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Deliberation-Without-Attention in Solving Insight & Analytic Problems: Does Distractor Type Have an Effect?

Viktoria Tidikis

Department of Psychological Sciences, Northern Arizona University, United States
Viktoria.Tidikis@nau.edu
https://orcid.org/0000-0002-6917-9673

Anthony Stenson

Washington State University
anthony.stenson@wsu.edu

Abstract. Replication failure is at the heart of criticism of Dijksterhuis' unconscious thought theory (UTT: Dijksterhuis, 2004). UTT has encountered considerable censure with many studies failing to replicate the original findings. This study proposes that such appraisals are lacking in their consideration of problem type and distractor tasks. Three experimental conditions were used in the study: conscious, unconscious with differing distractor task, and unconscious with like-kind distractor task. Additionally, problem type manipulation was achieved through the presentation of two problem types (insight and analytic). Participants in the unconscious deliberation with similar distractor task condition achieved significantly higher solution rates than those in the conscious and unconscious deliberation with dissimilar distractor task conditions. No difference was found between the conscious and unconscious dissimilar task conditions. Notably, patterns were the same for both types of problems (insight and analytic). Thus, this study provided partial support for the UTT effect on both creative and analytic problem solving.

Keywords: unconscious processing, deliberation-without-attention, problem solving.

Svarstymas be dėmesio skyrimo sprendžiant įžvalgos ir analitines problemas: ar atitraukiančių užduočių tipas turi poveikį?

Santrauka. Pagrindinė Dijksterhuis (2004) pasąmoninės minties teorijai pažeriama kritika yra dėl replikacijos nesėkmės, nes daugeliui tyrimų nepavyko atkartoti pradinių rezultatų. Mūsų tyrimu parodoma, kad tokiuose vertinimuose stinga atsižvelgimo į uždavinių rūšį ir atitraukiančių užduočių tipą. Tyrime buvo naudojamos trys eksperimentinės sąlygos: sąmoninga, pasąmoninga, kai pateikta skirtinga dėmesį atitraukianti užduotis, ir pasąmoninga, kai pateikta panašaus tipo dėmesį atitraukianti užduotis. Taip pat buvo manipuliuojama uždavinio tipu pateikiant įžvalgos arba analitines problemas. Dalyviai, esantys eksperimentinėje pasąmoninio apmąstymo grupėje ir gavę panašią atitraukiančią užduotį, pasiekė kur kas aukštesnį sprendimų lygį nei tie, kurie buvo sąmoningo apmąstymo ir pasąmoninio apmąstymo, kai buvo pateikta skirtinga atitraukianti užduotis, grupėse. Skirtumo tarp sąmoningų ir pasąmoningų, gavusių skirtingą atitraukiančią užduotį, grupių nebuvo. Svarbu paminėti, kad modeliai buvo tie patys abiejų problemų tipų (įžvalginės ir analitinės) atveju. Taigi šis tyrimas iš dalies patvirtino pasąmoninės minties teorijos efektą tiek kūrybiniam, tiek analitiniam problemų sprendimui.

Raktažodžiai: pasąmoninis apdorojimas, svarstymas be dėmesio skyrimo, problemų sprendimas.

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Introduction

The ongoing debate regarding the benefits of unconscious vs. conscious processing has been steadfast within the literature, with proponents of the former presenting compelling evidence which for the most part has failed to be replicated or has produced loud cries of outrage from the opposition camp (e.g., Perruchet, & Vinter, 2002; Smith, & Beda, 2023). A differing aspect to this debate is whether the unconscious is smart or dumb. Multiple evidence has been presented in support of the smart unconscious (e.g., Dijksterhuis, 2004; Dijksterhuis, & Nordgren, 2006, Li et al., 2020). The unconscious thought advantage phenomenon as articulated by Dijksterhuis' (2004) unconscious thought theory (UTT) has been observed in some, but not all studies. Failure to replicate and other methodological criticisms have seem to overrule Dijksterhuis' findings (Nieuwenstein et al., 2015). Nevertheless, Strick et al. (2011) found strong evidence for the unconscious thought effect and opined that those studies failing to replicate the original, did so simply because they did not meet the methodological criteria. On the other hand, a number of studies have shown support for conscious deliberation being superior to unconscious processing (e.g., Ding et al., 2019; González-Vallejo et al. 2008; Mamede et al., 2010). Yet, another camp of researchers (e.g., Newell, & Rakow, 2011) proposed to view even null findings of no difference between conscious and unconscious thought as noteworthy.

The dominant view of conscious processing is that it is effortful and serial in nature, allowing us to apply logic and rule-based functions to solve problems or make decisions. Nonetheless, conscious thought can only handle so much information at a given time before being overwhelmed (Baddeley, & Hitch, 1974). Should unconscious processing be less constrained than conscious processing in terms of the amount of information managed at any given time (Dijskterhuis, & Nordgren, 2006), then tasks requiring the processing of large amounts of information should be better handled by unconscious deliberations rather than the conscious. Ritter and Dijksterhuis (2014) suggested that even a short period of not thinking about the problem consciously can aid in processing of complex creative tasks.

In considering the conditions under which the unconscious thought advantage occurs, two things are worth considering: the type of task and the type of distractor. Different tasks require differing cognitive processing. Very broadly, a differentiation between automatic vs. effortful processes has been made in the dual-process model of cognition framework (e.g., Evans, & Stanovich, 2013). Type 1 processes are automatic and unconscious. These types of processes are the ones involved in automatically accessing semantic or conceptual knowledge through spreading activation. Whereas, Type 2 processes take place in the working memory (WM; Baddeley, & Hitch, 1974) and involve central executive functions. Type 2 processes are algorithmic and conscious. Based on this model, tasks that require predominant manipulation of information in the WM, such as logical reasoning, should be better handled by conscious thought. Indeed, studies showed that there is no advantage in thinking about syllogistic reasoning tasks unconsciously (e.g, Naumenko, 2006). On the other hand, tasks that rely heavily on accessing remote nodes in the associative network (e.g., divergent thinking tasks), seem to benefit from unconscious processing (e.g., Bos et al., 2008; Ritter et al., 2012).

Meta-analytic studies have identified the type of distractor used as one of the most theoretically promising moderators in the unconscious thought advantage paradigm (Nieuwenstein et al., 2015; Strick, et al., 2011). Studies in which a widely used decision making task is performed by participants having to choose the best option (e.g., an apartment) based on the attributes presented (e.g., location), the highest effect size was obtained when a word-search puzzle was used as a distractor task, but not so when anagram or n-back tasks were used. Li et al. (2021) also found that the distractor type had an effect on performance. However, their results showed an opposite trend, with dissimilar task producing better performance than similar task.

There might be several possible explanations for why distractor type may affect unconscious processing. First, the type of the distractor can be broadly differentiated into the type that is similar in terms of the cognitive processing requirements to the task the solver is trying to solve unconsciously or it may rely on different mechanisms. Baddeley's original model reasoned that WM has difficulty handling two tasks of a similar nature but is well-equipped to process two tasks requiring differing cognitive processes simultaneously (Baddeley, & Hitch, 1974). Thus, if we try to process two similar tasks in the WM, performance would suffer. Conversely, based on findings originating from procedural priming research (Mussweiler, & Epstude, 2009), similar tasks will activate associated procedures, thus making solving of the target problem easier. Other research also suggests that unconscious may utilize procedures very similar to those associated with conscious processing, if those procedures had become automatic (Naumenko, 2006). Accordingly, a similar distractor could conceivably activate the procedural steps necessary to solve the target problem.

Working memory has limited capacity and will be overloaded when excessive amounts of information are presented (e.g., Baddeley, & Hitch, 1974; Jonides et al., 1997). Proponents of the deliberation without attention effect argue that System 1 actively integrates information presented to it and, because it is unhindered by WM constraints, works towards a goal in a manner that would appear to give us an "ah-ha" moment of solution sometimes referred to as insight. In fact, Gilhooly & Fioratou (2009) found that insight tasks benefitted from Type 1 processes more so than Type 2, as it led to restructuring of problem's representation. However, System 2 conscious deliberation may override solutions or decisions made by System 1, this being the reason for our subjective perception that *we* are the ones making the tough decisions.

Overall, the deliberation without attention effect has empirical support and fits well with the dual-process model (Evans, & Stanovich, 2013); such that, our unconscious is better equipped to make a complex decision when there is both too much information presented for the conscious mind to integrate and the decision-making process is not bound by logical constraint.

In summary, previous research has yielded controversial results regarding the advantages of the unconscious processing. Thus, study's first goal was to revisit the unconscious thought paradigm and test two competing theories of unconscious processing. According to the unconscious thought advantage theory (Dijksterhuis, 2004), the unconscious condition outperforms the conscious condition. Thus, if this study found that participants in the unconscious deliberation condition solved more problems than participants in the conscious deliberation condition, it would yield support for the unconscious thought advantage theory. Conversely, based on a more traditional approach (e.g., Baddeley, & Hitch, 1974), consciously thinking about a problem should lead to a higher solution rate than that attained by unconscious deliberation. Therefore, if results showed that participants in the conscious condition outperform unconscious conditions, it would support the traditional approach to problem solving.

Our second goal was to try understanding the mechanisms of unconscious processing by manipulating the distractor task. Based on Baddeley's (Baddeley, & Hitch, 1974) model of the WM, the same type of the distractor would be most detrimental to obtaining the correct solution as it would be impossible to process the target problem that lays in the same domain as the distractor task, as the distractor would overwhelm the part of the WM necessary to solve the problem. Consequently, if the study found that in the similar distractor condition participants performed worse than in the different distractor condition, that would support such view. Contrarily, based on the UTT theory (Dijksterhuis, 2004), the condition having the same type of distractor would outperform all other conditions, as it would allow the target problem to be processed completely outside of conscious awareness, thus relying on a greater unconscious capacity. Thus, if participants in the similar distractor condition solved more problems than in the other conditions, that would support UTT theory. Furthermore, obtaining better results in the similar distractor condition as compared to the dissimilar distractor condition, would support the idea that the process of consciously solving a similar problem may activate procedures for solving it at unconscious level. Such a result would suggest that procedural priming (Fayol, & Thevenot, 2012) may occur on more complex tasks than previously thought. Should the results of the unconscious and conscious deliberation conditions yield similar results, an altogether different yet important finding may still be explored, the one suggestive of some level of problem-solving processing occurring without conscious awareness.

Our last goal was to see how insight and analytic problems fit into the unconscious thought paradigm. We chose those tasks as they were the least examined heretofore. Multiple studies found differences in how people solve analytic and insight problems (e.g., Metcalfe, & Wiebe, 1987). As these two task types have been found to rely on different cognitive mechanisms (Evans, & Stanovich, 2013), we expected to see tasks reliant on System 1 processing (such as insight problems) benefiting from unconscious processing, while tasks more heavily reliant on a System 2, or rule-based, approach (such as analytic problems) benefiting from conscious processing. Thus, we predict that more insight problems will be solved in the unconscious conditions, while more analytic problems will be solved in the conscious condition.

Method

Participants. A sample of undergraduate students (N = 133, 94 females, M_{age} = 19.82, SD_{age} = 2.45) from a large university in the Western US participated in the study. Students were recruited through a university-wide research participation system and received course credit for their participation. An a priori power analysis was conducted using G*power (Faul et al., 2007). Based on the small effect size provided by Strick et al. (2011), *Hedge's g* = .224, it was determined that to achieve a power of 0.8, there would need to be a total sample size of 132. The study was approved by the university's IRB. Ethical guidelines as set forth by the APA were followed. All participants consented to participate in the study.

Materials. **Insight and Analytic Problems.** All participants were asked to solve five insight and five analytic problems. For both types of problems participants solved two mathematical, one verbal, and two spatial problems, totaling ten problems for each participant (Appendices A & B). The mathematical/verbal/spatial distinction is commonly used in the problem-solving research, mapping onto three types of intelligence outlined by Sternberg in his Triarchic Theory of Intelligence (1984). Insight/analytic problem distinction has been used in research to analyze distinctly different problem-solving strategies employed by the solver. Insight problems require the solver to restructure problems' representation in order to solve (Knoblich et al., 1999). Insight problems used in the current study have been validated in previous studies examining cognitive processes in solving problems via insight (Metcalfe, & Wiebe, 1987). Analytic problems require to think incrementally to achieve the solution. Analytic problems used in this study have been validated in previous research (e.g., Gilhooly & Fioratou, 2009) and were selected to match insight problems in mathematical/verbal/spatial domains. A correct solution score was created by dividing the number of correct solutions by the total number of problems. To determine whether insight and analytic problems were equivalent in complexity, 15 participants participated in pilot-testing, as suggested by Isaac and Micheal (1995). There was no significant difference between the two problem types, t (11) = -1.11, p = .29. For problem solution rate, please see Figure 1.

Distractor Tasks. To match target problems, there were three types of distractor tasks: verbal, spatial, and mathematical. The verbal distractor task asked participants to complete an anagram, where a series of letters needed to be rearranged in order to form a word. The N*back (Jonides et al., 1997) was used as the spatial working memory distractor task. Finally, the mathematical distractor task presented complex math problems involving the division and multiplication of five-digit numbers.

Procedure. This procedure was adopted from the Dijksterhuis' (2004) and Ritter, van Baaren & Dijksterhuis' (2012) experiments investigating unconscious processing. Participants were randomly assigned into one of three between-subjects conditions: (1) conscious deliberation (CD); (2) unconscious deliberation with the same type of distractors (UDSD); and (3) unconscious deliberation with a different type of distractors (UDDD). All participants solved both insight and analytic problems, resulting in 3 (between) x 2 (within) mixed study design. Participants completed the experiment using paper packets in tandem with prompts from a computer using the *E*prime* program (Schneider et al., 2002). The presentation order of problems was randomized across the participants.

Participants were given a problem, and upon ascertaining their understanding, were asked to do one of three things depending on their assigned condition. The CD condition instructed to start solving it immediately. The UDSD instructed to allot three minutes working on the distractor task. Three-minute distraction time has been consistently used across multiple studies investigating the effects of distractors on unconscious deliberation (e.g., Li et al., 2020; Li et al., 2021). At the conclusion of three minutes, participants were prompted to reread the question and solve the problem. For the UDSD condition, the distractor tasks' domain matched that of the target tasks' domain, i.e., verbal tasks were paired with word search tasks, spatial tasks were paired with n*back tasks, and mathematical tasks were paired with the solving of math problems. The UDDD followed the same procedure as the UDSD group, except they were presented with a distractor task from a differing domain than that of the target task; verbal tasks were paired with n*back tasks, spatial tasks were paired with complex math problems, and mathematical tasks were paired with anagram solving problems. All participants, regardless of condition, then had eight minutes (Knoblich et al., 1999) to consciously consider and solve each problem. If participants did not indicate a solution within the allotted eight-minute time period, they were prompted to continue on to the next question within the experiment. To ensure that participants were actively working on the distractor tasks, a research assistant closely monitored participants' behavior. If participants exhibited signs of their attention shifting elsewhere, they were reminded by a research assistant to return to the task.

Results

To evaluate our hypotheses regarding participants' correct solution rate, a 3 (between: deliberation condition) x 2 (within: problem type) mixed ANOVA on rate of correct solutions was performed. It was calculated as follows: rate of correct solution = number correct/ total number of solutions (Table 1).

Table 1
Mean Solution Rates for Insight and Analytic Problems

Problem #	Insight	Analytic
1	54.89%	18.05%
2	34.59%	33.08%
3	49.62%	52.63%
4	49.65%	34.59%
5	27.82%	44.36%

There was a significant main effect of deliberation type on solution rates across both types of problems, F (2, 130) = 8.44, $p < .001$, η^2 =.12 (Table 2 & Figure 1).

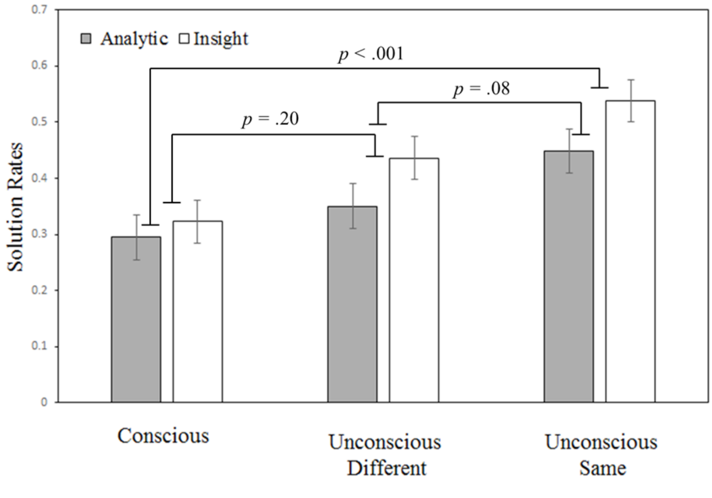
Table 2

Means and Standard Errors for Solution Rates per Condition

Condition		Analytic Problems		Insight Problems		Overall	
	N	*M*	*SE*	*M*	*SE*	*M*	*SE*
Conscious	44	0.30	0.04	0.32	0.04	0.31	0.03
Unconscious Task-Similar	45	0.45	0.04	0.54	0.04	0.49	0.03
Unconscious Task-Different	44	0.35	0.04	0.44	0.04	0.39	0.03

Figure 1

Mean Correct Solution Rates as a Function of Condition and Problem Type



Contrasts, using Bonferonni correction, revealed that individuals in the UDSD had a significantly higher solution rate than those in the CD, = 0.18, $p < .001$, 95% *CI* [0.07, 0.29]. Also, participants in the UDSD solved more problems than participants in the UDDD did, however, this difference did not reach the traditional significance level, = 0.10, $p = .08$, 95% *CI* [-0.01, 0.21]. No significant difference was detected between the CD and UDDD, = 0.08, $p = .20$, 95% *CI* [-0.19, 0.03]. Participants solved more insight than analytic problems, F (1, 130) = 7.21, $p < .01$, η^2 =.05. Finally, there was no significant interaction between deliberation type and problem type on solution rates, F (2, 130) = 0.64, $p = 0.53$, η^2 =.10.

To assess whether there was a significant difference in the actual time it took to solve problems, a 3 (deliberation condition) x 2 (problem type) mixed ANOVA on time to solve problems was performed. There was a significant main effect of problem type, F (1, 130) = 37.46, $p < 0.001$, η^2 =.25, with insight problems being solved significantly faster [M = 103.86 sec (1 min 44 sec), SD = 85.84 sec] than analytic problems [M = 155.91 sec (2 min 36 sec, SD = 99.80 sec]. None of the other effects were significant.

Discussion

The current study evaluated the unconscious thought theory, UTT (Dijksterhuis, 2004) within the domain of problem solving. Our results partly supported the UTT, in that participants in the similar distraction task unconscious conditions performed better than participants in the conscious condition. However, no significant difference was detected between the conscious and unconscious with a different task condition. To explain the findings, we may have to look back at Simon and Newell's (1971) problem space definition. A problem space is an abstract representation of a problem in a solver's mind. The initial state is presentation and understanding of a problem. The goal state is the solution. To get from the initial state to the goal state, the solver must go through the series of intermediate steps, during which they apply algorithms and heuristics to obtain a solution. Under normal conditions, the unconscious, when presented with a goal task, begins to work on it, in a parallel fashion to the WM, to obtain a solution (Bos et al., 2008). The unconscious presents the WM with possible solutions for evaluation. Once the correct solution is thought to be found, the process stops. In the current study, the conscious and unconscious conditions did not differ during the initial and goal states, what the manipulation affected were the intermediate steps. In the conscious condition, both the conscious and unconscious were expected to work in parallel to find a solution. Once a solution was found and deemed appropriate by the conscious, the solver moved on to the next goal state, and terminated the process. In the unconscious condition, on the other hand, while the unconscious sought solutions, there was no conscious evaluation, thus, the process may have well continued, until the conscious attended to the matter. As a result, participants in the unconscious conditions may have had more potential solutions available to choose from. Even though only one solution was correct, having a field of possible solutions might have led to a higher statistical probability to obtain the correct one. Previous creativity research supports the notion of an "incubation period" aiding in the obtainment of a higher number of possible solutions in divergent thinking tasks (e.g., Gilhooly, & Fioratou, 2016; Ritter, & Dijksterhuis, 2014).

But why was the difference found only for the task similar condition? Ineffectiveness of distractor tasks has been a shared criticism of previous research in the unconscious processing paradigm (Newell, & Rakow, 2011; Nieuwenstein et al., 2015; Strick et al., 2011). This study addressed this concern by manipulating the distractor task. This manipulation also served as the goal of further parsing out the mechanisms of unconscious processing. Based on the Baddeley's WM model (Baddeley, & Hitch, 1974), performance in a condition wherein distractor type and problem type matched would be worst, as both the distractor task and target problem would load onto the same WM component. Conversely, UTT theory predicts the opposite, i.e., performance within a condition with similar distractor task and problem type would do best, as the conscious would be prevented from intervening in the solving process, and reliance on the greater capacity of the unconscious would occur (Dijksterhuis, 2004). Participants in the unconscious condition with matched distractor task and target problem domain performed somewhat better than those in the unconscious condition with differing distractor and problem domains, thus giving some support for the UTT theory. However, another alternative explanation for the obtained effect is conceivable, that is of procedural priming. As procedural priming improves performance on arithmetic problems (Fayol, & Thevenot, 2012), it is possible that in the current study, the presence of same type distractor task activated the procedures necessary for solving the target problem, thus aiding problem solving. Future research may aspire to parse out what processes are responsible for the observed effect. Further, the use of both close- and open-ended problems may provide additional information regarding the number of responses generated as well as their quality.

Surprisingly, we did not find an interaction effect between deliberation type and problem type. As previous studies found differences in how people solve analytic vs. insight problems (beg. Metcalfe, & Wiebe, 1987), we expected to see more insight problems solved in the unconscious conditions, while more analytic problems being solved in the conscious condition. The lack if this interaction suggests that, at least within our experiment, analytic and insight problems were solved using similar mechanisms, thus supporting more recent findings within the domain (Weisberg, 2014). We found that insight problems were solved faster than analytic problems, however, this has been a consistent finding in insight problem-solving literature (Cranford, & Moss, 2012; Sandkühler, & Bhattacharya, 2008).

One limitation of this study is that despite our attempts to fully engage participants' WM with distractor tasks, we were unable to completely eliminate the possibility that participants may have realized that the presented tasks were distractors, and the real goal was to solve the problem. Therefore, some participants may have thought about the target problem periodically within the allotted time and consciously considered its context. Future research should seek to implement distractor tasks that have a measure of involvement associated with them (e.g., gaze analysis using eye tracking). Additionally, 70% of the study participants were females. Considering evidence from some studies showing gender differences in solving mathematical and verbal tasks (Keller et al., 2022), a more equal gender distribution would be desirable in the future. Our experiment adapted the procedure used in the original studies investigating unconscious versus conscious deliberation (Dijksterhuis, 2004; Ritter et al., 2012). Based on this procedure unconscious deliberation conditions had 11 min to solve problems (3 min distractor plus 8 min problem solving time) and conscious deliberation condition had 8 min, leading to a temporal discrepancy between these conditions. However, we analyzed time to solve and found that there was no significant difference in RT between these conditions. Furthermore, participants took on average about two minutes to solve problems, which was far shorter than their allocated time. Thus, we do not believe that temporal discrepancy had an effect on participants' solution rates.

Since participants on average used between one-and-a-half to two-and-a-half minutes to solve problems, rarely utilizing full eight-minute time allocation, using shorter solving time allotment may be warranted in the future. That would allow to increase the number of tasks in the follow-up study. Based on our hypothesis, we expected to see participants solving more problems in the unconscious condition using the distractor from the same domain as the target problem compared to the condition using distractor from a different domain. We did detect a difference in the expected direction; however, it fell short of reaching traditional significance level. A larger sample size may clarify whether lack of significance in our study was due to Type II error resulting from inadequate sample size.

Overall, this research partly supported the UTT within the problem-solving domain, in that complex problems benefitted from a period of unconscious deliberation, but only when the distractor was from the same domain as the target problem. This study reinforced the importance of considering the type of distraction as an essential moderator of the unconscious deliberation.

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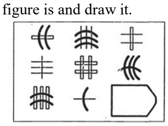
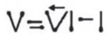
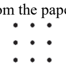
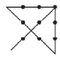
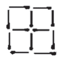
Appendix A
Insight Problems

Problem Type:	Problems:	Solutions:
Arithmetic	1. Given containers (which have no markings) of 163, 14, 25, and 11 ounces, an unlimited water source and ground on which to dump water, how can you obtain exactly 77 ounces of water.	1. Fill the 163 ounce container all the way. Out of the 163 ounce container, fill the 25 ounce container & dump it out, again fill the 25 ounce container & dump it out, fill the 14 ounce container & dump it out, then fill the 11 ounce container & dump it out, & finally, again fill the 11 ounce container and dump it out. This will result in the original container having 77 ounces. (Luchins, 1942)
Arithmetic	2. The values of x and y are related by the equation y = k / x, where k is a constant. If y = 45 when x = 3, what is the value of x when y = 180?	2. ¾ (Luchins, 1942)
Verbal	3. The police were convinced that either A, B, C, or D had committed a crime. Each of the suspects, in turn, made a statement, but only one of the four statements was true. • A said, "I didn't do it." • B said, "A is lying." • C said, "B is lying." • D said, "B did it." Who is telling the truth? And who committed the crime?	3. B is telling the truth & A committed the crime. (DeCaro et al., 2016)
Spatial	4. Three cards from an ordinary deck are lying on a table, face down. The following information (for some peculiar reason) is known about those three cards (all the information below refers to the same three cards): • To the left of a queen there is a jack • To the left of a spade there is a diamond • To the right of a heart there is a king • To the right of a king there is a spade Can you assign the proper suit to each picture card?	4. Jack of hearts, king of diamonds, queen of spades. (Schooler et al., 1993)
Spatial	5. Given a certain pattern of shapes determine what the missing figure is and draw it. 	5.  (Gilhooly, & Fioratou, 2009)

Appendix B
Analytic Problems

Problem Type:	Problems:	Solutions:
Arithmetic	1. The matchsticks in the following problem form Roman numerals. Notice that the equation is false. You need to make this a correct arithmetic equation by moving only a single matchstick. The specific rules are: only one matchstick can be moved, matchstick cannot be discarded, an upright stick cannot count as a slanted stick, so V is not V , and the result must be a correct arithmetic equation. V = XI − I	1.  (Knoblich et al., 1999)
Arithmetic	2. Water lilies double in area every 24 hours. At the beginning of summer there is one water lily on the lake. It takes 60 days for the lake to become completely covered with water lilies. On which day is the lake half covered?	2. Day 59. (Dow & Mayer, 2004)
Verbal	3. Our basketball team won a game last week by the score of 78-61, yet no man on our team scored as much as a single point. How is this possible?	3. It is a woman's team. (Dow & Mayer, 2004)
Spatial	4. Draw four continuous straight lines, connecting all the dots without lifting your pencil from the paper. 	4.  (Dow & Mayer, 2004)
Spatial	5. Move three sticks to make five squares. 	5.  (Katona, 1940)