundred and twenty adults participated in the study voluntarily. Participants were non-students, educated on secondary or higher level (60 males and 60 females). Participants were randomly assigned to 6 groups ($n = 20$), balanced in respect to gender.

3.2. Design

We used a 3×2 between-subjects design. Two priming conditions (effortless vs. effortful processing) and a control group as well as two framing conditions (gain domain vs. loss domain) were designed. The participants were presented with the Asian Disease decision task to which they had to respond by indicating their behaviour towards sure and risky options.

3.3. Priming the effortful and effortless mindsets

As risk analysis is strongly related to the probability concept and rules, we decided to aim the manipulation at activating both modes of processing in reference to numerical representations and arithmetical reasoning. We decided that if any verbal cues can influence the framing effects than no verbal contents should be involved in the manipulation tasks. In the previous research the participants' cognitive efforts could have been motivated with searching for normative correctness. Therefore in the present studies both effortful and effortless mindsets were induced with respect to equal focus on performing accurately in the manipulation tasks but concurrently with no stress to perform correctly in the decision tasks.

In the effortless condition, subjects were presented with 12 pairs of numbers, either identical or not (e.g. 856,04 vs. 856,04 or 121,31 vs. 131,21). Participants were asked to answer if the numbers are t*he same or different* by ticking one of the checkboxes below each pair. We assumed that such a task made people adopt effortless, perceptual and holistic processing because the task involves a mere act of perception. Even if it activates the representations of numbers, it is still possible to judge the similarity without any knowledge what the numbers really mean.

In the effortful condition subjects were presented with 12 arithmetical calculations, either correct or incorrect [e.g. $(9 \times 3 + 7) : 2 = 17$ or $7 \times (15 : 5 + 2) = 36$]. Participants were asked to answer if the solutions were right or wrong by ticking one of the checkboxes below each calculation. We assumed that this task demanded using abstract mathematical rules. A person with no mathematical knowledge would fail to do the task properly. Therefore we assumed that such a task makes people adopt effortful, rule-based and analytic processing.

The manipulation was tested in two between-subjects pilot studies ($N = 80$, age 19-32, $M = 23.3$, $SD = 2.65$, 39 male and 41 female). The aim of the pilot studies was to test whether the manipulation changes the performance and the reactions to other tasks related to the perceptual or rule-based operations. We decided to run the manipulation check as pilot studies due to the fact that the effects of priming tend to disappear with time and may be overridden by any mental processes involved in performing each subsequent task (e.g. Bargh & Chartrand, 2000).

In the pilot studies we applied each priming manipulation before two various target tasks which differed on their demand for the complexity of mental processes, with no framing and decision involved. Thus in the pilot studies the participants played two computer games: a less complex, motor-perceptual game and a more complex, reasoning one. In the less complex game there were moving dots presented on the screen and the task was to click on them to remove as many as possible. In the more complex game the task was to click and carry the blocks on the screen through the maze. After having read the instruction and a trial game, the participants were asked to do the manipulation task and then to start playing with no delay. The quantity of the dots removed successfully and the quantity of the blocks carried successfully through the maze were registered within the time of three minutes from the start of the games. After the games were over, the participants were asked to indicate how difficult the game was on the four-point scale and how tired they felt on the analog 100mm scale.

We expected that if the manipulation works, three results should be obtained. First, we predicted that there should be no difference between the effortless and effortful conditions in how well the participants scored on the less complex game but they should score better on the more complex game under the effortful manipulation. This prediction was confirmed. In the motor-perceptual game no significant difference in the scores between the groups with the effortless and the effortful priming task was obtained ($M = 38.7$, $SD = 1.72$ vs. $M = 39.35$, $SD = 0.99$ respectively), $t(30, 31) = -1.47$, $p = .15$. In the reasoning game the participants in the effortful condition ($M = 1.95$, $SD = 0.89$) scored better than those in the effortless condition ($M = 1.1$, $SD = 0.72$), $t(38) = -3.33$, $p < .01$. Secondly, we expected that participants in the effortful condition should judge

the more complex game as less difficult than the participants in the effortless condition while there should be no difference in the difficulty assessment of the less complex game. This prediction was also confirmed. In the motor-perceptual game the difference in the difficulty assessment between the effortless and the effortful conditions was insignificant ($M = 2.1$, $SD = 0.85$ vs. $M = 2.2$, $SD = 0.62$ respectively), $t(38) = -0.43$, $p = .67$. However, the participants evaluated the reasoning game as less difficult in the condition when the effortful processing was activated ($M = 2.45$, $SD = 0.69$) than in the condition when the effortless processing priming task was applied ($M = 3.0$, $SD = 0.65$), $t(38) = 2.6$, $p < .02$. Furthermore, we expected that the participants in the effortful condition would be more tired regardless of the complexity of the game. The last prediction was also confirmed. In the motor-perceptual game the tiredness was higher after playing the game having the effortful processing activated ($M = 32.3$, $SD = 20.95$) as compared to when the game was played after the effortless manipulation ($M = 14.2$, $SD = 4.91$), $t(21,08) = -3.76$, $p < .01$. In the reasoning game a similar effect was obtained: the tiredness was higher in the group with the effortful manipulation ($M = 46.1$, $SD = 21.25$) than in the group with the effortless priming task ($M = 23.5$, $SD = 14.58$), $t(33.65) = -3.92$, $p < .001$.

3.4. The decision task

The participants were presented with the slightly modified *Asian Disease* scenario. The first line which read *The authorities of the USA are preparing for the outbreak...* was replaced with *The authorities of a certain town are preparing for the outbreak...* The last part of the scenario included one sure and one risky rescue programme and was modified dependent on the framing condition. In the gain domain the first programme was framed as saving 200 people for sure and the second programme was framed as saving 600 people with a one-third probability and a two-thirds probability that no people will be saved. In the loss domain the first programme was framed as the sure death of 400 people and the second programme was framed as one third probability that nobody will die and two-thirds probability that all 600 people will die.

We measured the intention to implement each of the rescue programmes separately as well as the final choice between the two programmes. Under each programme there was an analog 100 mm long scale with the left end described as *I am definitely not going to implement Programme I* (or *Programme II* in case of the second programme) and the right end described as *I am definitely going to implement Programme I* (or *Programme II* respectively). The participants were asked to mark a point on each scale to indicate their intention. At the end of the experiment the participants were asked to point out which rescue programme

they would choose eventually by ticking one of two checkboxes presented next to Programme I and Programme II.

3.5. Procedure

At the beginning of the experiment participants were informed that the study concerned perception. Then they filled in the manipulation sheets and directly after they were presented with the decision task. Having completed the tasks, participants were thanked and debriefed.

4. Results

In the effortful condition, as hypothesized, a strong and statistically significant framing effect was observed ($X^2 = 7.15$, $p < .01$). As much as 75% of the participants were risk seeking in the domain of loss and 67% of them were risk averse in the domain of gains (see Figure 1). The statistical trend of the framing effect was obtained in the control group ($X^2 = 3.54$, $p = .06$): 85% of the participants in the loss frame were risk seeking, however in the gain condition only 42% of them displayed preference for certainty (see Figure 2). As hypothesized, in the effortless condition no effect was observed: 50% of the participants were risk seeking in the loss domain and 35% of the participants chose the sure option in gain domain ($X^2 = .92$, $p = .34$; see Figure 3).

Figure 1. The percentages of sure and risky choices in the effortful condition

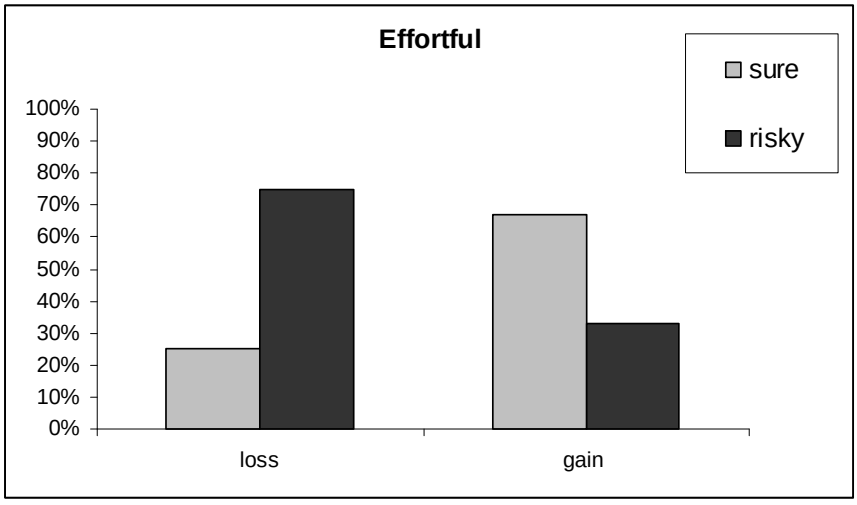


Figure 2. The percentages of sure and risky choices in the effortless condition

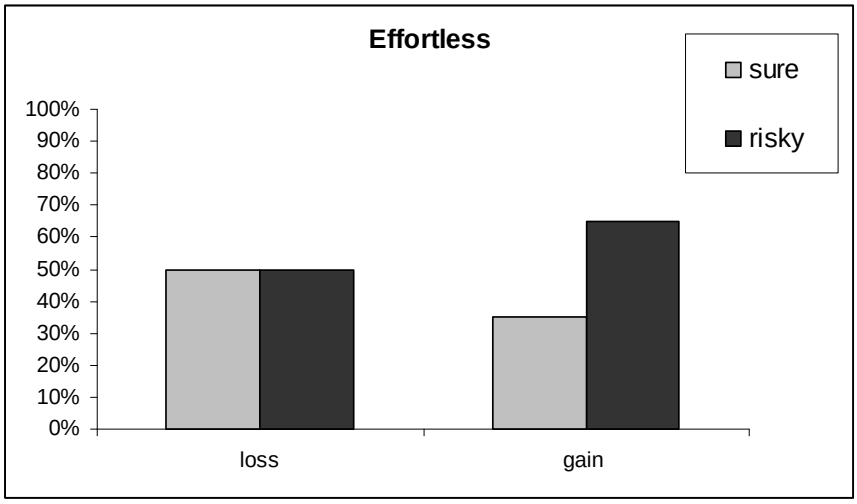
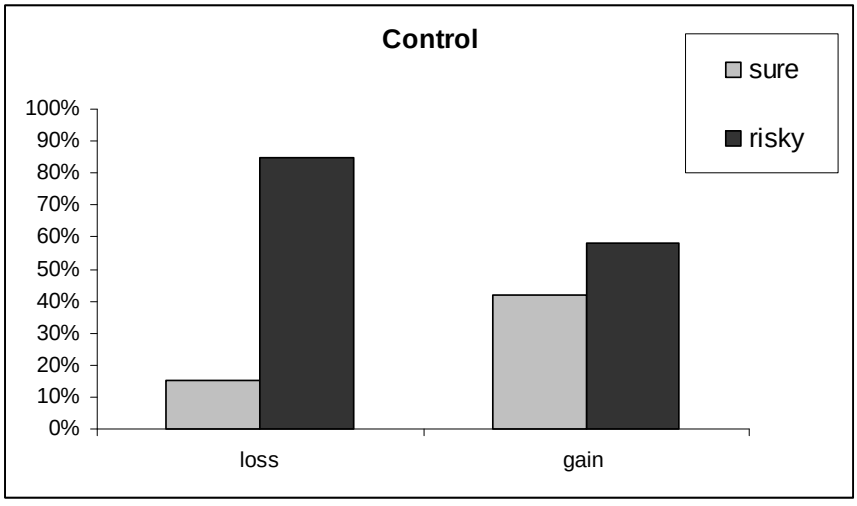


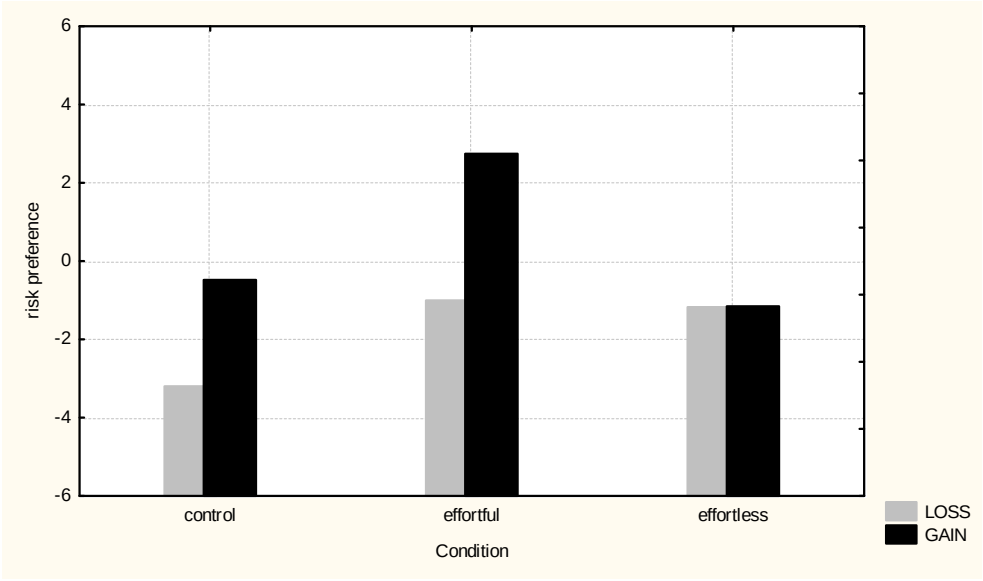
Figure 3. The percentages of sure and risky choices in the control group



The next step of analysis was performing 3 (effortful, effortless and control conditions) x 2 (gain vs. loss domain conditions) Anova for the risk preference as a dependent variable. The index of the risk preference was calculated as a difference between the behavioural intention to implement the sure option (i.e. the first rescue programme) and the risky option (i.e. the second rescue programme). The difference in the intentions to implement both programmes between gain an loss domains may be interpreted as a sign of a framing effect. The analysis

yields a significant effect of the frame ($F(1, 114) = 6.07$, $p < .02$, $\eta^2 = .05$) and a significant effect of the manipulation ($F(2, 114) = 3.46$, $p < .04$, $\eta^2 = .06$). The interaction was insignificant ($F(2, 114) = 1.62$, $p = .20$, $\eta^2 = .03$), however post-hoc tests revealed a significant difference in the mean level of the risk preference in the effortful condition ($p < .01$) and the similar statistical trend for the mean level of the risk preference in the control group ($p = .08$) However, no significant difference in the effortless condition was found ($p = .99$; see Figure 4).

Figure 4. The mean risk preference in the three conditions of the experiment



5. Discussion

The results of the experiment support the hypothesis that framing effects are generated by an effortful mode of processing. As expected, effortful-mode-primed participants were more risk seeking than those primed with the effortless mindset. The results are contrary to the most of the effects obtained in risky choice studies (i.e. effortful processing reduces the effects of the frame) but they go in line with the findings on goal framing (i.e. effortful processing enhances the effects). They indicate that the cognitive effort induced as the general mindset which all people can adopt (with no focus on normative correctness of the decision) does not reduce framing effects. In other words, there is no guarantee to arrive at normatively correct solution when the effortful processing is triggered as general mindset which causes the readiness for deeper thought, as in our experiment, or when it

is accompanied by social motivation (e.g. accountability). Comparing the results of our experiment with the findings of the previous studies may suggest that only when the effortful processing is operationalised by its quality (e.g. statistical literacy), it may lead to a normatively better decision. Thus, it is possible that the effects which are generated by the effortful processing may be reduced by the deliberative analytical thought of high mental quality.

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Efekt sformułowania a zaangażowanie wysiłku poznawczego

Abstrakt

Efekt sformułowania jest częstym błędem popełnianym przez ludzi podejmujących decyzje ryzykowne. Powodem popełniania tego błędu, według teorii perspektywy, jest awersja do strat. W literaturze dotyczącej podejmowania decyzji zazwyczaj przyjmuje się, że wysiłek poznawczy może zredukować występowanie tego błędu, tj. przy wysokim poziomie zaangażowania wysiłku poznawczego w rozwiązywanie problemu, decydenci nie będą podlegali wpływowi sformułowania scenariusza decyzyjnego (de-biasing) w kategoriach zysku lub straty. Z drugiej strony, w badaniach prowadzonych w paradygmacie sformułowania celów (goal framing) stwierdzono, że to właśnie procesy umysłowe związane z wysokim nakładem wysiłku poznawczego są odpowiedzialne za powstawanie tego efektu. W prezentowanym badaniu, uczestnicy zostali poddani manipulacji, polegającej na aktywizowaniu poprzez neutralne zadanie wysiłkowego i bezwysiłkowego trybu przetwarzania informacji, poprzedzającej klasyczny scenariusz „azjatyckiej choroby". Tak, jak zakładano, efekt sformułowania pojawił się tylko w grupie badanych przetwarzających informację w sposób wysiłkowy. Wynik ten wskazuje na wysiłkowy i refleksyjny charakter efektu sformułowania.

Słowa kluczowe: wysiłek poznawczy, wysiłkowe vs. bezwysiłkowe przetwarzanie informacji, efekt sformułowania.

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