

The Effect of Directed Forgetting on Completed and Interrupted Tasks

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Abstract

A total of 66 Winona State students participated in an experiment that attempted to recreate the *Zeigarnik Effect* and the phenomenon known as *Directed Forgetting*. In order to test the effects of *Directed Forgetting* on both completed and interrupted tasks (*Zeigarnik Effect*) a factorial design with 4 conditions was employed. Participants in all conditions solved 20 anagrams, spent 5-minutes on a logic task, and then recalled as many solutions to the anagrams as possible. Words were chosen for both their frequency in printed materials and solvability when rearranged as anagrams. Results showed no significant effects for instruction or interruption, and no interaction effect. Results were discussed in terms of theory, experimental design errors, and time constraints.

The Effect of Directed Forgetting on Complete and Uncomplete Tasks

E. G. Boring's book, published in 1957, related the following story about the beginnings of the Zeigarnik Effect: In 1927, in a restaurant in Berlin, Dr. Kurt Lewin and his colleagues were engaging in a long conversation. The waiter had not yet given them their tab, so Lewin called him over and asked for the amount. The waiter told him immediately, and Lewin paid and reengaged in the conversation for some number of minutes. Suddenly though, Lewin had an insight—he called the waiter over a second time and asked again for the amount of their bill. The waiter no longer knew (as cited in Van Bergen, 1968)).

This day marked the beginning of something known as the Zeigarnik Effect, a theory which was first dreamed up by Lewin and then later researched and named after his colleague,

Bluma Zeigarnik. It states that when a person intends to perform a task, a quasi-need is established which causes a strong desire for fulfillment of that task. These quasi-needs, or 'tension systems', come into being because of a person's decision to begin a task. Another more common, every-day example is one that is experienced by most students: when taking a timed multiple choice test, the questions which are never answered, or those that the student is not sure about, are the ones most often remembered after the test has been finished. According to Lewin and Zeigarnik, this represents a lack of closure, which is the driving force behind the tendency for individuals to remember incomplete or interrupted tasks better than completed ones. (Van Bergen, 1968)

Although the original article written by Zeigarnik in 1927 proved to be inaccessible despite its apparent fame (it was in Russian), its contents were made available through a thorough review which was done in 1968 by Annie Van Bergen. The first experiment done to test Lewin's inkling about the relationship between task receipt and recall after interruption was done in Berlin, and Zeigarnik chose 32 students of the University of Berlin as initial participants. The experiment was begun with directions to complete a soon-to-be given series of tasks as rapidly and correctly as possible; 22 tasks¹ were then handed out, one at a time, to each subject (presumably, the subjects were alone in a room with the experimenter) (Van Bergen, 1968). Fifty percent of the tasks were interrupted by the experimenter when the subject was "most engrossed in the task", at which time the experimenter would present the next task and then say "Now do this, please" (Van Bergen, 1968). As soon as the last task had been finished, the participants were asked to recall as many of the tasks as possible; they were given as much time as they wanted to do this, but only the items that were mentioned without hesitation were taken down as answers (Van Bergen, 1968). This was because it was assumed that unresolved tension systems would only be revealed by immediate answers (Van Bergen, 1968).

The results showed a predominance of interrupted items remembered by a large majority of the 32 participants, with respective percentages of 68% for uncompleted and 43% for completed (Van Bergen, 1968; Schiffman & Greist-Bousquet, 1992). Also, most of the tasks were recalled more accurately when they were in the interrupted group, and the recall of interrupted items usually came before the recall of completed ones. This, according to Zeigarnik, was the result of the tensions created by incompleting tasks (Van Bergen, 1968).

To test some potential confounds in the study, a number of other experiment design variations were tried by Zeigarnik herself (Van Bergen, 1968). The main experiment was replicated with a different set of 14 subjects and a group of 20 other tasks; the results were the same (Van Bergen, 1968). Some thought that it may have been the shock of interruption which made the interrupted tasks more memorable, so experiment three included an interruption of all of the tasks, with 50% being completed soon after the interruption (Van Bergen, 1968). Also, some thought that the predominant recall of incomplete tasks may have been because the participants assumed that the tasks would be resumed and that, as a result, they may have tended to retain the information (Van Bergen, 1968). To counter this, experiment IV was run with the remark “this task will be resumed later” while in IVa (the second part of task IV) the participants were told “You are not to work on this task anymore”; both groups showed the same results (Van Bergen, 1968). Experiments IV and IVa were also re-run with children 30 children aged 5-10, and the majority were found to remember the unfinished tasks ($p < 0.02$), though the number was slightly lower than that of the adults (Van Bergen, 1968). Zeigarnik also did some not-so-well-explained (or statistically analyzed) experiments with “infantile” adults and “ambitious subjects” (Van Bergen, 1968). To her credit, she seems to have examined many potential discrepancies regarding the Zeigarnik Effect, other than the fact that responses which were preceded by hesitation were discounted.

Though these experiments marked the end of Zeigarnik’s work with the theory, at least 600 studies have since been completed with various research methodologies. While some were effective, others were most definitely not so. Some showed expected trends, while others showed either no trends or trends that were the opposite of what was expected. However since Bluma Zeigarnik published the first study about the effect of quasi-needs on memory, people have been fascinated with the Zeigarnik Effect and its potential applicability to many real-life learning situations. The concept has been applied to or manipulated by a number of psychological subfields, regardless of the fact that it is an effect that is very hard to capture.

These studies have used countless tasks, participant groups, interruption methods, and testing measures, and though they were all important in the evolution of this theory, only some will be considered here. It is also worthwhile to note that even with all of this variation in experiment design, this phenomena has proved itself to be quite illusive. Though many of the

studies have found significant expected tendencies, many have found none or even contradictory results.

A variety of verbal and language-related tasks have been employed in the past in order to test people's memory of interrupted tasks. Schlote (1930), who thought that a series of homogeneous tasks would work better than a series of assorted tasks, used groups of non-sense syllables which required a rearrangement of one letter (as cited in Van Bergen, 1968). A nearly identical task was employed Stoller in 1935, where two letters were rearranged rather than one (as cited in Van Bergen, 1968). Another similar task was one used by Eriksen which consisted of phrases that needed to be unscrambled rather than words (1952a, 1952b). An experiment done by Watson in 1939 used nonsense syllables also, but participants wrote them repetitively rather than rearranging them (as cited in Van Bergen, 1968). Other word-related tasks such as remembering strings of consonants (Trowbridge 1938), naming strings of objects, and coming up with synonyms and antonyms to presented words have also been used (Pachuri, 1935a, 1935b, as cited in Van Bergen, 1968).

In another written task, Flemish (Dutch-speaking) school-age boys had to read a story in French and translate it back to their native language. The story contained 5-6 words which they could not have known and, therefore, required assistance for. They were told the answers, and were later required to remember the definitions (Nuttin, 1947).

Spoken sentences or jokes were also utilized as memory material (Harrower, 1933; Heider, 1938 [as cited in Van Bergen, 1968]; Rosenzweig & Mason, 1934 [as cited in Van Bergen, 1968]). Series of rhymes have also been used, where participants were presented with a word and had to think of as many rhyming words as possible. (Sanford and Risser, 1948). Various reading selections have also served as main tasks, as in Baler's unpublished Ph. D thesis in 1950 (as cited by Van Bergen, 1968).

Some non language-based tasks included remembering mazes (McKinney, 1935), jigsaw puzzles (Rosenzweig, 1933; Rosenzweig 1945), and figures (good and bad 'Gestalten', as well as open and closed figures) (Gurnee, Witzeman, & Heller, 1940; Torrey, 1949). Lastly, while Zeigarnik used "habitual" (fully learned) tasks for her experiments, others have used newly-learned tasks, such as the maze experiment noted above (McKinney, 1935)

Different methods of interruption have also been used throughout the last eighty years. The one used by Zeigarnik included the presentation of the tasks and then partial completion before interruption. Schlote utilized the method of presenting the task but not allowing participants to begin at all and (as cited in Van Bergen, 1968). Both of these methods have proved to be effective, though the latter one may have been less so (Van Bergen, 1968)

A number of studies have also attempted to find out when interruptions are most effective, including a study done by Watson. He instructed participants to write non-sense syllables over and over again, interrupting participants after the 5th, 10th, and 15th of the 20 repetitions. It was found that memory was most enhanced after the 15th repetition, which was better than after all 20 (as cited in Van Bergen, 1968).

Also, while some tasks were solvable, others were purposely not so, such as the one used by McKinnon & Dukes in 1962. This induced interruption without the use of outside distraction or instructions to stop (as cited in Van Bergen, 1968). Unsolvable problems could also be used by experimenters to bring about a sense of failure (by stressing this to participants), thereby testing the relationship between memory and ego-damaging interruptions (McAllister, 1952 [as cited in Van Bergen, 1968]; Rosenzweig and Mason, 1934; Sanford & Risser, 1949).

Another avenue taken by researchers to prove the existence of tension systems was the testing of task resumption rates. The theory was that the ‘quasi-need’ to finish an interrupted task would fuel resumption after interruption if the opportunity to resume the task was available. The time between task interruption (or completion, depending on the condition) and recall was also varied in an experiment by J.R. Martin (1940) to see if an incomplete immediate recall might cause a secondary tension towards the recall of all of the items. Recall was tested immediately after the task, after 2 minutes, after 2 days, after 1 week, and after 2 weeks.

In order to explain the entire line of research that led to the current study, a number of ‘odds-and-ends’ concepts should be added to this introduction. Firstly, it should be noted that, according to Schlote’s 1930 study, the attractiveness of an activity can affect its recall (as cited in Van Bergen, 1968). Secondly, according to McKinnon and Henle’s 1948 study, the relationship between a participant and the experimenter may very easily affect results, meaning that there must be a balance between good “rapport” with participants and firm control of their

activities during the study (as cited in Van Bergen, 1968) Also, task complexity can influence results; it has been found that with interpolated tasks (those that are interrupted with another task) complex (interesting) tasks are recalled better if they are incomplete. With dull tasks, the opposite was found. According to T. Walsh's research in 1940 and 1942, the length of time spent on a task can also affect results in unpredictable/counterintuitive ways, and relatively jolting or traumatic experience during experimentation can problematically skew data (as cited by Van Bergen, 1968). Lastly, there are a number of studies that have shown that ego-based tasks (those which affect one's pride/self-competence) are remembered better than those that are task-oriented or non-competitive (Alper, 1948; Lewis & Franklin, 1944; Rosenzweig, 1943).

Psychologists such as Gilmore ([1949] as cited in Van Bergen, 1968) have used both ego-oriented directions, such as "This is intended to be a test of your I.Q." and task-oriented directions, such as "This task is intended as a warm up". Some of these researchers have attempted to entirely explain the Zeigarnik Effect in terms of self-esteem needs (Rosenzweig 1943; Alper, 1948; Glixman, 1949). This has also been explained in terms of achievement because of the fact that many interrupted tasks are seen as failure by participants (Weiner, Johnson, and Mehrabian, 1968). It is important to note though, that studies can sometimes show no such differences and that experiment design is crucial to attaining such results. (Alper, 1946b; Glixman, 1949).

The discussed experiments represent only a small fraction of the multitude of Zeigarnik Effect studies that exist in psychology journals all over the world. They do, however, explain the concepts that are relevant to this study, so the remainder of this introduction will be dedicated to the other memory theory that was investigated in conjunction with the Zeigarnik Effect.

A more recently discovered memory effect, known as Directed (or Intentional) Forgetting, states that when a person is instructed to remember information their memory of that information will increase. Typically this is done by telling a participant that they will be tested on the information later. Conversely, if they are told that they will not be tested on the information, recall impairment is often seen. The reason for the naming of this phenomenon as "Directed Forgetting" rather than "Directed Remembering" is unclear, however it has been stated that it is the most theory-independent, general way to describe the effect (MacLeod & Golding, 1998).

The discovery of this phenomenon was first documented, more or less, in 1854 by John Brown. In his published but relatively unknown article titled “The nature of set to learn and of intra material interference in immediate memory”, he laid out the groundwork for later studies on Directed Forgetting (MacLeod & Golding 1998). He presented four rapidly shown arrow-number pairs for each trial. Either before exposure to the pictures or after, participants were instructed to recall only the arrows (presumably the direction that they pointed), only the numbers, or both, in a specific order. Recall of the arrows was the same across all conditions, but for the numbers there was a significant increase in recall if the instructions were given before the task. Instructions that were given after the presentation of the words also increased memory when compared to the condition where numbers were not emphasized, but did so to a lesser degree than when instructions were given beforehand.

Ten years later, Muther (1965) did a similar study where some participants were told that they would only need to remember half of letters presented to them. The ‘to-be-forgotten’ letters were cued by black screen that was either shown before or after the letter. For Condition One, a list of only 10 letters was shown, all to-be-remembered, and recall was 74%. For Condition Two, a list of 20 was shown, with 50% having the black-screen-cue to forget; these participants remembered 61% of the words which were cued to remember. Condition Three mirrored condition one save for the fact that 20 letters were shown instead of just 10, and the recall rate was 41%. Therefore, being allowed to omit half of the letters from recall (remembering 10/20) improved memory when compared to having to remember 20/20.

A few more distinctions regarding Directed Forgetting methodology are necessary before explaining the potentially explanatory link between Directed Forgetting and the Zeigarnik Effect. Firstly, there are two procedures that are used to administer the cue to remember or forget. The ‘list procedure’ utilizes one cue, typically presented halfway through the presentation of the information (MacLeod & Golding, 1998). For instance, if a researcher were to utilize Muther’s condition arrangement, s/he would insert an instruction to remember or forget after the first 12 words, and the remaining 12 words, if present, would always be presented with a remember cue prior to their appearance. The ‘item procedure’ experiments, which are still the most prevalent, feature a “forget” or “remember” cue before or after *each* word.

It has been found that when using the list procedure, there is no difference in the recall between F (forget) words and R (remember) words (Elmes, Adams, & Roediger, 1970; Block, 1971) and under the item procedure, recognition tests showed better recall of R items than F items. Also, short item presentation with longer cue presentation leads to more significant differences between F and R items (Wetzel & Hunt, 1977). These F-cues can be effective when presented during or after study, with both causing decreases in recall (Shebilske, Wilder, & Epstein, 1971). (Davis & Okada, 1971; Woodward, Bjork, & Jongewood, 1973; Timmins, 1974) Lastly, and quite interestingly, recall of F items is increased by knowledge that they are in fact an F item, indicating that participants should not know what the purpose of the directions are if the experiment is to succeed (Epstein & Wilder, 1972).

One interpretation of the effect of Directed Forgetting is that unnecessary information is discarded. If that is true, then it may also be possible that completed tasks are forgotten for the same reason, so it is therefore conceivable that once a task is finished, it is catalogued in the brain as unnecessary in short term memory. The hypothesis of this study was that task interruption and cues to remember would increase the number of words recalled, and that the number of recalled words in the complete/remember condition would be the close to the number recalled in the incomplete/forget condition.

Method

Participants

A total of 75 undergraduate students at Winona State University participated in this study. Sixty-four of the participants received extra credit for their participation in a psychology course of their choice (if instructors consented) and the other two were volunteers who knew the researcher. Participants were assigned to groups based on the order of their sign-up. The first nine were put into the “pretest” section, and the subsequent 66 were arranged into groups by rotation through conditions (i.e. #10 went to condition “A”, #11 to condition “B”, #12 to condition “C”, etc.)

Materials for Pretest

In order to develop materials for the study, a list of 40 anagram puzzles (created by picking various words from a list of the 500 most commonly found in print) was presented as the only task for the first nine participants. Participants would see, for instance, “irbd” (an anagram) and would solve the puzzle by writing “bird” next to the scrambled letters. The 20 that were solved by all participants were used for the experiment, as well as another ten which were used for the interrupted group (see below).

Materials for Experiment

The materials design of this study was modeled somewhat like the one done by Schiffman and Greist-Bousquet in 1992. Each participant received a list of the 20 most easily solved anagrams (those that were solved by 100% of the pretest group). All participants received at least two pages with 10 puzzles and some received a third page with 10 more puzzles (also taken from the test run, though their solvability was irrelevant). The first 20 puzzles were identical for both formats. They were ordered randomly and consisted of 4-8 letters. A “battleships” logic game, on paper, was also used as an interruption task.

The game was taken from a USA Today logic puzzles book. It consisted of a grid (numbered at the end of each row and column) with mostly blank spaces. Above the grid were shapes (squares, semi-circles, and circles) that represented four types of “ships” which differed from each other in terms of length (and therefore the number of grid boxes that they would fill). The goal of the game was to fit all of the depicted “ships” into the grid while obeying the numbers at the ends of the rows and columns, which specified the number of shapes that could be in each one.

Procedure

After obtaining consent, the researcher presented the anagram task and told participants to solve as many of the puzzles as possible. They were told that they could complete the puzzles on each page in any order, but that they could not turn back to any previous pages once they had moved on.

The design used was a two-by-two factorial with four conditions. The independent variables consisted of an interruption or no interruption (complete tasks and incomplete tasks) and instructions to either remember or forget the main anagram task.

The participants in the two complete conditions received only the first two pages; half of those individuals were told to forget the information and the other half were told to remember it. The participants in the two interrupted conditions received all three pages but were only allowed to solve the anagrams on the first two before being interrupted and told to either remember the information or forget it. Viewing of the third page was limited to one to two seconds—enough to see that the page existed but not enough to solve any of the puzzles.

All participants took roughly fifteen minutes to complete 20 anagram puzzles, or as many of them as possible. There was, however, no time limit imposed by the researcher. They were then told that it was time to start the next task.

All participants were given the same “battleships” logic game and were told that they had 5 minutes to complete as much of it as they could. After 5 minutes, the participants were stopped (if they had not yet finished the game), handed a blank sheet of paper, and asked to recall and write down as many of the anagram solutions as possible. There was no time limit for the recall.

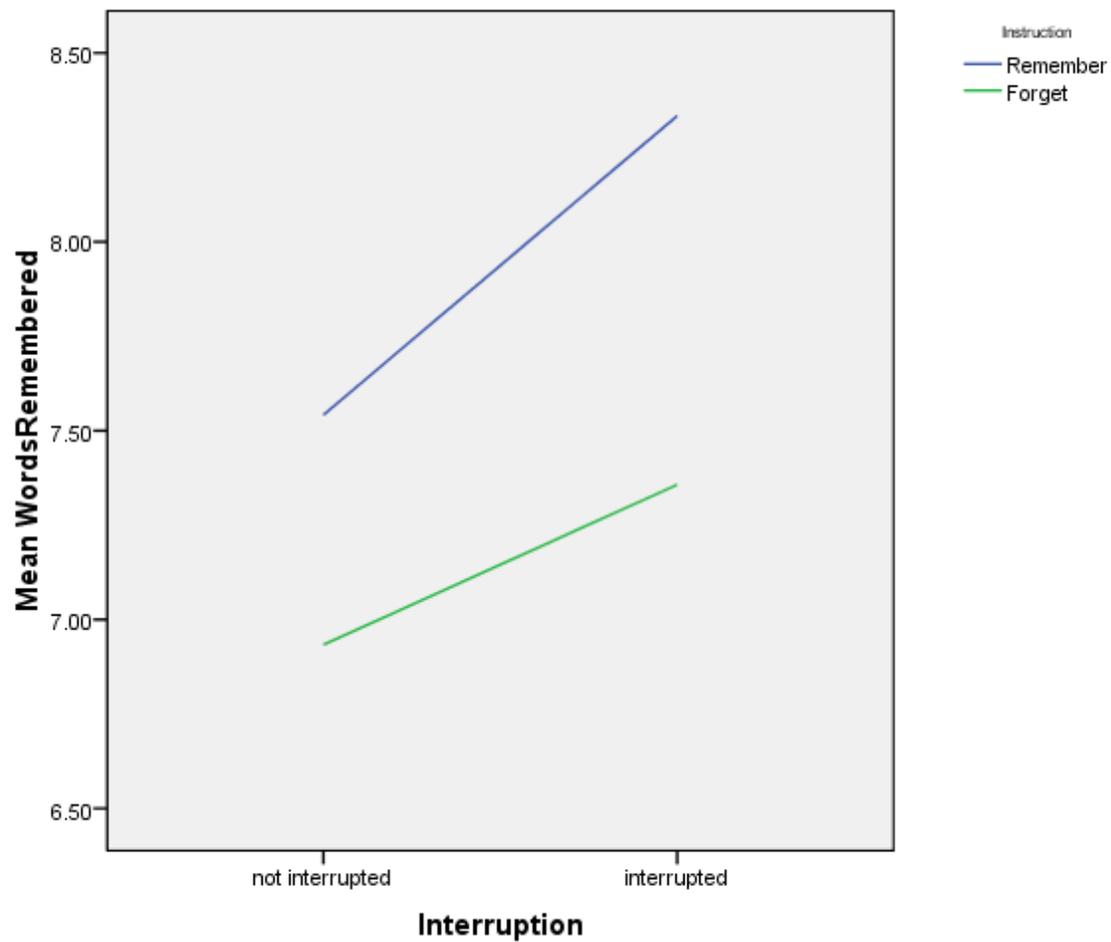
Results

The interruption by instruction effect was not significant $F(2,65) = 0.078, p=.781$. The interruption effect (the difference between completed and interrupted task recall) was not significant, $F(2,65) = 0.853, p=.360$, and the instruction effect (the difference in recall for those who were told to remember and those who were told to forget) was also not significant $F(2,65) = 1.449, p=.234$. The averages of the number of words recalled in each condition, as well as standard deviations, were calculated and are shown in table 1. They reflected expected tendencies/directions, but did not differ enough to be significant.

Table 1: Means and Standard Deviations across Conditions

Condition	Mean Number (and SD) of Words Recalled
Interrupted /Remember	8.33 (2.39)
Interrupted /Forget	7.14 (2.34)
Complete/Remember	7.54 (2.31)
Complete/Forget	6.93 (2.71)

Figure 1. Mean number of words recalled as a function of interruption and memory instructions. Expected but insignificant trends.



Discussion

This experiment showed no support for the hypothesis, which was that task incompleteness and instructions to remember that task (complete or interrupted) would increase recall significantly in comparison to instructions to forget it. It was therefore impossible to attempt to compare the two conditions that had conflicting interruption and instruction (completed/remember and interrupted/forget)

The lack of evidence for an interruption effect is not surprising considering past evidence. Many previous studies have shown no difference between remembering completed or interrupted tasks, so it is safe to say that this effect is indeed one that is hard to capture overall.

A number of theories about the nature of the Zeigarnik effect have been put forth and, taking most of the evidence into consideration, it is possible that there is some sort of underlying need-based mechanism. However the idea of some sort of tension based system that presents itself regardless of the task type or situation does not seem to be supported by available evidence. Also, studies show that there is no link between memory and I.Q. in these situations, so there is indeed cause for further investigation of such phenomena.

One of the goals of this research, other than to simply find the effects that had been previously documented, was to put forth a theory about the nature of the Zeigarnik effect. It seems plausible that the lack of memory sometimes found for completed tasks is not because of a relief of tension, but because task information is dispensable once the task is done. This would be related to practical necessity rather than issues dealing with task closure. This, of course, is not up for discussion since there are no differences in the memory complete and interrupted tasks in this case. The point is therefore, at this time, moot.

Experimental design flaws may have been the cause of the lack of evidence for Directed Forgetting. Although no formal data collection was done which might have indicated participants' perceptions of the experimenter or the purpose of the study, one person stated after the session that they had known all along that the experiment "had something to do with that" (the original word list). Others smirked and looked down when they were told to forget the information, most likely indicating that they knew that the researcher was attempting to deceive

them. As noted by Epstein and Wilder in 1972, this type of skepticism on the part of participants may very well block any natural memory tendencies.

Another issue with directions was inconsistency; the first half of the participants in the forget conditions were simply told to forget the information because it would not be needed later. Due to participants' apparent confusion, the instructions were then changed to include the phrase "this was just a warm-up". The purpose of this change was also to make the directions seem more believable, however there seemed to be no notable change in participants' reactions after the change was made.

Another problem may have been the lack of a connection between the information to be remembered and the directions. Participants were told to remember the information, however they were not given directions to specifically remember the answers to the anagrams. This, plus the apparently dubious nature of the instructions to forget, may have easily flattened any potential effects.

A smaller inconsistency among participants was the time spent on the interruption task (the battleships game). A few participants took less than five minutes to complete the task, which was due to strategic reasoning skills or, sometimes, because they simply gave up. The researcher also failed to stop the participant after exactly five minutes three times. Interruption times therefore varied from two minutes and forty-four seconds to six minutes, though only 13.6% of trials had this difference.

Lastly, because of time constraints and participants' failure to come to their appointments, the number of participants was lower than originally intended. The experiment design was supposed to allow for a minimum of 20 participants to each category, however the numbers ended up being between 12 and 14. It is definitely conceivable, considering the weak but expected trends that were shown, that having enough people in each condition may have caused significant results.

The results of this study are hard to interpret overall, so it is hard to apply them to real-life applications or even to theories. It seems unlikely that these results do in fact reflect the state of human memory, especially in light of the differences that have been found between completed/interrupted tasks and directions to remember/forget over the last 80 years. However, if

these results are accurate, we can assume that the mechanisms underlying memory have to do with other variables such as interest in the material, task perseverance, extra rehearsal, etc.

This type of experiment could show stronger results if a few changes were made. Young adults that are not college psychology students would probably work better as participants because of the fact that this group may be more apt to know when they are being deceived. Also, instructing participants to remember or forget a certain part of the tasks rather than just “information” could strengthen connections. Lastly, increasing the number of participants to 80 or more (20-40 per condition) may help to detect these seemingly illusive effects.

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