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Metahypermnesia: The Effects of Incentives and Item Types (Image vs. Word)

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People sometimes make predictions about life events. These often include monitoring and control processes. Metacognition, which is subfield of cognition, has these processes. Metacognition research includes memory, attention, and comprehension studies. Hypermnesia is one of the topics relating to memory, simply meaning level of recall with regard to a repeated task. Thus, metahypermnesia is thoughts and judgements about hypermnesia. The aim of the present study was to find out whether people would overestimate or underestimate their performance on a given hypermnesia task that used images and words. Additionally, the effect of monetary incentives on the image and word test were investigated. Thus, it was hypothesised that people would overestimate their performance compared to their actual performance in the tasks. 134 participants were recruited for the study. The results illustrated that participants' performance affected by monetary incentives and recall type. Importantly, giving incentives enhanced participants' performance on image test but not word test. Participants also overestimated their performance on both the image and word tests, regardless of whether they received monetary incentives. However, participants overestimated their performance when they were incentivized more than they were not.

Keywords: hypermnesia, metacognition, metahypermnesia, judgement, performance, monetary incentives.

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Метагипермнезия: эффекты вознаграждения и типа задач (Изображение vs. Слово)

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Людям свойственно делать предсказания относительно жизненных событий. Процессы мониторинга и контроля, сопровождающие предсказания, относятся к метакогнитивным процессам. Метакогнитивные исследования включают в себя исследования памяти, внимания и понимания. Одним из направлений исследований памяти является изучение гипермнезии, отражающей высокий уровень запоминания в заданиях на повторение, и метагипермнезии — мыслей и суждений о гипермнезии. Цель настоящего исследования состояла в том, чтобы выяснить, будут ли люди переоценивать или недооценивать свои результаты при выполнении заданий с гипермнезией, в котором использовались изображения и слова. Кроме того, было исследовано влияние денежного вознаграждения на выполнение образных и вербальных тестов. Таким образом, была выдвинута гипотеза, что испытуемые будут переоценивать свои результаты по сравнению с фактическими результатами выполнения заданий. В исследовании приняли участие 134 человека. Результаты показали, что на участников влияли их метакогнитивные суждения и денежные стимулы. Важно, что вознаграждение повышало результаты участников в тестировании с использованием изображений, но не слов. При этом, независимо от получения вознаграждения, участники переоценивали свои результаты как в заданиях с изображениями, так и в вербальных заданиях. Однако участники, получавшие вознаграждение, больше переоценивали свои результаты, чем участники без вознаграждений.

Keywords: гипермнезия, метакогнитивные процессы, метагипермнезия, суждение, эффективность, денежное вознаграждение.

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Metacognition

The term metacognition is associated with J.H. Flavell, who coined the definition of this term, which is "thoughts about thoughts". Metacognition is one of the subfields of cognition and includes cognitive monitoring, controlling proses over cognition, and thinking and appraising [9]. Over the decades, metacognition has grown rapidly as an interdisciplinary research field in cognitive science [16]. Metacognition has also recently been studied by A. Wells [29], who points out that some psychological problems like depression are associated with biased thinking and, in all likelihood, this kind of problem originates from people's controlled thinking, which is metacognition. J.H. Flavell noted a significant difference between cognition and metacognition, pointing out that metacognition is about monitoring and controlling the thinking and activities of cognition [9]. Metacognition is also defined as a judgement of being confident regarding future events. Although people are good at judging their knowledge of future events, there are always executive factors that can make people overconfident [7; 14; 17]. Cognition has a different dimension within it such as memory, attention, comprehension, etc. In line with cognition, metacognition also has its own dimensions such as meta-attention, meta-memory, and meta-comprehension [18; 21].

Meta-memory

Meta-memory is primarily defined by J.H. Flavell (1971) as an individual's knowledge and awareness about memory [8]. To date, many studies have indicated that people's judgement about their own memory is not always correct. In order to test this phenomenon, a study was recently conducted that was designed in a 3 (memorizer with money, memorizer late money, and memorizer no money) * 3 (judges with money, judges late money, and judges no money) factorial design. This study illustrated that people's predictions about their memories were inaccurate. People have a feeling that they can recall what happened or what is going to be happen (in fact they cannot) [13].

Hypermnesia

Firstly, the term hypermnesia is referred to as "reminiscence" by P.B. Ballard (1913), defining it as "the remembering again of the forgotten without relearning" [3]. D.G. Payne also defined hypermnesia as the increase in the number of items recalled by repeated tests or retention interval [22]. One of the leading studies was conducted in this field that tested how people can obtain hypermnesia in pictures and words if they employ the test repeatedly. It was found that participants gained hypermnesia over three trials for both pictures and words [6]. In another study, similar findings were observed tin hat people gained hypermnesia for pictures, words, and riddles. Also, the number of items recalled slowed down in the following trials as time passed [23].

Prediction for Future Events

When people make predictions about future events, they often behave overconfidently and become unrealistic about their future plans. An example shows that Sydney Opera house, which was going to cost $7 million and was estimated to be completed in 1963, in fact was not; it cost $102 million and was completed in 1973 [11]. In another example, the Channel Tunnel between Britain and France was estimated to be active in 1993 and cost £4.9 billion, but the

tunnel has its first run in 1994 and cost around £10 billion. This phenomenon can also be seen from a psychological perspective. For instance, people think that they can complete unfinished work if they take it home. However, past experience shows that they are quite often unable to do so. Even if people have past experiences of the same nature, they still believe that they can complete what they optimistically plan [4].

Rewarding

External regulators are able to alter people's situational motivation for a task or intended work [25]. Some early studies illustrated that external circumstances had a role in affecting one's motivation, such as prizes [12], competition [24], deadlines [2], and surveillance [15]. M. Ainley pointed out a strong association between motivation and cognition [1]. Thus, it is possible to make the inference that any external regulators that increase one's motivation for a specific task are also able to affect cognition. For example, research has shown that incentivising people made their memory performance better (e.g., [27; 28]). However, a more recent study illustrated that external regulators only enhanced memory performance for uninteresting materials. Therefore, monetary rewards do not seem to promote memory consolidation for interesting items [19]. Consequently, if we try to examine the effects of monetary incentives on memory, we are better to generate uninteresting or neutral items for the performance.

The Present Study

As is clear from the knowledge of metacognition, people's predictions of future events or tasks is imperfect. Many studies conducted in the metacognitive field have supported this idea, especially in memory and comprehension [26]. In this study, we were interested in testing people's predictions and actual performance via ten repetition tests on image and word tasks by incentivising them.

The present study focused on meta-hypermnesia which is a subtopic of meta-memory. Even though there are sufficient studies about hypermnesia, there are relatively few on meta-hypermnesia; also, those studies that do exist have not focused on the effects of monetary rewards. The present study focused on forecast on hypermnesia and how monetary rewards regulate metacognitive processes. Thus, the main hypothesis of this study is that "People would overestimate their performance on a hypermnesia task in both image and word tasks, and monetary rewards trigger people's feelings under any conditions". The second hypothesis is that "Although hypermnesia is obtained under any conditions, after a specific number of trials, approximately six or seven, hypermnesia is not obtained and participants' performance is stable or decreased". Many learning studies have shown that increasing the number of repetitions facilitates the learning of the material. However, we anticipate that the performance on the task will be stable or decrease after the middle of the experiment [20] due to practise effects and fatigue effects.

Method

Participants. 134 undergraduate students were recruited from the Department of Psychology of Bingol University, Turkey. Three of these subjects were excluded from the study due to low concentration on the experiment. Participants (58 male, 76 female) were in the age range of 18 to 25 and they were randomly allocated particular experimental conditions.

Participants were also asked to rate their stress level on a 9-point scale (1=no stress, 9=too high; M=4.75, SD=1.92). Participation was based on earning course credits in order to complete a specific course.

Design. Forecast (prediction vs. performance), recall type (image vs. word), and incentive (incentive vs. no-incentive) were all manipulated between subjects, and 2 by 2 by 2 factorial design was conducted.

Materials and Experimental Task. A demographic form was given to the participants to extract information about their age, gender, and current stress levels. Encoding forms were also given to participants to write down what they were able to recall after each trial. As an experimental task, neutral images and words were used such as tree, elevator, car, spoon, and the like. 10 image and 10 word tasks were generated, where each task comprised 80 different items. In total, 800 images and 800 words were employed. During the experimental session, participants only studied 80 images or 80 words. Tasks were also randomly allocated to the participants in turn. These images and words were shown to the participants in a slide format, where the time interval between each slide was one second.

Procedure. As soon as participants came to the testing room, they indicated their agreement to take part in the study by signing a consent form. All participants were randomly allocated to the eight conditions of the experiment. Half of the participants of the recall-type condition faced image tasks and other half faced word tasks. In the forecast condition for the prediction, subjects performed three image or word task trials. After each trial, identical to all conditions, subjects wrote down what they recalled during a three-minute period. At the end of the third trial, they were asked "*How many images or words would you be able to recall if you performed the task 10 times".* For the performance condition, subjects directly performed 10 trials and showed their performance by writing the items on an encoding form. This procedure was valid for the no-incentive condition. In the incentive condition, at the end of the third trial the subjects were asked "*How many images or words you would be able to recall after the tenth trial if you are paid 0.5 Turkish Liras (TL) for each image or word and over 50 you would be able to earn 20 TL extra"*. On the other hand, participants in the incentive condition were asked at the beginning of the experiment that "*You would earn 0.5 Tl for each image you recall, and you would get 20 TL extra as long as you recall over 50 images or words".* Then they performed the task 10 times and showed their performance on the encoding form at the end of each trial.

Results

134 participants were recruited for the current study. Three participants showed low concentration level according to self-report measurement. The data of these three participants were retrieved from the analysis. In total, the data of 131 participants were analysed. Three-way ANOVA results illustrated that there is a statistically significant interaction between forecast, recall type, and incentive, $F(1, 123)=4.468$, $p<0.05$. We then employed a two-way ANOVA between recall type and incentive to examine their effect on performance, $F(1, 60)=3.988$, $p<0.05$. However, recall type and incentive together did not have a significant effect on prediction, $F(1, 63)=1.286$, $p>0.05$ (see Figure 1).

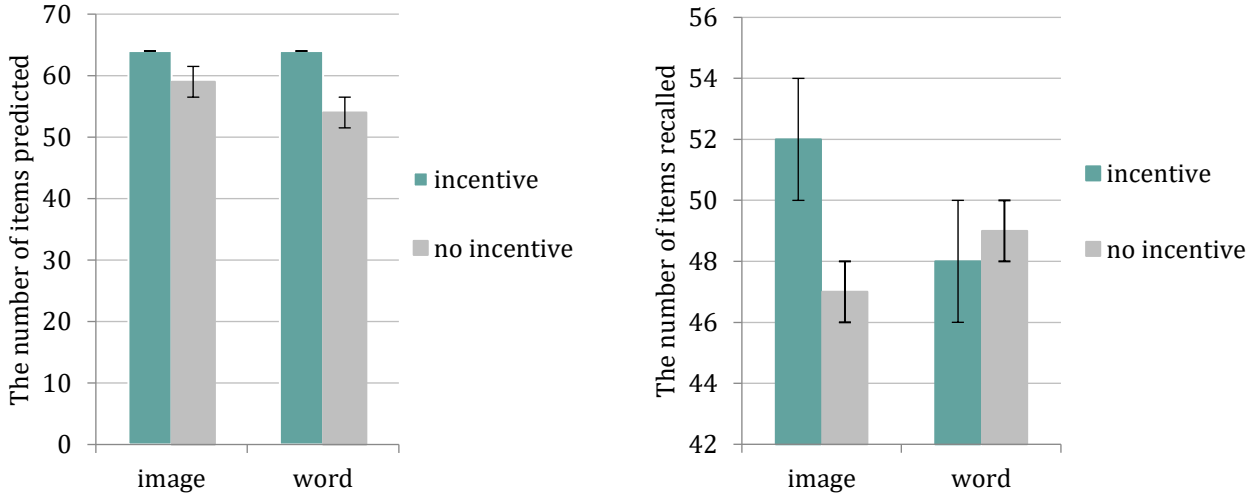

Figure 1. Mean numbers of predicted and actual hypermnesia for image and word tests in incentive and no-incentive conditions (the left chart represents the number of items predicted and the right chart represents the number of items recalled).

Interestingly, when the two-way ANOVA was conducted in only word test between forecast and incentive conditions, there was an interaction, $F(1, 62)=6.499$, $p<0.05$, but not in the image test $F(1, 61)=0.024$, $p>0.05$ (see Figure 2).

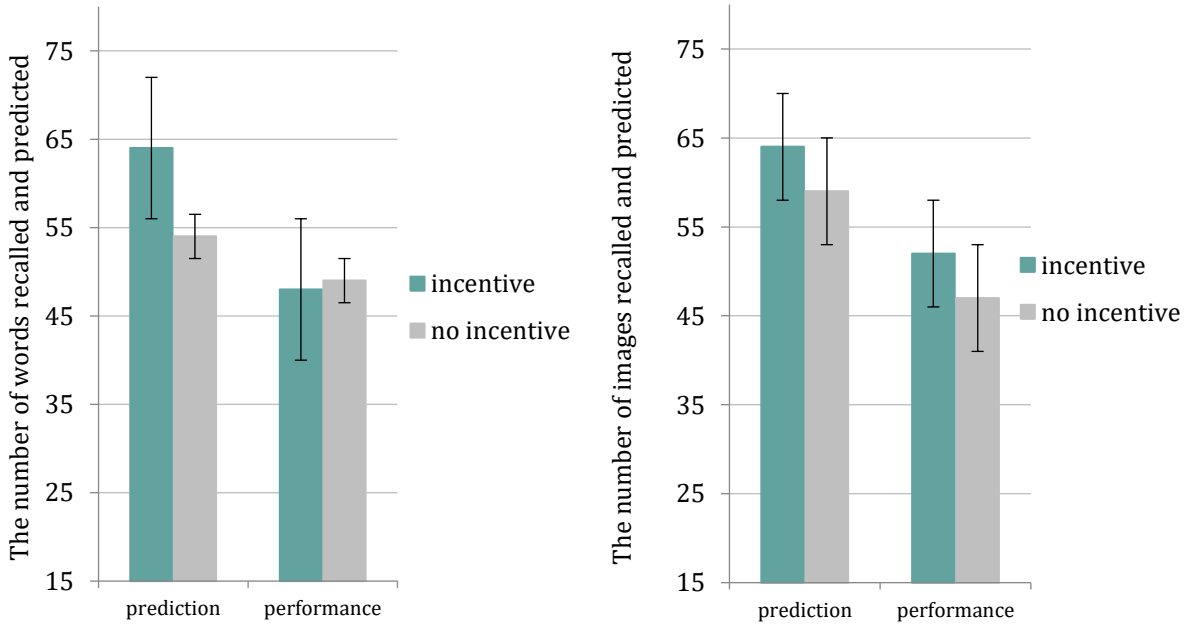

Figure 2. The number of words and images recalled and predicted under incentive conditions

We also employed two-way ANOVA for the incentive and no-incentive conditions separately between recall type and forecast variables, $F(1, 61)=1.092$, $p>0.05$, $F(1, 62)=3.986$, $p<0.05$, respectively (see Figure 3). A two-way ANOVA was conducted to investigate the effects

of item-type and incentive variables on prediction condition. There was no statistically significant interaction, $F(1, 63)=1.286$, $p>0.05$. Main effect was only found in incentive variable, $F(1, 63)=11.186$, $p<0.05$. When the mean numbers were examined, participants in incentive condition overestimated their performance ($M=63.94$, $SD=8.86$), compared to no-incentive condition ($M=56.74$, $SD=8.81$).

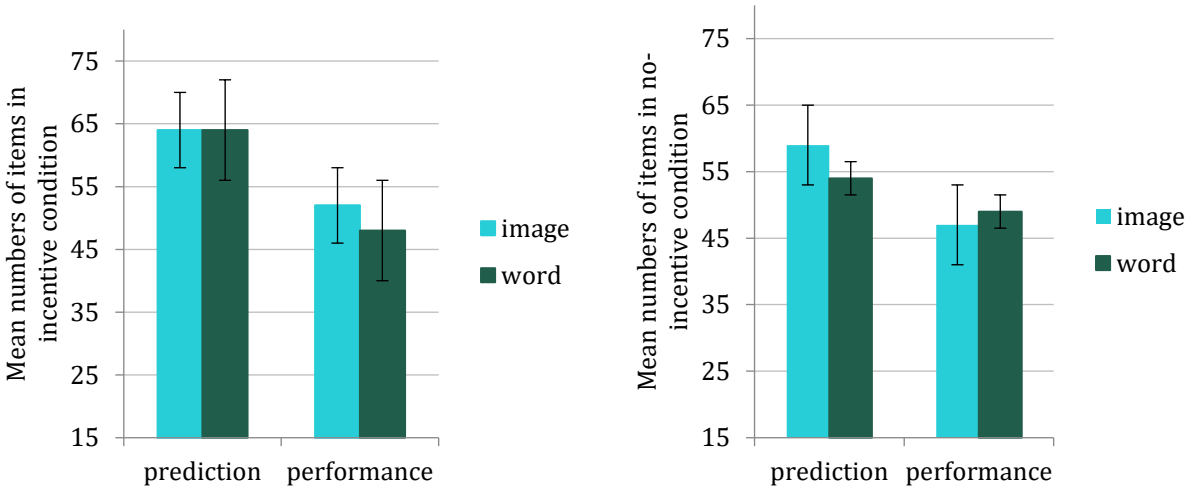

Figure 3. The numbers of items predicted and recalled for recall type in both incentive conditions

Furthermore, we applied one-way repeated measures ANOVAs through four performance conditions (image-incentive, image-no-incentive, word-incentive, and word-no-incentive) to determine whether hypermnesia had been obtained within 10 performance trials (see Figure 4).

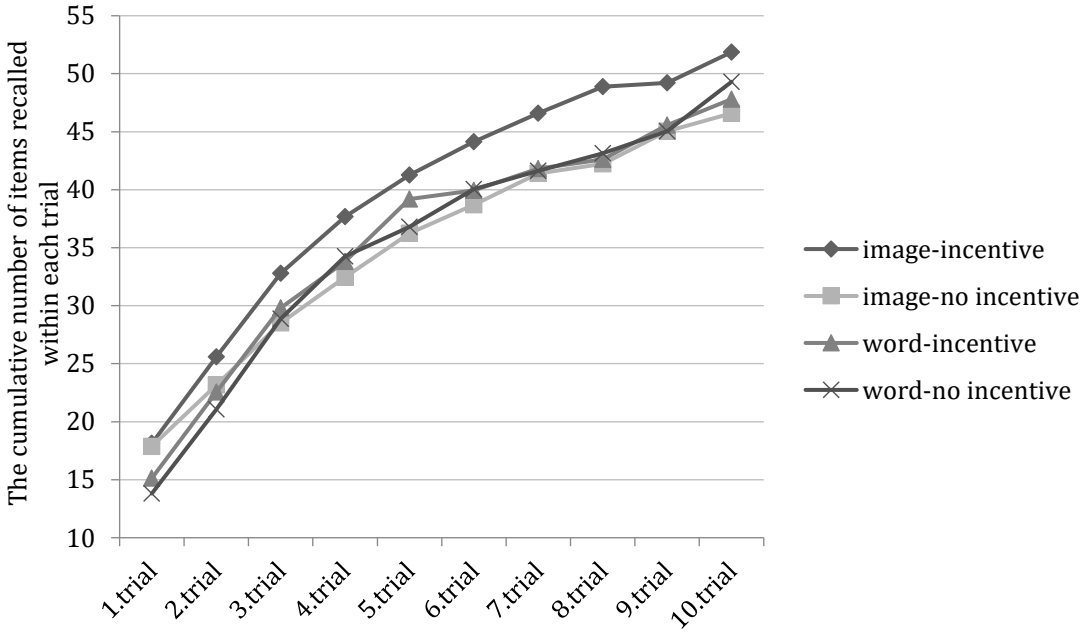

Figure 4. The cumulative participants' performance through each trial

For the image-incentive condition, assumption of sphericity was violated, $\chi^2(44)=70.510$, $p<0.05$. Thus, we applied the Greenhouse-Geisser correction and result showed that there were mean differences between trials in the image-incentive condition, $F(3.42, 47.94)=682.31$, $p<0.05$, ($\varepsilon=0.38$). In the image no-incentive condition, there was statistically significant difference between trials, $F(9, 144)=100.93$, $p<0.05$. Another one-way repeated measure ANOVA revealed a statistically significant mean difference under the word-incentive condition, $F(9, 135)=162.61$, $p<0.05$. Sphericity was also violated when participants were not incentivized during the word trials, $\chi^2(44)=67.263$, $p<0.05$. Therefore, Greenhouse-Geisser correction showed that there were also mean differences within trials, $F(3.96, 59.32)=200.73$, $p<0.05$, ($\varepsilon=0.44$).

Discussion

The present findings showed that three independent variables (recall type, forecast, and incentive) interacted significantly with each other. This means that when people repeat the test they are affected by the meta-cognitive processes and what they gained. To date, no studies have focused on meta-cognitive processes within hypermnesia.

Our performance-dependent analysis between recall type and incentive illustrated that rewarding participants had the effect of increasing the number of items recalled in the image test. By contrast, monetary rewards decreased participants' performance in the word test (see Figure 1). On the other hand, people overestimated their performance in all conditions of recall type and incentive. Correspondingly, our results are consistent with the previous knowledge (e.g.,[13; 17]).

Moreover, forecast and incentive conditions in the word test interacted with each other, but not in the image test. This may be due to the same decrease in the number of items across the conditions (see Figure 2). However, word-dependent effects were observed for the forecast and incentive conditions. We may conclude that in image tests, forecast (prediction vs. performance) is not statistically related to incentives (incentive vs. no-incentive).

Most hypermnesia studies have previously been based on item type (e.g., image vs. word). We found similar findings whilst obtaining hypermnesia compared with previous studies (e.g., [6; 22; 23]). Some of these studies employed two or three trials, whether or not this was adequate to decide whether hypermnesia was obtained, with the exception of a single study conducted by D.G. Payne & M.J. Wenger [23], with five trials. Thus, in the present study we would like to see the threshold where hypermnesia was obtained within ten test trials. In the present findings, subjects showed cumulative values towards the fifth trial and the effect of repetition then decreased constantly through to the tenth trials. Thus, each repetition does not strengthen memory to the same level.

In conclusion, when we incentivized participants, they were able to recall more images than when they were not incentivized. However, words were more easily memorised when they were not incentivized. In other words, it would be waste of money if one were to incentivise to study a word task compared to an image task.

Limitations and Implications

This study included only university students. Age and gender variables were not considered in this learning study. It is well known that many cognitive processes are impaired, especially with increasing age. Therefore, it is important to include groups with different age ranges for future studies. Gender differences is widely investigated on memory and learning studies. In this context, gender variable can be taken into consideration. In this study, only monetary rewards were employed as an incentive. However, the effectiveness of the incentive was not measured. Different types of incentives such as course credits, gift vouchers could be employed in future studies. Thus, the effects of different types of incentives can also be seen.

Only healthy participants were recruited for this study. The results obtained in this study are important to comprehend the performance of healthy participants. The findings of this study will be considered to be a baseline for future studies with clinical groups. Variables that have an effect on learning such as anxiety and depression can be added to future studies. These studies will contribute to understanding the effects of anxiety and depression on metacognition processes.

Alzheimer's disease has been reported to impair metacognition. It is well known that early or mild stages of Alzheimer's disease impair basic cognitive skills, but less is known about the effects of Alzheimer's disease on metacognition. It is important to understand how different aspects of metacognition will be affected by Alzheimer's disease. This is because an accurate understanding of one's own cognitive decline is needed to realistically set personal goals and avoid risky behaviors [10]. Thus, the data derieved from metacognitive studies could be helpful in diagnostic processes and devoloping interventional programs.

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