An Investigation of Pictography and Verbal Rehearsal on College Students' Recall of Expository Texts

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An Investigation of Pictography and Verbal Rehearsal on College Students’ Recall of Expository Texts

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A Thesis
Presented to
The Faculty of the Department of Communicative Disorders and Deaf Education
Utah State University

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In Partial Fulfillment
of the Requirements for the Degree of
Master of Science

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by
Joshua Woodruff

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Abstract

Purpose: This study investigated the effects of pictography with and without verbal rehearsal on informational recall of two types of expository texts. This study is part of a research program to further develop a treatment for younger students with language impairment called Sketch-and-Speak. Procedure: 66 undergraduate students between the ages of 18 and 40 were tested on recall of concrete versus abstract expository texts in a randomized group experiment across three conditions: pictography with and without verbal rehearsal versus re-reading. Participants were trained on the assigned testing condition and then proceeded to the experimental procedure. In the experimental procedure, participants read and studied two expository passages differing in concreteness and abstractness while utilizing the assigned learning strategy. Tests were presented in a counterbalanced order across participants within a condition. Following the reading and studying, participants were given a “mind wipe” to provide a pause between reading and testing. Participants then were administered a free recall on each text and then a multiple-choice recall test and a self-rating questionnaire on each. Results: For concrete exposition, pictography significantly improved free recall over re-reading for number of key details. For both concrete and abstract exposition, pictography plus verbal rehearsal significantly improved recall for ideas, holistic quality of free recalls, and multiple-choice testing. 86% of participants in the Picto and PVR judged pictography as useful for the concrete text and 72% judged it useful for the abstract text. 85% of participants in the PVR condition found verbal rehearsal helpful for both texts. Pictography and verbal rehearsal strategies help recall of abstract texts, but help concrete informational recall even more. Conclusion: This study indicates the potential for Sketch-and-Speak to improve student performance in expository comprehension and recall, and provides support and direction to further investigate this SLP treatment.
An Investigation of Pictography and Verbal Rehearsal on College Students’ Recall of Expository Texts

Children with language-related learning disabilities struggle to understand and remember what they read. They may be directed to take notes on what they are reading, but writing itself can be a struggle. Even if they can write legibly, reducing long complicated sentences from articles to a few memorable words is difficult. Speech-language pathologists (SLPs) treat children with these language-related difficulties, but they lack effective, practical procedures for older students who must often deal with challenging expository texts. Our lab has developed an expository strategy treatment protocol called Sketch-and-Speak that is still in the early stages of investigation.

Sketch-and-Speak is intended for students beyond the early elementary grades with language and learning difficulties. It is designed around the distinctive expertise of SLPs in individualized oral instruction to improve underlying communicative skills and strategies. SLPs can use Sketch-and-Speak in treatment to teach language skills and curricular concepts. It is also intended to equip students with flexible learning tools that they can use in class activities to learn the ideas and language of expository texts, and to help them prepare oral and written presentations and projects. Two key elements of the treatment are an alternative notation format consisting of student-generated quick simple sketches called pictography and repeated practice creating full, coherent oral sentences from the pictography, called verbal rehearsal. The purpose of this study is to determine whether the simple sketches of pictography can aid recall of informational language and abstract ideas, and whether adding verbal rehearsal further improves recall and comprehension. Although this study is not investigating the entire process of Sketch-and-Speak, it will investigate two key elements relating to “sketching” and “speaking”.
**Sketch-and-Speak Treatment**

In the Sketch-and-Speak treatment, students orally identify and then note “important and interesting ideas” from a shared reading text. Then pictographic notes are made on a structured form with designated or self-generated feature categories. Each pictograph is orally recreated into the student’s own well-formed sentence, which is then practiced. After the recitation of the sentences from the pictographs are completed, an entire oral report is presented and practiced, cued by the organization of the note form and the notes. The process is then repeated by making conventional written bulleted notes from the pictography. Again, each idea is produced as an oral sentence after the note is created, and then as a full oral report from the notes. Once a student begins to understand the core treatment, the student can formulate their own strategy on how to mix pictography and bulleted notes as needed. The key strategy that must not be excluded is the usage of verbal rehearsal to orally formulate their thoughts. The rehearsal is done throughout the note taking process, whether aloud or in their own heads, making full, well-formed sentences and reports, and then practicing them.

In this variation of note-taking plus verbal rehearsal, the student gains a solid, organized memory of the ideas, sentences, and discourse cued by the notes. The transformational process of turning ideas into images and then into the students’ own words is expected to aid comprehension of the read material. The pictography provides students who have difficulty writing with another option to get their ideas on paper, along with an improved understanding of conventional note-taking. The verbal rehearsal is a critical study habit and self-regulatory behavior that helps students to internalize and organize their thoughts and words. This promotes active and purposeful note-taking and note-reviewing.
**Sketch-and-Speak Research**

The first study of this treatment procedure was Ukrainetz (2019). This group study showed beneficial effects of a brief application of Sketch-and-Speak compared to a no-treatment control for fourth to sixth graders with language-related learning disabilities. The effects showed an increase of the quality of notes and some aspects of oral reporting. In this study, students were taught using descriptive animal texts for 30-min individual sessions with a 4-week span, and tested on descriptive social studies texts, demonstrating that improvements were due to the taught strategies and not to any incidental concept learning. A posttesting session was administered a week following treatment on an unfamiliar text, where the students utilized the same note-taking and oral report procedures. 1 to 3 days later, the students received their notes and were given 15 minutes to write a report on the information from the posttest text. Mean number of notes and quality of notes were greater for the treatment group than the control group. Ukrainetz also found that the SLP essays and treatment records revealed that the students in the study immediately caught on to creating “quick and easy” “just enough to remember” sketches. The SLPs in the study were also confident that pictography was a useful teaching strategy within the treatment. The SLPs observed that the students performed well and were highly engaged in the process on the taught texts, and strongly endorsed the Sketch-and-Speak procedure. The SLPs considered the information in the articles to be challenging but noted that the students quickly became at ease with the articles and then began to engage well in the tasks.

In the study, students were told how important oral practice was, but were not specifically scaffolded on the independent use of the strategy. The author noted that it became apparent that verbal rehearsal was the missing leg of Sketch-and-Speak as a learner strategy. One student in the study was of particular interest. The student had an attention-deficit/hyperactivity disorder
diagnosis and after posttest scoring had an oral report that was substantially better. The author noted that the main reason for this progress was due to the student’s preparatory behavior at posttesting. After a prompt to take a more time to look over his notes, the student began to look over his notes, saying sentences quietly while extending his fingers as if counting items. This student was of particular interest and highlighted the importance to further investigate the verbal rehearsal component of Sketch-and-Speak.

Peterson et al. (2020) conducted a follow-up case study with three fourth to sixth graders with language impairment. In this study, there was increased emphasis verbal rehearsal in treatment, including introduction of a new strategy of “whisper rehearsal.” Whisper rehearsal was used to demonstrate to students that they could practice their reports in a classroom or other learning environment without being too disruptive to their peers, but allowed the investigators to monitor practice of fluent reporting and complete sentences overtly. The treatment time was extended and involved more varied learning contexts, using the same type of expository texts. The extended treatment allowed students to use pictography and/or bulleted note combinations in activities on new topics to further encourage pictography as a note-taking tool. Discussion of pictography as a viable note-taking tool across contexts and academic activities occurred throughout the treatment and participants were explicitly told they could use pictures to take notes at the pre- and post-test sessions. Students were also encouraged to spend more time reviewing their notes at post-test to potentially increase their participation in verbal or whisper rehearsal behaviors. Although this study was only a descriptive study, results showed similar benefits for the quality of note-taking and oral reporting, and additional improvements in preparatory behavior, written reporting, and strategy awareness. The combination of pictography and verbal rehearsal has shown improvement in student skills with understanding and expressing
information in expository texts, though the impact of these study strategies alone has not yet been explored. Studying these intervention tools independently would allow for better understanding of the efficacy of Sketch-and-Speak as an intervention that SLPs can teach to students and encourage application to new texts outside the treatment context.

**Pictography**

An aspect of Sketch-and-Speak that needs to be investigated further is the pictography. Typical note-taking instruction uses conventional written bulleted notes. In Sketch-and-Speak, pictography is used as a “quick & easy” “just enough to remember” sketch strategy that students can employ as an alternative to writing. The notion of using pictography to represent discourse has logical and empirical support. Research studies and clinical use have shown it to be easily learned and accepted by students who struggle with and are often resistant to writing (McFadden, 1998; Ukrainetz, 1998; Ukrainetz et al., 2018). Importantly, it allows students to focus on the content of what they are noting, rather than on how to spell or what words to use. A further benefit is that it can be done quickly and is thus suited to the brief treatment sessions typical of school-based SLP intervention.

Pictography is clearly applicable to a discourse type that lends itself to “stick figure” iconic representations and chronological-sequential organization, such as narratives. It has been shown to improve the quality of oral narratives compared to writing and drawing (McFadden, 1998; Ukrainetz, 1998) and has been used as a component of effective manualized narrative interventions (e.g., Gillam et al., 2018; Petersen et al., 2014). There is much less information on the use of pictography for learning of expository text, but visual mapping is clearly part of the scientific tradition with flowcharts, maps, and iconic images (e.g., carbon chain molecules), and logographic Chinese script (essentially pictographs) successfully represents the full range of
human concepts. There is even documentation of invention of pictographic mapping by children to solve spatial puzzles (Karmiloff-Smith, 1979). Mayer and Gallini (1990) found that, for college students, schematic images of “parts and steps” are helpful for conceptual recall and problem-solving of the operation of mechanical devices, especially for students with lower prior knowledge of the topic. However, the specific applicability of user-generated pictography to expository texts, especially those dealing with less “picturable” ideas, has not been established.

**Expository Writing**

Exposition involves multiple discourse types, with different purposes and organizations. Research in discourse comprehension has shown that certain organizations are more amenable to simple recall and some to more advanced, integrative comprehension (Meyer & Freedle, 1984; Wiley et al., 2005). For example, Meyer and Freedle found that, for adults, short descriptive essays were harder to recall than similar length comparative, problem-solution, and causal essays. Meyer and Freedle attributed this to the greater level of organization of the latter types. Meyer and Freedle also claimed that information presented in problem-solving and persuasive essays can be challenging to remember because of the possibility that the reader can disagree with the problem premise or solution.

To explain differences in recall and comprehension of types of expository texts, Wiley et al. (2005) introduce Kintsch’s (1998) three-layered model of text comprehension:

On one level, a representation of the text is developed in terms of the surface form or the exact words that appear. A second level, the text-base, is a slightly more processed version in which the information that was read is now represented in terms of syntactic or semantic constituents … On the highest level of
representation, termed by Kintsch as the situation model, there is integration of the ideas that were presented with prior knowledge (pp. 411-412)

Wiley et al. (2005) explain how simple linear texts with few implicit relations require only surface or text-based levels of comprehension – essentially minimally-processed information recall – while the other text structures involve understanding of causal relations and linkages with prior experience that make them applicable to novel situations. Wiley and colleagues note that, for descriptive expository texts, recall and comprehension may be indistinguishable, while for the more relationally-structured expository texts, the two can diverge considerably: one may recall the words or claims, but not really understand or be able to apply the relations among the ideas, or vice-versa, remembering little of the surface text but leaving with a functional understanding of the argument or explanation. The learning strategies in this study are expected to promote mainly the second level of recall because the notation system and sentence paraphrasing, but no integration of new information with background knowledge.

**Concrete Versus Abstract Texts**

The two types of expository writing that will be investigated in this study will be concrete exposition and abstract exposition. Sadoski et al. (2000) explain concreteness as a form of expository writing that engages readers comprehension, interest, and learning. Concreteness relies more on facts that are specific, definite, and vivid (e.g. a nuclear reactor is a device used to initiate and control a self-sustained nuclear chain reaction). Sadoski et al. (2000) then explain abstract expository writing as writing that uses topics requiring more associations to connect meanings (e.g. to understand the abstract topic of knowledge one must also understand associated topics like experience, concept, memory, facts, and beliefs). Information in abstract writing is
considered more vague than concrete exposition and express qualities and characteristics that are apart from any specific object or instance.

Sadoski and colleagues (2000) investigated concreteness and abstract as text features that engaged readers’ comprehension, interest, and learning across four separate text types: persuasion, exposition, literary stories, and narratives. They used three concrete and three abstract texts in each of the four text types. They ran two experiments that had undergraduate students read the texts and had them either provide written recalls or ratings on familiarity, concreteness, interestingness, and comprehensibility. They found that when a text was written in a concrete format, recall was better than when written abstractly. They also found that concrete texts better predicted a learners’ perceptions of comprehension, interest, and recall.

The differences in memorability and comprehensibility of different types of exposition may have implications for the utility of different notation systems. Pictography requires reformulation of a text idea into a visual image, which then must be reconstituted into words. Unlike most conventional written notes, the words of the text are not recorded, thus demanding paraphrasing and transformation, rather than verbatim recall of the original text. There is a large body of research indicating that such active retrieval and processing of ideas substantially improves comprehension compared to more passive ways of studying (Arnold et al., 2017; Boyle & Rivera, 2012; Kobayashi, 2006). Thus, hypothetically, pictography might produce better informational recall than conventional note-taking or verbatim copying. Pictography should help with the recall of concrete texts, but due to the transformational processes required in pictography, abstract expositional recall may improve more. This technique may lead to findings for abstract texts that were similar to what Sadoski et al. (2000) found in regards to concrete texts.
Verbal Rehearsal

The second key element of Sketch-and-Speak treatment is verbal rehearsal. A possible limitation of pictography is that details of the text are not recorded within the minimal images, so important words or particular sentences from the text may be not be recalled. After the images are created, students must compose their own statements about the ideas represented in the pictographs into words. These words too could be easily lost from memory. However, in Sketch-and-Speak, note-taking is combined with repeated oral practice of the student’s sentences where they say the sentence aloud at least twice. This verbal rehearsal firmly establishes the student’s own words in memory, with the pictographic and written notes serving as on-going memory cues. For elementary-age children, verbal rehearsal can improve performance on working memory, passage comprehension, and retell tasks (e.g., Dawson et al., 1980; Peng & Fuchs, 2017; Swanson et al., 2010). However, these studies dealt only with sentences or very short passages that were not sufficient to be considered an identifiable unit or type of expository discourse.

For college students, verbal rehearsal has also been shown to be an effective study procedure: McDaniel et al. (2009) found benefits for a procedure they called read-recite-review, in which learners read the text, set it aside, recite aloud what they remember, and then re-read the text to check recall accuracy. McDaniel et al. found this effect for both simple short passages and longer, technical explanatory passages accompanied by schematic pictures. In both experiments, college students recalled better when using read-recite-review than when using note-taking or re-reading conditions. With the more difficult passage, the self-talk was equivalent to note-taking, but faster. A variety of other college studies have shown the benefits of effortful repeated retrieval, which is related to verbal rehearsal, over more passive types of studying (Karpicke &
Roediger, 2008; Karpicke et al., 2009; Smith et al., 2013). Although these studies dealt mainly with college students and not elementary-age children, they still provide information pertaining to the cognitive nature of learning, comprehension, and recall.

The Current Study

Pictography has some evidence suggesting it can help the chronological recall of narratives for young learners (McFadden, 1998; Ukrainetz, 1998), but much less for other discourse types. Verbal rehearsal also has evidence it helps with memory demands for children (Dawson et al., 1980; Peng & Fuchs, 2017; Swanson et al., 2010) and college students (McDaniel et al., 2009), but effects with different types of expository discourse are not known. Furthermore, no investigations have been located on the value of combining user-generated pictography with verbal rehearsal.

Two recent studies in our lab showed strong potential for this innovative treatment procedure with later elementary grade students with language and literacy difficulties (Ukrainetz, 2019; Peterson et al., 2020). Within the Sketch-and-Speak format, pictography and conventional note-taking give two practice opportunities to recall, reduce, and recreate ideas from the original text, along with repeated oral practice within each of these stages. After learning the two notation formats, students can choose or combine the formats for other learning activities. The studies however did not separate the effects of pictography from verbal rehearsal. Additionally, the studies only examined expository information on concrete topics. This study will continue the development and investigation by specifically examining the two key elements of pictography and verbal rehearsal from the treatment procedure with a more accessible, but still relevant, population of college students.
This study will investigate the effects of pictography with and without verbal rehearsal compared to simply re-reading a passage on recall and comprehension of expository text for college students. While pictography may be better suited to young learners, demonstrating that simple iconic sketches improves recall and comprehension for more mature learners will provide support for the continued use of pictography within the Sketch-and-Speak protocol. In addition to the logical generalization of these findings to much younger learners, the Sketch-and-Speak treatment could potentially be used with older learners who have literacy difficulties. Based on informal explorations, college students have been receptive to use of pictography to help recall ideas. There are currently no controlled investigations of the use of pictography as a note-taking strategy to improve college students’ learning of expository texts. Therefore, this study establishes another understanding of the effects of pictography on learner outcomes. The comparison is to a Re-reading only condition, consistent with other research (Karpicke et al., 2009; McDaniel et al., 2009) on reading comprehension strategies.

This study will also investigate the effects of pictography with and without verbal rehearsal on two types of expository texts. While concrete texts may be more vivid and thus imageable, the pictographic representations may cause loss of text details. In contrast, abstract texts may be more vague and thus less imageable, but the pictography may force a deeper level of understanding. Adding verbal rehearsal should promote retention of the student’s own words and aide in the retention of both types of exposition.

Lastly, the study will investigate how college students rate the utility of the two elements of Sketch-and-Speak. Studies note that college students consistently lack awareness of the benefit of retrieval, effort, and reflection on learning challenging materials (Karpicke & Roediger, 2008; Karpicke et al., 2009; Smith et al., 2013). As a result, it is uncertain if college-
aged students will be able to realize the benefit from the strategies. Additionally, the strategies have been mainly utilized for a younger population, and therefore it is uncertain if college-aged students will be receptive to the two elements of Sketch-and-Speak.

The first hypothesis is that college students will improve their expository text recall with pictography compared to re-reading only, and even more so when utilizing pictography coupled with verbal rehearsal. The second hypothesis is that Sketch-and-Speak will be beneficial for both types of exposition, but will more helpful for abstract texts due to vague elements being pushed into a deeper level of understanding. The final hypothesis is that college students will benefit from the usage of pictography alone but see more value in combining it with verbal rehearsal as a learning strategy.

**Research Questions & Design**

A randomized group experimental design was used to examine the effects of pictography with and without verbal rehearsal on text recall and comprehension. Participants were randomly assigned to one of three conditions: (a) Re-read (RR), (b) Pictography (Picto), (c) Pictography plus Verbal Rehearsal (PVR), (with group size kept as similar as possible. The following research questions were investigated in a between- and within-group comparison:

1. What are the effects of pictography with and without verbal rehearsal compared to re-reading on expository text recall?
2. What are the effects of pictography with and without verbal rehearsal versus re-reading on recall of concrete and abstract texts?
3. How do college students rate the utility of pictography with and without verbal rehearsal for recall of two types of expository text?
Method

Participants

The participants were 66 undergraduate students between 18 to 40 years of age. For participation, participants received college SONA credits or a $20 amazon gift card. The study was conducted on two days, and participants signed-up for one of six available sessions. Sessions were then randomly assigned a condition prior to the scheduled time. Random assignment was such that on each testing day PVR was the first session, Picto was the second session, and RR was the final session. 78 total people signed up for the six separate slots. Of the 78, four did not show up for testing. Of the remaining 74, seven wrote about the practice article and one was older than 40: their data was excluded from the study. This left 66 participants with 23 in the RR condition, 17 in the Picto condition, and 26 in the PVR condition. Demographic data pertaining to gender, education, age, student status, major, GPA, year in college, and employment status were collected from each participant (see Table 1). Conditions were not balanced by demographics, but similar ratios for gender, education, age, student status, GPA, year in college, and employment status were present across all conditions. Ratios for Major in the RR condition and PVR condition were similar. However, the Picto condition was almost primarily COMD majors.
Table 1. Participant demographic feature by condition

<table>
<thead>
<tr>
<th>Condition</th>
<th>Re-Read (n = 23)</th>
<th>Picto (n = 17)</th>
<th>PVR (n = 26)</th>
</tr>
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<tbody>
<tr>
<td><strong>Gender</strong></td>
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<td></td>
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</tr>
<tr>
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<tr>
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<td>13</td>
<td>16</td>
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<tr>
<td>Other</td>
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<td>22</td>
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<td>4</td>
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<tr>
<td>Not Employed</td>
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</tbody>
</table>
**General Procedure**

Each condition was tested separately, but followed similar procedural guidelines. The participants were widely spaced in a large room with visual barriers (cardboard tabletop study carrels) between each person. Earplugs were provided to each participant to minimize noise distractions. Trained monitors followed a checklist of instructions for each condition (see Appendix A), with at least one monitor per five participants within a group. Each monitor circulated throughout the room on a predetermined plan that included some overlap between monitors, and recorded procedural adherence of participants. The student investigator gave all task instructions, oversaw the process, and dealt with any questions or issues that arose.

Participants read and studied two expository passages following instructions pertinent to their assigned testing condition: RR, Picto, or PVR. The texts were presented in a counterbalanced order across participants within a condition. All conditions received training on one practice item adhering to the full study procedure of that condition. The practice item was a concrete expository text about the history of chocolate.

Following the training, participants were given the first experimental text and were told they were studying to prepare for a free recall test and a multiple-choice test on the information presented. They were given up to 12 minutes to read each passage and engage in the study strategy, with a signal five minutes and one minute prior to the end to finish up. Participants were instructed to turn their materials face-down upon completion of their reading, and to sit without doing anything else until the others had completed their task on that same text. After the allotted time, or when all the participants in that group had finished, the text and study materials
were removed. The participants were then given the second text and engaged in the same process, with the materials removed again.

After the study period, participants had a “mind wipe” break. During this break, participants completed a brief demographic and interest questionnaire, and solved a set of simple arithmetic problems (Appendix B). This was intended to put some memory distance between the passage reading and the testing times. Participants were permitted to go the restroom if required, but were told to not talk to other people and leave their phones in the room.

For testing, participants were administered two free recall measures on each of the texts, with the topic order matching the order the passages were studied. Each participant individually and silently read the instructions and wrote their responses. The instructions informed the participants to write down everything they could remember from the text they had studied using their own words or words from the text. It also instructed the participants to write in sentence form, rather than a list of words or phrases. If participants could only recall an isolated word or phrase, it instructed them to write the statement “I can only remember X”. It also instructed them to turn the pages face-down and notify a monitor upon completion of the task to progress through testing, the texts were not named specifically in the instructions, and participants were not given a specific time limit for each test other than to finish before the two-hour session had finished. The multiple-choice tests were then administered for the first text and then for the second text. The free recall task was administered for the two passages before the other outcome measures to promote maximal quantity and quality of responses on this effortful task. The free recall was the primary outcome measure because the multiple-choice questions were designed specifically for these texts in this study, and it is uncertain how revealing it would be. The procedure concluded with each participant completing a set of ratings on their familiarity with the topics of the
articles, and their perceptions of the utility of what they did (see Appendix C). The entire procedure took one to two hours, depending on the condition.

**Pictography and Verbal Rehearsal Procedures**

A brief training on pictography was administered to participants in the two pictography conditions. An expository article about the history of chocolate (Chocolate, Freeman, 1997, see Appendix D) was handed to each participant and projected on a blank screen at the front of the room utilizing a Surface Pro. The Surface Pro allowed the administrator to draw pictographs for the participants to view. The administrator taught pictography and verbal rehearsal utilizing this method, following the condition procedures, with demonstration and practice opportunities.

Participants were told that pictographic notes are quick and easy sketches that give just enough detail to remember. They were told pictographs consist of simple images, lines, shapes, and possibly numbers, single letters, or end marks (question or exclamation), but no written words. Participants were told that they would not be tested on the training article, but that they would be tested later on two articles that they used to make pictographic notes. The instruction included training on how to write a pictograph in each box of a 9-grid organizer for pictographs and how to utilize underlined information (see Appendix E). The underlined information pertained to key details spread across six paragraphs.

Participants read the practice text completely and then turned the paper face-down and raised their hands. The student researcher then modeled pictography before moving on to the next underlined idea. The student researcher modeled this process for the first four underlined ideas and then allowed the participants to finished the remaining five underlined ideas on their own. The student researcher and monitors circulated the room giving feedback and answering questions. When participants completed the practice article, they were instructed to turn the
article face-down and raise their hand. Articles and pictography were collected from all participants. When everyone was finished, pictographic notes alone were handed back to the participants and they were instructed to check pictographs and adjust as needed. Following completion this, participants were instructed to stand up and stretch in preparation for the experimental procedure.

Participants in the verbal rehearsal condition received added instruction to turn their articles print down and orally formulate their own single full, well-formed sentence from the pictograph of the text information. They then repeated that sentence before moving on the create the next pictograph. If the participant modified orfaltered on a sentence, he or she was asked to repeat the modified or repaired sentence before proceeding. After completing all the pictographs and sentences, the articles and pictography were collected from the participants. When everyone was done, the pictographic notes were handed back to the participants. The participants reviewed their pictography and said all of their sentences aloud as if giving an oral report using, as much as possible, the same sentences as practiced individually. Participants then stood and stretched.

For the testing portion, participants were given the first text and the task instructions were repeated. They read the text once silently and then indicated completion by raising their hand. Following this, participants were given a nine-grid paper, a pencil, and eraser. Participants then re-read the text at their own pace and created pictographs for underlined main ideas from the article, with accompanying sentences for the verbal rehearsal condition. They re-read the text and revised the pictographs as desired. When they were done, they turned the texts face-down, indicate they were finished, and sat without doing anything else until the others have completed the task on that text.
Re-read Procedure

A brief training on re-reading texts was administered to participants in the RR condition. The same chocolate article was handed to each participant and projected on a blank screen at the front of the room. Participants read the article one time to themselves, then turned the article face-down and raised their hand. When all participants completed with initial reading, they turned the papers over and re-read the article. They then turned the article back face-down and raised their hand to have the article collected. Participants were given an opportunity to stand up and stretch and to prepare for the experimental procedure. The trainer gave a few comments about the ideas in the chocolate article so the topic was somewhat in the participants’ minds since it had been discussed at length in the other two conditions.

For the testing portion, participants were then given the first text and instructed orally to read the passage to themselves silently at their normal reading speed. When they indicated they were done, they were instructed to re-read the passage silently to themselves a second time. Participants were given a total of five minutes to read and re-read with a 30 second warning. The texts were taken from participants immediately following the re-read of the text. They were then given the second text to read and re-read.

Texts

A concrete expository text about the history of chocolate (Freeman, 1997) was used in the training process. The text consisted of 242 words and had nine underlined ideas for participants to practice on. C-units or communication units, are measures of syntactic complexity. A C-unit is made up of an independent clause with its modifiers and dependent clauses, or an elliptical response or sentence fragment (Loban, 1976). The C-units were also used
as an indication of the number of propositions or idea units per text. Idea units are variably operationalized across the literature, but clauses are a common metric (e.g., Cofer, 1941; Kintsch, 1975; Meyer, 1975; Stein & Glenn, 1975). The Chocolate text consisted of 18 C-units with a mean length of C-unit (MLC) of 13.4. The text was intentionally shorter, easier, and less technical than the other texts.

Two expository texts of 400 words were used during testing. The texts were developed by the research team (see Appendix F). They were brief essays structured as two types of expository discourse: concrete and abstract. The texts involved topics on which the participants were not expected to have extensive prior knowledge. The topics were Microbiome and Our Health, and Man’s Search for Meaning. The two passages contained 25 C-units and an MLC of 16.0. The C-units contained subordination and elaborated noun phrases with technical vocabulary in the concrete text and complex, subtle ideas with literary vocabulary in the abstract text.

In each text, nine key details were underlined. The study provided only very brief instruction and practice in pictography, and was not testing how well students could identify key details, so the underlining indicated which ideas to pictographically sketch. Participants could incorporate additional text details into their pictographs as desired. These nine ideas were then used in the scoring procedure.

**Outcome Measures**

For the free recall tests (see Appendix G), participants wrote as much of the article information as they could, in sentences, following Meyer and Freedle’s (1984) description of their instructions:
Write down everything they could remember from the passage using their own words or words from the passage. They were asked to recall it in sentence form, rather than list ideas remembered. If they could recall only one idea, but not how it related to the other information in the passage, they were to state this and not simply list in isolation the word remembered. (p. 131)

Free recall performance was measured based on the number of ideas correctly recalled out of the nine possible. Idea expression could be verbatim or paraphrased, and in the same or different order from the text. Because the verbal rehearsal involved composing well-formulated sentences that clearly expressed the intended ideas, the items had to be in at least a simple sentence. They could be grammatically incorrect, but could not be single words and phrases. If an underline consisted of a list of two or more facts, points were only given in scoring if more than 50% of the list was correct. For example, if the list had three items, participants were only scored correct if they had two or more facts correct. Additionally, ideas were only scored correct if the information was accurate to the text information, not if the idea was true but not stated in the text. Number of words was also counted for each free recall essay after transcription, using the MSWord function.

A holistic rating was also conducted on the free recall data. The participants’ handwritten essays were transcribed into single blocked paragraphs. Spelling errors and punctuations errors were also transcribed as to not change a participant’s original work. Holistic raters scored the free recall essays on a 0-4 scale using a rubric, example anchors, and practice free recalls (see Appendix H, I, & J). Ideas were differentiated as text details versus paragraph main ideas, and explicitly stated versus implied. Relational ideas that are not contiguous in the text but could reasonably be combined or integrated were counted in the holistic rating but not free recall
measures. Four raters participated with two independent ratings of each participant free recall. For the holistic rating, raters were trained on researcher generated free recalls to better understand the zero-four rating system. Microbiome was rated on day one and Man’s Search for Meaning was rated on day two. For one-point disagreements, scores were averaged and for two-point disagreements the student researcher judged which rater was correct. A 12-item multiple choice test was given for each article. It contained six questions related to the underlined ideas and six questions about text ideas that had not been underlined (see Appendix K). Performance was measured by the number of correct responses.

The short demographic questionnaire asked basic demographic questions about gender, ethnicity, education, and employment. Participants also solved a math worksheet containing 24 simple addition problems.

A self-rating questionnaire matched to condition was also administered. The questionnaire contained items that involved a five-point Likert scale ranging from strongly disagree to strongly agree. Questions on the self-rating related to how familiar the topic was, the usefulness of pictography, the helpfulness of verbal rehearsal, and perceptions of the articles. Due to the lay-out of the questionnaire, questions had to be condensed in order to provide descriptive data instead of inferential statistics. A rating of one or two was rated as a disagree, a three was rated as neutral, and four or five was rated as an agree, Questions had four rated elements and were counted as agree or disagree when two or more were for disagree or agree. In case of a tie it was rated as neutral and to be conservative this was put into the disagree category. Participants were also given the option of adding comments about whether their condition was potentially helpful as a study behavior for college or younger students.
Administration Fidelity and Testing Reliability

To ensure administration fidelity, monitors watched pictograph creations and listened to the oral sentence statements, and verbal rehearsals of the participants. The monitors could give up to two redirections per text if the participant was not following directions. If the participant deviated more than twice, that data was retained, but was not included in the analysis.

Administration fidelity was checked for the experimental procedures using checklists for the student administrator and monitors. A lead monitor checked administration fidelity for the student researcher and a separate monitor checked fidelity for the four monitors circulating the room. Fidelity was found to be 100% for the administrator across all sessions and conditions and 100% for the four monitors helping in each session.

Inter-rater reliability on the ideas correctly recalled was determined by having two scorers count the ideas in half the free recall written reports, with an overlap on a random selection of 24% of responses from each text type (16 of 66 for each text). Independent point-point agreement was found to be 92% between the two raters for the abstract text, and 89% for the concrete text.

Participant free recall answers were transcribed for the holistic rating. All participant transcriptions were checked by two separate research assistants to ensure accuracy and similarity in paragraph blocking.
Results

This study examined two key components of an expository strategy treatment called Sketch-and-Speak as a part of a research program to develop treatment for younger students with language impairment. College students were tested on recall of concrete versus abstract expository texts in a randomized group experiment across three conditions: pictography with and without verbal rehearsal versus re-reading. For this study, all significance levels were set to an alpha level of .05 and standard effect size magnitudes from Cohen (1988) were used: small for \( d \) of 0.20-0.49, medium for 0.50-0.79, and large for 0.80 and above. Tables are included to report mean correct performance, and bar graph figures are included to better illustrate the patterns of the data.

Abstract Text

Results on the total number of words, ideas recalled from the free recall, multiple-choice answers, and a holistic rating were gathered for the abstract text (see Table 2 and Figure 1). The number of words from free recall of the abstract text for each participant were recorded. The total number of words used across conditions were within a 10-word range with 87 to 96 (of a possible 400 words from the original texts). A 3-way analysis of variance (ANOVA) with Tukey pairwise comparisons by condition indicated that there was no significant effect for number of words, \( F(2, 63) = 0.247, p = 0.782 \). The RR condition compared to the Picto condition was \( t(63) = 0.304, p = 0.950, d = 0.10 \). The RR condition compared to the PVR condition was \( t(63) = 0.701, p = 0.764, d = 0.21 \). The Picto condition compared to the PVR condition was \( t(63) = 0.332, p = 0.94, d = 0.10 \). These \( p \)-values indicate no significant differences between total number of words used by condition and the \( d \) values indicate minimal to small effect sizes.
Table 2. Mean Correct Performance for Abstract Text

<table>
<thead>
<tr>
<th>Condition</th>
<th>Re-read (n = 23)</th>
<th>Picto (n = 17)</th>
<th>PVR (n = 26)</th>
<th>Re-read compared to Picto</th>
<th>Re-read compared to PVR</th>
<th>Picto compared to PVR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of Words</td>
<td>87.3 (43.2)</td>
<td>91.7 (45.9)</td>
<td>96.3 (45.5)</td>
<td>0.10</td>
<td>0.21</td>
<td>0.10</td>
</tr>
<tr>
<td>Number of Ideas</td>
<td>3.2 (2.2)</td>
<td>4.9 (2.5)</td>
<td>6.3 (2.2)***</td>
<td>0.72</td>
<td>1.41</td>
<td>0.60</td>
</tr>
<tr>
<td>Multiple-choice</td>
<td>8.5 (1.4)</td>
<td>7.9 (2.7)</td>
<td>9.2 (1.7)</td>
<td>0.28</td>
<td>0.45</td>
<td>0.58</td>
</tr>
<tr>
<td>Holistic Rating</td>
<td>1.6 (0.8)</td>
<td>2.2 (0.8)</td>
<td>2.6 (1.1)***</td>
<td>0.75</td>
<td>1.04</td>
<td>0.42</td>
</tr>
</tbody>
</table>

Note: The table presents means with standard deviation in parentheses. Picto = Pictography only. PVR = Pictography Plus Verbal Rehearsal.

***p < .001

Figure 1. Mean Correct Performance for Abstract Text

Note: Values for Words bar graphs divided by 10 to fit to the scale of the other outcomes. Free recall was scored by number of ideas recalled out of a possible score of nine. A 3-way ANOVA with Tukey pairwise comparisons on these data indicated that there was a
significant difference between conditions for free recall scores, $F(2, 63) = 11.114, p = .0001$. The RR condition compared to the Picto condition was $t(63) = 2.324, p = 0.0597, d = 0.72$. The RR condition compared to the PVR condition was $t(63) = 4.714, p < .0001, d = 1.41$. The Picto condition compared to the PVR condition was $t(63) = 1.943, p = 0.135, d = 0.60$. These $p$-values indicate a significant difference between the RR condition and PVR condition and near significance for the RR condition compared to the Picto condition. The effect size magnitudes indicate medium effects for RR compared to Picto and Picto compared to PVR, and large effects for RR compared to PVR.

The multiple-choice test was scored by correct answers out of 12. A 3-way ANOVA with Tukey pairwise comparisons on these data indicated that there was not a significant difference among conditions on multiple-choice, $F(2, 62) = 2.464, p = .093$. The RR condition compared to the Picto condition was $t(63) = 0.748, p = 0.736, d = 0.28$. The RR condition compared to the PVR condition was $t(63) = 1.464, p = 0.315, d = 0.45$. The Picto condition compared to the PVR condition was $t(63) = 2.133, p = 0.091, d = 0.58$. These $p$-values indicated no significant differences in multiple-choice scores and the effect sizes were small to medium.

A holistic rating of recall quality was scored for each participant by two independent raters. A 3-way ANOVA with Tukey pairwise comparisons of this data indicated that there was a significant difference in holistic quality, $F(2, 63) = 6.458, p = 0.003$. The RR condition compared Picto condition was $t(63) = 1.817, p = 0.172, d = 0.75$. The RR condition compared to the PVR condition was $t(63) = 3.592, p = 0.001, d = 1.04$. The Picto only condition compared to the PVR condition was $t(63) = 1.432, p = 0.331, d = 0.42$. The $p$-values indicate a significant difference between the RR condition and PVR condition. The effect size magnitudes indicate
medium to medium approaching large for RR compared to Picto and Picto compared to PVR, and large effects for RR compared to PVR.

**Concrete Texts**

Results on the total number of words, ideas recalled from the free recall, multiple-choice answers, and a holistic rating were gathered for the concrete text (see Table 3 and Figure 2). Total number of words from free recall of the concrete text for each participant were recorded. A 3-way analysis of variance (ANOVA) with Tukey pairwise comparisons by condition indicated that there was no significant effect for total number of words used, $F(2, 63) = 1.540, p = 0.222$. The RR condition compared to the Picto condition was $t(63) = 0.116, p = 0.993, d = 0.04$. The RR condition compared to the PVR condition was $t(63) = 1.596, p = 0.255, d = .45$. The Picto condition compared to the PVR condition was $t(63) = 1.346, p = 0.376, d = 0.41$. These $p$-values indicate no significant differences between total number of words used and the $d$ values indicate a minimal effect size for RR compared to Picto, and medium effect sizes for RR compared to PVR and Picto compared to PVR.

Free recall was scored by ideas recalled out of nine. A 3-way ANOVA with Tukey pairwise comparisons by condition indicated that there was a significant difference between free recall scores, $F(2, 63) = 16.662, p = 0001$. The RR condition compared to the Picto condition was $t(63) = 2.607, p = 0.030, d = 0.90$. The RR condition compared to the PVR condition was $t(63) = 5.771, p = <.0001, d = 1.70$. The Picto condition compared to the PVR condition was $t(63) = 2.622, p = 0.029, d = f 0.79$. These $p$-values indicate a significant difference between all conditions. The effect size magnitudes indicate large magnitudes for all conditions.
Table 3. Mean Correct Performance for Concrete Text

<table>
<thead>
<tr>
<th>Condition</th>
<th>Re-read (n = 23)</th>
<th>Picto (n = 17)</th>
<th>PVR (n = 26)</th>
<th>Re-read compared to Picto</th>
<th>Re-read compared to PVR</th>
<th>Picto compared to PVR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of Words</td>
<td>89.6 (36.9)</td>
<td>91.1 (36.1)</td>
<td>108.0 (45.3)</td>
<td>0.04</td>
<td>0.45</td>
<td>0.41</td>
</tr>
<tr>
<td>Number of Ideas</td>
<td>2.4 (1.9) *</td>
<td>4.2 (2.1) *</td>
<td>5.9 (2.2) ***</td>
<td>0.90</td>
<td>1.70</td>
<td>0.80</td>
</tr>
<tr>
<td>Multiple-choice</td>
<td>8.3 (2.3)</td>
<td>8.4 (2.0)</td>
<td>9.9 (1.4) **</td>
<td>0.05</td>
<td>0.84</td>
<td>0.87</td>
</tr>
<tr>
<td>Holistic Rating</td>
<td>1.7 (0.7)</td>
<td>2.1 (1.0)</td>
<td>2.8 (0.9) ***</td>
<td>0.46</td>
<td>1.49</td>
<td>0.84</td>
</tr>
</tbody>
</table>

*Note: The table presents means with standard deviation in parentheses. Picto = Pictography only. PVR = Pictography Plus Verbal Rehearsal
*p < .05. **p < .01. ***p < .001

Figure 2. Mean Correct Performance for Concrete Article

*Note: Values for Words bar graphs divided by 10 to fit to the scale of the other outcomes.*
The multiple-choice test was scored by correct answers out of 12. A 3-way ANOVA with Tukey pairwise comparisons by condition indicated that there was a significant difference between performance on multiple-choice, $F(2, 62) = 6.527, p = .003$. The RR condition compared to the Picto condition was $t(63) = 0.361, p = 0.939, d = 0.05$. The RR condition compared to the PVR condition was $t(63) = 3.317, p = 0.0043, d = 0.84$. The Picto condition compared to the PVR condition was $t(63) = 2.708, p = 0.0234, d = 0.87$. These p-values indicate significant differences in multiple-choice scores for RR compared to PVR and Picto compared to PVR. The effect sizes indicate minimal effects for RR compared to Picto, and large effects for RR compared to PVR and Picto compared to PVR.

A holistic rating of recall quality was scored for each participant by two independent raters (see Figure 2). A 3-way ANOVA with Tukey pairwise comparisons by condition indicated that there was a significant difference in holistic quality, $F(2, 63) = 9.198, p = 0.0003$. The RR condition compared to the Picto condition was $t(63) = 1.681, p = 0.221, d = 0.46$. The RR condition compared to the PVR condition was $t(63) = 4.271, p = 0.0002, d = 1.49$. The Picto condition compared to the PVR condition was $t(63) = 2.196, p = 0.796, d = 0.84$. The p-values indicate a significant difference between the RR condition and PVR condition. The effect size magnitudes indicate small approaching medium effects for RR compared to Picto, and large effects for RR compared PVR and Picto compared to PVR.

**Self-rating**

A self-rating questionnaire was scored for each participant on usefulness of pictography and helpfulness of verbal rehearsal. Responses were only examined descriptively and not inferentially due to the questionnaire layout. For questions pertaining to the usefulness of pictography, 23 out of 26 (88%) participants in the PVR group agreed that it was useful for the
concrete text. In regards to the usefulness for the abstract text, 17 out of 26 (65%) of the PVR participants rated it as useful. In the Picto group, 13 out of 17 (76%) participants rated the strategy useful for the concrete text, and 14 out of 17 (82%) for the abstract text. Combining the two conditions indicated that 37 out of 43 (86%) participants found pictography useful for the concrete text, and 31 out of 43 (72%) found it useful for the abstract text. Only the PVR group rated the helpfulness of verbal rehearsal. Ratings from these participants showed that 22 out of 26 (85%) found the strategy helpful for both texts.

**Discussion**

The purpose of this study was to investigate the effects of pictography with and without verbal rehearsal on text recall and comprehension. The study included 66 undergraduate students randomly assigned to one of three conditions with separate learning strategies. The experiment studied the effects of pictography and verbal rehearsal compared to simply re-reading a passage on the recall and comprehension of expository texts for college students, as well as the effects on different types of exposition, while also gathering information on participant perception of the utility of Sketch and Speak. The experiment revealed robust advantages of two key components of a treatment procedure called Sketch-and-Speak, pictography and verbal rehearsal, for recall of main ideas of expository texts.

**Pictography Only**

Pictography is used as an SLP tool in intervention to support language development and provide children with learning strategies (Paul & Norbury, 2012). Pictography is used as a “quick & easy” “just enough to remember” sketch that students utilize as an alternative to written or conventional notes. Research studies have shown positive effects on the quality of narratives produced by children with learning disabilities and typically developing children (McFadden,
1998; Ukrainetz 1998; Ukrainetz et al., 2018; Ukrainetz, 2019), however, little is known on the effects of pictography on older populations such as college students. As a result, these findings fill a hole in the research base that will continue additional discussion and provide further analysis.

A visual analysis of bar graphs presented in Figure 1 and Figure 2 indicates a trend in participant scores. In the control RR condition, scores indicated 20% recall of main ideas for concrete texts and 30% for abstract texts. When pictography was utilized as a strategy, scores improved to between 45% and 55% recall depending on the type of text. A statistical analysis even indicated a significant difference between all conditions in the concrete article. Thus, we have evidence that when college students utilize pictography, expository text retention is greater than when they only re-read a text. Therefore, it is plausible to think that if a college student were to utilize this strategy, especially for hard sciences, better recall of material might be the result. It could also improve the ability of a student to perform well on various assignments and exams requiring informational recall of material in a free response format.

A visual analysis of the graphs reveals that when participants utilized pictography, their free recall was more holistically accurate and descriptive. The holistic ratings identified information that was similar to the underlined main ideas, but also considered the supporting information and additional information surrounding the underlined ideas. In the RR condition, mean holistic scores for the concrete text were 1.7 and 1.6 out of 4 possible points for the abstract text. When pictography was used, mean scores improved to 2.1 for the concrete text and 2.2 for the abstract text. These findings are consistent with what was learned from the free recall portion of the discussion. This is of particular interest because it shows that when students engage in pictography or pictography plus verbal rehearsal, they are remembering and recalling
additional details that those who are simply re-reading textbooks or notes. This could help college students better engage in meaningful classroom behaviors by encouraging active listening and retention. It could also help college students avoid distractions. For example, many students engage in the act of doodling in the margins. In a survey of 215 students ranging from high school to college, Yocum (2017) found that 86% of students engage in the act of doodling. By utilizing the Sketch-and-Speak strategy, student can transform a typical doodling distraction into learning.

A visual and statistical analysis indicate little to no gains on multiple choice scores for the pictography only group. An implication could be that pictography is not particularly useful for classes utilizing exams that are multiple choice dependent. An important thing to consider in this experiment was that multiple choice was not the primary outcome measure for learner outcomes in the study, but simply an additional measure to examine recall from another direction. Limitations of this measure will be discussed further in a later section.

Although not every analysis between the Picto, PVR, and RR group were statistically significant, all trends except for multiple choice on the abstract article showed an increase in scores. These findings are compatible with and add to the current research base that indicate pictography facilitates better planning, recall, and revision of discourse, both narrative and expository (McFadden, 1998; Ukrainetz, 1998) The findings indicate that this strategy can be as helpful for students of all ages and not simply a strategy for students with language and learning disabilities.
Pictography plus verbal rehearsal

The process of verbal rehearsal takes a person from simply reading to learn, or in the case of pictography drawing to learn, and combines it with talking to learn. Pictography combined with verbal rehearsal takes a learner from being passive to active learning by invoking reduction by drawing it simply, reorganization, transformation, and retrieval, through to saying it fully, and revision of ideas needed to learn academic topics and exposition (Ukrainetz, 2019). Prior research has shown that formulating and then repeatedly saying a sentence aloud from a drawn picture results in confident, fluent presentations of learned ideas. However, this process of verbal rehearsal is often underutilized and is missing from common expository interventions (c.f. Ukrainetz & Ross, 2006). The findings from this experiment highlight the importance of talking to learn in academic settings and expository topics.

Visual and statistical analysis of the PVR condition indicated gains across all participants for both articles in regards to the ideas that were recalled. When pictography was combined with verbal rehearsal, recall increased to 66% for the concrete text and 70% for the abstract text, with large effect sizes compared to RR for both text types and Picto for the concrete text. These gains are the most notable finding from this experiment. Re-reading has a passive verbal review but no active note-taking with its knowledge transformation. Pictography alone has an active note creation with clear knowledge transformation but passive review because it is not required to be in words. When pictography is combined with verbal rehearsal, active note-taking and active verbal review happen, and the benefits are clear. The findings from this experiment support the conclusion that verbal rehearsal can be incorporated into the teaching and learning process to improve information recall. In regards to a college setting, one common type of college test formats is the essay exam. This type of exam format allows for students to share their ideas in
their own words and indicates how much material was retained from their readings. The findings from this experiment indicate that using pictography and verbal rehearsal could be beneficial for this type of testing format.

The benefits of verbal rehearsal were not simply confined to the free recall portion of this experiment. Once again, a visual analysis of the multiple-choice scores indicated gains. When verbal rehearsal was utilized mean scores for the concrete article were 9.9 and 9.2 out of 12 possible points for the abstract article, which was 1.5 above the other conditions for the concrete article and a range of .7 to 1.5 for the abstract article. A statistical analysis of the concrete article even indicated significant differences for the concrete text. These findings suggest the importance of utilizing verbal rehearsal as an active learning strategy. These findings are also important due to the other commonly used college testing format of multiple-choice tests. Multiple choice favors rapid memorization, retention of facts, and limited expression of deep knowledge. This experiment provides evidence that pictography combined with verbal rehearsal allows for effective recall of ideas, especially the learning of concrete facts.

The benefits of pictography and verbal rehearsal do not simply stop at a superficial level of better scores, but also indicate a deeper and more holistically accurate recall of information. Visual and statistical analysis of the findings indicate yet again the growth for participants when expected to verbally rehearse. When verbal rehearsal was added to pictography, the scores increased from 1.7 and 2.1 to 2.8 for the concrete text and 1.6 and 2.2 to 2.6 for the abstract text. The benefits of these strategies are noteworthy in regards to what it means to learn. Learning is defined as gaining or acquiring knowledge. If more knowledge is desired, then utilizing the pictography and rehearsal aspects of Sketch-and-Speak will promote deeper learning where knowledge is acquired more fully.
For the abstract article, the number of words used in the free recall was not statistically significant, but the number of main ideas recalled when using verbal rehearsal combined with pictography was significant. This indicates an important interaction. One could logically assume that simply writing more words would lead to more ideas recalled and more detail. However, that was not the case in this experiment. Even though the number of words was relatively the same, when participants utilized verbal rehearsal, they recalled more ideas. For example, a PVR participant recalled all nine key details for the abstract article in only 97 words, whereas a RR participant recalled six out of nine key details for the same article in 198 words. This provides support that the strategy is not simply to write as much as one can, but to combine reading to learn with talking to learn.

**Concrete Versus Abstract**

Another aim of this experiment was to learn about the effects of pictography with and without verbal rehearsal on two types of expository texts. Exposition has many different discourse types, with research indicating some types are easier or harder to learn from. This study adds to the research base of learning from expository text types. It also provides insights into which type of exposition the strategies of pictography with and without verbal rehearsal help with as there were no clear hypotheses at the onset of the experiment regarding which one would have more benefits.

For concrete information, pictography significantly improved free recall of ideas over just re-reading. When verbal rehearsal was added, free recall was not the only outcome that significantly improved, but also multiple choice and holistic quality. These findings indicate that pictography with and without verbal rehearsal is very beneficial for concrete texts. This could be due to imageability or drawability of the ideas depicted in the concrete texts. For example, the
concrete text had very clear facts about the human microbiome, the large intestine, and even had examples for newer terms like prebiotics being bananas. During testing, participants were able to draw concrete pictures pertaining to these ideas clearly. Many of the participants had similar pictures to indicate the same main idea. Therefore, this study provides added insight into the ability of active learning process such as Sketch-and-Speak to positively affect recall of concrete descriptive-explanatory exposition.

Although concrete texts had more statistically significant gains across outcomes, pictography and verbal rehearsal strategies helped recall of information from abstract texts in regards to free recall and holistic quality. It revealed that using simple iconic sketches is useful for recall of abstract texts from informational articles. Abstract ideas are inherently less imageable and vague, but the highest mean score for free recall of abstract texts when using pictography with verbal rehearsal. This provides evidence for an argument that although two of the strategies taught in Sketch-and-Speak may not improve performance for abstract texts in a multiple-choice format, it may be suited for more open formats. This may be due to the information being vague and requiring more detail to fully explore thoughts.

**Perceptions of Utility of Sketch-and-Speak**

The last questions investigated pertained to college student’s perception of the utility of pictography with and without verbal rehearsal. The original hypothesis was that students would benefit from using pictography and find more value when adding verbal rehearsal. The findings supported that: over three-quarters of these college students judged pictography as useful and verbal rehearsal as helpful when separated as learning strategies. The layout of the questionnaire and even the design of the study were not conducive to directly comparing pictography alone and verbal rehearsal alone, so a comparison of these two strategies could not be done. However,
further data analysis for these two strategies is available from the information gathered from the questionnaire. For example, data was collected on whether the pictography only group talked to themselves while participating in the experiment. This data was not examined for this report, but could be analyzed to go deeper into how particular participants performed when they spoke to themselves or not. The findings from the comments also suggest that college students think that pictography promotes a deeper learning of expository material by constructing a mental image and then forcing a link between the provided information and the sketch (Mayer& Gallini, 1990). For example, one participant from the PVR condition said, “I have terrible recall and find it hard to study. Doing pictures and rehearsal helped me depict what I was repeating back, even in detail.”, and one from the Picto condition said “The Man’s Search for Meaning article was harder to make pictures for so I spent more time drawing and thinking about it. I felt more confident being tested on this article than the Microbes one.”

When the two text types were compared, 86% of participants said that pictography alone was useful for concrete texts and 72% said it was useful for abstract texts. Although there is a 14% difference between the text type, the majority of participants found the strategy useful.

Examples of comments from participants highlight negatives and positives for pictography. For example, a participant from the Picto condition was critical of the usage of pictography for abstract concepts by saying, “Pictography is helpful for simpler concepts, but creating a picture for a word like “endowment” is difficult. I see there being a threshold in difficulty of the concept and effectiveness of pictography.” This is contrasted with a participant from the PVR condition saying, “Pictography is a good study behavior especially to help recall info about a difficult topic.”
In regards to verbal rehearsal, 85% of participants from the PVR condition found it helpful for both texts. Verbal rehearsal may not be a common practice or even a natural strategy to learners. For example, a participant said, “The hardest part was getting the sentence exactly the same, that made it more difficult when saying it all together.” This difficulty could be alleviated with further instruction and practice on the technique and understanding of the purpose of verbal rehearsal. The benefit of the Sketch-and-Speak strategy combination is encapsulated in a few comments from the participants. One said, “I have terrible recall and find it hard to study. Doing the pictures and rehearsal helped me depict what I was repeating back even in detail.”, and another said, “I liked the verbal rehearsal it made the ideas shorter and easier to understand and remember.”

This research question on how college students rate the utility of pictography with and without verbal rehearsal has potential to be explored further with a well-developed rating system and further experimentation. The questions we asked did not lend well to easy analysis and hindered analysis of the findings. For example, the first question of the questionnaires consisted of four sub questions that were rated on a scale of one to five. The questions were insightful, but not all of them pertained directly to the usefulness of pictography. For example, one asked if “the pictography notes were easy to generate”. It provided information on how easy it was to do the pictography, but not necessarily on the usefulness of pictography on informational recall. Also, a more consistent Likert scale and clearer questions will help in future studies. For example, the layout of the questionnaire had two separate Likert ratings, where one was a scale of one to five using an agree/disagree format, where the other was a scale of one to five comparing the types of exposition.
Implications

Children and adults need to be able to understand expository texts, take notes, and recall information in order to succeed in educational settings. Children with language-related learning disabilities have significant literacy issues (Conti-Ramsden & Durking, 2012) that impact academics, but that is not all. They also struggle to simply take notes which then leads to long term retention difficulties (Boyle & Forchelli, 2014). These limitations lead to multiple problems in educational settings where a student is expected to have short-term and long-term retention of material. This study explored the key components of the expository intervention, Sketch and Speak, and adds to the evidence base as a high-quality study that specifically targeted the effects of pictography with and without verbal rehearsal on expository recall of different types of exposition. The findings can be adapted and applied to various educational settings for various demands.

Sketch-and-Speak provides a unique set of two strategies that when utilized could be more useful for college students than simply re-reading. Palmatier and Bennet (1974) reported that 99% percent of college students report taking notes, and Karpicke et al. (2009) reported that college students engage in rereading text or notes as a preferred learning strategy. Wigent (2013) found that both above-average readers and students with learning disabilities use re-reading as their primary mode of knowledge construction. With Sketch-and-Speak students cannot be passive re-readers. The strategies encourage a higher level of student engagement and may result in a better product. Participants were only briefly exposed to both strategies, but their scores indicated significant differences. Interestingly, the participants were able to do better than re-reading only, even though they did not have their pictography available to them during the testing portions. The benefit that was gained was obtained truly from better internalization and
not simply from the pictures cueing them during testing. The experiment indicates potential for the implementation of Sketch-and-Speak for helping students recall and express information from challenging texts.

Sketch-and-Speak promotes a deeper learning by giving the learner autonomy and more responsibility in their learning process. Sketch-and-Speak can be utilized in classrooms as a note taking strategy, or alone while learning through standard text books. Ultimately, the amount of learning is significantly increased the more any effective strategy is mastered and implemented. Prior studies have shown the benefits of sketching and speaking in narrative contexts (McFadden 1998; Ukrainetz, 1998; Petersen et al., 2014, Gillam et al., 2018), and this study shows some benefits of using Sketch-and-Speak for expository contexts. Thus, Sketch-and-Speak provides a benefit across multiple outcome measures.

Limitations

The current study investigated two components of Sketch-and-Speak in an experimental group design. The findings support continued development and further research of Sketch-and-Speak as a learning intervention. The study did, however, have some limitations that could potentially impact the generalizability of the findings to other participants and settings. The limitations fall into the categories of participants, materials, and procedure.

The main participant limitation was due to the majority of the participants coming from the Communicative Disorders and Deaf Education major. 47 of the 66 participants identified themselves as belonging to this major, with 31 of the 47 identifying as a junior or senior. The background of a COMD student lends itself to talking to learn. Educational background with this focus could have impacted the ability to participate in verbal rehearsal more readily in certain conditions. Data is available for a deeper analysis of this question on a further date.
Material limitations were experienced due to material layouts and a lack of extensively piloting all testing material. For example, underlining of main ideas in the texts was used to direct the pictography with and without verbal rehearsal conditions. To provide consistency across materials, the underlining was also present for the re-read condition. As a result, all conditions were impacted by knowing what to re-read and what to draw and rehearse. The underlining could have improved re-read conditions scores, as they were focused on what to re-read. It could also have impacted the experimental conditions by limiting the additional information that they were able to capture due to having to make specific pictographs for the underlined information.

The idea to utilize underlining came from seeing that some of those participating in the pilot were making a pictograph for every sentence. As a result, the researchers created a 9-sheet box to capture 9 underlined ideas. However, additional piloting was not done to see if simply adding a 9-sheet box helped participants limit the number of pictographs they were drawing to learn the article. This limitation could be explored and changed in further research by simply utilizing the 9-sheet box instead of underlining main ideas.

Another example of a material limitation was the multiple-choice tests that were given. The multiple-choice tests were not extensively piloted for difficulty previous to running the experiment. The mean for almost all test conditions was above an 8 out of 12 indicating the potential for a ceiling effect as most participant scores were clustering toward the higher end of the test. It also indicates that the underlining of material could have affected the recall and that the test questions could have been too easy.

The largest procedural limitation came in the form of the additional information required for the pictography with and without verbal rehearsal compared to the re-read condition. The re-
read condition required less instruction and less time on the training article, and therefore provided fewer distractions and less superfluous information. This is opposed to the pictography with and without verbal rehearsal conditions, which required a longer training process and in-depth exploration of the chocolate article. The training chocolate article proved to be a bigger distraction than anticipated as evidenced by the seven participant datum that had to be deleted due to the participants writing about chocolate in their free recall testing. In future experiments, it would help to better clarify for participants that the training article was not an article that would require any testing later. This was said in the procedure, but needed more repetition for the participants to follow.

Although the training process was longer for the experimental conditions, it was still a very limited training. In future studies, it would be better to have longer time to train participants and more repeated opportunities to practice the two strategies. This would provide a deeper look into the ability of a person to learn and apply the strategies. It would also help with participants feeling self-conscious about having to talk out loud around other people. The researchers attempted to mitigate this through ear plugs and visual barriers, but some participants still expressed discomfort with having to speak out loud with others able to hear them.

An additional procedural limitation was due to the randomization of the various conditions on testing days. Although randomization of the test conditions was used, the condition schedule was such that PVR was first in the day, followed by Picto, and then finished with RR on both testing days. The two testing days had different times to attempt to control for the confounding variable of test time, but this was still a weakness in experimental control. The principal test administrator was better with each iteration of the instructions and it is possible that
this familiarity improved the RR participants’ performance, thus possibly decreasing the
difference between it and the experimental conditions.

**Future Research**

This study investigated three questions: (a) the effects of pictography with and without
verbal rehearsal compared to re-reading on expository text recall, (b) the effects of pictography
with and without verbal rehearsal versus re-reading on recall of concrete and abstract texts and,
(c) and how college students rate the utility of pictography with and without verbal rehearsal for
recall of two types of expository text? Future experiments could explore all three of the research
questions deeper by utilizing different contexts ranging from SLP pull-out to SLP push-in
service delivery models. This would allow researchers to answer long-standing questions
regarding the effects of this strategy combination on learner motivation and depth of learning in
various educational settings. Because researchers have not explored the effects of the
combination of these two strategies in regular education classrooms, resource classrooms, or
even SLP classrooms, further studies and replication studies could be beneficial.

Researchers could further explore participant’s ability to learn and master both strategies
of Sketch-and-Speak. The current research has focused on the efficacy of the two strategies, but
not on required times to learn and implement the strategies as part of a student’s educational tool
kit. Students with reading difficulties often fail to generalize learned strategies to new and novel
contexts (Reynolds & Perin, 2009), and therefore further research in regards to a participant’s
ability to generalize the strategies to new contexts could be beneficial. The findings for Sketch-
and-Speak indicate positive outcomes, but there is no research yet in regards to a participant’s
ability to generalize these strategies to novel and new contexts.
Additional experiments could also investigate the interdisciplinary aspects of Sketch-and-Speak. Current research has focused around utilizing these strategies as means to help struggling learners better access expository texts. However, there have been no controlled studies utilizing an interdisciplinary model, where an SLP seeks to train educational personnel to allow them to instruct on these strategies in a typical classroom setting. Research could explore the effects of these strategies in regular education classrooms, as SLPs train classroom teachers to emphasize both the pictography and the verbal rehearsal aspects of Sketch and Speak to maximize expository learning. It could also highlight the difficulty of using this in a regular education classroom as teachers are more used to conventional note-taking and less talking to learn. Findings from studies such as these could lead to further development and use of Sketch-and-Speak in multiple contexts.

Lastly, the effects of separating the two strategies could also be further investigated. The findings indicate that the combination of the two strategies provides the most gains, but further exploration of verbal rehearsal alone could be beneficial. Research could follow similar experimental conditions as this study to investigate simply having students utilize verbal rehearsal as the single learning strategy. The findings could further indicate the usefulness of implementing both sketching and speaking to increase learning outcomes and learner accountability.

Conclusion

This study investigated two key components of an expository strategy treatment for grade-school students with language and literacy difficulties, called Sketch-and-Speak: pictography and verbal rehearsal. College students were tested on recall of concrete versus abstract texts in a randomized group experiment across three conditions: pictography with and
without verbal rehearsal and re-reading. The experiment revealed significantly better performance when participants used both pictography and verbal rehearsal to learn information. Participants were able to recall more information and had better quality of written recalls. In regards to the type of expository writing, the results revealed that pictography and verbal rehearsal strategies help recall of abstract texts, but have more positive outcomes for concrete texts. Participants largely found pictography and verbal rehearsal useful and helpful. This study suggests Sketch-and-Speak shows potential as an effective set of learning strategies that should be further developed and investigated.
References


doi:10.3200 GENP.132.4.408-428

### Appendix A – Fidelity Checklists

#### Monitor Fidelity Checklist – Picto + VR

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<tbody>
<tr>
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<td>Monitor participants during training and condition:</td>
</tr>
<tr>
<td></td>
<td>1. Training: Circulate to ensure comprehension and alert administrator if needed</td>
</tr>
<tr>
<td></td>
<td>2. Article A: Read whole article once, turn face-down</td>
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<tr>
<td></td>
<td>3. Article A: Re-read and make pictographs for lined ideas and other details from article</td>
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<td></td>
<td>4. Article A: Say &amp; repeat full sentence after each picto, repeat modified sentences</td>
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<td></td>
<td>5. Article A: Article face-down for all spoken sentences and repetitions</td>
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<tr>
<td></td>
<td>6. Article A: No article, all pictos, brief review, revise, &amp; rehearse pictographs and sentences</td>
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<tr>
<td></td>
<td>7. Article B: Read whole article once, turn face-down</td>
</tr>
<tr>
<td></td>
<td>8. Article B: Re-read and make pictographs for underlined ideas and other details from article</td>
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<tr>
<td></td>
<td>9. Article B: Say and repeat full sentence after each pictograph, repeat modified sentences</td>
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<tr>
<td></td>
<td>10. Article B: Article face-down for all spoken sentences and repetitions</td>
</tr>
<tr>
<td></td>
<td>11. Article B: No article, all pictos, brief review, revise, &amp; rehearse pictographs and sentences</td>
</tr>
<tr>
<td></td>
<td>12. Timings A &amp; B: 5 min &amp; 1 min warning for pictos &amp; sentences, collect by 12 min; 3 min for review, revise, rehearse</td>
</tr>
</tbody>
</table>

|     | Monitor participants during testing: |
|     | 13. Free Response A: Complete, turn face-down |
|     | 14. Free Response B: Complete, turn face-down |
|     | 15. Multiple Choice A: Complete, turn face-down |
|     | 16. Multiple Choice B: Complete, turn face-down |
|     | 17. Self-Rating: Complete, turn face-down |
|     | 18. Confirm SONA credit |

|     | **Total P+VR Instruction** | 18 |
## Monitor Fidelity Checklist – Picto Only

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<tr>
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<tr>
<td>21.</td>
<td>Article A: Re-read and make pictographs for lined ideas and other details from article</td>
</tr>
<tr>
<td>22.</td>
<td>Article A: No article, all pictos, brief review and revise all pictographs</td>
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<tr>
<td>23.</td>
<td>Article B: Read whole article once, turn face-down</td>
</tr>
<tr>
<td>24.</td>
<td>Article B: Re-read and make pictos for lined ideas and other details from article</td>
</tr>
<tr>
<td>25.</td>
<td>Article B: No article, all pictos, brief review &amp; revise pictographs</td>
</tr>
<tr>
<td>26.</td>
<td>Articles A &amp; B: 5 min &amp; 1 min warning for pictos, collect by 12 min; 3 min for review &amp; revise</td>
</tr>
</tbody>
</table>

|     | Monitor participants during testing: |
| 27. | Free Response A: Complete, turn face-down |
| 28. | Free Response B: Complete, turn face-down |
| 29. | Multiple Choice A: Complete, turn face-down |
| 30. | Multiple Choice B: Complete, turn face-down |
| 31. | Self-Rating: Complete, turn face-down |
| 32. | Confirm SONA credit |

| 13  | Total Picto Instruction |
Monitor Fidelity Checklist – Re-read Only

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<td>Monitor participants during training and condition:</td>
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<tr>
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<td>33. Training: Circulate to ensure comprehension and alert administrator if needed</td>
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<tr>
<td>___</td>
<td>34. Article A: Read whole article once, turn face-down</td>
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<tr>
<td>___</td>
<td>35. Article A: Re-read article at own pace</td>
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<tr>
<td>___</td>
<td>36. Article B: Read whole article once, turn face-down</td>
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<tr>
<td>___</td>
<td>37. Article B: Re-read article at own pace</td>
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<tr>
<td>___</td>
<td>38. Articles A &amp; B: No timing announcement but 30 sec warning and collect by 5 minutes</td>
</tr>
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</table>

| Monitor participants during testing: |
| ___ | 39. Free Response A: Complete, turn face-down |
| ___ | 40. Free Response B: Complete, turn face-down |
| ___ | 41. Multiple Choice A: Complete, turn face-down |
| ___ | 42. Multiple Choice B: Complete, turn face-down |
| ___ | 43. Self-Rating: Complete, turn face-down |
| ___ | 44. Confirm SONA credit |

___/12 Picto Instruction
### Administration Fidelity Checklist – Picto + VR

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<tr>
<td></td>
<td>46. Training: Explain pictography and verbal rehearsal as study strategies</td>
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<td></td>
<td>47. Training: Reading, each silently on entire article first</td>
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<td></td>
<td>48. Training: Use underlined ideas and other ideas stated in article, but not own ideas</td>
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<tr>
<td></td>
<td>49. Training: Re-read, model, direct <em>quick &amp; easy, just enough to remember</em> pictograph</td>
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<td></td>
<td>50. Training: Cover article, model, direct composing and repeating full spoken sentence</td>
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<td></td>
<td>51. Training: Model, guide, monitor picto, say &amp; repeat full sentence for three more pictographs</td>
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<td></td>
<td>52. Training: Show non-lined idea in picto, picto modify, sentence modify &amp; repeat somewhere</td>
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<tr>
<td></td>
<td>53. Training: Guide and monitor on remaining reading, pictographs, sentences &amp; repetitions</td>
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<tr>
<td></td>
<td>54. Training: No article for all sentences and repetitions</td>
</tr>
<tr>
<td></td>
<td>55. Training: No article; all pictos; model, monitor brief review, revise, &amp; rehearse all sentences</td>
</tr>
<tr>
<td></td>
<td>Instruct &amp; monitor participants:</td>
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<td></td>
<td>56. Article A: Read whole article once, turn face-down</td>
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<td></td>
<td>57. Article A: Re-read and make pictographs for lined ideas and other details from article</td>
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<td></td>
<td>58. Article A: Say &amp; repeat full sentence after each picto, repeat modified sentences</td>
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<td></td>
<td>59. Article A: Article face-down for all spoken sentences and repetitions</td>
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<td></td>
<td>60. Article A: No article, all pictos, brief review, revise, &amp; rehearse pictographs and sentences</td>
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<tr>
<td></td>
<td>61. Article B: Read whole article once, turn face-down</td>
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<td>62. Article B: Re-read and make pictographs for underlined ideas and other details from article</td>
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<tr>
<td></td>
<td>63. Article B: Say and repeat full sentence after each pictograph, repeat modified sentences</td>
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<tr>
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<td>64. Article B: Article face-down for all spoken sentences and repetitions</td>
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___ /22 Total P+VR Instruction
### Administration Fidelity Checklist – Picto Only

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<td></td>
<td>72. Training: Model, guide, monitor picto, for three more pictographs</td>
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<td>73. Training: Show non-lined idea in picto and picto modify somewhere</td>
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<td>82. Article B: Re-read and make pictos for lined ideas and other details from article</td>
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<td>87. Training: Reading, each silently on entire article first</td>
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<tr>
<td></td>
<td>88. Training: Use underlined ideas and other ideas stated in article, but not own ideas</td>
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<td>89. Training: Cover article between read and re-read</td>
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<td>90. Training: Direct and monitor re-read and think about ideas</td>
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<td>93. Article A: Re-read article at own pace</td>
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<td>94. Article B: Read whole article once, turn face-down</td>
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<td>95. Article B: Re-read article at own pace</td>
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<td></td>
<td>96. Articles A &amp; B: No timing announcement but 30 sec warning and collect by 5 minutes</td>
</tr>
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<td><strong>/12 Picto Instruction</strong></td>
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</tbody>
</table>
Appendix B – Questionnaire & Worksheet

Participant Code ___________                       Date________

Demographics Questionnaire

1. What is your gender?
   a. Male
   b. Female
   c. Prefer not to answer

2. What is your highest level of education completed?
   a. GED
   b. High school diploma
   c. Trade school certificate
   d. Associate degree
   e. Bachelor’s degree
   f. Master’s degree or beyond

3. What is your age?
   a. 18-24
   b. 25-33
   c. 34-40
   d. 41+

4. What is your student status?
   a. Full-time student (9+ credits fall enrollment)
   b. Part-time student (less than 9 credits per fall/spring semester)
   c. Not enrolled in university credits

5. What is your major?   _______________________________________________________________________

6. What is your GPA?
   a. 3.5 – 4.0
   b. 3.0 – 3.4
   c. 2.5 – 2.9
   d. 2.0 – 2.4
   e. < 2.0

7. What is your year of college education?
   a. Freshman
   b. Sophomore
   c. Junior
   d. Senior
   e. 2nd Bachelor
   f. Graduate student

8. What is your employment status?
   a. Employed part-time
b. Employed full-time

c. Not employed

d. Prefer not to answer
Math Worksheet

13 +2  
+5  

15 +4  
+2  

9 +2  
+3  

10 +3  
+3  

8 +2  
+7  

13 +4  
+2  

13 +2  
+3  

16 +3  
+3  

17 +3  
+3  

14 +2  
+8  

13 +2  
+2  

15 +2  
+2  

16 +3  
+3  

12 +3  
+3  

18 +3  
+3  

19 +2  
+5  

12 +4  
+2  

14 +3  
+3  

14 +2  
+3  

17 +3  
+3  

19 +3  
+3  

Participant Code ____________  Date ____________
Appendix C – Self-Rating Questionnaires

Participant Code: __________

Study Behavior Ratings & Reasons Form – Picto+VR

Which text did you read FIRST? Circle the text you read first.
Microbiome and Health or Man’s Search for Meaning

Rate each item in Questions 1 to 3 using the following 5-point scale

<table>
<thead>
<tr>
<th>Strongly Disagree</th>
<th>Disagree</th>
<th>Neutral</th>
<th>Agree</th>
<th>Strongly Agree</th>
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<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
</tbody>
</table>

1. For the text called Microbiome and Health:
   _____ The pictography notes were easy to generate
   _____ The pictography notes helped me remember ideas in general
   _____ The pictography notes helped me remember in some detail
   _____ With texts like this in college, this study behavior would be helpful for idea recall

2. For the text called Man’s Search for Meaning:
   _____ The pictography notes were easy to generate
   _____ The pictography notes helped me remember ideas in general
   _____ The pictography notes helped me remember in some detail
   _____ With texts like this in college, this study behavior would be helpful for idea recall

3. For both texts:
   _____ Making up a sentence after each pictography note helped idea recall
   _____ Repeating each sentence helped idea recall
   _____ Verbal rehearsal of the entire set of notes helped idea recall
4. Which article topic did you know more about prior to participation?

<table>
<thead>
<tr>
<th></th>
<th>Much more for Microbiome and Health</th>
<th>A little more for Microbiome and Health</th>
<th>No Difference</th>
<th>A little more for Man’s Search for Meaning</th>
<th>Much more for Man’s Search for Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td></td>
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</table>

5. Which article was more interesting to you?

<table>
<thead>
<tr>
<th></th>
<th>Much more for Microbiome and Health</th>
<th>A little more for Microbiome and Health</th>
<th>No Difference</th>
<th>A little more for Man’s Search for Meaning</th>
<th>Much more for Man’s Search for Meaning</th>
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<td>2</td>
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<td>4</td>
<td>5</td>
<td></td>
</tr>
</tbody>
</table>

6. Which article ideas were easier to remember?

<table>
<thead>
<tr>
<th></th>
<th>Much easier for Microbiome and Health</th>
<th>A little easier for Microbiome and Health</th>
<th>No Difference</th>
<th>A little easier for Man’s Search for Meaning</th>
<th>Much easier for Man’s Search for Meaning</th>
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</tbody>
</table>

7. For which article were pictography notes more helpful?

<table>
<thead>
<tr>
<th></th>
<th>Much better for Microbiome and Health</th>
<th>A little better for Microbiome and Health</th>
<th>No Difference</th>
<th>A little better for Man’s Search for Meaning</th>
<th>Much better for Man’s Search for Meaning</th>
</tr>
</thead>
<tbody>
<tr>
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<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td></td>
</tr>
</tbody>
</table>

8. For which article was verbal rehearsal more helpful?

<table>
<thead>
<tr>
<th></th>
<th>Much better for Microbiome and Health</th>
<th>A little better for Microbiome and Health</th>
<th>No Difference</th>
<th>A little better for Man’s Search for Meaning</th>
<th>Much better for Man’s Search for Meaning</th>
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<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td></td>
</tr>
</tbody>
</table>

9. Please add any comments you have about whether pictography and verbal rehearsal are potentially helpful study behaviors for college or younger students.
Participant Code:__________

**Study Behavior Ratings & Reasons Form – Picto Only**

Which text did you read FIRST? Circle the text you read first.
Microbiome and Health or Man’s Search for Meaning

Rate each item in Questions 1 to 3 using the following 5-point scale

<table>
<thead>
<tr>
<th>Strongly Disagree</th>
<th>Disagree</th>
<th>Neutral</th>
<th>Agree</th>
<th>Strongly Agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
</tbody>
</table>

4. For the text called **Microbiome and Health**:
   _____ The pictography notes were easy to generate
   _____ The pictography notes helped me remember ideas in general
   _____ The pictography notes helped me remember in some detail
   _____ With texts like this in college, this study behavior would be helpful for idea recall

5. For the text called **Man’s Search for Meaning**:
   _____ The pictography notes were easy to generate
   _____ The pictography notes helped me remember ideas in general
   _____ The pictography notes helped me remember in some detail
   _____ With texts like this in college, this study behavior would be helpful for idea recall

6. For both texts:
   _____ I said phrases or sentences to myself as I created each pictography note
   _____ I said phrases or sentences afterwards for the entire set of notes
4. Which article topic did you know more about prior to participation?

<table>
<thead>
<tr>
<th></th>
<th>Much more for Microbiome and Health</th>
<th>A little more for Microbiome and Health</th>
<th>No Difference</th>
<th>A little more for Man’s Search for Meaning</th>
<th>Much more for Man’s Search for Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

5. Which article was more interesting to you?

|                              | Much more for Microbiome and Health | A little more for Microbiome and Health | No Difference | A little more for Man’s Search for Meaning | Much more for Man’s Search for Meaning |
|------------------------------|-------------------------------------|----------------------------------------|---------------|------------------------------------------|                                       |
| 5                            |                                     |                                        |               |                                          |                                       |

6. Which article ideas were easier to remember?

|                              | Much easier for Microbiome and Health | A little easier for Microbiome and Health | No Difference | A little easier for Man’s Search for Meaning | Much easier for Man’s Search for Meaning |
|------------------------------|--------------------------------------|------------------------------------------|---------------|---------------------------------------------|                                       |
| 5                            |                                     |                                        |               |                                              |                                       |

7. For which article were pictography notes more helpful?

|                              | Much better for Microbiome and Health | A little better for Microbiome and Health | No Difference | A little better for Man’s Search for Meaning | Much better for Man’s Search for Meaning |
|------------------------------|---------------------------------------|------------------------------------------|---------------|---------------------------------------------|                                       |
| 5                            |                                      |                                        |               |                                              |                                       |

8. If you said phrases or sentences to yourself, for which article was it more helpful?

|                              | Much better for Microbiome and Health | A little better for Microbiome and Health | No Difference | A little better for Man’s Search for Meaning | Much better for Man’s Search for Meaning |
|------------------------------|---------------------------------------|------------------------------------------|---------------|---------------------------------------------|                                       |
| 5                            |                                      |                                        |               |                                              |                                       |

9. Please add any comments you have about whether pictography and verbal rehearsal are potentially helpful study behaviors for college or younger students.
Study Behavior Ratings & Reasons Form – Re-Read

Which text did you read FIRST? Circle the text you read first.

Microbiome and Health or Man’s Search for Meaning

1. Which article topic did you know more about prior to participation?

<table>
<thead>
<tr>
<th>Much more for Microbiome and Health</th>
<th>A little more for Microbiome and Health</th>
<th>No Difference</th>
<th>A little more for Man’s Search for Meaning</th>
<th>Much more for Man’s Search for Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
</tbody>
</table>

2. Which article was more interesting to you?

<table>
<thead>
<tr>
<th>Much more for Microbiome and Health</th>
<th>A little more for Microbiome and Health</th>
<th>No Difference</th>
<th>A little more for Man’s Search for Meaning</th>
<th>Much more for Man’s Search for Meaning</th>
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<td>1</td>
<td>2</td>
<td>3</td>
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</tr>
</tbody>
</table>

3. Which article ideas were easier to remember?

<table>
<thead>
<tr>
<th>Much easier for Microbiome and Health</th>
<th>A little easier for Microbiome and Health</th>
<th>No Difference</th>
<th>A little easier for Man’s Search for Meaning</th>
<th>Much easier for Man’s Search for Meaning</th>
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4. As you were reading the articles, what did you do to help you remember the information?

5. Please add any comments you have about whether re-reading is a potentially helpful study behavior for college or younger students.
Appendix D – Training Text

Chocolate

Today almost anyone can buy chocolate. But it wasn’t always that way. Until the 1500s, chocolate was a secret known only to the people of Central and South America.

In 1519 the Spanish explorer Hernan Cortes reported that the Aztecs in Mexico drank amazing amounts of something they call choclatl (show-co-LAH-tul). This watery, bitter drink was made from a tree they called kakahuatl (ka-ka-joo-AH-tul).

Montezuma, the Aztec king, drank 50 golden goblets of the drink every day. Montezuma’s palace staff drank 2000 pitchers of it! Cortes figured that if an Aztec king liked chocolatl, a Spanish king would too. So he took some beans back to Europe as one of the fabulous treasures of America.

The Spanish royalty called their new drink chocolate (cho-co-LAH-tay). They sweetened it with sugar or honey and flavored it with cinnamon. The supply of beans was limited and they didn’t want to share them with anyone. They kept their chocolate a secret so that, for many years, very few people in Europe knew about chocolate.

The great taste of chocolate reached North America in 1765. That’s when the first chocolate factory opened in New England. Even Thomas Jefferson got the chocolate habit. He and many others believed that chocolate was good for the health.

Chocolate is eaten by millions of people around the world, but very few of them know chocolate’s history. If they did, they’d all be glad that chocolate was a secret nobody could keep!
Appendix E – Pictography Grid

<table>
<thead>
<tr>
<th>Participant Code</th>
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<th>8</th>
<th>9</th>
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</tbody>
</table>
Appendix F – Abstract and Concrete Texts

Man’s Search for Meaning

Man’s search for meaning is a primary force in his life. Even the worst life conditions can be borne with the knowledge that there is meaning in one’s life. This meaning is specific to each person and must be fulfilled by each person in his own way.

Man’s search for meaning and values may arouse inner tension rather than inner equilibrium, but this is a necessary tension. A degree of tension between what one is and what one should be is indispensable to mental well-being. It is a dangerous misconception to assume that what a person needs is equilibrium. What man actually needs is the striving and struggling for some goal worthy of him. What he needs is not the discharge of tension at any cost, but the call of potential fulfillment.

So many people are haunted by the experience of inner emptiness, a void within themselves. This existential vacuum is a widespread phenomenon of modern times, arising from the two-fold loss: no animal instinct tells him what he has to do and no tradition tells him what he ought to do; leaving him only with what he wants to do. The void is especially strong in his leisure hours away from enforced activity. In this existential vacuum, mankind seems doomed to vacillate eternally between distress and boredom.

Each person’s meaning of life can be discovered in three ways: doing a deed, experiencing a value, and suffering. The first way, of achievement or accomplishment, is quite obvious. The second way is to experience something, such as a work of nature or culture, or experiencing someone else through love. By the act of love, man can see the essential traits and features in his beloved; and even more he sees that which is potential, that which is not yet actualized. The loving person seeks to enable the loved person to be aware of what he is and of what he can become, giving them both life meaning. The third way is by suffering. Whenever one is confronted with an inescapable dire situation, whenever one has to face a fate that cannot be changed, then one can find meaning in suffering. What matters above all is the attitude in which we take our suffering upon ourselves.

What a man becomes – within the limits of endowment and environment – he must make out of himself. Life is the search and struggle for that meaning.
Our Microbiome and Our Health

Our bodies have their own ecosystems -- made up of 100 trillion microorganisms, or microbes, in and on our bodies. These bacteria, fungi, viruses and other tiny organisms form a person's microbiome, and are essential to our health.

The large intestine (or colon) contains the highest concentration and greatest diversity of microbes in the entire body. The large intestine is lined with a layer of mucus and microbes. This gut microbiome affects everything from how our bodies use the food we eat to how we fight off infection and how we regulate emotions. Each person has a unique make-up of gut microbes as a result of many factors such as genes, age, hygiene, and even climate.

What we eat affects our gut health. So-called "Western diets" - high in fat and highly-processed carbohydrates or sugars - can cause the good and bad bacteria in the gut to become unbalanced. This imbalance can erode the mucus layer that protects the intestinal cells causing pain and inflammation. We can also get leaky gut syndrome, when the tight junctions in the large intestine open to allow bacteria and toxins to get into the rest of the body. Foods rich in fiber, prebiotics, and probiotics can help prevent this. Fibrous foods include vegetables and whole grains. Prebiotics, like bananas or onions, ferment in the gut and support microbe growth. Probiotics are beneficial bacteria in already fermented foods like yogurt and sauerkraut.

The gut microbiota works to keep our bodies healthy. The gut microbiota stores nutrients, regulate appetite, and control weight. It releases compounds which can lower inflammation and prevent an attack on the immune system. Large populations of beneficial microbes crowd out harmful bacteria that cause infections. Our microbiome also works to keep our skin healthy by fighting acne, dermatitis, and psoriasis.

Another effect of your gut microbiome can be in your brain. Dubbed the second brain, the enteric nervous system is one of the main divisions of the autonomic nervous system. It consists of a mesh-like system of neurons embedded in the gastrointestinal lining from esophagus to anus. This "gut-brain axis" not only governs gastrointestinal function, but can affect our perception of pain, quality of sleep, depression, or anxiety.

This vast internal ecosystem of microbes help us control our weight, fight infection, regulate our emotions, help our skin, and so much more. A busy gut microbiome is essential to human health and well-being.
Appendix G – Free Recall Instructions

Participant Code ___________                   Date ______________

Free Recall Article A
Write down everything you can remember from the text using your own words or words from the text. Write it in sentence form, rather than as a list of words or phrases. If you can recall only an isolated word or phrase, write the statement “I can only remember X”. When you are finished, turn your pages face down and notify a monitor.

Participant Code ___________                   Date ______________

Free Recall Article B
Write down everything you can remember from the text using your own words or words from the text. Write it in sentence form, rather than as a list of words or phrases. If you can recall only an isolated word or phrase, write the statement “I can only remember X”. When you are finished, turn your pages face down and notify a monitor.
# Holistic Rating Rubric

<table>
<thead>
<tr>
<th>4 – Superior</th>
<th>3 – Proficient</th>
<th>2 – Basic</th>
<th>1 – Weak</th>
<th>0 – No Attempt</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>All or almost all</strong> major ideas present</td>
<td><strong>Most</strong> major ideas present</td>
<td><strong>A few</strong> major ideas</td>
<td><strong>One to two</strong> major ideas</td>
<td><strong>Did not answer</strong></td>
</tr>
<tr>
<td><strong>Many</strong> minor ideas are present</td>
<td><strong>Multiple</strong> minor ideas</td>
<td><strong>Some</strong> minor ideas</td>
<td><strong>Few to no</strong> minor ideas</td>
<td><strong>Said “Did not remember anything”</strong></td>
</tr>
<tr>
<td><strong>All or almost all</strong> ideas are elaborated</td>
<td><strong>Many</strong> ideas are elaborated</td>
<td><strong>Some</strong> ideas are elaborated</td>
<td><strong>Little</strong> to no elaboration</td>
<td><strong>Stated just the topic of the article</strong></td>
</tr>
<tr>
<td>Ideas <strong>match</strong> the source article</td>
<td><strong>One idea does not fully match the source article</strong></td>
<td><strong>One to two ideas clearly do not match the source article</strong></td>
<td><strong>Several ideas clearly do not match the source articles</strong></td>
<td><strong>Information not pertaining to articles</strong></td>
</tr>
</tbody>
</table>

**Note:**
- Elaboration = full details from underlined idea or relevant details from article beyond the underlined idea
- Do not rate based on spelling or grammar
Appendix I – Holistic Rating Anchors

Man’s Search for Meaning Anchors

Man Anchor 0
I don’t remember this one… I think there was something about “ecosystems & endowment” at the endish?

Man Anchor 1
The first text was about finding yourself? There were three ways experience... such as love. I can only remember that one... whoops. There was also something about needing to face hardships... I also remember reading the word equilibrium A LOT.

Man Anchor 2
The first article was talking about having purpose in life. It mentioned that even the greatest burdens can be borne if you have a sense of purpose. The second paragraph discussed the issues of not having purpose/feeling like you have purpose. People that feel they don't have purpose can sense a void or emptiness within themselves that many struggle with during empty moments. The third paragraph mentioned three ways to find purpose and fulfillment. I can't remember them all exactly, but it was along the lines of achievement, doing, and suffering. Those things help people learn about themselves and what fulfills them as they gain experiences in life.

Man Anchor 3
Mans search for purpose is a struggle, but it is super necessary. The void is when: we have no animal instinct on what we should do, and we have no tradition telling us what to do. We find fulfillment when we accomplish a goal that is worthy of accomplishing. People can find their purpose in life by: experiencing a value, doing a deed, or suffering. Our attitude on suffering is very important for our learning. People loving each other fill each other’s lives with purpose. Everyone must find their purpose or meaning of life. It is a good thing to struggle to find our meanings.

Man Anchor 4
The focus in a human being's life is finding purpose. This search for meaning can sometimes cause unbalance and tension, but that is a necessary part of the process. Some people deal with a feeling of emptiness or a vacuum inside themselves. This may be caused by our modern times and a lack of animal instinct driving our survival and a lack of traditions to guide us. This feeling of emptiness is especially apparent during times of leisure, meaning that as human beings we oscillate between distress and emptiness. The three ways to find meaning are through achievement, experiences of love, and experiences of suffering. Ultimately we must all do our best to make something with our own abilities within, the confines of our environment.

Our Microbiome and Our Health Anchors

**Micro Anchor 0**
I don’t remember this one… I think there was something about “ecosystems & endowment” at the endish?

**Micro Anchor 1**
Our microbiome and our health. We all have our own ecosystem made up of bacteria. The collen is the largest that contains microbiome and muscles. This is our gut. The western diet makes our good or bad microbiome unbalanced. If we eat protein like grains and starches it helps our microbiome grow and won’t be as unbalanced. If our microbiome is strong so is our health.

**Micro Anchor 2**
Our microbiology is very important to our health. Our bodies have 100 trillion microbes. One of the places with the most microbes is the gut. The lining of the gut is made of mucus and microbes. These microbes are very varied. We can help our gut by eating right. The American diet includes too many sugars and highly processed foods. We need fibers (example whole-grains), prebiotics, and postbiotics (like yogurt). There's a web of microbes on the intestines from the sarcaufagus to the anus. The gut is sometimes called the 2nd brain, because of its many functions, including: effects on emotional processing, food processing, and others.
Micro Anchor 3
No person has the same body ecosystems. There are 100 trillion microbiomes. Viruses, bacteria, & fungi make up human biome. The large intestine (colon) has high concentration in biome. Each person has unique biome depending on genes, age, hygiene, & climate. Western diets have highly saturated food w/ high carbohydrates making the body unbalanced. Foods rich in fibers & probiotics can prevent having leaky gut syndrome. Out gut biomes keep our body healthy. Our busy gut biomes help our human health & well being.

Micro Anchor 4
There are 100 trillion microorganisms in your body. The microbiome consists of bacteria, viruses, fungi, and other microorganisms to keep you alive. The human colon is highly concentrated in these microorganisms. They help with breaking food down and keeping us healthy. Foods can have a major affect on these microorganisms and then eventually affect us. For example, the western diet, which has lots of sugar and carbohydrates, can cause the microbiomes to be unbalance. Thus making us sick. Eating fiber, probiotics, and prebiotics can help us keep our microbiome balanced and healthy. This equilibrium helps us maintain sleep, mental health, our acne, and so many other health conditions. Remember to keep our microbiome balance and busy to keep yourself and your health in a good state.
Appendix J – Holistic Rating Practice Items

**Man Practice 1 – 3 Rating**

Man spends his life trying to find out why he exists. What is his purpose? He is often going to feel this tension throughout life and probably won’t (and maybe shouldn’t) find equilibrium. He will go through life trying to fill the void that is haunting him. It will be a struggle since there are no animal instincts or traditions that will tell him what to do. Ultimately, he will have to find within himself what his purpose is. There are 3 major parts of this - #1 achievements, #2 experiences & #3 suffering. Accepting that one cannot change a known outcome is part of suffering. A man controls what he becomes.

**Man practice 2 – 4 Rating**

A man’s search for meaning is a primary force in life. This search for meaning can cause inner conflict, but this conflict is actually necessary in order to reach a true fulfillment. Many people are haunted by feeling of emptiness. This emptiness causes an existential vacuum and is a modern phenomenon as a two-fold conflict arises. This eventually leaves a man to vacillate between distress and boredom especially during leisure activities. There are 3 ways that man can find true meaning. First, by achieving something important. Second is by experiencing something. This is done through love or experiencing a culture. And lastly, by suffering that you can’t escape from. Through these three things man’s search for meaning is mostly found through attitude and the ability to handle life experiences. If a man wants to become something they must choose to do so.

**Man practice 3 – 0 Rating**

This article was about something like finding meaning. Personally, I think it is best to find meaning through rigorous debate and conversations that lead to a deeper understanding of the world.

**Man practice 4 – 2 Rating**

This was the article about man. I can recall it being about finding meaning. Sometimes searching for meaning can cause distress vs. an equilibrium, but it is necessary. I remember there being a part about “two fold”. There were 3 steps and they were: achievement, experiencing it, and suffering. I remember experiencing the most because it talked about how we really experience things through other people, especially like love. I also remember there being a part that mentioned the word “beloved”.

**Man practice 5 – 1 Rating**
Man’s search for life is found as inner tension from life’s experiences spread over time. Inner tension can off balance one’s life, but it an essential part of life because equilibrium is not always a good thing. Man finds meaning by becoming religious and devoting themselves to a cause that is worth-while. Facing the unknown is what leads to a broader understanding of what makes us stronger.

**Man practice 6 – 3 Rating**

One of the primary purposes of man’s existence is to discover his purpose and meaning. This discovery process can cause inner tension and throw off our equilibrium, but that is actually a good thing! Man actually needs this tension because it helps them to strive for more worthy goals and to not be complacent. During man’s search a void can arise. This vacuum comes because of two fold loses. Man is is stuck going back and forth between no animal instinct and no tradition. This vacuum leads man to vasillate between knowledge and confusion. A person’s life can find true meaning in three different ways. First by doing something magnificent (which is self-explanatory), second by loving others and their culture, and third by suffering. Whenever one is suffering their attitude matters most. What a man becomes no matter the situation is what he makes out of himself.

**Man practice 7 – 2 Rating**

Man’s search for meaning is a primary force in his life. Even if a person is in an absolutely terrible situation there can still be meaning found. World War 2 concentration camps are a perfect example of this process of finding meaning despite terrible situations. I have heard stories that the people in the concentration camps still found hope and joy because they knew that the Nazi’s could take everything from them except for the attitude that they faced the world with. No matter how bad it gets, we can still choose to find meaning and be happy. Many people are actually haunted today because they feel an inner emptiness or a void from not finding this meaning. That is why they vassilate between distress and boredom. Suffering is a very important way to find meaning in life. Our attitude during suffering dictates who we become. So no matter the environment we find ourself in or the circumstances we have, we must find meaning ourself if we are to become something great. It can not be stated enough how important it is to actually choose to find meaning and not simply let life happen to you.

**Man practice 8 – 1 Rating**

Man’s search for meaning is a primary force in life. Each person’s life can be discovered by achievement, experiencing something, or suffering.
Micro practice 1 – 3 Rating
Each person has its own ecosystem made up of 100 trillion microorganisms within them. These can help protect our bodies from disease. These things such as our genes, age, and hygiene can effect good and bad bacteria. Western diets lead to an imbalance or leaky gut. If we have a leaky gut, fiber can help prevent or heal that. A perfect example of a high fiber food is whole grains. A busy gut is a good healthy gut and is essential to our well-being. Our colon has the highest diversity of microorganisms. Our skin is also effected by our gut microbiome. Also, our emotions can be effected.

Micro practice 2 – 4 Rating
Our bodies contain 100 trillion microorganisms that make up our person ecosystems called microbiomes. These bacteria, fungi, and viruses are essential to our health and helping us prosper. Our large intestine contains the largest number and diversity of each microbe. Each individual has a unique microbiome due to factors such as genes, hygiene, age, and climate. Foods that are high in fats and surges are bad for our gut microbiomes and can cause imbalances. These types of foods are typically classified under the western-diet. Foods that contain fiber, probiotics, and prebiotics help create a balance in our microbiome. For example, bananas and onions ferment in our stomach and help create healthy microbes. The health of our gut also affects our brains. The enteric nervous system is an axis that connect the gut and brain. Having a healthy and busy working gut microbiome is essential to being happy and healthy.

Micro practice 3 – 0 Rating
I can’t remember anything except that it was about our microbiome.

Micro practice 4 – 2 Rating
I remember this article being about microorganisms. In the article it talked about how it was good to eat prebiotics, probiotics, and foods high in fiber. These different foods help balance and regulate good and bad microbes. I remember it saying that bananas and onions were especially good. These good foods are what we call the “western diet”. The large intestine has the highest concentration of organisms. The central nervous system, like the brain, is in charge of regulating our health and appetite. A balance of bacteria leads to a good health and a happy life.

Micro practice 5 – 1 Rating
Microbiome is affected by high carbohydrate foods. Prebiotics and probiotics help. There are 100 million microbes in the boy. The largest concentration of microbes are in the small colon.

**Micro practice 6 – 3 Rating**

The Human body contains 100 trillion microbes inside of our body and it makes what is called our microbiome. These microbes include bacteria, fungi, and viruses and are in our gut. This combination is essential to our health. The brain contains the largest diversity and highest concentration of microbes. The western diet is high in fats and sugars and causes an imbalance in our microbes in the gut. The enteric nervous system is a way that our gut effects our brain. This system helps with our sleep, anxiety, and other emotions. Our gut worked hard to keep us healthy. DNA, age, hygiene, and environment lead to a wide diversity of microbes. Our gut microbiome also affects how we regulate weight and even the appearance of our skin!

**Micro practice 7 – 2 Rating**

Our bodies have 100 trillion microorganisms. The large colon has the highest concentration and greatest diversity of microbes. The large colon is lined with layers of mucus and microbes. Western diets ruin our microbiome. Foods rich in fiber, prebiotics, and probiotics help our microbiome. These foods include vegetables and grains. A busy gut can either be good or bad for our health.

**Micro practice 8 – 1 Rating**

Our bodies are made up of 100 trillion microorganisms. These organisms include bacteria and other tiny things. Each person has almost the exact same make-up of microbes from our genes, age, and even hygiene. Eastern diets are bad. Foods rich in fiber, prebiotics, and probiotics are cannot always prevent an imbalance. The gut microbiota can make us sick. The peripheral nervous system affects our gut microbiome. A busy gut is not essential to human health.
Appendix K – Multiple Choice Tests

Comprehension Questions

Answer the following questions based on information from the article that you read. Circle the single best answer.

1. What is the central force in a man’s life?
   a. Developing virtue
   b. Finding love
   c. Being of service to others
   d. Searching for meaning

2. It is a dangerous misunderstanding to assume that mental well-being requires ______.
   a. Purpose
   b. Attachment
   c. Equilibrium
   d. Achievement

3. Which of the following is not a reason for why so many people feel inner emptiness?
   a. A lack of animal instincts that lead to certain actions
   b. The loss of traditions to guide people on what they ought to do
   c. Being left with only what one chooses to do
   d. Spending too much time at required activities

4. What inner state is necessary in man’s search for meaning and values?
   a. Tension
   b. Equilibrium
   c. Mindfulness
   d. Energy

5. At what time can the void within a person become most profoundly manifest?
   a. After the death of a loved one
   b. When we become complacent with life
   c. After obtaining a goal
   d. During leisure time

6. Modern man seems doomed to move back and forth eternally between _____.
   a. Happiness and sorrow
   b. Fulfillment and emptiness
   c. Distress and boredom
   d. Meaning and ambiguity

7. The ways to reveal each person’s meaning of life does not include ______.
   a. Accomplishing something valuable
   b. Experiencing something impressive
   c. Achieving something stable
   d. Suffering something awful

8. Which of the following is a way for a person to discover meaning?
   a. Immersion in nature
   b. Accepting a higher being
c. Recognition from peers
d. Having profound debates

9. Which of the following is not what the act of love does?
   a. Gives the loving person purpose in life
   b. Helps the loved person know what he could become
   c. Makes the two persons a single greater whole
   d. Allows the loving person to see potential in the beloved

10. The act of love allows for a man to discover meaning according to which principle?
    a. Doing a good deed
    b. Establishing connections
    c. Experiencing a value
    d. Suffering

11. What matters above all when we suffer in an inescapable situation?
    a. Personality
    b. Attitude
    c. Endurance
    d. Belief

12. Which of the following limit what a man can make out of himself?
    a. Endowment and environment
    b. Attitude and perspective
    c. Knowledge and wisdom
    d. Patience and perseverance
Comprehension Questions

Answer the following questions based on information from the article that you read. Circle the single best answer.

1. The human body is made up of ______ microbes.
   a. 150 trillion 
   b. 100 trillion 
   c. 150 billion 
   d. 100 billion 

2. A person’s microbiome includes:
   a. Bacteria, fungi, viruses 
   b. Colon, intestine, stomach 
   c. Mucus, microbes, pathogens 
   d. Cells, platelets, antibodies 

3. Which part of the body contains the greatest diversity of the microbes?
   a. Small intestine 
   b. Large intestine 
   c. Liver 
   d. Kidney 

4. Which of the following was not stated as affecting the types of microbes in a person?
   a. Age 
   b. Ethnicity 
   c. Hygiene 
   d. Climate 

5. ________ is when the junctions in the large intestine open to allow bacteria and toxins to get into the rest of the body.
   a. Irritable bowel syndrome 
   b. Seeping enterocolitis 
   c. Paracellular permeability syndrome 
   d. Leaky gut syndrome 

6. What type of food can help alleviate an intestinal inflammatory response?
   a. Low-fiber foods 
   b. Fatty foods 
   c. Probiotics 
   d. Carbohydrates 

7. Which of the following foods would not alleviate an intestinal inflammatory response?
   a. Celery 
   b. Sauerkraut 
   c. Milk 
   d. Bananas 

8. What is a probiotic?
   a. Fibrous foods 
   b. Foods that ferment in the gut 
   c. Foods that are made fermented
d. Foods that inhibit microbe growth

9. The microbiome in our gut does not _______.
   a. Store nutrients
   b. Lower inflammation
   c. Fight acne
   d. Shrink tumors

10. The second brain in the gut is called the _______.
    a. Autonomic nervous system
    b. Central nervous system
    c. Peripheral nervous system
    d. Enteric nervous system

11. The second brain does not have the feature of _______.
    a. Located in junctions of the large intestine
    b. Mesh-like system of neurons
    c. Goes from esophagus to anus
    d. Embedded in the gastrointestinal lining

12. Our health habits should not promote _______.
    a. A calm gut microbiome
    b. A balanced gut microbiome
    c. A busy gut microbiome
    d. A vast gut microbiome