Source Monitoring and It's Relationship to Hypermnesia

Caeleigh MacDonald

Department of Psychology, Brandon University

Thesis Advisor: Dr. Phillip Goernert

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Abstract

The purpose of this study was to explore the relationship between the source monitoring framework and hypermnesia. The source monitoring framework is the mechanism behind how we store and form memories, and it plays an imminent role in our ability to recall items as well as identifying the source in which it came from. Source monitoring was operationalized by exploring how effectively, when encoded simultaneously, the source of a pictorial drawing can be correctly retrieved with the drawing itself, and this will be demonstrated by evaluating the hypermnesic effects across three consecutive recall tests. Hypermnesic effects appear when scores improve by repeated testing. These effects are present when people either remember more (item gains/reminiscence) or forget less (item losses/intertest forgetting) for each consecutive test. The novelty of this study is the fact of whether experimenter provided sources can enhance hypermnesic effects across three tests. This means that the experimenter provided both the pictorial drawing and the set it belonged to, to explore our mental abilities in terms of retaining to consecutive pieces of information simultaneously, and how that effects our ability to correctly recall. For this, university students were presented with thirty-six pictorial drawings, along with their corresponding set, and were instructed to recall both the drawing and the set for future recall. A total of three recall tests were administered, where the subjects printed the name of the object, they remember under each column representing each set, and this test was repeated three times, to determine whether hypermnesic effects were present, and whether they were accounted for by item gains or losses, or both. The present findings suggest that hypermnesia is present for repeated testing, but there are errors present in our source monitoring framework that is causing

correct drawing, but incorrect set identifications and these findings were correlated with forgetting less, rather than remembering more from one test to another.

Introduction

The effect of hypermnesia refers to the increased recall of items by subjects when they undergo repeated testing. (Wallner & Bauml, 2018). There are two mental processes that are compared to determine whether hypermnesic effects have occurred. The first process is reminiscence, or *item gains,* and this occurs when items that were previously not recalled on an earlier test are then recalled on the following test, also referred to as remembering more (Wallner & Bauml, 2018). The second process, intertest forgetting, or *item losses,* occurs when items recalled on the first test are not recalled on the subsequent test, and this is also called forgetting (Wallner & Bauml, 2018). When reminiscence surpasses intertest forgetting, there is a total memory increase, and this causes the beneficial effect known as hypermnesia (Wallner & Bauml, 2018). Hypermnesic effects can also be explained by decreased intertest forgetting and stable reminiscence, but in both situations, reminiscence must be higher than intertest forgetting in order to observe hypermnesic effects (Wallner & Bauml, 2018).

Wallner and Bauml (2018) looked at hypermnesia using delay, as well as hypermnesia using different recall methods (forced vs free recall). The concept of delay and method of recall is important because Wallner and Bauml (2018) observed that when using longer delays (such as 24 hours), the hypermnesic effects on free recall were much stronger than in short delays, because of the decrease in item losses between testing periods. It is important to note that these results were not found in forced recall. A reason for there being a difference in hypermnesic effects for free and forced recall is the idea that free recall has “looser” constrictions, meaning that the subjects are not expected to recall a certain item (like they are in forced recall), instead, they are instructed to recall any items that they can remember (Wallner and Bauml, 2018). These results demonstrate the effects of delay and type of recall on hypermnesia and can explain why hypermnesia is present in certain testing conditions over others. This experiment also looked at using both pictures and words as stimuli, and they found that the pictures (which were pictorial drawings from Snodgrass and Vanderwarts norms) had a larger hypermnesic affect than the words did, which means that the participants were able to recall more visual images than they were able to recall words (Wallner & Bauml, 2018). This is primarily because the subjects integrate the pictures into their memory in a separate way than words, and upon cues, may affect which stimuli is more easily retrieved (Wallner & Bauml, 2018).

There is a gap in the literature regarding the storage of word and visual stimuli and more research needs to be conducted in this area to further understand the mechanisms behind it. In addition, Wallner and Bauml found that hypermnesic effects are stronger with longer rather than shorter delays when the participants were using free recall, and this is primarily because longer delays reduced item losses (2018). In contrast, there was a decrease in hypermnesia with a delay when forced recall was used, indicating that both the delay and recall type influences how effective memory is (Wallner & Bauml, 2018). This study demonstrates the connection between hypermnesia and the roles of recall and delay on retrieval accuracy, and helps the audience understand what conditions (delay length and type of recall) that hypermnesic effects are the most prominent.

Hypermnesic effects by increased reminiscence are formed by the inner workings of two main components: incrementing and finding alternate retrieval cues (Otani et al, 1999). Incrementing is the concept that when an item and its source are recalled once on an earlier test, both the item and the source becomes easier to recall on the subsequent tests, because there is repeated rehearsal of the item and the source it belongs too, allowing it to be retained in short term memory for a greater length of time, preventing intertest forgetting (Otani et al, 1999). This means that there is an increase in the amount of information being remembered and a decrease in the amount of information being forgotten, which causes the participants to be able to recall information they were just presented with on consecutive testing (Otani et al, 1999). This means that if there is an increase in reminiscence and a decrease in intertest forgetting, results will reflect an overall total memory increase, and with repeated testing, represents hypermnesia (Otani et al, 1999). Moreover, Otani et al explain how retrieval and recall are positively correlated with each other, by explaining that when information is able to be retrieved in the brain, then it can be recalled, because if it is not retrievable, it is *lost*, and that means it cannot be recalled (1999). Essentially, in order for a piece of information to be recalled, it has to be able to be retrieved from a memory store in the brain and incrementing can help retain newly learned information in the short-term memory store (Otani et al, 1999).

The second process that Otani et al emphasize as being a crucial component of hypermnesia involves using alternative retrieval cues in the brain as a means of gaining access to previously unrecalled items (1999). This means that there are multiple cues that a stimulus can be encoded with, so when triggered, it increases the chance of that particular item being recalled. This can also correlate directly to recall and retrieval, because the more cues that are connected to a piece of information, the easier it is to retrieve it and recall it when necessary (Otani et al, 1999). To this date, there is a significant lack of research done in the area of looking at alternate retrieval cues, but there are significant studies done on incrementing (Otani et al, 1999). This may be due to the fact that is much easier to test for recall skills than observe what cues a brain encodes stimuli as. Retrieval cues are memory cues, in that help trigger an item stored in memory (Otani et al, 1999). Retrieval cues can either be self-generated or provided by the experimenter, and either way, their function is to help the subject remember the item that is to be recalled on subsequent testing (Otani et al, 1999). Retrieval cues are relevant to the present study, because the subjects are expected to create self-generated cues about a pictorial drawing and its set, in a way that will help them remember it on subsequent testing. Without retrieval cues, subjects will just be relying on short term memory, and this could result in intertest forgetting, impeding on hypermnesic effects. This demonstrates the importance of retrieval cues and the relevance it has to the present study.

Otani et al (1999) looked at retrieval cues and free recall. For this study, they did three experiments where the subjects were either assigned one cue, three cues, or free recall as a means of recalling the information that was presented. For the subjects in the three-cue group, they were given a cue by the experimenters, and then they were instructed to create two self-generated cues to help them remember for future recall (Otani et al, 1999). The one cue setting was chosen to explore self-generated cues and their impact on a subject's ability remember items (Otani et al, 1999). The third condition was free recall, where the participants were not limited in terms of recalling the pictures they could remember and were allowed to recall those items in whatever order they like. They found that when the participants were given three cues, the effects of hypermnesia were stronger (the subjects recalled significantly more information from the tests) than they did with one cue or free recall (Otani et al, 1999). The one cue condition was based on greater reminiscence rather than on lower intertest forgetting which means that the reason for hypermnesia in this experiment was due to the fact that the participants were remembering more of the information than forgetting (Otani et al, 1999). This is because having these self-generated cues present increases the chance of triggering memory and can help trigger information that may have been forgotten (Otani et al, 1999). The results of this study demonstrate the importance of cue retrieval on the effects of hypermnesia and how the amount of cues present can influence how well one is able to recall information that they stored.

Due to the fact that hypermnesia is a mental effect based on enhanced memory over repeated testing, it is important to understand the mental framework that allows for the storage and retrieval of memories-the source monitoring framework. Source monitoring is a critical process, and it is used everyday as a function of differentiation between the real world and human imagination (Johnson et al, 1993). This pertains to human life, because without being able to differentiate between real and imagination, one’s world would just be a fantasy. Source monitoring includes information such as identifying who told you a piece of information, the source in which that information came from, and when an event occurred, etc. (Johnson, 1997). The source monitoring framework works by a combination of both heuristic (using self-generated means of remembering information) and systematic processing (using strategies such as deep and critical thinking) techniques which account for both the similarities and differences between individuals that are seen under testing conditions (Johnson et al, 1993).

In a testing situation, when items are correct, but the source is incorrectly recalled, this represents the concept of source monitoring error (Johnson et al, 1993). People who are experiencing source monitoring error may try to give their best guess to fill in the blanks to the information they cannot recall, or simply be recalling information that was not shown to them in the testing stage (Johnson et al, 1993). An example of how source monitoring error can be measured by researchers is to determine how accurately a subject can recall an item and its source by experimenter provided information, and if the item is correct but the source is incorrect, this would demonstrate a source monitoring errors (Johnson et al, 1993). This is demonstrating that the subjects cannot accurately retrieve both the source and the item paired with that source, representing a failure to correctly identify the source that a piece of information came from. Researchers will then be able to see which items they got correct or incorrect and then they are able to identify if source monitoring errors are present. If source monitoring errors are present, the researcher should be able to identify whether the subject used confabulation's (replacing unknown gaps in memory with guesses from one's own memory) or just simply did not know the answer due to intertest forgetting (Johnson et al, 1993). This would be demonstrated by changes in responses over repeated testing, which indicates that the subject unsure of the correct source that the items belong too, resulting in new guesses on each consecutive test. This demonstrates that the source monitoring mental framework provides the basis of decision making and it guides our behavior and actions, and most importantly, these studies on this mental framework helps researchers understand how memories are formed and how they are stored in the brain (Johnson et al, 1993).

In a study conducted in 1993 by Johnson et al, they looked at source monitoring and explained how the source (where information is retrieved from) can come from multiple areas in the brain, which means that memories do not come from the same part of the brain, and certain areas of the brain are responsible for certain types of memories. In saying this, when these different areas of the brain get damaged, they all influence source monitoring in an unusual way (Johnson et al, 1993). For example, Johnson et al, found that when there is damage to the temporal areas of the brain, people have trouble recalling the *context* of an event (1993). Source monitoring not only depends on the part of the brain, but it also depends on the information available during activated memory, which can affect the quality of a certain memory (Johnson et al,1993). This means that only the activated parts of the brain can retrieve memories and they can be distorted or only partially recalled (Johnson et al, 1993). The aim of this study was to explore source monitoring and how much it can vary depending on brain structure and person, as well as the role this framework plays in memory formation and retrieval (Johnson et al, 1993). This demonstrates the link between source monitoring and hypermnesia that was previously mentioned, in that source monitoring acts as the backbone. The term “backbone” means that if source monitoring error is present, or there are damaged parts of the brain, then there will be deficits in hypermnesia, and certain information may not be able to be correctly recalled. The reference of “backbone” simply means that the structure of the source monitoring framework (intact or damaged), will influence our ability to retain and recall information (Johnson et al, 1993).

In contrast, if the source monitoring framework is fully functioning, one should be able to accurately recall information they are trying to remember. This also means that the source monitoring framework is essentially what allows information to be recalled after being exposed to it, because the cues that are associated with that information gets stored in the source monitoring framework, and it is that same framework that is responsible for retrieval after being triggered, allowing for the reminiscence aspect of hypermnesia to occur (Johnson et al, 1993). If the information is not integrated enough into the source monitoring framework or it is deemed irrelevant for future recollection, then it is lost and cannot be retrieved and hypermnesia will not be present (Johnson et al, 1993).

The source monitoring framework aids in the presence of hypermnesia by providing the storage of items that were recalled on an earlier test that are able to be recalled on subsequent testing, and it is also responsible for the way information is stored as well as influencing how and if the items in memory are able to be recalled in the future (Johnson et al, 1993). If information is not integrated and maintained in the source monitoring framework, then it is not able to be recollected, because those memories are lost; hypermnesia is reliant on the source monitoring framework for the effective recall of memories (Johnson et al, 1993). When information is presented, and then recalled through repeated testing, this can allow for more than one cue to be associated with that piece of information, and these will all be stored in the source monitoring framework which allows for an increased chance of being triggered by multiple cues during test time (Johnson et al, 1993). The cues created by the brain lead to the later recall of items because those cues will allow for an item to have the chance to be brought into consciousness (or be recalled) because the cue is responsible for triggering the item it is paired with (Johnson et al, 1993).

Mitchell and Johnson (2008) looked at source monitoring errors and the effects they have on human brain functioning, and they found that the most prominent issue that was seen in people who sustained brain damage was the presence of false memories, which is confusing the real world with the imaginative world. These results further demonstrate that the source monitoring framework is responsible for the retrieval of both the memory and its source, and damage to this framework in any way can impair the correct recall of both the source and its corresponding memory. In this case, sustaining brain damage had implications on what the subject remembered, and this included incorrect sources, which in turn led to incorrect memory recall, once again, illustrating the relationship between the source monitoring framework and the presence of hypermnesia (Mitchell & Johnson, 2008).

The process of the distinction of false memories and true memories, Johnson emphasizes, is done by a process called reality monitoring (1997). This process is said to occur by the reflection of memories derived from perception, and errors in the source monitoring framework are seen when people misattribute an item or memory that was reflectively created to perception (Johnson, 1997). As previously stated, these errors in source monitoring can be present in the form of confabulations, and these confabulations can be as simple as filling in small gaps in memory such as where an event occurred, to something much more complex, such as an entire story that is entirely composed of false memories (Johnson, 1997). These findings demonstrate the importance of the source monitoring framework on the recollection of memories, and how if this framework is damaged in any way, then it can result in the recollection of false memories.

Another vital component of the source monitoring framework, explored by Roberts et al is looking at how accurate source retrieval is when it occurs at the encoding stage of memory tests (2016). For this study, they conducted two studies that looked at how well children ages 3-8 could remember the source of a memory between two videos in conditions where they were given no instructions, a second condition where they were told to note differences between the two videos, and another condition where they were asked to just pay attention (Roberts et al, 2016). They were tested through an interview that took place a week after watching the two videos, and found that, for the first study, the older children who were told to note differences in the video made more source confusions than younger ones, indicating that *content* related memory improves with age but not *source* memory (Roberts et al, 2016). For the second study, a new condition was added, where the experimenter pointed out the differences, along with the source, and after a test a week later, they found that children in this group made less source monitoring errors than those in the control condition (Roberts et al, 2016). These results indicate that binding of source and memory at the encoding period may improve source monitoring for this age group, and these findings further demonstrate the effect that the storage of information can influence the accuracy of future recall of memories (Roberts et al, 2016).

The source monitoring framework can also influence feelings of self-assurance, as seen in a study conducted by Luna and Martin- Luengo (2013). They conducted a study where they looked at self-assurance, specifically confidence ratings. To do this, they showed subjects two witness forms from a bank robbery, one from a bank teller and one from a customer, and then were asked questions regarding who said something, with the choice of four options (teller, customer, both, or neither) and then were asked to rate their confidence of their answers, in terms of how confident they were that the specific person said it (or not) (Luna & Martin- Luengo, 2013). These results were predictive of their hypotheses, in that confidence ratings were higher for correct attributions, than incorrect attributions, and they also found that only source misattributions inferred from the retrieval of incorrect source cues will be rated with low confidence (Luna & Martin-Luengo, 2013).

The results of the studies that investigate source monitoring demonstrate how it functions to store memories, and how having deficits in this framework, such as brain damage, can impair proper recall, and create false memories. These studies also demonstrate the impact of the source monitoring framework on the feelings of self-assurance, specifically confidence and in turn, effecting our ability to accurately recall information. The source monitoring framework helps us understand how the source and memory are influenced at both the encoding and the retrieval stages. These findings are all extremely important and relevant to our society and helping us understand how and why we function the way we do.

Current Study

Unlike the past studies, the focal point of *this* experiment is going to aim at exploring how hypermnesia and source monitoring are connected and how these two factors benefit each other in terms of memory improvement over repeated testing, through experimenter provided information. The previously discussed study by Otani et al demonstrates the ways in which items that are paired with a cue from an earlier test are then encoded into the source monitoring framework (one or three cues), which in turn influences if that item will be recalled on subsequent testing (1999). For this study, the source monitoring framework, and its relationship to hypermnesia will be explored by testing how accurately a subject can recall both item and its set in their memory. This will be done by exposing the subjects to thirty-six distinct visual stimuli (pictorial drawings) and their associated sets (1, 2 or 3) to memorize for future recollection. This means that subjects will not only have to remember the visual image that they see, but also what set of photos the image belongs to. This is measuring source monitoring and its relationship to hypermnesia because the way in which the subjects create cues for the specific images and the context that the image gets stored as will affect how and if the image gets retrieved at the time of recollection, and if it can not be correctly recalled, source monitoring errors will be present.

Hypotheses

It was hypothesized that overall recall will increase across the three tests. This means that the total number of correct pictorial drawings demonstrated in the slideshow will increase in each subsequent test. For Otani et al, their study demonstrated that overall recall increased for repeated testing, due to repeated rehearsal which led to the item and its set being stored in short term memory together, and how it was able to be recalled on subsequent tests (1999). We will then be breaking up overall recall into correct and incorrect recall. For the purpose of this study, correct recall is defined as the drawing recalled with its correct set, and incorrect recall would be considered a correct drawing and an incorrect set. These topics were also represented in Otani et al's (1999) study as reminiscence as correct recall, and intertest forgetting as incorrect recall.

Incorrect recall was indicative that the subject forgot the set in which the item belonged too, and had to guess, which is representing an error in the source monitoring framework. Thirdly, it was also hypothesized that correct and incorrect item gains (new drawings reported on test 2 and 3) will increase but correct and incorrect item losses (drawings recalled on test 1 or 2 not recalled on test 2 or 3) will maintain constant and not change for both the item set and drawings. This is due to incrementing and alternate retrieval cues proposed by Otani et al (1999). More specifically the total correct recall will increase due to there being a decrease in the amount of information being forgotten as opposed to remembering more, and this hypothesis is consistent with Otani et al findings (1999).

Methods

The design of this study is a 3x3 single factor repeated measures design. It looked at three sources (set 1, 2, or 3), and three repeated tests. The independent variable for this experiment is the three tests, as all subjects will each undergo these three tests. The dependent variable is the recall scores, which include both the item gains and item losses, as these scores will be dependent upon which of the three tests the subject has completed. This study investigated whether subjects could correctly remember a pictorial drawing with its correct set, which will be either set one, two, or three, and this test was repeated three times. Thirty-six distinct drawings from Snodgrass and Vanderwarts norms were used and presented in a slide show and then each subject was assessed on their ability to correctly recall not only the pictorial drawing, but the set in which it belonged to as well. Subjects will be given a test paper at the end of the slide show that contains the source options (which will either be set one set two or set three), and they will be responsible for remembering the pictorial drawing shown in the slideshow and correctly writing it under the column with the corresponding set with which it was shown.

Subjects

Thirty-nine undergraduate students enrolled in psychology courses at Brandon University participated for a 1% bonus mark towards their course credit.

Procedure

The participants were informed of the instructions prior to the exam, where they were instructed to pay attention for the entire duration of the slideshow and put forth their best effort to remember the pictorial drawing of a single item, along with its corresponding set that it belongs to. The design of the slideshow consisted of two attention slides, which notified the subjects that it was time to be alert and observe, and this was shown until the test was ready to commence. Then, there was a "+" sign to signal its was time to remember the subsequent drawing shown. This was displayed for one second. Then, the pictorial drawing was shown next, which was shown for 5 seconds. Immediately following the image, the next slide displayed the set number associated with that drawing, which was stated in words, either (Set 1, Set 2, or Set 3), which the subject was also expected to remember for future testing. There was a total of twelve images associated with each set, for a total of thirty-six images.

Once the slideshow was over, the subjects were given their first recall test, which was a piece of paper, that had three columns labelled "set 1 drawings, set 2 drawings, and set 3 drawings", and there was twelve lines under each column, labelled 1-12, and this is where the subjects were told to write the name of the drawings they remember were with each set, underneath the column that it belongs too. This first test took place for 7 minutes, and then immediately following, that paper was removed, and they were given another fresh, unwritten paper that was designed in the exact same format as the previous test, and they repeated the task they just did previously for 7 minutes. After 7 minutes, this paper was taken away, and once again, the participants were given a replica of their past two tests, and this test was repeated once more, for 7 minutes. After the three tests were completed, the subjects were debriefed and thanked for their time, and they were dismissed. Items were score in terms of the correct drawing and the correct set in which that item came from.

Proposed Analysis

For this study, there will be a compilation of repeated measure data analyses (repeated measures analysis of variance and t-tests) to explore the differences between the participants scores and the different tests. Repeated measure tests will be used for this study, because we are looking at how participants perform on the same measure, multiple times. More specifically, we will be investigating how scores will differ on three tests after studying information one time. There will be one group of participants who undergo all the same conditions and who repeat the same three tests. Furthermore, repeated t-tests will be used to explore whether the averages of the groups differ across each test performed in the study. This is exploring the differences in the three tests for each individual and seeing if they differ statistically and determine if there are any hypermnesic effects present.

Firstly, there will be a repeated measures analysis of variance to see if there is a significant difference between the total number of items recalled for each test. This will help determine if hypermnesic effects are present across the three tests and see if there is a main effect of test. Secondly, there will be another repeated measures analysis of variance test, to assess if there is a significant difference in the number of correct items recalled for each test. These will be compared against another repeated measures test see if there is a significant difference in the number of incorrect items recalled for each test. This will help us to understand if there are any source monitoring errors present and see the significance of these errors. This will be explained by assessing if there is a significant difference in the number of correct and incorrect items recalled, by seeing which is more prominent across the three tests. Lastly, there will be two repeated measures T-tests administered. The first one will assess to see if there is a significant difference when comparing total gains and losses for test two. This will see the extent of hypermnesic effects that occur from test 1 to 2, but comparing the new items remembered against the items forgotten. The same procedure will take place for the last repeated measures T-test, but this time it is to evaluate to see if there is a significant difference when comparing total gains and losses for test three. Overall, these repeated measures analysis of variance tests will help us see if there is a main effect of test, set and an interaction between test and set, and determine if hypermnesic effects are present when the subject has to encode both the drawing and its set simultaneously.

Results

A total of thirty-nine participants were included in the data analyses. The results of the 3(set) x 3 (tests) repeated measures analysis of variance indicated that the effects of set were not significant (F=2.83, p=0.072). The main effect of test was significant (F=4.397, p=0.019), but the interaction between test and set was not (F=1.43, p=0.239). For each test, the total number of items recalled slightly increased, and when you compare the overall recall for the three tests, hypermnesia is present (F=4.397, p=0.019). Table 1 shows the average number of total items recalled across the three tests. The most items recalled appeared on test three, however, if you compare test 1 and 2, or 2 and 3, the results are not significant. It is only when you compare the overall changes from test one to three that the results are statistically significant and demonstrate hypermnesic effects.

Table 1: The average number of words recalled for each of the three tests

	Mean	Standard Deviation	F
Total recall test 1	14.744	4.57	4.397, sig= 0.019
Total recall test 2	14.949	4.76	
Total recall test 3	15.667	5.22	

Furthermore, when total correct recall was divided into correct recall (F=0.889, p=0.420) and incorrect recall (F=1.968, p=0.154), there is no statistically significant difference. Table 2 demonstrates the average number of correct items recalled for each of the three tests, and table 3 represents the average number of incorrect items recalled for each of the three tests. The most items were recalled on test three, and each time the amount of correct information was increasing, but this incline was not significant. The same goes for the incorrect recall; the amount of incorrect information being recalled was increasing each test, but they were not significant.

Table 2: the average number of drawings with their correct set recalled for each of the three tests

	Mean	Standard Deviation	F
Correct recall test 1	9.026	4.20	0.889, sig=0.420
Correct recall test 2	9.128	4.11	
Correct recall test 3	9.410	4.67	

Table 3: the average number of drawings with their incorrect set recalled for each of the three tests

	Mean	Standard Deviation	F
Incorrect recall test 1	5.718	3.38	1.968, sig= 0.154
Incorrect recall test 2	5.821	3.06	
Incorrect recall test 3	6.256	3.03	

In addition, a repeated measures T-test was administered to compare the gains and losses from test 1-2, as well as gains and losses for test 2-3. When comparing the gains and losses from test 1-2, the results indicated that there was no statistically significant difference (T=0.309, p>0.05). This means that the total amount of novel items recalled on test two that were not recalled on test one and items that were recalled on test one and not on test two was not significantly different. In contrast, when comparing the gains and losses from test 2-3, the T-test results show that there was a significant difference (T=3.76, p=<0.05). This demonstrates that the total amount of new items recalled on test two that were not recalled on test one and items that were recalled on test one and not on test two were in fact, significantly different. Table 4 represents the total gains and losses from test 1-2 and from 2-3. The gains from test 2 to 3 only increased by 0.2, but the losses decreased by 0.7, which indicate that the subjects were not remembering more information each test, but they were forgetting significantly less information on each consecutive test.

Table 4: The average total gains and losses from test 1-2, and average gains and losses from test 2-3.

	Mean	Standard Deviation	T	p
Total gains for test 2	1.795	1.81	0.309	>0.05
Total losses for test 2	1.487	1.39		
Total gains for test 3	1.590	1.25	3.76	<0.05
Total losses for test 3	0.795	1.00		

Discussion

The results indicate that hypermnesic effects were present when reminiscence and intertest forgetting were assessed together. This means that on each test, the mean number of items recalled were increasing. These results were due to the fact that the participants were experiencing less intertest forgetting, rather than enhanced reminiscence. The participants were essentially “forgetting less items” as opposed to “remembering more items” for each consecutive test. These results correlate with the Otani et al, (1999) findings, in that engaging in rehearsal is keeping those items in short term memory, to prevent intertest forgetting. This holds true for this study, because the participants are rehearsing the drawings in their memory each time, they recall it on the tests, and each new test acts as another rehearsal.

Furthermore, there appears to be source monitoring errors present, as new drawings tended to be recalled on each consecutive test, but the set was usually incorrect, or the set that was paired with the drawing would change from each test. This demonstrates the idea that the participant could clearly recall the drawing that was shown, but the set was a guess. These source monitoring framework errors are illustrating that it is challenging human mental capacity to remember both a drawing and its set in our memory, and the fact that we may be incapable of trying to remember two facts simultaneously may account for these errors. For this study, the errors were present in the form of guesses, since the subjects knew the source was either set 1, 2, or 3, and from test to test, the set they paired a drawing with often changed, indicating that they forgot the set it belongs to. In addition, the source monitoring framework proves to be responsible for human ability to recall drawings, and these source monitoring errors in this framework lead to intertest forgetting, and this was observed by Johnson et al, (1993).

For correct (correct drawing recalled with the correct set) and incorrect (correct drawing with the incorrect set) recall, even thought the most items recalled were observed on test three, the increase in the number of correct items recalled was not significant. These results further support the fact that the source monitoring framework is responsible for the formation and recall of memories, and when items are not properly integrated into our frameworks in a way that makes future recall possible, this leads to intertest forgetting. These results also demonstrate that it is extremely challenging to remember two pieces of information simultaneously and pair them together for future recall, and this may indicate why there was no difference between the number of correct and incorrect items recalled.

When comparing item gains and losses from test 1-2, the means were remarkably close, and this represents that concept that about the same number of items were forgotten, as were the latest items that were recalled. However, when comparing the gains and losses from test 2-3, the gains slightly increased which was not significant, but the losses declined, which was significant. These result correlate with Wallner et al, (2018), in that the hypermnesic effects are observed due to the fact that the number of items being forgotten from test 2-3 are significantly decreasing, but the gains are staying the same.

For future research, it is important to further explore the capacities of our source monitoring framework, to specifically investigate why these errors occur, and try to find a median to where we can effectively recall multiple pieces of information without overchallenging our mental capabilities. These can have positive implications in areas such as education, to help students incorporate more effective ways of studying to enhance recall and reduce intertest forgetting. The results show that experimenter provided sources have negative impacts on the ability for correct recall, so having students create their own sources by either heuristic or systematic techniques is also a topic that should be investigated further, to help explore ways they gain the most out of their education experience. Not only this, but it can also help in the students actually understanding and integrating the information into their source monitoring frameworks, as opposed to strictly memorizing that will be forgotten at a later point (which tends to be an exceedingly popular study technique).

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