The Influence of Enjoyment on Remembering:
An Analysis of Memory in Decision-Making

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Dissertation written under the supervision of professor Daniel Fernandes.

Dissertation submitted in partial fulfilment of requirements for the MSc in Management with the Specialisation in Strategic Marketing, at the Universidade Católica Portuguesa, 03. January 2023.

Abstract

Forgetting is a constant companion in people's lives. Throughout the day, people face multiple situations in which they need to evaluate whether they will remember to do an activity or not and decide on the usage of memory aids. However, people err in making predictions about their memory which leads to forgetting. To gain a deeper understanding of people's failure to remember, this work examines influences on an individual's memory performance with the purpose of understanding how accurately people predict their memory performance. Thus, a study on judgements of learning is conducted with common activities as to-be-remembered items, and it reveals that people overestimate their memory, believing they would remember more than they do. This overconfidence is even more apparent when people are tasked to remember items for five days. Further, influences of enjoyability and indication of external memory aid usage on actual and predicted memory performance is explored, however, no statistical evidence is found. The data suggests that people do not accurately predict their memory, indicating a need for improvements of the evaluation processes people use or higher usage of memory aids. Especially, if items need to be remembered for longer periods, it is recommendable to make use of memory aids to prevent needless forgetting.

Keywords: Judgements of learning; Memory; Metamemory; Enjoyability; External memory aids

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Resumo

O esquecimento é um companheiro constante na vida das pessoas. Ao longo do dia, as pessoas enfrentam múltiplas situações em que precisam avaliar se vão ou não se lembrar de fazer uma atividade e decidir sobre o uso de ajudas de memória. No entanto, as pessoas erram ao fazer previsões sobre a sua memória, o que leva ao esquecimento. Para obter uma compreensão mais profunda da incapacidade de memória das pessoas, este trabalho examina as influências sobre o desempenho da memória de um indivíduo com o objetivo de compreender a precisão com que as pessoas preveem o seu desempenho de memória. Assim, um estudo sobre julgamentos de aprendizagem é conduzido com atividades comuns como itens a serem recordados, e revela que as pessoas sobrestimam a sua memória, acreditando que se lembrariam mais do que se lembram. Este excesso de confiança é ainda mais evidente quando as pessoas são encarregues de recordar objetos durante cinco dias. Além disso, são exploradas as influências do prazer e da indicação da utilização de ajuda da memória externa no desempenho real e previsto da memória, no entanto, não são encontradas provas estatísticas. Os dados sugerem que as pessoas não preveem com precisão a sua memória, indicando a necessidade de melhorias nos processos de avaliação que as pessoas utilizam ou uma maior utilização de ajudas de memória. Especialmente, se os itens precisarem de ser lembrados por períodos mais longos, é recomendável fazer uso de ajudas de memória para evitar o esquecimento desnecessário.

Palavras-chave: Julgamentos de aprendizagem; Memória; Metamemória; Prazer; Ajudas de memória externa

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Content

Table of Contents

Introduction

Throughout the day, people make plans for things they want to do or want to get done, but they tend to forget some parts of their plans which they originally intended to realise. These forgotten plans can range from nearly inconsequential if forgotten, e.g., going from one room to another with a specific task in mind and forgetting it, to forgotten plans that bring about grave consequences if not remembered, e.g., forgetting to take important medicine. People might consider using external memory aids, such as sticky notes, calendar entries, to-do lists, alarms, or other people asked to remind one to do something, to reconcile their memory's susceptibility to mistakes and forgetting, but decide against them in certain situations. These decisions can be put into context of metamemory which refers to the judgements and beliefs people have about their memory (Kornell et al., 2011). This includes beliefs about how well an individual remembers things, their strategies for learning and recalling information, and their awareness of the factors that influence memory and learning. Thus, by studying metamemory it is possible to gain new insights into how individuals can optimise their memory and enhance their learning abilities. This may have practical relevance in both educational and professional contexts.

An individual's decision to not use any aids when it comes to memory may depend on their own judgements of how well they believe that they have mastered the to-be-remembered content. Therefore, this aforementioned decision relies on the individual's evaluation of their metacognition, i.e., an individual's evaluation of their knowledge of their own knowledge (Metcalfe & Finn, 2008). However, this introspection can lead to errors as some aspects that may or should be drawn into consideration during the decision-making process can be missed, biased, or wrongly remembered (Nelson and Narens, 1990).

Past research on metamemory addressed among other things prospective judgements, i.e., predictions of future memory performance, under which judgements of learning can be categorised (Schwartz, 1994). Judgements of learning (JOL) refer to the subjective judgements that people make about their own learning or the learning of others. These judgements can be related to the amount of information that has been learned, the quality or accuracy of the learning, or the confidence that people have in their own learning. Judgements of learning are often used in educational and psychological research to evaluate the effectiveness of different teaching methods or to assess the learning abilities of individuals. Further, research on JOLs in study settings has demonstrated that these judgements are generally reliable in predicting

following recall (Koriat et al., 2002). However, it is still possible that forgetting occurs despite an individual's moderately accurate JOL.

There have been several identified connections between affect (an individual's emotional or mental state, typically characterised by emotion, mood, and emotion-related traits) and judgement and decision-making through which affect can influence decision-making. For example, Efklides (2006) studied the relationship between metacognitive experiences and the learning process and found that it is important to consider affective states in learning situations. These situations elicit *feelings of familiarity* associated with positive affect or *feelings of difficulty* associated with negative affect, in the learner during task processing. She also observed that these affective states can influence an individual's metacognitive performance and their decision-making regarding study-time allocation. Schwarz and Clore (1983) evaluated the effect of affective states on judgements concerning their well-being and found that individuals use moods, i.e., affective states, to make judgements about their well-being. Bradley et al. (1992) report supportive results for improved recognition during immediate and delayed free recall situations when the to-be-remembered materials are high in arousal, as well as positive effects of pleasantness on memory performance in immediate free recall situations. Altogether, affect is closely intertwined with judgement and decision-making, with memory playing a crucial role in providing the necessary information and experiences that inform and guide an individual's choices and decisions.

To be able to understand people's failure to remember, their predictions of their memory's performance need to be considered, too. People's active decision against methods that could lower their likelihood of forgetting, i.e., the use of external memory aids, can be better understood if people had the ability to accurately predict their memory's performance. Further, as indicated by previous research, the extent of the enjoyability of an activity should be considered in this regard as enjoyable activities seem to have the potential to improve memory performance. However, not much attention has been put towards these connections. Thus, the following work explores several influences that can affect an individual's memory performance to determine whether their memory performance predictions accurately reflect their memory's performance, especially the enjoyment level of an activity.

Theoretical Background

Judgements of Learning

Past research on metamemory and, specifically, judgements of learnings explored the underlying mechanisms and influences that might have an impact on metamemory. Metamemory refers to the judgements and beliefs people have about their memory (Kornell et al., 2011). Judgements regarding metamemory can be divided into two stages: either judgements of learning or feelings of knowing. Judgements of learning are made during the process of knowledge acquisition, while feelings of knowing are judgements made when information is retrieved (Nelson and Narens, 1990). However, only JOLs will be discussed in this work. Notably, this work will use JOLs, predicted recall and predicted memory performance interchangeably when referring to judgements of learning. JOLs refer to an individual's judgement about how well they have learned something. Predicted recall touches on an individual's prediction about how well they will be able to recall specific information in the future, while predicted memory performance refers to an individual's prediction about their overall memory performance which includes their ability to retain and retrieve information over time. Although all three terms have some subtle but distinct differences, they all refer to the subjective evaluation of an individual's own cognitive process, and are, therefore, used synonymously in this work.

Koriat et al. (2004) discuss the two prevalent views in metacognitive of experience-based or theory-based metacognitive judgements, which are widely recognised as not being mutually exclusive and can subconsciously be used simultaneously by individuals to make judgements. On the one hand, experience-based JOLs are assumed to be based on heuristics, i.e., mnemonic cues that give rise to subjective feelings, related to the ease with which information is processed at the acquisition stage, i.e., during encoding. On the other hand, according to the theory-based view, judgements are made by using specific information and beliefs. They are then combined to be able to derive with an educated guess about one's knowledge. The authors conducted a series of studies providing evidence for a dual-based view on metacognitive judgements, indicating individual's ability to apply any of these strategies depending on the context. Participants were asked to study a list of word-pairs and indicate their JOLs representing their recall performance after each study trial. Koriat and colleagues designed three different retention intervals: Subjects were either tested on their recall performance immediately, one day or seven days after studying, and, additionally, were asked to consider their respective retention interval in their JOLs. The results show that participants disregarded retention

intervals (especially during Experiment 1 and 2) when making JOLs. The finding suggests that JOLs are primarily determined by the subjective experience of processing fluency, and is, thus, consistent with the idea of processing fluency during encoding not being affected by the anticipated conditions of retrieval. However, the authors found that, especially in Experiment 3B and subsequent experiments, except for 5B and 7, JOLs can be manipulated regarding their sensitivity to the retention interval when the experiment design is changed to a within-person condition. With these manipulations, the theory-based view finds applicability in regard to JOLs, too. The authors conclude that these mixed results align empirically and conceptually with the dual-basis view of metacognitive judgements, which is considered standard in the metacognitive research field (Dunlosky & Nelson, 1992; Schwartz, 1994, Zimmerman & Kelley, 2010). These results indicate that people have the ability to adapt their underlying mechanisms which guide their judgements according to the situations they are in.

Moreover, previous research has found notable evidence on individuals' JOLs being decently reliable and accurate and that JOLs elicited following study generally do not exhibit the overconfidence bias that is typically seen in retrospective confidence judgements (Koriat & Bjork, 2005). Overconfidence in this context refers to the difference between an individual's actual and predicted recall, indicating that their predictions about their memory's recall abilities is generally higher than their actual recall. Hence, their estimation and judgement about their own memory's capabilities and subsequent performance is inflated reflecting their overconfidence in their memory's performance. Evidently, this overconfidence mostly occurs in single study trials, and is observed to be calibrated in subsequent study trials, when studies are designed to incorporate multiple study trials after which subjects are informed about their performance (Koriat et al., 2002; Finn & Metcalfe, 2007).

Based on these aforementioned findings, one of this work's hypotheses will explore if this overconfidence is replicable, especially in view of the different retention times as indicated by Koriat et al. (2004). Hence:

> H1: Participants will display a marked difference between their actual and predicted memory performance.

It is expected that participants will generally display overconfidence, regardless of whether the recall task is completed shortly after studying. Moreover, it is expected that this effect will be larger for participants who complete the task several days after the study session.

Influences on JOLs

Further research on metamemory explored the influences that affect JOLs and often refer to Koriat's cue-utilisation approach (1997). Koriat's framework suggests that people use a variety of cues to make judgements about how well they have learned something. It distinguishes between three general types of cues that could influence JOLs: intrinsic, extrinsic, or mnemonic cues. Intrinsic cues relate to the characteristics of the studied item that signal its difficulty of learning it. A characteristic that reflects this could be the degree of relatedness in the case of to-be-remembered word pairs, e.g., cow and milk. Extrinsic cues relate to the environment of the study situation, i.e., the learning conditions, or the operations undertaken by the subject to encode the information. An example for the former is the clarity of the provided instructions in the study phase, while an example for the latter is the degree to which interactive imagery, to mentally visualise a to-be-remembered word pair, should be applied. Mnemonic cues give rise about the extent to which the respective item is learned by the subject and their ability to recall it in the future. It should be noted that, according to the cue-utilisation approach, people use all three types of cues to make judgements about how well they have learned something. The relative importance of each type of cue can vary depending on the individual and the corresponding situation.

Similarly, Undorf, Söllner & Bröder (2018) showed that when multiple cues are given, subjects include two to four cues in their JOLs. For example, in Experiment 3, the authors integrated four cues (number of study presentations, font size, concreteness, and emotionality) and found that subjects included three to four cues in their JOLs. In Experiment 4, they tested three nonorthogonal cues (font size, concreteness, and emotionality) of which, two to three were found to be considered in all individuals' JOLs. These findings indicate that people have the ability to consider multiple cues in their metacognitive judgements and, additionally, are able to integrate multiple cues in a flexible and adaptive manner, depending on the situation and circumstances.

Furthermore, research on the influences on JOLs yielded interesting insights based on the three types of cues outlined in Koriat's framework. Metcalfe and Finn (2008) studied the effects of three different heuristics (memory for tests in the past, retrieval attempts, and assessment of study fluency) on JOLs. The authors found that individuals use their JOLs to evaluate their decision to continue or abandon further studying, but not the cues of their current performance or any differences to their past test performances. Serra and England (2008) studied the effects of framing on metacognitive judgements and found that a forget framing elicits more

confidence in subjects regarding their memory than a remember framing. They observed that subjects' predictions on forgetting or remembering were not as sensitive to improvements as their memory performance when several study trials were completed. This may be due to subjects using different anchor points as basis for their JOLs. Rhodes and Castel (2008) studied the effects of perceptual information on JOLs by varying the font size of the to-be-remembered word pairs and found that this type of perceptual information has a strong influence on subjects' recall predictions but not on actual recall. The authors discovered that the influence of perceptual information persisted when, firstly, subjects completed a pre-test, secondly, subjects were informed that font size would be unrelated to memory performance, and, thirdly, the relatedness of the word pairs varied, although only to a smaller degree. The ease-of-processing heuristic was specified by the authors as an explanation for these findings indicating that the participants subjectively perceived the large type as being easier to process, which, hence, affected their predictions but not actual recall. Kornell et al. (2011), who examined the underlying mechanisms of why predictions based on Koriat's cue-utilisation framework are often correct, found further evidence for the ease-of-processing heuristic being an influence on metacognition. While this influence may generally produce accurate predictions, the authors note that errors can still occur and stress that the heuristic can serve as a guide for memory judgements, but, otherwise, can also bias them. This indication stems from participants' overestimation of the effect of type size on their memory performance and from their disregard of the effect that study repetition has.

Affect and Memory

Turning towards other aspects that influence memory and relatedly an individuals' memory predictions, the literature suggests a relationship between affect and memory. In relation to the previous topic, research has found that fluency, which can be put into context of the ease-of-processing heuristic, is greater for items that are emotional than for items that are neutral (Kensinger & Corkin, 2003). Kensinger and Corkin (2003) studied whether emotional words create a qualitative memory benefit. The authors found evidence that subjects had better memory for emotional words than neutral words. Throughout six studies, each controlled for different aspects that might affect memorability, the researchers were able to observe that this effect was not due to differences that became apparent in the words' frequency, length, or complexity. The effect that emotional words are more memorable than neutral ones can be significantly observed when words have arousal, but also to a lesser extent when words have valence only. The authors mention the possibility of emotions serving as a theme that unifies

memories making it easier for items to be clustered and ultimately remembered. Notably, Kensinger and Corkin point out that this possibility is not the only factor contributing to this effect. Furthermore, Kern et al. (2005) examined the effects of emotional stimuli and divided attention on memory and found that emotional pictures are more likely to be remembered than neutral ones. Additionally, they were able to rule out that this effect was not due to the differences in the complexity of the presented pictures or the level of attention, which they demanded from the subjects. These findings support the *Pollyanna principle,* which refers to an individual's tendency to remember things more positively than negatively or neutrally (Matlin & Stang, 1978, as cited in Bradley et al., 1992). Further, the phenomenon suggests that pleasant materials are the most memorable materials, and that happy events or pleasant materials can have a positive effect on memory performance (Bradley et al., 1992).

Based on the connection between affect and memory, and the positive effect on memory performance elicited by pleasant materials, this work can contribute to further research by exploring the effect that the enjoyment level of an activity has on recall. Previously, researchers were able to vary the level of arousal or valence of a to-be-remembered word pair (Kensinger & Corkin, 2003; Zimmerman & Kelley, 2010). Extending these approaches to activities that potentially have a more practical implication for the subjects as well as applying the induction of affective states to the activities may yield interesting results. Hence, another hypothesis that is explored within this work is as follows:

H2: Enjoyable activities positively affect recall.

It is expected that that the enjoyment level of the activity will influence an individual's actual and predicted recall, and specifically, that activities that are deemed enjoyable will be the most memorable.

To explore this effect, a list of activities is created loosely based on Cummins' (1996) model. In his model, Cummins proposes seven life domains (Material, Health, Productivity, Intimacy, Safety, Community, and Emotional well-being) according to which individuals experience and prioritise different aspects of their lives, and how these experiences and priorities impact their overall well-being. While this present work does not focus on an individual's well-being, the model provides a comprehensive view on domains that have an impact on an individual. To assess the effect of enjoyability of an activity on an individual's memory performance, it is crucial to establish a list of activities that covers a broad range of tasks. Basing this activity list

on a model that provides an extensive view on domains that have an impact on an individual fits well. Further, this approach allows for broader variations of the enjoyability of activities. Therefore, Cummins' seven life domains are condensed into four categories which comprised into: First, tasks and activities focussing primarily on social, family, and relationship aspects. Second, tasks and activities relating to profession and education. Third, tasks and activities that are usually undertaken for recreation or leisure. Fourth, tasks and activities revolving around personal finances and domestic affairs.

Social cognitive research found that social pressure to fulfil an intended behaviour exists when the behaviour involves responsibilities towards others (Cialdini, 2001). This is relevant for tasks and activities in both the social, family, and relationship category, and the professional, educational category, as outlined above, because tasks and activities often involve interactions and relationships with other people. Therefore, it is assumed that it is likely that social pressures will also influence the individual and increase the memorability of these tasks. It is, therefore, assumed that categories 1 and 2 will have a higher memorability than categories 3 and 4. Generally, memorability of tasks will decrease from category to category in the stated order because the amount of social pressure that is inherent to these activities steadily decreases. Hence, a further hypothesis concludes:

> H3: Memorability for the individual categories will decrease from Category 1 to Category 4 due to the decrease of inherent social pressure of the respective category.

Because a multitude of influences can affect an individual's decision-making, such as external and intrinsic motivation (Deci & Ryan, 1991), cognitive biases, such as the endowment effect (Thaler 1980), or cultural influences, social pressure will not be the only influence that will affect decision-making. Nevertheless, as the categories were designed to amount to four, an even split of relatively high/low levels of social pressure inherent to the category was achieved to address this type of influence specifically.

External Memory Aids

Research on external memory aids has focused in part on how they can be used to improve memory and decision making. External memory aids, which are external tools or devices that are used to enhance remembering, can include, among others, calendars, to-do lists, notebooks, sticky notes, shopping lists, or garbage bags by the door.

These external memory aids may find application when individuals are faced with tasks that require them to make multiple decisions, while multiple distractions may occur during the process (Block & Morwitz, 1999). Intons-Peterson and Fournier (1986) explored people's usage of internal and external memory aids in their daily lives. They found that external memory aids are participants' preferred method of improving memory as well as that memory aids in general are effective tools in enhancing memory performance, especially, external memory aids were observed to significantly improve remembering. However, as forgetting is a natural aspect in an individual's life and external memory aids offer relief for this problem, individuals still consciously decide against using them.

Block and Morwitz (1999) examine this active decision against the usage of external memory aids in a consumer task context, and more specifically, why some items are noted down on shopping lists while other items are not. Their study reveals several reasons why people are more likely to use an external memory aid when grocery shopping. Some of these reasons include financial incentives that are tied to items, familiarity with the store, or familiarity with the product category. Consequently, the authors observed that the likelihood of using external memory aids is higher when there is a benefit for accurate remembering and when need-based incentives are in play.

A similar study by Fernandes et al. (2016) explored the effects of different shopping strategies and purchase frequency on forgetting as well as consumers' predictions about their own memory. They find an interaction between the applied shopping strategy, either memory- or stimulus-based search, and the type of item. In other words, consumers are more likely to forget items they infrequently buy while shopping with a memory-based search strategy, e.g., choosing the to-be-bought items by trying to recall every item, and when they are asked to perform a recall task instead of a recognition task. Further, the authors observed poorly calibrated memory predictions by the participants resulting in participants not taking the appropriate actions that could have helped to prevent forgetting, i.e., the use of external memory aids in the form of shopping lists. Notably, Fernandes et al. observed a negative effect between subjects' predictions of their memory performance and the likelihood of using a shopping list as an external memory aid. The higher the number of things subjects predicted they would remember, the lower their self-reported likelihood of using a shopping list as an aid would be.

In the context of individual's subjective decision to use an external memory aid or not, an examination of the relationship between JOLs and the use of external memory aids can provide

insights into how individuals use these aids to support their memory and learning, and whether that is effective. Further, it would be interesting to show whether individuals take external memory aids into consideration when making predictions about their own memory performance. Based on these considerations, especially the negative effect between predicted recall and likelihood of memory aid usage (Fernandes et al. 2016), another hypothesis for this work was derived:

H4: Indication of memory aid usage does not affect memory performance.

To explore the influence of enjoyability on memory, this dissertation aims at investigating the abovementioned hypotheses, that

1) participants will display a marked difference between actual and predicted recall;

2) the enjoyment level associated with an activity influences a participant's recall;

3) the memorability of the activities decreases in the order of category 1 to 4;

4) indication of memory aid usage does not affect memory performance.

Hence, a study consisting of a questionnaire and a task exploring predicted memory performance and actual memory performance is conducted. In the following section, the methodology of the study is outlined. This will be followed by the analysis of the data and the discussion of the results with concluding remarks.

Methodology

Participants and Design

23 English-speaking people, whose demographic information is described in Table 1, participated in the study (Appendix A) which consisted of two main tasks: Firstly, completing a questionnaire and, secondly, a memory task consisting of a study part and a recall part.

To establish a reference base, every participant completed the same questionnaire indicating their enjoyability for the respective task or activity as well the likelihood of the participants needing an external memory aid. A description for external memory aids was provided, indicating that sticky notes, calendar entries, reminders from other people, or leaving full garbage bags in front of the door as a reminder would represent such an aid. As indicated, tasks and activities were categorised based loosely on Cummins' (1996) model.

For each category, 24 tasks and activities common to an average person were selected, resulting in 96 items to be rated by the participants. The questionnaire was asked to be filled out by the participants based on their actual or anticipated enjoyment level of an activity and their subjective likelihood of using an external memory aid for the respective activity.

Table 1
Participant Demographics

Demographic	*Range*	*Percent*
Age	Less than 18 years (N = 1)	4.3
	18-25 years (N = 13)	56.5
	26-35 years (N = 9)	39.1
Gender	Male (N = 9)	39.1
	Female (N = 14)	60.9
Occupation	Full-time employed (N = 9)	39.1
	Part-time employed (N = 2)	8.7
	Unemployed (N = 1)	4.3
	Student (N = 11)	47.8
Highest Achieved Education Level	Lower secondary education (N = 2)	8.7
	Upper secondary education (N = 1)	4.3
	Apprenticeship (N = 4)	17.4
	Bachelor's degree (or equivalent) (N = 12)	52.2
	Master's degree (or equivalent) (N = 4)	17.4
Country of Residence	Belgium (N = 1)	4.3
	Germany (N = 18)	78.3
	Norway (N = 2)	8.7
	Portugal (N = 2)	8.7

The second part of the study consisted of the memory task involving a study session, a JOL indication component and a recall part. The design for the memory task was identical for every participant except for the recall task, for which participants were divided into two groups. One group of participants started the recall task ten minutes after the study part, while the second group had their recall task scheduled five days after studying. This condition was added to the study as to better explore the notion whether enjoyability impacts participants' actual and predicted recall, and to test whether they would be sensitive to the retention time in making their JOLs.

Procedure

During the recruitment process, participants were informed that the study aims at exploring memory predictions. As participants were recruited from four European countries, the study was conducted in a virtual setting via the social media platforms Zoom, Google Meets, and

Discord. These applications were chosen because they offered video calls, session recording and screen sharing features. Following the recruitment, participants were assigned to either the 10-minute or 5-day recall group.

At the start of the study, participants were instructed about the procedure and explicitly informed about the recall condition they were assigned to. Participants had the chance to clarify any uncertainties and questions throughout the whole session.

At the beginning, participants were asked to fill out the questionnaire containing all 96 tasks and activities judging them according to their actual and anticipated enjoyability and likelihood of using an external memory aid for the respective activity. For both question types, subjects had the option between two answer choices: "*enjoyable task or activity*" or "*unenjoyable task or activity*" and "e*xternal memory aid likely*" or "*external memory aid unlikely"*. The possible answer choices were limited to two options to encourage participants to explore their attitudes towards the respective task and activity as well as to avoid collecting vague information, i.e., predominantly answers that reflect indifference such as "*neither enjoyable nor unenjoyable*" answers should be avoided with this approach. At the end of the survey, participants were asked to provide personal demographic information.

Following the procedure, participants were then presented further instructions for the memory task and the subsequent query for JOLs. Participants were then shown a black Microsoft PowerPoint slide with 48 tasks and activities in the font Calibri, font colour white, and font size 18. The list was divided into four columns of 12 activities, separated by white dashed lines. The presented activity list was randomised for every participant and followed the pattern that 12 randomly chosen tasks and activities of each category were included. Randomisation was achieved by using Microsoft Excel's randomisation formula. The randomised 12 activities of each category were listed below each other, and then again randomised. This randomisation was chosen to ensure that participants memorised the tasks and activities according to their own organisation. Participants were then asked to study the list and memorise as many activities as possible within a four-minute time frame. The study part was directly followed by the participants' predictions on the likelihood of them being able to recall the respective activity in the successive recall task. Participants were asked to orally state their predictions which were then recorded by the experimenter.

For the recall task, participants were given four minutes to freely remember as many activities as possible. The study design incorporated the free recall approach, instead of a cued-recall

approach, as to examine the participants subjective judgements about their own memory performance to the objective measures posed by their actual memory performance. Lastly, to avoid interruptions in subjects' thought processes or recall flow, this part was recorded with the consent of the participants.

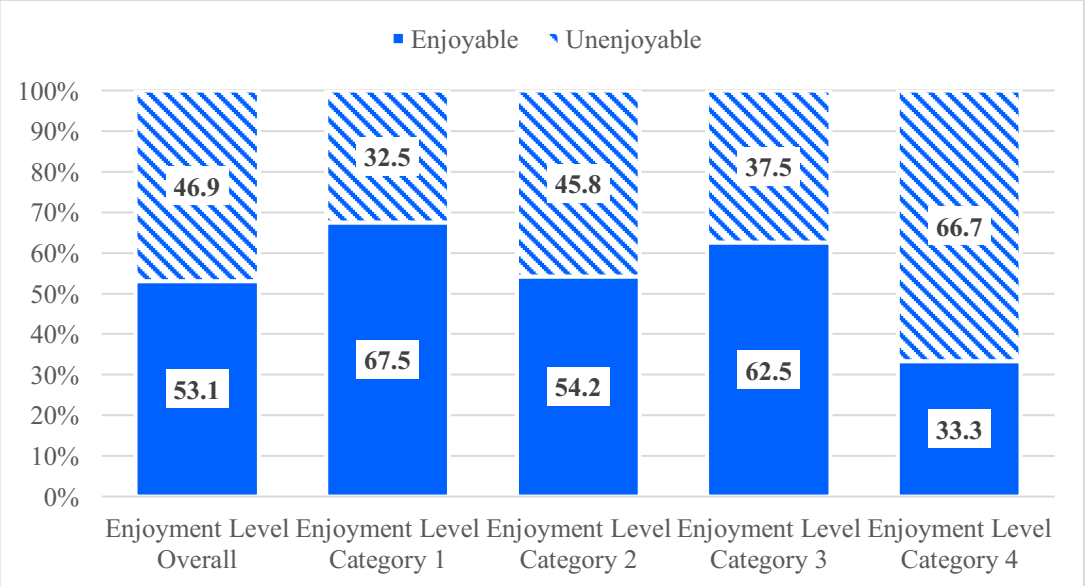
Results

Questionnaire

Participants were asked to rate the enjoyment level and the likelihood of using an external memory aid for the respective task and activity on a two-item scale as either *enjoyable* or *unenjoyable*, or as either *external memory aid likely* or *external memory aid unlikely*, respectively. Depending on which answer option received the most agreement, a task or activity was rated as either enjoyable or unenjoyable. The same principle was applied to the indication of the likelihood of using an external memory aid. The data, as visualised in Figure 1, indicates nearly an even split: 53.1% (N = 51) of the 96 tasks and activities are perceived as enjoyable and 46.9% (N = 45) as unenjoyable by the subjects. A closer examination of the enjoyment of the differing categories produced the following results: Categories 1, 2 and 3 were rated as rather enjoyable ($M_{Category1}$ = 62.5%, $N_{Category1}$ = 15; $M_{Category2}$ = 54.2%, $N_{Category2}$ = 13; $M_{Category3}$ = 62.5%, $N_{Category3}$ = 15), while Category 4 was rated as rather unenjoyable ($M_{Category4}$ = 66.7%, $N_{Category4}$ = 16).

Figure 1

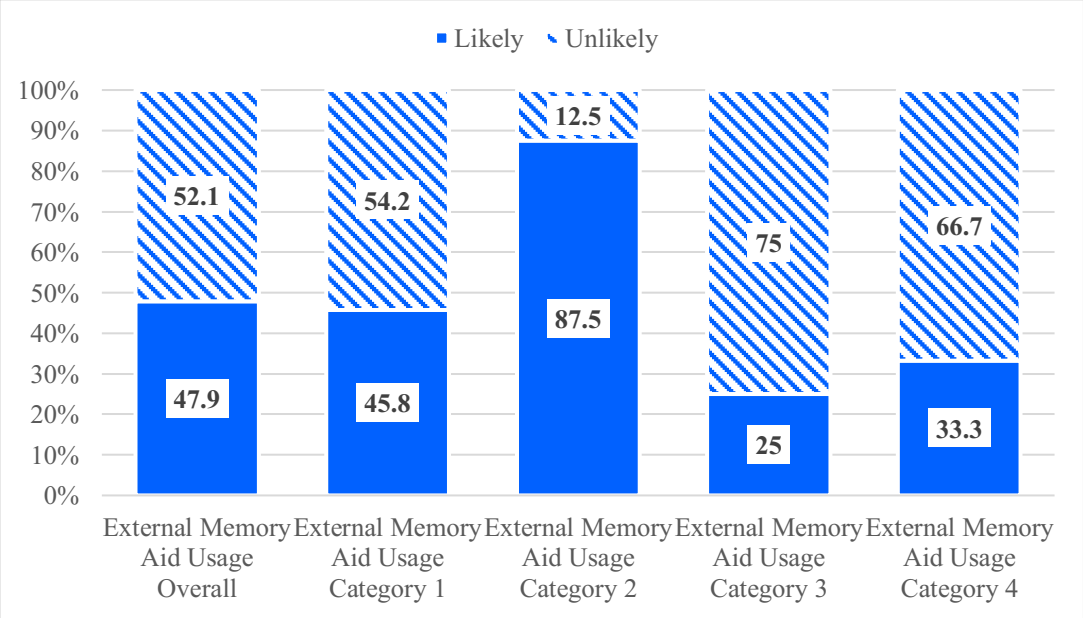
Participants' ratings of the enjoyability overall and on a category level.



Similar results are obtained when assessing subjects' likelihood indication of using an external memory aid for the respective task. Subjects indicated that they would likely use an external memory aid for 47.9% (N = 46) of the 96 activities, while it would be unlikely to use an aid in 52.1% (N = 50) of the cases (Figure 2). Looking at the differences among the categories, Category 2 is the only category for which subjects indicated the usage of an external memory aid as rather likely ($M_{Category2}$ = 87.5%, $N_{Category2}$ =21). Subjects rated the likelihood of using an external memory aid as rather unlikely for Category 1, 3 and 4 ($M_{Category1}$ = 54.2%, $N_{Category1}$ = 13; $M_{Category3}$ = 75%, $N_{Category3}$ =18; $M_{Category1}$ = 66.7%; $N_{Category4}$ = 16).

Figure 2

Participants' ratings of external memory aid usage overall and on a category level.



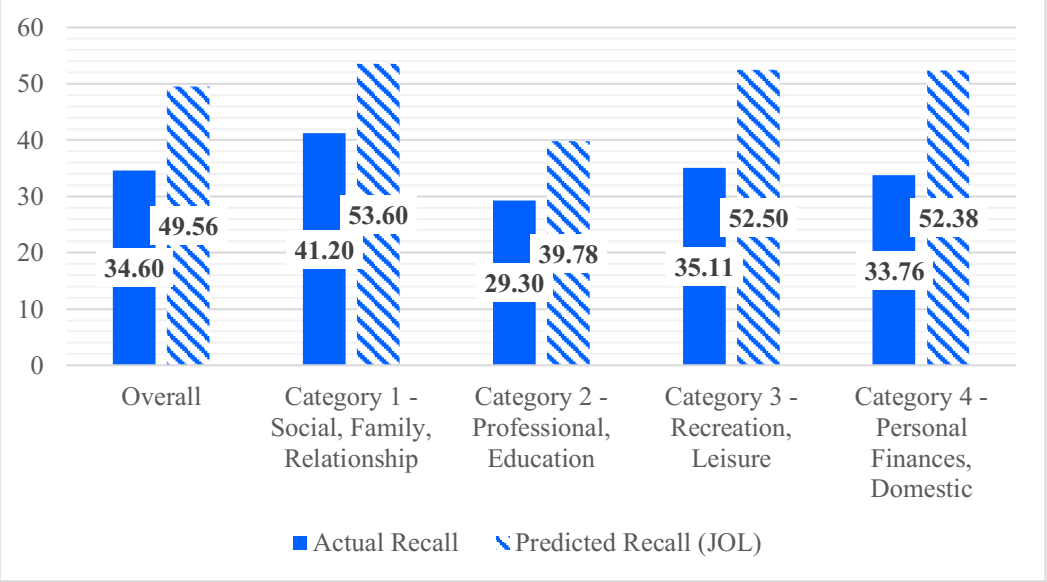
Measure vs Enjoyment Level

Analysing the data as a whole, subjects' average JOLs and average recall widely differ (Appendix B). Mean percentages of actual recall and predicted recall (JOL) are illustrated in Figure 3. While subjects' mean percentage of actual recall for all studied items is at 34.60 (SD = 18.02), their mean percentage JOL is at 49.56 (SD = 14.56). This indicates overconfidence in their predictions of their own memory performance. Breaking actual and predicted recall down into the category level, the data, as illustrated in Figure 3, yielded mean percentages of actual recall of 41.2%, 29.3%, 35.11%, and 33.76% for category 1, 2, 3 and 4, respectively, and mean percentages of predicted recall of 53.6%, 39.78%, 52.5%, and 52.38% for category 1, 2, 3, and

4, respectively. The overconfidence observation of the aggregated data can also be observed when analysing the data on a category level.

Figure 3

Mean percentages of actual and predicted recall (JOL).



With view at mean percentages of actual and predicted recall as a function of enjoyability of the tasks and activities, subjects' mean percentages for enjoyable tasks and activities are 35.09 (SD = 17.8) and 52.25 (SD = 15.15) respectively (Figure 4), while the mean percentages for actual and predicted recall of unenjoyable tasks and activities are 34.56 (SD = 18.47) and 46.52 (SD = 13.38) respectively (Figure 5). Consistent with the data on overall actual and predicted recall, participants' overconfidence in their own memory performance can also be observed when observing their actual and predicted memory performance is broken down to the enjoyability of the considered task and activity. This effect is consistent with results from previous studies that explore the calibration of JOL (Koriat et al., 2004; Zimmerman & Kelley, 2010). Therefore, the data lends support for the acceptance of H1.

To evaluate the effect of the enjoyability of a task or activity (enjoyable vs unenjoyable) on the measure (actual vs predicted recall), a one-way ANOVA is modelled (Appendix C1) with standardised enjoyment level variables. The analysis results in $F(14, 8) = 1.461$, $p = .301$ for the enjoyment level as a whole. The result does not indicate a statistical difference and does not allow for the rejection of the null hypothesis. Therefore, it cannot be ruled out that the enjoyability of activities has no effect on actual memory performance.

Figure 4

Mean percentages of actual and predicted recall (JOL) as a function of enjoyment level in view of the enjoyable aspect of a task and activity.

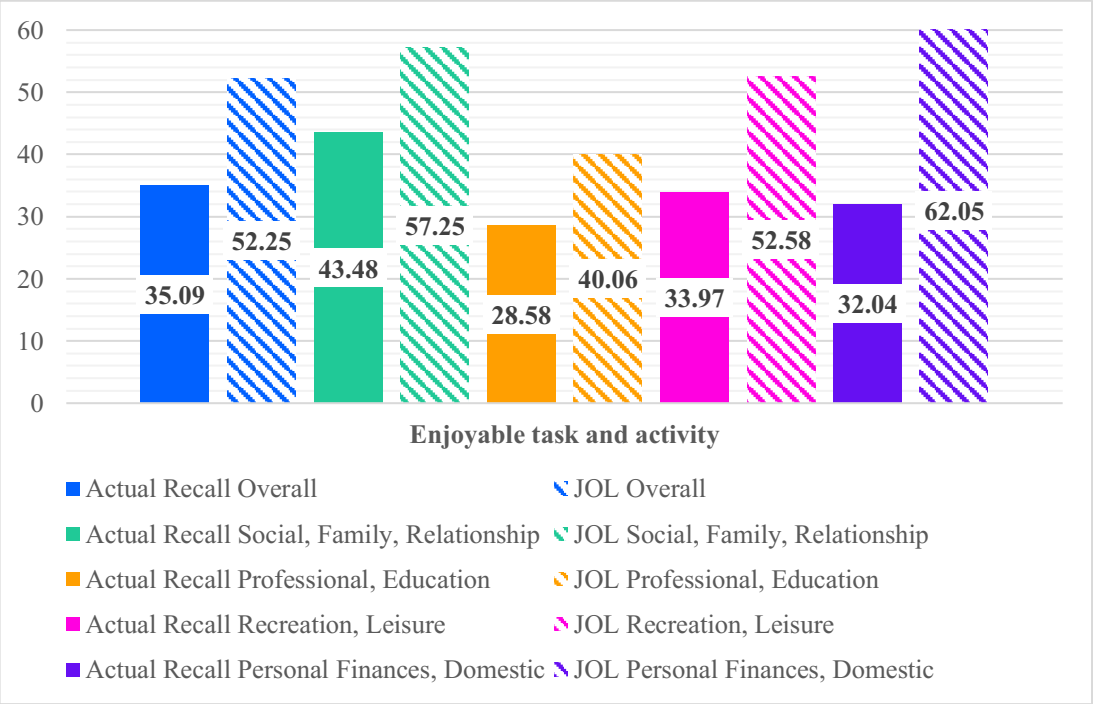
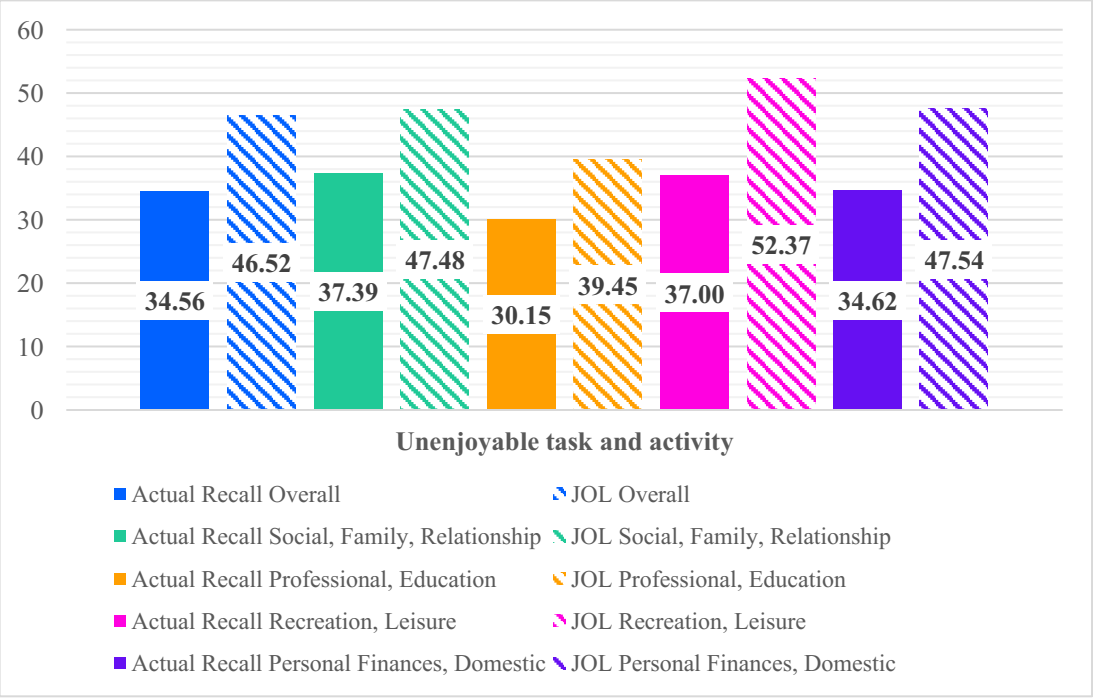


Figure 5

Mean percentages of actual and predicted recall (JOL) as a function of enjoyment level in view of the unenjoyable aspect of a task and activity.



Exploring the effect of the enjoyment level broken down into the four categories on the measure yielded $F(14, 8) = 1.653$, $p = .240$ for Category 1; $F(14, 8) = 1.565$, $p = .266$ for Category 2; $F(14, 8) = 1.427$, $p = .313$ for Category 3, and $F(14, 8) = .879$, $p = .602$ for Category 4. With the p-value above the 5%-confidence level for each category, the results reinforce the previous findings that no statistical difference can be found, and that the available data does not allow for the rejection of enjoyability having no effect on actual memory performance.

Analysing the results of the enjoyment level x measure ANOVA with regard to the subjects' JOLs (Appendix C1), the analysis yielded similar results: The analysis of enjoyment level as a whole yielded $F(15, 7) = .808$, $p = .657$. As the acquired p-value lies above the 5%-confidence interval, it, again, cannot be rejected that enjoyability has no effect on predicted recall. Breaking the enjoyment level down into the differing category levels as well, the analysis put forth $F(15, 7) = 2.676$, $p = .096$ for Category 1; $F(15, 7) = .730$, $p = .713$ for Category 2; $F(15, 7) = 1.011$, $p = .525$ for Category 3, and $F(15, 7) = .912$, $p = .586$ for Category 4. However, it must be noted that the data on the enjoyment level of category 4 violated the ANOVA assumption of the homogeneity of variances in view of the effect on predicted memory performance. The Levene's test p-value of .030 for this category lies within the 5%-confidence interval which requires the Welch and Brown-Forsythe tests to be conducted. However, both tests could not be performed as at least one group had the sum of case weights less than or equal to 1. Nevertheless, the analysis was proceeded with caution due to the violation of homogeneity of variances.

The findings do not allow for the rejection of the enjoyment level per category having no effect on an individual's prediction of their memory performance as no statistical effect could be found. The data does not support H2 since the results do not allow for statistically confident conclusions that enjoyability has an effect on actual or predicted memory performance.

Measure vs External Memory Aid Usage

Turning towards the effects of the indication of using external memory aids regarding actual memory performance, a one-way ANOVA [Measure (actual vs predicted recall) x External Memory Aid likelihood (likely vs unlikely)] is computed with standardised variables for the likelihood of using external memory aids. The computation yielded $F(14, 8) = 2.624$, $p = .087$ for the case of a subject indicating their likelihood of using an external memory aid as a whole (Appendix C2). Following these findings, the null hypothesis for external memory aids having no influence on actual memory performance cannot be rejected with confidence. However, the

p-value is close to reaching significance ($p < .05$) which could indicate that weak statistical evidence exists that an individual's indication of using external memory aids exerts influence on their actual memory performance. Looking at the data on a category level, the ANOVA yielded $F(14, 8) = .751$, $p = .694$ for Category 1; $F(14, 8) = 4.597$, $p = .018$ for Category 2; $F(14, 8) = 1.923$, $p = .177$ for Category 3, and $F(14, 8) = 1.045$, $p = .496$ for Category 4. Again, it should be noted that the following analysis was proceeded with caution as the assumption of the homogeneity of variances was violated in the Category 2 (Levene's test *p*-value = <.001) and Category 3 (Levene's test *p*-value = .007). From this premise, it cannot be confidently concluded that there is statistical evidence that the indication of external memory aid usage for tasks and activities within the professional, education or within the recreation, leisure categories have a significant effect on actual recall of individuals. Nevertheless, the results for categories 1 and 4 do not indicate a statistical difference since none of the *p*-values lie below the 5%-significance level.

Evaluating the data in terms of memorability differences among the four categories (Figure 3), the mean percentages of the categories indicated that tasks and activities from category 1 were the most memorable, followed by categories 3 and 4, and lastly category 2. These results do not reflect the expectation of tasks and activities in category 2 being more memorable than those of categories 3 and 4.

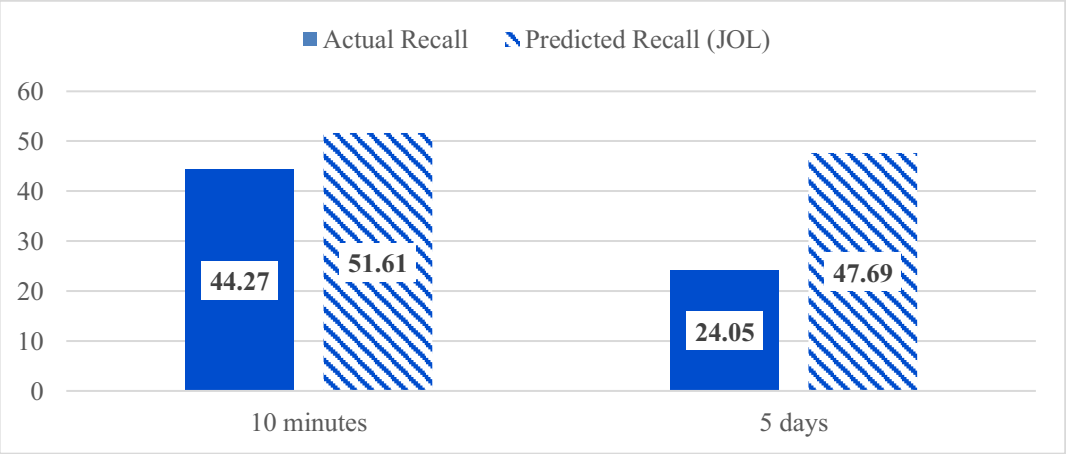
The assessment of the effect of external memory aid usage on subjects' predicted memory performance with the same model (Appendix C2) is performed for completeness of the analysis, though the results are not essential to address the assumptions of this work. Moreover, the results of this analysis must be considered with caution since none of the variables on external memory aid passed the test of homogeneity of variances. Nevertheless, the analysis yields $F(15, 7) = .453$, $p = .906$ for the indication of using an external memory aid as aggregated for all categories; $F(15, 7) = .403$, $p = .934$ for Category 1; $F(15, 7) = .739$, $p = .707$ for Category 2; $F(15, 7) = .809$, $p = .656$ for Category 3, and $F(15, 7) = 1.418$, $p = .332$ for Category 4. None of these groups seem to have an effect on JOLs which can be statistically accepted. Considering these results, it cannot be confidently and statistically concluded that the external memory aid usage does not affect predicted memory recall. The data set does not allow for the rejection of the null hypothesis in the case of the effect of external memory aid usage on individuals' predicted memory recall. All pieces of evidence considered, H3 cannot be supported with the acquired data as no statistical evidence can be found.

Measure vs Retention Interval

Considering the differing retention intervals of either 10 minutes or 5 days, participants' actual recall mean percentages indicate 44.27 (SD = 14.46) and 24.05 (SD = 7.53) respectively. Participants' mean percentage for predicted recall after 10 minutes is at 51.61 (SD = 13.01) and at 47.69 (SD = 10.9) for predicted recall in the 5 days condition (Figure 6). In general, participants in the 5-day retention interval condition exhibited more conservative predictions which were slightly calibrated to the retention interval. However, these participants demonstrated a similar overconfidence as subjects in the 10-minute retention interval condition. These findings are coherent and in line with previous expectations and indicate that retention interval impacts an individual's memory performance, but not their predictions of their own recall performance.

Figure 6

Mean percentages of actual and predicted recall as a function of retention interval.



A one-way ANOVA is computed to assess the effect of the retention interval (10-minutes vs 5-days) on the measure (actual vs predicted recall). The computation yields $F(1, 21) = 17.172$, $p = < .001$ for actual recall, and $F(1, 21) = 2.111$, $p = .161$, for predicted recall (Appendix A3). According to these computations, there is strong statistical evidence to reject the null hypothesis, i.e., that retention interval affects individuals' memory actual performance. However, the results do not allow for such a conclusion regarding predicted memory performance. Taken together, the results indicate that the retention interval condition has a significant effect on actual recall performance which is consistent with the reported results of previous studies.

Discussion

The purpose of the study was to examine the effect of types of influences on memory, especially in regard to enjoyability on memory performance. In terms of the proposed hypotheses, the data supports the previously expected outcomes for H1. The data provides statistical evidence that participants' memory performance is significantly affected by the retention interval. It was expected that participants would, in general, overestimate their memory's performance resulting in their predicted recall displaying their optimism and overconfidence while their actual recall is considerably lower. Overall, participants tended to predict their memory performance higher than it was, and this effect is robust across both retention interval conditions. Participants in the 10-minute retention interval condition exhibited a markedly better memory performance than the participants in the 5-day retention interval condition. Notably, participants in the 5-day retention interval condition displayed this overconfidence in their memory's performance even stronger. Their mean average JOLs in comparison to the 10-minute retention interval condition did not display any type of calibration which would indicate their sensitivity and awareness towards the fallibility of their memory. These findings are in line with the literature (Koriat et al., 2004) and support the first proposed hypothesis. Further research could continue and enhance this research topic by exploring whether multiple study opportunities would be able to alleviate this overconfidence. Interestingly, researchers were able to observe that participants rectify their predictions drastically after receiving their results of the first study trial (Koriat et al., 2002). After considering their performance during the first trial, participants calibrated and adjusted their future memory performance drastically, thus, exhibiting their underconfidence in their own memory's performance. Notably, researchers were able to observe that this underconfidence, which develops after the first study trial, persists at similar levels in multiple subsequent study trials although participants continue to adjust their predictions after each study trial. This phenomenon is labelled as *underconfidence with practice effect* (Koriat et al., 2002). Following this, it would be interesting to explore whether the *underconfidence with practice effect* would also appear in this study format when the study design is adapted.

Regarding the second hypothesis, which explored the effect of the enjoyment level of an activity on memory performance, the collected data does not allow for statistically confident conclusions which indicate that the enjoyment level of an activity affects individual's actual or predicted memory performance. In the case of the effect of enjoyability on actual memory

performance, the one-way ANOVA yielded scores that lied outside the 5% confidence intervals when examined for actual memory performance as aggregated for all categories, but also for the examination of the data broken down into the category levels. When turning towards the results of enjoyability on predicted memory performance, similar results can be observed: None of the computations for enjoyment level as aggregated for all categories or split and considered on a category level yields satisfactory results which allow for statistical conclusions that the inherent enjoyability of a task or activity influences an individual's predicted memory performance. Only the recreation, leisure category (*p*-value = .096) approaches the confidence level of 5% which would provide evidence for a statistical difference. However, this result lies within a 10% confidence interval which could be interpreted as lending weak evidence for the existence of a statistical difference indicating an effect on an individual's JOLs. Taking all this into consideration, H2 cannot be supported with the acquired data. Further research involving a larger sample size could provide the necessary data to statistically accept or reject this indication of a potential effect. Keeping in mind that previous research (Bradley et al., 1992; Schwarz & Clore, 1983) with larger samples were able to demonstrate the existence of this effect, it is reasonable to assume that this effect, be it less significant or not, should be observable within the scope of this study design as well.

Turning towards the fourth hypothesis that addressed the expectation of the decreasing memorability of the tasks and activities from category 1 to 4, the data does not support this expectation. According to the results, it stands out that the social, family, and relationship category contained the most memorable tasks and activities, followed by the recreation, leisure category, the personal finances, domestic category, and lastly the professional, education category. The expectation that with decreasing social pressure inherent to the respective categories the memorability of the tasks and activities within those categories decreases as well cannot be confidently concluded due to the lack of statistical evidence that the data supported. Comparing the results of the enjoyment level of the categories with the results for actual recall per category, a tendency in support of social pressure and enjoyability being a direct influence on memory becomes apparent. In terms of enjoyability, activities listed among the social, family, and relationship category and the recreation, leisure category received the most *enjoyable* ratings ($M_{Category\ 1}$ = 62.5%; $M_{Category\ 3}$ = 62.5%), followed by the professional, education category ($M_{Category\ 2}$ = 54,2%), and personal finances, domestic category ($M_{Category\ 4}$ = 33.3%). The observable preference of activities within categories 1 and 3 paired with actual recall being the highest in these categories suggests an interaction. This should be further

researched as this present data does not allow for these further investigations. Therefore, H4 cannot be supported with the present data. Although the data does not directly support the notion that memorability of the respective category decreases as the social pressure inherent to them decreases, the study does not provide any evidence on social pressure not affecting memorability. Memory is a complex system, and it is known to be guided by a multitude of underlying mechanisms and influenced by multiple factors. Further adaptations to the material can be undertaken to explore this research field. Revision and correction of the list of tasks and activities can potentially rectify the violation of the homogeneity of variances assumption of the applied one-way ANOVA in this analysis. Moreover, another possibility of avoiding this violation could be to skip the condensation that was performed to create the list. Instead of condensing the seven life domains that affect an individual's well-being proposed by Cummins (1996) into four more compact categories, it would be interesting to explore alternative study designs with the seven life domains determining the pool of tasks and activities. Different designs may produce more reliable results for which the necessary assumption of homogeneity of variances is complied with.

With focus on the effects of participants' indication of the likelihood of using an external memory aid, the analyses primarily yield results that must be considered with caution. In a few cases within the scope of this one-way ANOVA, the necessary assumption of homogeneity of variances was violated lowering the significance and validity of the results. The analysis of the effect of the external memory aid usage likelihood on actual memory performance mainly yields results which do not allow for the rejection of the null hypothesis, except for the professional, education category whose p-value (p = .018) lies within the 5%-confidence interval. Although this latter result reflects what has been hoped to be achieved, it can only be considered with caution as the computations for this category produced a violation of the homogeneity of variances assumption. The results of this analysis regarding the predicted memory performance must also be observed and interpreted carefully because none of the variables (observation of external memory aid usage likelihood as aggregated from all categories and of the four categories broken down to their levels) passed the test for the homogeneity of variances. Therefore, the acquired data does not provide support for the acceptance of H4. If the ANOVA had uncovered statistical differences indicating an effect of the indication of external memory aid usage on JOLs, the results would have provided evidence for the accuracy of participants' predictions regarding their own memory performance. Neither a positive nor a negative effect was observable with the acquired data, so it would be interesting

to further pursue this research branch to be able to derive more relevant, reliable, and useful study recommendations as to aid memory performance.

With these results in mind, it is not possible to derive with specific, tailored learning methods that account for multiple influences affecting memory performance, which are designed to improve and aid an individual in advancing their personal education. The only advancement that can be pursued with this work's results would be to adapt existing external memory aids or design new ones that better account for the fallibility of the memory due to the retention interval. Considering this tendency of not being able to remember as much as anticipated, people should generally decide for memory aids when the question arises whether to use one or not. Especially when it comes to remembering activities for longer periods of time, they should be taken into stronger consideration. In the long run, it would be useful for people to improve their methods of evaluating their memory. Learning how to accurately predict memory performance will help avoiding negative consequences resulting from forgetting.

Reflecting on the design of the study critically, it must be noted that conducting the study online was not an ideal location as it required a lot of trust in the participants to strictly follow the instructions. While every participant was asked to attempt the study without any aid, i.e., to not make any recordings, pictures, screenshots, or notes, there was still a chance for the participants to cheat. To minimise the chance of cheating opportunities, both parties activated the video function of the meeting application allowing the supervision of any suspicious note taking or attempts at video or photo recording. Despite this anticipated possibility, the study was designed to be conducted online due to geographical restrictions, which could not be resolved in other ways.

Moreover, it should be noted that study was designed and intended to be conducted in English. The questionnaire, the instructions, the slide deck were all written and presented in the English language. This also implied that the recall task was intended to be attempted originally in English. However, since most of the participants primarily speak German, though being proficient in English as well, some participants recalled the remembered task or activity in German, or even in a mix of German and English as the to-be-remembered items consisted of at least a noun and a verb. This opportunity was especially useful in clarifying any uncertainties if some of the terms were unknown to the participant. But, regardless of the language in which the participants attempted their recall task, the requirements for the recollection of the tasks and activities recalled were the same for all participants. Acceptable answers had to include both

the noun and the corresponding verb, however, close synonyms and mix-ups of the singular or plural forms were also accepted. For example, the to-be-remembered item list hypothetically contained "wash dishes", an acceptable variation would be "clean dishes" since the performed action is implied with the alternative verb.

Evaluating the data from a bigger sample would possibly lead to a more informative analysis since at some point, unreliable results were acquired, decreasing the chance of statistically significant results. Possible options to address this issue during the analysis have been considered: The data was checked for significant outliers, which could have skewed the results, though none could be detected; the data was standardised, but the analyses yielded the same results; and the aggregation of several data points to combine groups was considered but due to the multilevel analysis of the data, this option was not further pursued. Thus, to increase the explanatory power of the study, the sample size should be increased, in order to collect more valuable data supporting reliable and valid statistical tests. Another limitation of this work is the exclusion of a neutral answer choice for participants. Previous research compared high affective words, states, or items (positive or negative) to neutral words, states, or items, and therefore, concluded that words, states, or items high in affect positively affect memory performance, and consequently, decision-making. The decision to limit the answer choices to two opposite affective choices (either enjoyable and unenjoyable, or external memory aid usage likely or unlikely) stemmed from the derivation of the *Pollyanna* effect, which describes the observation that positive material is more memorable than neutral or negative material (Bradley et al., 1992). Moreover, this assumption was further strengthened considering the inclusion of intrinsic motivation in enjoyable activities which provides another strong influence on an activity which would make it more memorable. However, the study was not able to reflect these expectations, therefore, to test this hypothesis again, it would be useful to adapt the study design in order to ensure valid results. This could be achieved when affective states are first compared to neutral states. After successful evidence was acquired, it is worth to consider adapting the study design further to test whether enjoyable activities are indeed more memorable than unenjoyable activities.

Concluding Remarks

This work explored the effects of multiple influences on an individual's memory, specifically, whether enjoyable activities are more memorable than unenjoyable activities. It did not yield

evidence to accept this notion as no statistical difference was found. Nevertheless, the literature provides evidence that activities, items, words, or states that are high in affect have a positive effect on memory performance. The lack of evidence in this present work could be attributed to the small sample size. In a similar sense, this work explored the assumption that activities that are marked with a high degree of social pressure are more memorable. Specifically, it is explored that the memorability for activities of the four designed categories – first, social, family and relationship, second, professional and educational, third, recreation and leisure, and fourth, personal finances and domestic – decreases in that order. However, the data does not support this assumption due to lack of statistical evidence. In fact, the data indicates that the social, family and relationship category was the most memorable, followed by the recreation, leisure category, then the personal finance, domestic category, and then the category professional, education category as the least memorable category. Despite the lack of statistical evidence for these assumptions, practical implications can still be derived from this study: The findings suggest that individuals overestimate their learning performance, leading to them forgetting more tasks and activities than previously assumed and predicted. This observation shows that individuals do not anticipate their tendency to forget. It becomes especially clear when considering the different retention intervals, within which participants were supposed to remember the list of tasks and activities, which produced statistically reliable results. The participants displayed overconfidence in their memory's performance, and thus, a lack of sensitivity to the retention interval suggesting that individual's fail to use external memory aids in a useful manner. If individuals cannot accurately predict their memory and anticipate how much and how fast they forget, they will decide against tools that would improve their memory's performance. In some cases, it might be redundant to use external memory aids or nearly inconsequential if the task was forgotten, e.g., forgetting to mow the lawn or forgetting to cancel a dinner reservation. However, there may be grave consequences in other instances if the task is forgotten because the individual decided not to take the appropriate actions of assisting their memory in remembering, e.g., forgetting to drive to a surgical removal procedure or forgetting to deliver a work project. Thus, it is of importance for individual's to better understand and evaluate their memory to avoid negative consequences resulting from forgetting. Consequently, individuals should make more use of external memory aids as they forget more than they think they would.

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Appendices

Appendix A

Questionnaire

For the following tasks and activities, please indicate your actual and anticipated enjoyment level AND the likelihood of you using an external memory aid (e.g., sticky notes, physical reminders, calendar entries) for the respective tasks and activities.

Category 1 – Social, Family and Relationship

	Please indicate your actual or anticipated enjoyment level of this task or activity.		Please indicate your likelihood of using an external memory aid (e.g., sticky notes, physical reminders, calendar entry) for this task or activity.	
	Enjoyable	Unenjoyable	External Memory Aid Likely	External Memory Aid Unlikely
Meet up with friends				
Volunteer at the Red Cross				
Help parents' renovations				
Meet up for drinks				
Cancel a holiday				
Ask for help				
Book a sibling holiday				
Attend a wedding				
Donate to charity				
Provide tech support for parents				
Provide care for a relative				
Plan a trip with friends				
Go on a date				
Organise a party				
Make dinner plans				
Attend forced family gatherings				
Cancel dinner reservations				
Help a friend move				
Drive partner to a medical procedure				
Plan a picnic				
Call grandparents				
Reschedule a night out				
Face an argument				
Potty train children				

Category 2 – Professional, Education

	Please indicate your actual or anticipated enjoyment level of this task or activity.		Please indicate your likelihood of using an external memory aid (e.g., sticky notes, physical reminders, calendar entry) for this task or activity.	
	Enjoyable	Unenjoyable	External Memory Aid Likely	External Memory Aid Unlikely

Cancel business lunch				
Set calendar entry				
Order office supplies				
Write an essay				
Prepare a meeting				
Apply for a new job				
Deliver an assignment				
Deliver a presentation				
Reschedule a meeting				
Attend trainings				
Respond to acceptance letters				
Partake in a team lunch				
Prepare feedback				
Follow-up on colleague				
Attend workshops				
Do homework				
Plan next career move				
Support a struggling colleague				
Go on a business trip				
Request vacation days				
Organise documents				
Proofread texts				
Attend a meeting marathon				
Contact a colleague				

Category 3 – Recreation, Leisure

	Please indicate your actual or anticipated enjoyment level of this task or activity.		Please indicate your likelihood of using an external memory aid (e.g., sticky notes, physical reminders, calendar entry) for this task or activity.	
	Enjoyable	Unenjoyable	External Memory Aid Likely	External Memory Aid Unlikely
Listen to a new album				
Go to a concert				
Dust gaming set-up				
Watch a movie				
Draw a picture				
Take pet for vaccinations				
Remove body hair				
Assemble furniture				
Go swimming				
Go jogging				
Schedule doctors' appointments				
Pick up packages				
Write 'Thank you'-cards				
Visit a doctor				
Play video games				
Read a book				
Take a bath				
Wrap presents				
Paint the walls				
Move house				
Watch a sunset				

Drive to the gym				
Exercise at the gym				
Visit a museum				

Category 4 – Personal Finances, Domestic Affairs

	Please indicate your actual or anticipated enjoyment level of this task or activity.		Please indicate your likelihood of using an external memory aid (e.g., sticky notes, physical reminders, calendar entry) for this task or activity.	
	Enjoyable	Unenjoyable	External Memory Aid Likely	External Memory Aid Unlikely
Apply for a loan				
Write a grocery shopping list				
Create a meal plan				
Repair a broken cabinet				
Create an investment plan				
Water plants				
Iron clothes				
Decorate the Christmas tree				
Fill out tax return				
Pay off debt				
Take medication				
Clean the windows				
Create a budget				
Cancel phone contracts				
Take out the garbage				
Sort out the wardrobe				
Do laundry				
Go shopping				
Buy work supplies				
Order take-away				
Bake a cake				
Go grocery shopping				
Change the bed sheets				
Clean the bathroom				

Demographics

Age

- Less than 18 years
- 18-25 years
- 26-35 years
- 36-45 years
- 46-55 years
- 56-65 years
- 66+ years

Gender

- Male
- Female
- Non-binary / third gender
- Prefer not to say

Occupation

- Full-time employed
- Part-time employed
- Unemployed
- Student
- Retired
- Other

Please indicate the highest education level that you have achieved

• Lower secondary education (i.e., middle school) • Upper secondary education (i.e., A-levels, Abitur) • Apprenticeship • Bachelor degree (or equivalent) • Master degree (or equivalent) • Doctoral degree (or equivalent)

Country of Residence

Study Material / Slide Deck

Instructions

For the purpose of this study, you will be asked to perform two tasks:

1. Fill out a questionnaire, and
2. Study a list of tasks and activities while focussing on trying to remember each item.

The provided list contains 48 items and you will have 4 minutes to study it. After studying the last activity on the list, you will be asked to make a judgement of learning for each item, indicating the likelihood of you being able to remember the respective activity in the following recall test.

The recall test will take place 10 minutes / 5 days after this study task. For the recall test, you will be asked to orally recall as many listed tasks and activities as possible. The experimenter will then record your response. You will have 4 minutes for this recall task.
Do you have any questions?

Questionnaire Task

Please access the questionnaire via the following link:

https://ucplbusiness.co1.qualtrics.com/jfe/form/SV_a2xwwIx34OvI6hM

The collected data will be kept strictly confidential, and only aggregated results will be used in any report on the survey.

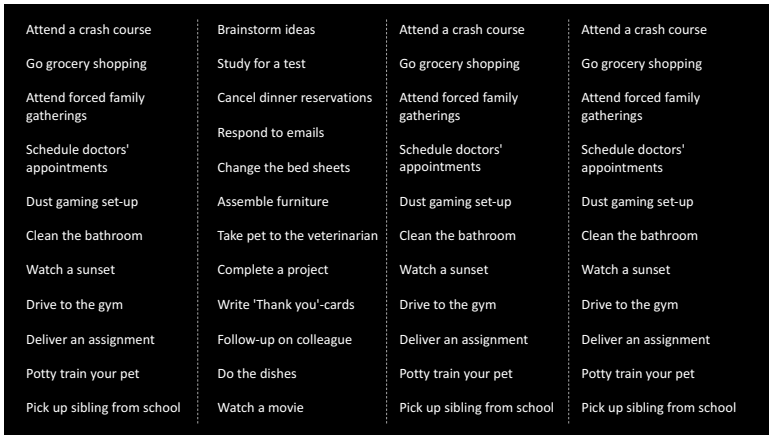
Memory Task

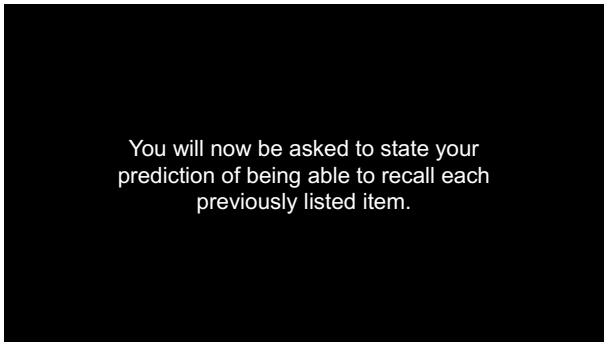
You will now study a list of 48 tasks and activities. You will be able to study the list for 4 minutes.

After studying the list, you will be presented each listed task and activity individually and you are asked to orally indicate the likelihood of you remembering this task in the following recall task. The experimenter will record your answers.

These predictions are made on a scale of 0 to 100, with 0 meaning *'I will definitely not recall the activity'* and 100 meaning *'I will definitely recall the activity'*.
For example, if you believe that you have a 60% chance of recalling the activity, you would orally state *'60'*.

You are free to use the whole range of the scale.





Appendix B

Aggregate Results of Actual Recall Performance

Participants' aggregate results for actual recall performance. Of the 96 items in the task and activity list, 48 randomly chosen items and were presented to the participants. Activities that were remembered are labelled "*y*" while not-remembered activities are labelled "*n*". Blank cells indicate that the participant with the corresponding number was not queried that task and activity.

Activities	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
Call grandparents	y	n	n	y					n		y	y		n								y	y
Make dinner plans	y	y		y		y	n	y		y	n	n		n	n	y	n	y		y			
Organise a party			n			n	y	n	n	n	n	n	n	y	y	n	n	y			n	n	n
Volunteer at the Red Cross	n	n	n		y	y		n			y					y	n		n		n		
Meet up for drinks	y		n					n	y		n		y	n	n			n	y	y		n	
Book a sibling holiday		n		n	y			n	n		y	n	y					n		y	y	n	n
Plan a trip with friends		n		y			n	y	n			n			n		n	n	n	y		n	n
Meet up with friends	n	y	y	n	y	n		y	y	n		n	n	n		n	n			y		n	
Donate to charity	y	n	n							n		y	n	n		y		n					
Attend a wedding		n		n		n		n	n	n	n		y		n	n				y	y	n	n
Go on a date			n	n	y		y												y	y	n	n	y
Plan a picnic			n				y	y	n			n			y		y		y	y	y	y	n
Reschedule a night out	n	n			y				y	n	y	n		n								n	
Cancel dinner reservations	n	n	n		n	n	y	n		n				y		y	y	n	n		y		
Cancel a holiday				n			y							n		n	y	n	n				
Ask for help						n	n			n	n	n	n		n	n			y	y	n		n
Provide care for a relative	n			n			n		y			y	n	n	y			y	n				
Provide tech support for parents				y		y	y			y			y	n					n	y	n		n
Help a friend move	y		n		y		n		n					n	y		y		n		y		n
Help parents' renovations	n		n		y	y					y		n				n				y	y	
Face an argument		n			n	n	n			y	n				y	n	n	n		n			n
Potty train children			y	n	y	y		y		y			y		n		y	y		y		n	n
Attend forced family gatherings	y				y	n				n		n	n		y	n			n		y		
Drive partner to a medical procedure		n		n	y			y	y		y					n		n					
Respond to acceptance letters		y				n		n	y	n						y		y			n		
Attend workshops		n	n	n	y	n			n				n		y	n	n	n				y	
Go on a business trip			n	n	y				y		n					n	n	n					
Set calendar entry	n	n				n		n	y					n	y	n			n	n		n	
Order office supplies		n	n					n			y	n	y		n		y				n		n
Support a struggling colleague	n		n	n		n	y		n				n		y								n
Contact a colleague	y			n			y	n				n	y	n		y	n	n		n	n	n	y
Partake in team lunch		n	y		y		y			n		y				n	n		y	n	y	n	y
Request vacation days				n	n	n	y		n	n	y			y		n	y	n	n				n
Attend trainings		n		n	y		n		n	n	n		y	n	n					n		n	
Deliver an assignment	y	n		y	y	n	y		n		n	n		n		n			y				n
Prepare feedback			n			n			n	n	n	n	y	n	n		n			n		y	n
Apply for a new job			y	n	n	n		n									y	n	n		n		
Prepare a meeting	n										n		y					n	y		n	n	
Cancel business lunch		y			y		n	n				n	y	n			y	n		y	n	n	n
Do homework	n		n			n	n	n		n	n	y		n	y	n				y		n	
Organise documents	n		y		n					n			n			n	n		n	n			
Reschedule a meeting		y	n				y	n	n				n		y				y				
Follow-up on colleague	n	n			y					y					n			n	n	n	y	n	
Plan next career move	n	n	n	n		n	y	n	y	n	n	n		n		n			n	n	y		
Proofread texts	n			n	y	n				n	n	n		n	n			n	n		y		n
Attend a meeting marathon	n	n				n		n				n	y	y	y		y	y	n	n	y	y	n
Deliver a presentation			n	n			n	n	n	n	n	n			n	n		n			n		y
Write an essay	y			n	y		n	n		n	y	y	y	n			n			y		n	y

Exercise at the gym	y	n	n		n		y	n				n		y		n	y		y				y
Listen to a new album		n	n				y				n	n	y	n	n	y	n		n	n	y		n
Go jogging					y	y	y	n	y	n	y	n			y	n	y			n		n	y
Go to a concert		n	n	n		n	n	n				n	n	n	n	y		n		n	y	n	
Go swimming	y	n			y	y			n		y						y		y		y		
Draw a picture	y		n	n		n		n	y	n		y	n				n	n				n	
Visit a museum						n	n			n	n							n		n	n		n
Watch a sunset	n			n	y		n	n	n	n			n				n			y	y		n
Read a book		n	y			n						n	y				n	n	y		y	y	
Watch a movie		n	y	n	y	n	y			n		n	n					n	n	n	y	y	n
Play video games	n		n	y		y	n	n						y	y			n					
Take a bath		n	y	n					y	n	n	n		n	y	y		n	n		n	y	
Move house	n		n		y	y			n	y	y	y	n			y	n					n	
Dust gaming set-up					y		y			n	n	n	y	n			y			n			n
Assemble furniture		n			y	n								n	y	y	n	n	n		y	n	
Paint the walls	y			n		n	n	n	y		n	n	n	y	y	n	n		n	n	y	n	n
Pick up packages	n		n	n	n								n		n					n	n		n
Wrap presents	n			n	n		n	n	n	n	n		n				n			n			n
Remove body hair	y	n		n				n	n	n		y	n		n	y			y			n	
Visit a doctor		n						n	n	y					y	n							
Drive to the gym	y									n	n			y				n	y			n	y
Schedule doctors' appointments		y	n	y				n	y		y			y		n		n	n	n			n
Write 'Thank you'-cards	n	n	n		y	n	n	n						n	n	n		y	y	n			
Take pet for vaccinations				y	y			y	y					n	y			n			y	n	
Create a meal plan		n	n		y	n	n		y			n	y	n	n				y			n	
Water plants	n	n	n				y				y	y		y					n		n	n	n
Create a budget	n		n	n	y			n			y				y	n		n	n	n	n		n
Bake a cake	n		n			n	y	n		y		y		n		n	y	y	n	n		n	
Write a grocery shopping list			y	n				n	n	n	n		n						n			n	
Pay off debt	n	n	n	n	y	n	y					n		n	y		n				n	n	y
Decorate the Christmas tree		n						y	n		n			n	n		y		y	n		n	y
Create an investment plan	n	n		n			y	n		n			y	n		n	y	n					
Order take-away			n			n	n	n	n	n			n		n	n	n	n		n	n		
Buy work supplies				n		n				n						n	y		n	n			n
Go shopping		n				y		n			y		n	n		y			y	y	y		
Take medication	n	n			y				n		n		n		y			n	y	n	n		n
Clean the bathroom	y	n		n	n		y	n		y	y	y			n			n			y		
Go grocery shopping	y		y	n	n	y	y		y		y	y			n	n			y	y	n		
Sort out the wardrobe		n		n	y			n		n			n	n	y	n	n	y		n		n	n
Apply for a loan	n		n	n		n		n	n	n	y								n	n			
Do laundry	y			y	y		y	n		y		y				y		n			y	y	
Repair a broken cabinet	n					n	y	n	y		n	n	n	n	n		y	y	n		y	n	n
Fill out tax return			y	n	y		y		n		n		n				n					n	n
Take out the garbage		n	n	n	y	n			n	n			n				n	n			y		y
Clean the windows		n								n		n	n	y		y	y	y		y			
Cancel phone contracts					n	n	n		n			n		n							n		n
Change the bed sheets	y	y	n			n				n		y		n	y	y	n			n		n	
Iron clothes					y				y		y	y	y		y	n		y				n	n

Aggregate Results of Predicted Recall (JOL)

Participants' aggregate predictions of their likelihood of remembering the respective task and activity. The higher the number, the higher the participant's predicted likelihood of remembering. Blank cells indicate that the participant with the corresponding number was not queried that task and activity.

Activities	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
Call grandparents	100	50	70	25					65		30	50		0								50	100
Make dinner plans	80	50		75		75	50	60		75	80	10		75	50	60	100	40		90			
Organise a party			70			15	80	90	80	55	70	40	100	90	100	60	64	70			20	60	10
Volunteer at the Red Cross	30	99	50		100	95		30			10					30	99		30		60		
Meet up for drinks	95		50					70	90		100		50	80	50			60	50	80		80	
Book a sibling holiday		70		15	95			40	70		80	5	15					20		50	50	10	30
Plan a trip with friends		20		80			90	100	80			20			50		70	50	40	50		90	0
Meet up with friends	90	40	70	80	80	100		100	90	90		40	100	100		65	96			100		100	
Donate to charity	35	10	20							3		40	70	45		45		20					
Attend a wedding		30		50		100		90	90	55	70		22		100	35				100	70	20	50
Go on a date			20	85	23		90												70	100	10	100	100
Plan a picnic			50				60	100	70			5			50		99		50	90	40	100	0
Reschedule a night out	50	10			30				40	14	90	30		1								10	
Cancel dinner reservations	45	70	45		84	50	80	20		5				0		50	90	20	20		20		
Cancel a holiday				1			100							85		35	47	20	50				
Ask for help						100	0			70	90	20	95		50	45			60	30	10		30
Provide care for a relative	30			30			10		95			5	20	60	100			70	30				
Provide tech support for parents				95		95	10			70			20	25					20	25	20		0
Help a friend move	75		0		98		20		70					80	50		92		40		60		50
Help parents' renovations	15		0		75	30					90		60				33				50	10	
Face an argument		20			5	100	5			100	100				100	40	100	60		10			60
Potty train children			80	40	84	100		70		3			0		0		69	50		30		10	40
Attend forced family gatherings	95				80	90				40		10	40		100	40			10		70		
Drive partner to a medical procedure		20		15	80			100	99		100					35		20					
Respond to acceptance letters		85				30		2	75	35						40		30			0		
Attend workshops		10	0	30	30	2			75				60		50	25	29	50				0	
Go on a business trip			50	60	80				100		80					45	69	60					
Set calendar entry	0	30				20		100	80					2	100	55			10	15		50	
Order office supplies		95	0					50			30	5	20		30		82				50		0
Support a struggling colleague	10		0	60		85	90		80				50		50								10
Contact a colleague	35			10			100	30				40	90	75		55	47	0		65	20	10	0
Partake in team lunch		99	0		60		50			22		20				30	67		30	30	0	0	40
Request vacation days				15	64	100	80		80	35	100			45		60	89	70	30				0
Attend trainings		70		40	45		0		60	17	80		60	30	0					45		0	
Deliver an assignment	45	10		10	80	100	50		95		40	5		5		30			40				30
Prepare feedback			10			2			60	65	30	10	70	50	50		99			25		30	0
Apply for a new job			0	15	55	60		80									64	70	40		10		
Prepare a meeting	25										90		100					60	30		0	40	
Cancel business lunch		60			75		0	20				20	50	0			38	50		20	30	0	0
Do homework	65		70			20	50	100		5	80	5		80	50	50				90		20	
Organise documents	10		10		62					75			100			60	12		30	20			
Reschedule a meeting		80	0				0	40	65				60		50				20				
Follow-up on colleague	10	10			15					25					0			10	20	10	10	20	
Plan next career move	50	40	10	20		2	0	40	100	75	100	5		10		30			10	75	0		
Proofread texts	20			5	95	50				5	20	5		60	50			30	30		40		0
Attend a meeting marathon	15	70				80		20				20	0	25	50		13	70	20	5	10	20	0
Deliver a presentation			40	10			30	10	90	83	90	10			100	30		10			40		10
Write an essay	40			10	40		30	60		30	50	5	20	10			40			100		20	40

Exercise at the gym	95	40	50		32		50	60				20		100		70	100		50				80
Listen to a new album		2	60				20				50	0	100	100	100	85	93		30	80	70		30
Go jogging					38	70	40	50	50	18	90	0			100	40	79			90		70	80
Go to a concert		10	60	50		100	50	100				10	10	100	50	85		30		95	70	80	
Go swimming	85	30			12	10			70		80						100		50		40		
Draw a picture	5		80	55		30		90	30	11		40	10				76	70				50	
Visit a museum						50	80			25	40							40		80	10		20
Watch a sunset	90			95	48		20	40	50	18			50				55			85	50		80
Read a book		10	50			83						5	15				21	50	60		90	90	
Watch a movie		20	70	90	20	40	50			40		20	90					50	60	100	80	90	50
Play video games	64		70	100		10	0	80						100	100			100					
Take a bath		80	50	70					85	15	100	60		90	0	45		50	60		70	100	
Move house	80		50		30	80			100	100	30	0	70			80	44					90	
Dust gaming set-up					70		0			2	100	0	20	70			100			1			20
Assemble furniture		20			18	48								5	50	45	53	40	30		60	20	
Paint the walls	35			35		90	30	40	60		60	0	60	80	100	70	73		40	40	70	30	0
Pick up packages	90		20	75	12								100		50					20	30		0
Wrap presents	55			10	10		50	100	60	45	50		5				23			70			0
Remove body hair	100	90		75				20	50	65		10	70		50	55			50			80	
Visit a doctor		5							70	67	90				50	75							
Drive to the gym	65									90	70			65				50	30			40	60
Schedule doctors' appointments		80	70	30				20	80		70			35		60		50	20	20			0
Write 'Thank you'-cards	70	5	0		20	30	20	40						10	0	20		70	40	30			
Take pet for vaccinations				25	90			100	95					30	100			30			60	50	
Create a meal plan		10	60		25	40	10		20			5	100	70	0				30			50	
Water plants	55	70	70				90				20	60		100					60		80	55	50
Create a budget	15		10	20	50			100			60				30	20		80	30	30	0		10
Bake a cake	40		70			60	90	90		35		0		60		50	88	60	70	70		80	
Write a grocery shopping list			50	80				4	50	70	90		70						30			70	
Pay off debt	20	50	60	5	80	50	0					0		17	100		24				40	0	0
Decorate the Christmas tree		60						100	50		100			65	100		76		50	85		100	100
Create an investment plan	10	80		15			20	100		10			100	3		20	100	50					
Order take-away			80			90	10	80	85	85			90		50	55	90	80		30	80		
Buy work supplies				25		14				5						30	44		30	5			10
Go shopping		60				20		80			80		90	70		80			70	100	100		
Take medication	50	90			40				60		80		60		50			40	50	60	50		50
Clean the bathroom	90	50		50	8		100	100		45	100	60			30			70			100		
Go grocery shopping	92		50	90	84	30	80		60		90	40			30	70			60	90	80		
Sort out the wardrobe		55		20	20			70		72			15	55	50	45	26	50		10		70	20
Apply for a loan	45		0	25		5		20	99	5	40								40	10			
Do laundry	90			65	70		80	100		70		60				80		80			90	90	
Repair a broken cabinet	5					32	80	0	10		40	0	0	30	0		73	30	30		20	0	10
Fill out tax return			0	10	90		90		50		80		60				75					40	0
Take out the garbage		40	50	65	85	50			50	77			45				70	50			80		100
Clean the windows		60								10		20	60	99		65	98	60		100			
Cancel phone contracts					52	50	0		50			5		35							10		0
Change the bed sheets	95	40	50			100				15		60		90	50	50	96			70		90	
Iron clothes					3				40		40	60	70		50	45		40				80	50

Appendix C

Appendix C1 – Output of Enjoyment Level x Measure ANOVA

Enjoyment Level x Actual Recall ANOVA

Tests of Homogeneity of Variances

		Levene Statistic	df1	df2	Sig.
Zscore: enjoyment level all	Based on Mean	.731	4	8	.596
	Based on Median	.574	4	8	.690
	Based on Median and with adjusted df	.574	4	4.987	.695
	Based on trimmed mean	.726	4	8	.599
Zscore: enjoyment level category 1	Based on Mean	2.600	4	8	.117
	Based on Median	1.071	4	8	.431
	Based on Median and with adjusted df	1.071	4	4.378	.468
	Based on trimmed mean	2.270	4	8	.150
Zscore: enjoyment level category 2	Based on Mean	3.237	4	8	.074
	Based on Median	2.242	4	8	.154
	Based on Median and with adjusted df	2.242	4	2.595	.289
	Based on trimmed mean	3.175	4	8	.077
Zscore: enjoyment level category 3	Based on Mean	.642	4	8	.648
	Based on Median	.595	4	8	.677
	Based on Median and with adjusted df	.595	4	4.256	.685
	Based on trimmed mean	.641	4	8	.648
Zscore: enjoyment level category 4	Based on Mean	1.334	4	8	.337
	Based on Median	.335	4	8	.847
	Based on Median and with adjusted df	.335	4	4.257	.843
	Based on trimmed mean	1.182	4	8	.388

ANOVA

		Sum of Squares	df	Mean Square	F	Sig.
Zscore: enjoyment level all	Between Groups	15.814	14	1.130	1.461	.301
	Within Groups	6.186	8	.773		
	Total	22.000	22			
Zscore: enjoyment level category 1	Between Groups	16.349	14	1.168	1.653	.240
	Within Groups	5.651	8	.706		
	Total	22.000	22			
Zscore: enjoyment level category 2	Between Groups	16.116	14	1.151	1.565	.266
	Within Groups	5.884	8	.736		
	Total	22.000	22			
Zscore: enjoyment level category 3	Between Groups	15.710	14	1.122	1.427	.313
	Within Groups	6.290	8	.786		
	Total	22.000	22			
Zscore: enjoyment level category 4	Between Groups	13.334	14	.952	.879	.602
	Within Groups	8.666	8	1.083		
	Total	22.000	22			

Robust Tests of Equality of Means[b,c,d,e,f]

		Statistic[a]	df1	df2	Sig.
Zscore: enjoyment level all	Welch	.	.	.	.
	Brown-Forsythe	.	.	.	.
Zscore: enjoyment level category 1	Welch	.	.	.	.
	Brown-Forsythe	.	.	.	.
Zscore: enjoyment level category 2	Welch	.	.	.	.
	Brown-Forsythe	.	.	.	.
Zscore: enjoyment level category 3	Welch	.	.	.	.
	Brown-Forsythe	.	.	.	.
Zscore: enjoyment level category 4	Welch	.	.	.	.
	Brown-Forsythe	.	.	.	.

a. Asymptotically F distributed.

b. Robust tests of equality of means cannot be performed for Zscore: enjoyment level all because at least one group has the sum of case weights less than or equal to 1.

c. Robust tests of equality of means cannot be performed for Zscore: enjoyment level category 1 because at least one group has the sum of case weights less than or equal to 1.

d. Robust tests of equality of means cannot be performed for Zscore: enjoyment level category 2 because at least one group has the sum of case weights less than or equal to 1.

e. Robust tests of equality of means cannot be performed for Zscore: enjoyment level category 3 because at least one group has the sum of case weights less than or equal to 1.

f. Robust tests of equality of means cannot be performed for Zscore: enjoyment level category 4 because at least one group has the sum of case weights less than or equal to 1.

Enjoyment Level x Predicted Recall (JOL) ANOVA

Tests of Homogeneity of Variances

		Levene Statistic	df1	df2	Sig.
Zscore: enjoyment level all	Based on Mean	3.016	4	7	.096
	Based on Median	1.743	4	7	.244
	Based on Median and with adjusted df	1.743	4	4.000	.302
	Based on trimmed mean	2.936	4	7	.102
Zscore: enjoyment level category 1	Based on Mean	3.281	4	7	.081
	Based on Median	.734	4	7	.597
	Based on Median and with adjusted df	.734	4	2.306	.638
	Based on trimmed mean	2.976	4	7	.099
Zscore: enjoyment level category 2	Based on Mean	1.422	4	7	.321
	Based on Median	.748	4	7	.590
	Based on Median and with adjusted df	.748	4	3.369	.615
	Based on trimmed mean	1.369	4	7	.336
Zscore: enjoyment level category 3	Based on Mean	1.196	4	7	.391
	Based on Median	.513	4	7	.729
	Based on Median and with adjusted df	.513	4	4.000	.733
	Based on trimmed mean	1.141	4	7	.411
Zscore: enjoyment level category 4	Based on Mean	5.138	4	7	.030
	Based on Median	3.625	4	7	.066
	Based on Median and with adjusted df	3.625	4	4.000	.120
	Based on trimmed mean	5.041	4	7	.031

ANOVA

		Sum of Squares	df	Mean Square	F	Sig.
Zscore: enjoyment level all	Between Groups	13.947	15	.930	.808	.657
	Within Groups	8.053	7	1.150		
	Total	22.000	22			
Zscore: enjoyment level category 1	Between Groups	18.733	15	1.249	2.676	.096
	Within Groups	3.267	7	.467		
	Total	22.000	22			
Zscore: enjoyment level category 2	Between Groups	13.422	15	.895	.730	.713
	Within Groups	8.578	7	1.225		
	Total	22.000	22			
Zscore: enjoyment level category 3	Between Groups	15.051	15	1.003	1.011	.525
	Within Groups	6.949	7	.993		
	Total	22.000	22			
Zscore: enjoyment level category 4	Between Groups	14.555	15	.970	.912	.586
	Within Groups	7.445	7	1.064		
	Total	22.000	22			

Robust Tests of Equality of Means[b,c,d,e,f]

		Statistic[a]	df1	df2	Sig.
Zscore: enjoyment level all	Welch	.	.	.	.
	Brown-Forsythe	.	.	.	.
Zscore: enjoyment level category 1	Welch	.	.	.	.
	Brown-Forsythe	.	.	.	.
Zscore: enjoyment level category 2	Welch	.	.	.	.
	Brown-Forsythe	.	.	.	.
Zscore: enjoyment level category 3	Welch	.	.	.	.
	Brown-Forsythe	.	.	.	.
Zscore: enjoyment level category 4	Welch	.	.	.	.
	Brown-Forsythe	.	.	.	.

a. Asymptotically F distributed.

b. Robust tests of equality of means cannot be performed for Zscore: enjoyment level all because at least one group has the sum of case weights less than or equal to 1.

c. Robust tests of equality of means cannot be performed for Zscore: enjoyment level category 1 because at least one group has the sum of case weights less than or equal to 1.

d. Robust tests of equality of means cannot be performed for Zscore: enjoyment level category 2 because at least one group has the sum of case weights less than or equal to 1.

e. Robust tests of equality of means cannot be performed for Zscore: enjoyment level category 3 because at least one group has the sum of case weights less than or equal to 1.

f. Robust tests of equality of means cannot be performed for Zscore: enjoyment level category 4 because at least one group has the sum of case weights less than or equal to 1.

Appendix C2 – Output of Measure x External Memory Aid Usage ANOVA

External Memory Aid Usage x Actual Recall ANOVA

Tests of Homogeneity of Variances

		Levene Statistic	df1	df2	Sig.
Zscore: external memory aid likelihood all	Based on Mean	1.925	4	8	.200
	Based on Median	1.918	4	8	.201
	Based on Median and with adjusted df	1.918	4	4.021	.271
	Based on trimmed mean	1.925	4	8	.200
Zscore: external memory aid likelihood category 1	Based on Mean	3.351	4	8	.068
	Based on Median	.725	4	8	.599
	Based on Median and with adjusted df	.725	4	2.387	.640
	Based on trimmed mean	3.001	4	8	.087
Zscore: external memory aid likeliness category 2	Based on Mean	38.639	4	8	<.001
	Based on Median	26.200	4	8	<.001
	Based on Median and with adjusted df	26.200	4	5.000	.001
	Based on trimmed mean	38.132	4	8	<.001
Zscore: external memory aid likeliness category 3	Based on Mean	7.892	4	8	.007
	Based on Median	6.577	4	8	.012
	Based on Median and with adjusted df	6.577	4	3.000	.077
	Based on trimmed mean	7.873	4	8	.007
Zscore: external memory aid likeliness category 4	Based on Mean	.884	4	8	.515
	Based on Median	.479	4	8	.751
	Based on Median and with adjusted df	.479	4	4.321	.753
	Based on trimmed mean	.777	4	8	.570

ANOVA

		Sum of Squares	df	Mean Square	F	Sig.
Zscore: external memory aid likelihood all	Between Groups	18.066	14	1.290	2.624	.087
	Within Groups	3.934	8	.492		
	Total	22.000	22			
Zscore: external memory aid likelihood category 1	Between Groups	12.495	14	.893	.751	.694
	Within Groups	9.505	8	1.188		
	Total	22.000	22			
Zscore: external memory aid likeliness category 2	Between Groups	19.568	14	1.398	4.597	.018
	Within Groups	2.432	8	.304		
	Total	22.000	22			
Zscore: external memory aid likeliness category 3	Between Groups	16.961	14	1.212	1.923	.177
	Within Groups	5.039	8	.630		
	Total	22.000	22			
Zscore: external memory aid likeliness category 4	Between Groups	14.224	14	1.016	1.045	.496
	Within Groups	7.776	8	.972		
	Total	22.000	22			

Robust Tests of Equality of Means[b,c,d,e,f]

		Statistic[a]	df1	df2	Sig.
Zscore: external memory aid likelihood all	Welch	.	.	.	.
	Brown-Forsythe	.	.	.	.
Zscore: external memory aid likelihood category 1	Welch	.	.	.	.
	Brown-Forsythe	.	.	.	.
Zscore: external memory aid likeliness category 2	Welch	.	.	.	.
	Brown-Forsythe	.	.	.	.
Zscore: external memory aid likeliness category 3	Welch	.	.	.	.
	Brown-Forsythe	.	.	.	.
Zscore: external memory aid likeliness category 4	Welch	.	.	.	.
	Brown-Forsythe	.	.	.	.

a. Asymptotically F distributed.

b. Robust tests of equality of means cannot be performed for Zscore: external memory aid likelihood all because at least one group has the sum of case weights less than or equal to 1.

c. Robust tests of equality of means cannot be performed for Zscore: external memory aid likelihood category 1 because at least one group has the sum of case weights less than or equal to 1.

d. Robust tests of equality of means cannot be performed for Zscore: external memory aid likeliness category 2 because at least one group has the sum of case weights less than or equal to 1.

e. Robust tests of equality of means cannot be performed for Zscore: external memory aid likeliness category 3 because at least one group has the sum of case weights less than or equal to 1.

f. Robust tests of equality of means cannot be performed for Zscore: external memory aid likeliness category 4 because at least one group has the sum of case weights less than or equal to 1.

External Memory Aid Usage x Predicted Recall (JOL) ANOVA

Tests of Homogeneity of Variances

		Levene Statistic	df1	df2	Sig.
Zscore: external memory aid likelihood all	Based on Mean	14.570	4	7	.002
	Based on Median	2.540	4	7	.133
	Based on Median and with adjusted df	2.540	4	2.338	.275
	Based on trimmed mean	12.638	4	7	.003
Zscore: external memory aid likelihood category 1	Based on Mean	14.111	4	7	.002
	Based on Median	4.435	4	7	.042
	Based on Median and with adjusted df	4.435	4	3.723	.097
	Based on trimmed mean	13.063	4	7	.002
Zscore: external memory aid likeliness category 2	Based on Mean	10.026	4	7	.005
	Based on Median	2.109	4	7	.183
	Based on Median and with adjusted df	2.109	4	2.102	.338
	Based on trimmed mean	8.954	4	7	.007
Zscore: external memory aid likeliness category 3	Based on Mean	5.677	4	7	.023
	Based on Median	1.081	4	7	.434
	Based on Median and with adjusted df	1.081	4	3.987	.471
	Based on trimmed mean	5.024	4	7	.032
Zscore: external memory aid likeliness category 4	Based on Mean	5.250	4	7	.028
	Based on Median	2.803	4	7	.111
	Based on Median and with adjusted df	2.803	4	2.108	.270
	Based on trimmed mean	5.069	4	7	.031

ANOVA

		Sum of Squares	df	Mean Square	F	Sig.
Zscore: external memory aid likelihood all	Between Groups	10.836	15	.722	.453	.906
	Within Groups	11.164	7	1.595		
	Total	22.000	22			
Zscore: external memory aid likelihood category 1	Between Groups	10.190	15	.679	.403	.934
	Within Groups	11.810	7	1.687		
	Total	22.000	22			
Zscore: external memory aid likeliness category 2	Between Groups	13.484	15	.899	.739	.707
	Within Groups	8.516	7	1.217		
	Total	22.000	22			
Zscore: external memory aid likeliness category 3	Between Groups	13.954	15	.930	.809	.656
	Within Groups	8.046	7	1.149		
	Total	22.000	22			
Zscore: external memory aid likeliness category 4	Between Groups	16.553	15	1.104	1.418	.332
	Within Groups	5.447	7	.778		
	Total	22.000	22			

Robust Tests of Equality of Means[b,c,d,e,f]

		Statistic[a]	df1	df2	Sig.
Zscore: external memory aid likelihood all	Welch	.	.	.	.
	Brown-Forsythe	.	.	.	.
Zscore: external memory aid likelihood category 1	Welch	.	.	.	.
	Brown-Forsythe	.	.	.	.
Zscore: external memory aid likeliness category 2	Welch	.	.	.	.
	Brown-Forsythe	.	.	.	.
Zscore: external memory aid likeliness category 3	Welch	.	.	.	.
	Brown-Forsythe	.	.	.	.
Zscore: external memory aid likeliness category 4	Welch	.	.	.	.
	Brown-Forsythe	.	.	.	.

a. Asymptotically F distributed.

b. Robust tests of equality of means cannot be performed for Zscore: external memory aid likelihood all because at least one group has the sum of case weights less than or equal to 1.

c. Robust tests of equality of means cannot be performed for Zscore: external memory aid likelihood category 1 because at least one group has the sum of case weights less than or equal to 1.

d. Robust tests of equality of means cannot be performed for Zscore: external memory aid likeliness category 2 because at least one group has the sum of case weights less than or equal to 1.

e. Robust tests of equality of means cannot be performed for Zscore: external memory aid likeliness category 3 because at least one group has the sum of case weights less than or equal to 1.

f. Robust tests of equality of means cannot be performed for Zscore: external memory aid likeliness category 4 because at least one group has the sum of case weights less than or equal to 1.

Appendix C3 – Output of Retention Interval x Measure ANOVA

Tests of Homogeneity of Variances

		Levene Statistic	df1	df2	Sig.
actual memory performance	Based on Mean	2.014	1	21	.171
	Based on Median	1.415	1	21	.247
	Based on Median and with adjusted df	1.415	1	14.714	.253
	Based on trimmed mean	1.801	1	21	.194
predicted memory performance	Based on Mean	1.263	1	21	.274
	Based on Median	1.177	1	21	.290
	Based on Median and with adjusted df	1.177	1	20.899	.290
	Based on trimmed mean	1.313	1	21	.265

ANOVA

		Sum of Squares	df	Mean Square	F	Sig.
actual memory performance	Between Groups	540.501	1	540.501	17.172	<.001
	Within Groups	660.977	21	31.475		
	Total	1201.478	22			
predicted memory performance	Between Groups	116.609	1	116.609	2.111	.161
	Within Groups	1159.826	21	55.230		
	Total	1276.435	22			

Robust Tests of Equality of Means

		Statistic[a]	df1	df2	Sig.
actual memory performance	Welch	18.092	1	16.849	<.001
	Brown-Forsythe	18.092	1	16.849	<.001
predicted memory performance	Welch	2.157	1	20.573	.157
	Brown-Forsythe	2.157	1	20.573	.157

a. Asymptotically F distributed.