The Effect of Explanatory and Non-Explanatory Illustrations on Text Comprehension

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Abstract

This study investigated the extent to which illustrations affect reading comprehension, specifically in academic textbooks. Although prior research has examined the use of illustrations in text, the current project sought to expand upon this topic by comparing text passages with different types of illustrations, which were relevant to the text (i.e., explanatory and non-explanatory). Based on evidence that illustrations facilitate comprehension only when they elaborate on the text and might be distracting when they are not explanatory, it was predicted that the text/non-explanatory illustration condition would yield the lowest comprehension, the text/explanatory illustration condition would yield the highest, and the text-only condition would fall somewhere in the middle. The central hypothesis for this study was not supported. Results showed that the text-only condition showed the highest comprehension levels, suggesting that neither type of illustration benefited comprehension.

The Effect of Explanatory and Non-Explanatory Illustrations on Text Comprehension

Reading comprehension is an integral part of most people's lives, and is particularly important in the context of academics. In academia, there has been a trend toward an increasing number of pictures in textbooks since the 1960s (Smith & Elifson, 1986, as cited in Carney & Levin, 2002). Is the use of illustrations within textbooks helping students? The specific issue addressed in the current research is the effect of textbook illustrations on reading comprehension, with particular focus on the level of explanation the illustrations provide. To lay the groundwork for the study, the following literature review will discuss cognitive factors involved in text and pictorial processing, and describe empirical studies, which have investigated how illustrations can be both helpers and hindrances in the process of reading comprehension.

Theories on the Utilization of Pictures and Words

When exploring the phenomenon of reading comprehension it is important to consider theories for how the human cognitive system utilizes pictures and words during reading. Atkinson and Shiffrin proposed the modal model of memory in 1968. This model consists of three stages, starting with sensory memory, which holds information for a few seconds. Information that is attended to enters short-term memory (STM), which holds information for approximately 15-30 seconds. At this stage information can be rehearsed in order to keep it 'fresh' in the mind. An example of rehearsal might be repeating the information to oneself. From STM, information can be encoded into long-term memory (LTM), which theoretically holds information for a lifetime (Goldstein, 2005). Once information is encoded, it can then be retrieved, which is the process of transferring information stored in LTM back into STM.

The components of the Atkinson-Shiffrin (1968) model can be mapped onto the process of text reading because reading requires the encoding of new information from STM into LTM,

as well as the retrieval from LTM of information regarding the sounds the letters make, the meaning of the words, and how they relate to prior words in the reading. The Atkinson-Shiffrin model does fall short in that the role of STM is described as simply a holding place for information. However, Baddeley's (1974) model of working memory updated this concept with the idea that there is an active processing occurring during STM.

Baddeley's (1974; 1990) working memory (WM) model suggests that information held in a shorter-term store is not just held passively, but is also actively manipulated. WM consists of three separable cognitive components: the phonological loop, the visuo-spatial sketchpad, and the central executive. The phonological loop maintains speech-based information (Baddeley, 1990). This is critical for reading, as it keeps the previous verbal information in WM while you continue to read. The visuo-spatial sketchpad is a subsystem that temporarily maintains visual and spatial information. This is also needed for reading, given that reading is a visual task, and is also needed for perceiving, maintaining, and interpreting any illustrations that accompanies text. The central executive oversees and coordinates the resources of the phonological loop and the visuo-spatial sketchpad and, Baddeley argues, is important in one's ability to carry out more than one task at a time (Purdy et al., 2001). Text reading is clearly one such multi-component cognitive task.

To relate this theory to text processing, WM is important not only in the act of reading (i.e., at the encoding stage), but also for later retrieval of previously read information. The central executive may be thought of as being responsible for coordinating and combining textual and pictorial information in WM, which can then be transferred into LTM for later retrieval.

One model that specifically describes the combination of textual and pictorial information in the mind, and is generally in agreement with Baddeley's model, is the dual-coding

theory (Paivio, 1986; Schnotz & Bannert, 2003). This suggests that the combination of pictures and text leads to better comprehension and later recall from LTM. Verbal and pictorial information are processed in different cognitive subsystems; whereas verbal information is processed and coded in the verbal system (e.g., phonological loop), pictorial information is processed and encoded in both the verbal and imagery (e.g., visuospatial sketchpad) systems. This double processing and encoding of pictorial information is thought to provide memory-enhancing effects compared to the single coding of text-only information. The dual-coding theory does not address the issue of whether one type of picture is better than another, but simply maintains that when information is presented both verbally and visually, comprehension is better than when information is presented in the form of text alone.

A vital concept when considering the integration of textual and pictorial information is the *mental model*. Mental models are cognitive representations of multiple components, which relate to one another, and are stored in LTM. Schnotz and Bannert (2003) report that mental models are more abstract than perceptual images; that is, they contain less information than visual illustrations, as not all details are represented. However, in some ways they are more detailed than an illustration accompanying a text because mental models include prior knowledge from LTM (Schnotz and Bannert, 2003). As an example, a mental model of a bicycle allows causal relationships to be interpreted as the image in the mind is manipulated using prior knowledge. In comparison, a true picture of a bicycle will provide details, but it may be unclear how to interpret the details without the application of prior knowledge. Creating a mental model from textual information requires more cognitive resources than creating a model from pictures because one has to transform the letters, words, and sentences into a pictorial representation, and then into a mental model (Kools, van de Wiel, Ruiter, & Kok, 2005). Thus, there is logic behind

the idea that adding illustrations to help explain text might also aide memory, based on the facilitation of mental model formation.

The construction of mental models is very important to comprehension of text when one must apply the text to solve new problems, but may be less important when one must answer questions that only require direct recall of the information read. In order to assess basic retention of a text, one could ask, "Write down everything you remember from the passage you have just read as if you are writing an encyclopedia for beginners" (Schnotz, 1994, p. 129), whereas to assess the level of transfer one would ask a question such as, "What could be done to make a car's brakes more reliable, that is, to make sure it would not fail?" The answer to this question is not directly stated in the reading but could be inferred if the reader comprehended what he/she read (Schnotz, 1994, p. 129). Mayer (1994) found an improvement in learner performance for problem-solving transfer questions when learners read a text with explanative illustrations compared to the learners who were given text-only. Inserting an illustration with text improved scoring for level of transfer solving questions an average of 91% (Schnotz, 1994). This performance improvement provides support for the role of construction of mental models in text comprehension, as well as for one hypothesis of this study, which predicts that there will be better performance for explanatory illustrations compared to the non-explanatory illustrations.

Theories about the use of visualizations in constructing mental models include the *structure mapping hypothesis*, which assumes that structural features of illustrations are mapped onto mental models. Specifically, task-appropriate visualizations support mental model construction and, conversely, task-inappropriate visualizations may interfere with mental model construction because these visualizations contradict the mental model that must be constructed (Schnotz & Bannert, 2003). In line with the structure-mapping hypothesis, Mayer (1997) found

that when text and illustrations are explanatory as well as related to one another, readers benefit with regard to comprehension compared to text alone. This evidence suggests it is possible that the use of a picture and text together allows for the construction of stronger mental representations than those constructed with text or pictures alone. This, in turn, should help with later recall of the text. Mayer also highlights coherence effects, which refer to the finding that when non-explanatory material is excluded, students learn more deeply from multimedia explanations (Mayer, 2003).

To summarize the research and theories reviewed so far, the dual-coding hypothesis does not discriminate regarding the effectiveness of different types of picture, but suggests an overall improvement in memory when pictures are added to text, whereas the structure-mapping hypothesis predicts that there would be different patterns of memory and comprehension depending on the type of visualization used with the related text, particularly with regard to level of relatedness or explanation of an illustration (Schnotz & Bannert, 2003).

In conclusion, there is support for the use of illustrations in situations in which the reader can make a clear connection between the text and the illustration, and therefore, can create a useful mental model. This information is the basis of the current study. Additionally, this study expands upon the ideas presented by the dual-coding and structure-mapping hypotheses by positing that the illustrations accompanying text may not only serve as helpers when they are explanatory but that when illustrations do not expand upon the information provided by the text, as presented in the form of a cartoon, the illustrations may hinder comprehension.

Application of Reviewed Theories

Prior research has addressed whether textbook illustrations help readers to comprehend what they are reading, or if looking at the pictures serves as a distraction that ultimately hinders

comprehension. It has been suggested that well-constructed illustrations can help improve the learning process (Carney & Levin, 2002); however, there is also some support for the idea that pictures may hinder comprehension. The evidence for both sides is reviewed below.

David (1998) found a recall advantage for the combination of text and pictures. In one condition, undergraduate participants read a story about a celebrity with text-only, and in the other condition participants read a text accompanied by a photograph of the celebrity. After reading the story, the participants completed a filler task and then recalled the celebrities that the stories were about. David found the addition of pictures to be beneficial in later recall.

Peeck (1974), in a study of fourth-graders from three schools (A, B, and C), had half the children from each school read a story with illustrations and the other half read the same text without illustrations. Testing was done immediately for school A, unexpectedly after one day for school B, and unexpectedly after one week for school C. Results show that illustrations affected retention in numerous ways: for questions that covered only pictorial information as well as questions that covered information in both the text and pictures, participants who read the text with illustrations scored significantly better than the control condition. Also, participants who read the text with illustrations answered questions that covered information that was presented differently in the text than it was in the illustration more frequently with answers corresponding to the details in the illustration. The results of this study suggest that readers may place special emphasis on illustrations, which may in turn lead to lower comprehension of text material, especially when the illustrations do not accurately elaborate on the text information.

A study examining the effects of illustrations showing how to use asthma devices provided an overwhelming amount of support for the positive effects of illustrations on comprehension. Kools et al.'s (2005) participants were given one of four forms of instructions

for two different asthma devices (i.e., text-picture of inhaler chamber, text in bullet points of inhaler chamber, text-picture peak flow meter, and text in bullet points of peak flow meter). Along with the instructions, the asthma device was placed in front of them to view but not touch. Participants read the instructions, and when they felt they understood the instructions, the device was removed from sight. After a short delay, participants then verbally recalled what they remembered from the instructions provided. Lastly, they were asked to perform the task with the device. The text-picture inhaler chamber condition outperformed the text-only condition when it came to the number of correctly recalled propositions. Additionally, significantly more instructional steps were recalled with the text-picture condition than the text-only condition for the inhaler chamber condition. This study shows that the presence of pictures in instructions for medical devices provided an added value to comprehension of the use of the device.

Similar results were found by Stone and Glock (1981) when looking at the effects of illustrations on the assembly of a model of a loading cart. This study consisted of three conditions, which varied in how the instructions were presented. The conditions were illustrations only, text-only, and text with illustrations. Participants read the instructions, according to their condition, while simultaneously putting together the model cart. Comprehension was defined as accuracy (i.e., number of errors) in following directions while performing the task. Results showed that the addition of illustrations yielded significantly fewer errors of orientation of parts in both the text with illustrations condition as well as the illustration only condition, compared to the text-only condition.

The results provided by Peeck (1974), Kools et al. (2005), and Stone & Glock (1981) all provide support for the hypothesis that illustrations that are relevant to the text improve readers' comprehension.

In contrast to research on illustrations as aides in reading comprehension, other studies have suggested that pictures may interfere with knowledge acquisition from text. A research review by Fillippatou and Pumfrey (1996) states that pictures may be meaningless if readers do not understand how the picture is to be incorporated into the text. This inability to understand the connection leads to misinterpretations and therefore interference in comprehension. They also point out that pictures may serve as distracters from text, especially for poor readers who tend to be distracted by the non-relevant details of the illustrations (Fillippatau & Peumfrey, 1996). These results show that the ability of the reader is another important factor in understanding the relationship between reading and comprehension. As such, in the current research, data were collected to address this factor in the form of ACT reading sub section scores, collected from each participant.

Only a few research studies have examined the central factor in the proposed research, namely the level of relevance, or explanatory nature, of illustrations that accompany text. One study examined children's speed and accuracy of reading in relation to the presence of pictures. Willows (1978) found that of the three conditions (text-only, text with related pictures, and text with unrelated pictures), children read slower when there were pictures present, and unrelated pictures produced the most interference, especially in poorer readers. This information suggests that unrelated pictures interfere with reading and may therefore result in lower comprehension compared to related pictures. This finding also corroborates the idea presented above that non-explanatory pictures may be especially distracting for people with low reading ability.

The phenomenon of unrelated picture interference was further examined by Schnotz and Bannert (2003) in their extension of the dual-coding hypothesis. They suggested that the type of graph used with text would affect comprehension. Three experimental conditions (i.e., text with

carpet diagrams, text with circle diagrams, and text-only conditions) were used to examine the effect of graph use on comprehension. Participants were presented with material representing the time zones on Earth. The test phase consisted of an equal number of time difference tasks and circumnavigation tasks presented in multiple-choice format. Results show that the text-only condition performed best on the time difference tasks, and the poorest performance was in the circle graph condition. With regard to the circumnavigation tasks, the circle graph condition performed the best followed by the text-only condition. These results suggest that mental model structure is affected by the structure of graphics, and that while task-appropriate graphics may benefit comprehension, graphics that are not task-appropriate may interfere with mental model structure and therefore decrease comprehension.

Turning to evidence from college students, Goldstein, Bailis, and Chance (1983) focused specifically on illustrations in college-level introductory psychology textbooks. This study did not seek to understand the influence of illustrations on comprehension, but instead examined memory for pictures in these textbooks. Students were required to read the textbook for their class. Pictures were used from all 16 chapters as the target set; however, graphs, tables, and cartoon sketches were not presented in this study. Additionally, 55 illustrations from ten other introductory textbooks were used as foils in the testing session. When presented with the illustrations, participants were to respond with whether the picture was “old” (picture was in textbook used) or “new” (picture was not in textbook used). Results showed that the recognition performance of participants was higher for illustrations reviewed in the last three weeks of class, as 82% of the illustrations were correctly identified; on the other hand, only 59% of the illustrations from further back than three weeks prior to this test were correctly identified. In

conclusion, this study shows that pictures in textbooks are often remembered and retained for a period of time; however, their educational value is not clear from this study.

Although several research studies have investigated the impact of illustrations on reading comprehension, there is a gap in the literature when it comes to research examining the influence of illustrations such as generic photographs and comics, which are relevant to the text, but do not truly aide in further explaining the concepts in the text. The currently study attempted to fill the gap between the research on the influence of illustrations and the implications of the findings for classroom situations involving comics and photographs in textbooks.

Overview of Proposed Research

Debate remains whether illustrations accompanying text facilitate or obstruct comprehension. Research up to this point has mainly looked at whether text alone or text with a picture is better for comprehension, but little research has been conducted on whether the type of illustration used (i.e., clearly explanatory as presented in the form of a graph versus not clearly explanatory as presented in the form of a cartoon or photograph) affects comprehension (Kools et al. 2005; Schnotz & Bannert, 2003). This study built upon the existing theories and research conducted on the influence of illustrations in comprehension while focusing on the question, "Does the presence and type of illustration affect comprehension of the text?"

This study used a 3 (Reading condition) X 2 (Question type) within-subjects experimental design. Reading condition consisted of *text*, *text/explanatory illustration*, and *text/ non-explanatory illustration*. Participants read one of three passages which were text alone (*text*), text with an illustration that was explanatory and clearly connected to the text (*text/explanatory* condition), or text with an illustration that was relevant but did not necessarily provide a clear connection to the text, such as a photograph or cartoon (*text/non-explanatory* condition). The

question type factor consisted of definitional and conceptual multiple-choice questions about the readings. Conceptual questions required the participant had an understanding of what they read, and were able to apply the information in novel ways; the answers were not directly stated in the text. Definitional questions required the participant to recall information directly stated in the text. The dependent variable was the number of questions correctly answered.

The hypothesis with regard to the reading conditions was that the *text/explanatory illustration* condition would yield the highest comprehension results, while the *text/non-explanatory illustration* condition would yield the lowest comprehension, with the *text-only* condition showing results somewhere in between. Though there is no strong theoretical basis for the prediction of an interaction with question type, I predicted that if an interaction were found, it may be that for conceptual questions, the *text/explanator*y condition would yield the largest correct proportion of conceptual questions, the *text/non-explanatory* would yield the smallest correct proportion of conceptual questions, and the *text–only* condition would fall in the middle of these scores. However, definitional question performance may be similar across all three conditions, especially given that answering them is a pure recall test for the text information without any need for additional application or advanced conceptual knowledge.

Method

Participants

Participants were 36 Marietta College students (19 males, 17 females) enrolled in Psychology 101, an introductory psychology course, who received 1 ½ hours research credit in exchange for their participation. There were 24 freshmen, 9 sophomores, and 3 juniors. The age range was 18-22 (M = 18.97, SD = 0.99) and the average GPA was 2.88 (SD = 0.37). There were 2 psychology majors and 34 non-psychology majors. All participants gave permission for

the researcher to obtain ACT scores; however, 3 participants did not have ACT scores and were omitted from the analyses. ACT scores for the 33 remaining participants had a mean of 22.33 (*SD* = 5.86). In addition, 33 participants allowed the researcher to obtain their Psychology 101 exam scores (*M* = 75.17, *SD* =11.73) (see Table 1).

Materials and Measures

The materials used in this study were three excerpts from *Psychology* by David G. Myers (2004). Standard 12-point Times New Roman font was used to reproduce all excerpts in order to create a standard two-page text (see Appendix A). Pictures were taken from *Psychology* by David G. Myers (2004), *Psychology* by Stephen F. Davis and Joseph J. Palladino (2007), and *Psychology* by Carole Wade and Carol Tavris (2008) (see Appendix B). The passages varied in presentation format, such that one was text-only, one was text with a relevant and explanatory illustration, and one was text with a relevant but non-explanatory illustration.

In addition to the study materials, a set of 140 simple math problems was used as a filler task. The math problems were triple and quadruple digit addition and subtraction problems and double-digit multiplication problems.

Multiple-choice questions about the reading (see Appendix C) were used to measure comprehension. The 20 questions consisted of 10 questions measuring conceptual information and 10 measuring definitional information. Within the questions there were target questions that directly assessed the text content related to the illustration. There were two conceptual target questions and two definitional target questions for each passage. The number of questions answered correctly was used to assess the level of comprehension.

A short questionnaire about participants' perception of how helpful illustrations are for them when reading texts, as well as how often they use them to aide in understanding material

was completed at the conclusion of the last reading task (see Appendix D). Demographic information was also collected for possible exploratory analyses. Pencils were provided to participants for the math problems, comprehension questions, and questionnaire. The study ended with a short debriefing.

Procedure

Individual sessions, lasting approximately 90 minutes, included the following components: informed consent, text passages, math problems, comprehension questions, questionnaires, and debriefing. Each participant read and signed a consent form (see Appendix E). Each participant read a total of three passages from *Psychology* (Myers, 2004), one of which was text-only, one of which was text with an explanatory illustration, and one of which was text with a non-explanatory illustration. Each passage was followed by a filler task and comprehension questions. Participants were given 8 minutes to read each passage at their own pace. Passages were read one at a time. After each passage, a 5-minute filler task of 140 simple math questions was administered; participants completed as many problems as possible in the 5-minute time frame. The questions were different between readings but the same for all participants. After the filler task, 20 multiple-choice comprehension questions were administered with a 10-minute time allowance for completion. These questions were presented in the form of multiple-choice, to mirror that of a typical quiz or exam.

Both the ordering of the passages and the ordering of text/picture conditions were counterbalanced so that each passage was paired with each text/illustration condition, and all participants read one text/illustration condition for each passage.

Once all three passages, filler tasks, and multiple-choice questions were completed, participants filled out the post-experiment questionnaire. The session ended with a short debriefing.

Results

An alpha level of .05 was used for all statistical tests. Partial η^2 is reported as an effect size measure for analyses of variance (ANOVAs) and analyses of covariance (ANCOVAs), where partial $\eta^2 = .01$ represents a small effect size, partial $\eta^2 = .06$ represents a medium effect size, and partial $\eta^2 = .14$ represents a large effect size (Cohen, 1988).

Preliminary analyses focused on self-ratings of prior knowledge of the reading passages. Self-ratings of prior knowledge across the three text/illustration conditions showed no significant differences, $F(2, 70) = 1.50$, $p = .229$, partial $\eta^2 = .041$. To further ensure that levels of prior knowledge of the content of the passages were not influencing the results, participants who rated themselves as having known all the information in the passages were excluded from all analyses; however, because the patterns of results were similar to those that included all participants (see below), they are not reported here. Results below include all participants.

The central analysis for this study was a 3 (reading condition: text-only, text/explanatory illustration, text/non-explanatory illustration) X 2 (question type: definitional, conceptual) analysis of covariance (ANCOVA), with psychology exam performance as the covariate. The dependent variable was performance on the comprehension test, specifically the number of questions correct out of 10 for each condition. The decision to use exam performance as a covariate was based on high correlations between this variable and performance on the reading comprehension tests. However, to confirm this decision, an ANOVA was also run using the

same factors, and showed the same pattern of results as the ANCOVA. Therefore, the ANCOVA results are reported here as the primary analysis.

Results showed there was a main effect of reading condition, $F(2, 62) = 6.77$, $p = .002$, partial $\eta^2 = .180$. However, there was no main effect for question type, $F(2, 62) = 0.765$, $p = .389$, partial $\eta^2 = .024$, and no interaction, $F(2, 62) = 0.505$, $p = .606$, partial $\eta^2 = .016$. Follow-up tests for the main effect of reading condition showed better performance for the text-only condition ($M = 7.303$, $SD = 0.233$) than the text/explanatory condition ($M = 6.591$, $SD = 0.218$), $p = .013$. However, the text/non-explanatory condition ($M = 7.000$, $SD = 0.294$) did not differ significantly from either of the other two reading conditions ($ps > .05$) (see Table 2).

A corollary analysis focused on performance on a subset of test questions labeled *target questions*, which directly assessed the text content related to the illustration. There were 4 such questions for each condition, 2 definitional and 2 conceptual. The ANCOVA using target question performance as the dependent variable (i.e., number correct out of 2) showed a similar pattern as the previous analysis, such that there was a main effect of reading condition, $F(2, 62) = 2.764$, $p = .071$, partial $\eta^2 = .082$, but no main effect for question type, $F(1, 31) = 1.270$, $p = .268$, partial $\eta^2 = .039$, and no interaction, $F(2, 62) = 0.478$, $p = .622$, partial $\eta^2 = .015$. The main effect of reading condition was driven by the text-only condition yielding significantly higher performance for target questions ($M = 1.47$, $SD = 0.074$) compared to the text/non-explanatory condition ($M = 1.23$, $SD = 0.097$), $p = .045$. The text-only condition was also numerically higher than the text/explanatory ($M = 1.27$, $SD = 0.076$) condition, but this difference was not significant, $p > .05$. The text/explanatory and text/non-explanatory conditions did not differ, $p > .05$.

A further analysis focused on ACT reading test performance as it related to performance on comprehension questions for this study. A median split was used to divide the scores into "lower" and "upper" groupings. Based on a median score of 24, the lower scores spanned from 11 to 23, and the upper scores spanned from 24 to 35. In a 3 (reading condition) X 2 (question type) X 2 (ACT group) ANOVA, using comprehension test performance as the dependent variable, there was only a main effect of ACT score, $F(1, 31) = 4.38$, $p = .045$, indicating higher performance for participants with higher ACT scores, but no interactions between ACT group and the other factors, all ps $> .05$.

In addition to assessing test performance to measure comprehension, participants also self-reported their levels of comprehension for each passage they read. Self-rated levels of passage comprehension were compared in the three text/illustration conditions, and showed a significant result, $F(2, 70) = 3.85$ $p = .026$, partial $\eta^2 = .099$. Follow-up tests indicated that the self-rated levels of passage comprehension, on a 5-point Likert scale, were lowest for the text/explanatory reading condition ($M = 3.16$, $SD = .971$), compared to both the text-only condition ($M = 3.50$, $SD = .845$), $p = .026$, and also the text/non-explanatory condition ($M = 3.58$, $SD = .649$), $p = 034$. The latter two conditions did not differ ($p > .05$).

Discussion

The current study was carried out to investigate the impact of the presence and type of illustrations on comprehension of textbook passages. The central hypothesis was that texts with non-explanatory illustrations would yield the lowest comprehension scores, text with explanatory illustrations would yield the highest comprehension scores, and the text-only condition would fall somewhere in the middle.

Although a statistically significant main effect was found for reading condition, it did not match the pattern of the central hypothesis. Instead, results show that the text-only condition had significantly higher comprehension scores than the text/explanatory condition. Only one piece of the hypothesis was partially supported, in that the text-only condition was numerically higher than the text/non-explanatory condition; however, this difference was not significant. Interestingly, there were no main effects or interactions involving question type, suggesting that the pattern found here with regard to reading conditions was similar for both definitional and conceptual questions. The major conclusion from this study, therefore, is that the condition that presented the text alone, with no illustrations, resulted in the overall best comprehension. Contrary to prediction, neither type of illustration appeared to benefit test performance, and there was evidence that in some cases the illustrations interfered with comprehension. This pattern was found in both the central analysis, and also in an analysis that examined target questions.

The current results are generally consistent with Fillippatou and Pumfrey (1996), who found that pictures may be meaningless, or may even hinder comprehension, if readers do not understand how the picture is to be incorporated into the text. These conclusions are contrary to the results Willows' (1978) found, where unrelated pictures were found to produce more interference compared to related pictures. Also relevant to the present findings are the conclusions from Schnotz and Bannert (2003), who found that a text-only condition performed best, compared to conditions with graph-based illustrations, on test questions directly relevant to the text information. It is possible, therefore, that at least some illustrations have a distracting effect on comprehension, perhaps because they provide extra details (Fillippatou & Pumfrey, 1996).

One factor previously found to correlate with reading comprehension is the level of reading ability. Poorer readers appear to be more distracted by illustrations, specifically by the non-relevant details of the illustrations (Fillippatau & Peumfrey, 1996; Willows, 1978). In the current study, using ACT reading scores as a correlate of reading performance, results showed that those with higher ACT scores performed better than those with low ACT scores overall on the comprehension questions. However, the fact that there were no interactions between ACT group and reading condition suggests that the illustrations did not affect poor readers any more than they affected better readers.

Additional analyses focused on participants' perceptions of passage comprehension in the three reading conditions. Ratings were lowest for the text/explanatory reading condition, suggesting the illustration may have played some part in hindering comprehension. However, this condition was significantly lower than both the text-only and the text-non-explanatory condition, a pattern not anticipated by the researcher. The results here imply that reader's self-perceived comprehension was negatively affected by the presence of illustrations, but only in the explanatory condition.

The patterns described above are particularly interesting in relation to student self-reports on the demographic survey about their general opinions of illustrations in textbooks. Contrary to the overall superiority of the text-only condition when measured by comprehension test and self-report, participants indicated that in general they "often" used illustrations when reading textbooks ($M = 3.25$, $SD = 0.906$), on a 5-point Likert scale. Interesting findings arose from the post-experiment questionnaire. Participants reported a mean rating of 3.25 on a 5-point Likert scale where 1 was "Never" and 5 was "Always" for their utilization of illustrations to understand text. Additionally, when asked to rate how distracting they found illustrations to be

when reading textbook chapters, using a 5-point Likert scale, where 1 was “Strongly Disagree” and 5 was “Strongly Agree”, participants did not rate illustrations as being very distracting (M = 2.13, SD = 0.682). Using the same scale participants rated illustrations as helpful in comprehending text when reading textbook chapters for class (M = 3.69, SD = 0.749). The self-report numbers indicate that participants use illustrations often and do not find them distracting but in fact deem them as helpful. The outcome of the self-report measures does not coincide with the results. It is important to note the difference between participant’s perception of the usefulness of illustrations and the reality of the illustrations distractibility. The discrepancy seen here may be helpful for publishers who may assume the same as the readers when it comes to how distracting they are.

Although this was a well-controlled experimental study, there were also limitations that might affect interpretation of the results. One aspect of the study, which could have been changed, is the amount of time between reading the passage and answering the comprehension questions. Because Goldstein et al. (1983) found that illustrations in textbooks are remembered for a short time after viewing, and that this memory diminishes over time, perhaps a longer time between reading the passage and answering the questions would have allowed for participants to forget about the illustrations, which in turn could affect performance on the comprehension questions. In addition, lengthening the delay between study and test would increase external validity, in that a substantial amount of time typically passes between students’ studying of the text and illustrations, and their being tested on the material.

An additional limitation of this study is the passage selection. Though results indicate that prior knowledge of passages was not a major factor, controlling for this factor from the start may lead to different results. Additionally, the passages were selected from a textbook with which the

participants were familiar with the type of writing as it was the same textbook used in their Psychology 101 course. If selections were made from a book with an unfamiliar author, overall participant comprehension may have been affected, and a clearer pattern of results might have emerged.

A final limitation to this study is the use of ACT score as a measure of reading comprehension. Although there was some range of variation in ACT scores in the current sample, it is possible that a wider, more diverse, sample might have provided a stronger basis for separating the participants into "low" and "high" reading groups. Also, instead of using a standardized test score such as ACT, another way to quantify reading comprehension could be through the use of a pre-test of passage reading and comprehension questions, similar in structure to the current study's methods, but on a different topic. Performance on this test could be used to sort the participants into "high" and "low' performance readers, and then analyze reading ability as a factor in relation to the text/illustration conditions.

Because the results of this study disagree with evidence that illustrations do help reading comprehension (e.g., Kool et al., 2005; Stone & Glock, 1981), future research in the area of the effects of illustrations might lend its way to studying how illustrations are utilized. From the data presented here, it appears that individuals may automatically assume that an illustration will be helpful to their comprehension prior to reflecting upon it. However, illustrations may only be helpful in certain situations. Future research should focus on the extent to which individuals are able to assess the level of usefulness of an illustration, thereby choosing whether or not to focus attention on it for the purposes of comprehension and memory. Finally, these results propose that reducing the number of illustrations in textbooks could be beneficial to students, contrary to what students think.

In sum, understanding how illustrations in textbooks affect readers' comprehension is an important issue in psychology and education. It is important to the students who are trying to perform well in school, the instructors who are trying to instruct their courses in the most effective way, and the publishers of the textbooks who strive to keep their consumers satisfied with their products. Expanding the knowledge in this realm will allow for improvements in the design of effective textbook products and help fill the gap in applied research on the effects of illustrations on textbook reading. The results of this study support the removal, or at least careful selection, of illustrations in academic textbooks.

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Appendix A

Passage 1

(Myers, 2004, p. 127-130)

Gender Roles

Gender Roles

In psychology, as in the theater, a role refers to a cluster of prescribed actions – the behaviors we expect of those who occupy a particular social position. One set of norms defines our culture's **gender roles** – our expectations about the way men and women behave. Traditionally, men have initiated dates, driven the car, and picked up the check; women have decorated the home, bought and cared for the children's clothes, and selected the wedding gifts. And consider work roles: In Australia, women devote 54 percent more time to unpaid household work and 71 percent more time to child care than do men (Trewin, 2001). In the United States, married mothers do 90 percent of the laundry and 13 percent of the car maintenance (Acock & Demo, 1994). And, I do not have to tell you which parent, about 90 percent of the time in two-parent families, stays home with a sick child, arranges for the baby-sitter, or calls the doctor (Maccoby, 1995).

Gender roles can smooth social relations, saving awkward decisions about who does what. But they often do so at a cost: If we deviate from such conversations, we may feel anxious.

Evolution seemingly predisposes men everywhere to be aggressive and tough in order to serve their reproductive goals, and predisposes women to the interpersonal skills that serve their reproductive goals (Archer, 1996). But we know that some gender roles are not rigidly fixed by evolution, because they vary across cultures. In nomadic societies of food-gathering people, there is minimal division of labor by sex. Boys and girls receive much the same upbringing. However, in agricultural societies, women remain close to home, working in the fields and staying with the children; men often roam more freely, herding cattle or sheep. Such societies typically socialize their children into distinct gender roles (Segall & others, 1990; Van Leeuwen, 1978). In agricultural communities of the Ivy Coast, for example, men do all the fencing and building repairs, but women do nearly all the indoor domestic tasks plus crop work – and thus work two to three more hours per day than do men (Levine & others, 2001).

Gender roles everywhere have tended to limit women's rights and power. "There are no human societies in which women dominate men." Notes Felicia Pratto (1996). In 2002, women were 14.3 percent of the world's national legislators, 5 percent of the presidents and prime ministers of the world's countries, and 0 percent of the Nobel awardees in economics since the prize began in 1901 (CIA, 2002, IPU, 2002).

Among the industrialized countries, gender roles and attitudes nevertheless vary widely. Would you say that "being a housewife is fulfilling"? The likelihood of saying no depends on where you live.

Gender roles vary over time as well as across cultures:

○ As we begin the last century only one country – New Zealand – granted women the right to vote. As we ended it, only one democracy – Kuwait – did not (Briscoe, 1997).

○ With the flick of an apron, the number of U.S. the number of college women hoping to be full-tie homemakers plunged during the late 1960s and early 1970s. In 1970, 1 in 10 entering U.S.

law students were women; in 2001, half were (Glater, 2001). Over the decades since 1930, women's assertiveness has increased and decreased with their social status – up until the end of World War II, then down until the mid 1960s, then up again (Twenge, 2001).
○ Gender ideas also vary across generations. When families emigrate from Asia to Canada and the United States, the immigrant children often grow up with peers who assume different gender roles than those of the immigrant parents. Daughters, especially, may feel torn between competing sets of norms (Dion & Dion, 2001).
Gender and child rearing

Society assigns each of us – even those few whose biological sex is ambiguous at birth – to a *gender*, the social category of male or female. The inevitable result is our strong **gender identity**, our sense of being male or female. To varying extents, we also become **gender-typed**. That is, some boys more than others exhibit traditional masculine traits and interests, and some girls more than others become distinctly feminine.

Social learning theory assumes that children learn gender-linked behaviors by observing and imitating and by being rewarded or punished. "Nicole, you're such a good mommy to your dolls"; "Big boys don't cry, Alex." But modeling and rewarding is not done by parents alone, because differences in the way parents rear boys, and girls aren't enough to explain gender-typing (Lytton & Romney, 1991). In fact, even when their families discourage traditional gender-typing, children organize themselves into "boy worlds" and "girl worlds", each guided by rules for what girls and boys do.

A later version of social learning theory, called social cognitive theory, also recognizes the importance of children's emerging conceptions (Bussey & Bandura, 1999). So, too does **gender schema theory**, which also combines social learning theory with cognition: Out of your struggles to comprehend the world came concepts, or schemas, including a schema for your own gender (Bem, 1987, 1993). Gender became a lens (a schema) through which you view your experiences. Before age 1, children begin to discriminate male and female voices and faces (Martin & others, 2002). After age 2, language forces children to begin organizing their worlds on the basis of gender. English, for example, uses the pronouns *he* and *she*; other languages classify objects as masculine ("le train") or feminine ("la table"). Through language, dress, toys, and songs, social learning shapes gender schemas. Children then compare themselves with their concept of gender ("I am male – thus, masculine, strong, aggressive," or "I am female – therefore, feminine, sweet, and helpful") and adjust their behavior accordingly.

Passage 2

(Myers, 2004, p. 108-110)

Twin Studies

Twin Studies

To ease apart environment and heredity, it would be nice if we could control the home environment while varying heredity. Happily for our purposes, nature has given us ready-made subjects for this experiment: identical versus fraternal twins. **Identical twins**, who develop from a single fertilized egg that splits in two, are *genetically* identical. They are nature's own human clones – indeed, clones who share not only the same genes but the same conception, uterus, birth date, and cultural history.

Fraternal twins, who develop from separate eggs, are genetically no more similar than ordinary brothers and sisters. A person whose identical twin has Alzheimer's disease has a 60 percent risk of sharing the disease; if the affected twin is fraternal, the risk is only 30 percent (Plomin & others, 1997). Such a difference suggests genetic influence.

Behavior geneticists ask: Are identical twins, being genetic clones of one another, behaviorally more similar than fraternal twins? Studies of nearly 13,000 pairs of Swedish twins, of 7,000 Finnish twin pairs, and of 3,810 Australian twin pairs provide a consistent answer: On both extraversion (outgoingness) and neuroticism (emotional instability), identical twins are much more similar than fraternal twins. In explaining individual differences, genes matter.

If genes influence traits such as emotional instability, might they also influence the social effects of such traits? To find out, Matt McGue and David Lykken (1992) studied divorce rates among 1,500 same sex, middle-age twin pairs. Their result: If you have a female twin who has divorced, the odds of your divorcing go up to 1.6 times (compared to the odds with a not-divorced twin). If you have an identical twin who has divorced, the odds of your divorcing go up to 5.5 times. From such data McGue and Kykken estimated that people's differing divorce risks are about 50 percent attributable to genetic factors. Another study of 2,315 twin pairs confirms that identical twins' recent troubles at home, work, and elsewhere are more alike than are those of fraternal twins (Kendler & others, 1993).

Other dimensions of personality and ability also reflect genetic influences. When John Loehlin and Robert Nichols (1976) gave a battery of questionnaires to 850 U.S. twin pairs, identical twins were much more similar than fraternals in many ways – in abilities, personality traits, and interests. However, the identical twins, more than fraternal twins, also reported being treated alike. So, did their experience rather than their genes account for their similarity? No, said Loehlin and Nichols; identical twins whose parents treated them alike were *not* psychologically more alike than identical twins who were treated less similarly. Research on 336 Canadian twin pairs also shows a substantial genetic influence on attitudes toward reading, organized religion, playing sports, and assisted suicide (Olson & others, 2001).

Separated twins

Identical twins Oskar Stohr and Jack Yufe presented striking similarities. One was raised by his grandmother in Germany as a Catholic and a Nazi, while the other was raised by his father in the Caribbean as a Jew. Nevertheless, they share traits and habits galore. They like spicy foods and sweet liqueurs, have a habit of falling asleep in front of the television, flush the toilet before using it, store rubber bands on their wrists, and dip buttered toast in coffee. Stohr is domineering toward women and yells at his wife, as did Yufe before he and his wife separated.

Aided by publicity in magazine and newspaper stories, Bouchard and his colleagues (1990; DiLalla & others, 1996; Segal, 1999) have located and studied more than 70 pairs of identical twins reared apart. They continue to find similarities not only of tastes and physical attributes but also of personality, abilities, attitudes, interests, and even fears.

In Sweden, which has a national registry of 70,000 twin pairs, Nancy Pederson and her co-workers (1988) identified 99 separate identical twin pairs and more than 200 separated fraternal twin pairs. Compared with equivalent samples of identical twins reared together, the separated identical twins had more dissimilar personalities. Still, separated twins were more alike when genetically identical than when fraternal. Separation shortly after birth (rather than say, at age 8) didn't amplify their personality differences. And what about twins of parents who misidentify their similar-appearing fraternal siblings as identical twins, or who misperceive their identical twins as fraternal twins? In both cases, their tested similarities have reflected what they

really were, not what their parents thought them to be (Kendler, 1983). Parental perceptions hardly mattered.

The startling twin similarity stories do not impress Bouchard's critics. They contend that if any two strangers were to spend hours comparing their behaviors and life histories, they would probably discover many coincidental similarities. If researchers created a control group of biologically unrelated pairs of the same age, sex, and ethnicity, who did not grow up together but who were as similar to one another in economic and cultural background as are separated twin pairs, wouldn't these pairs also exhibit striking similarities (Joseph, 2001)? (Bouchard replies that separated fraternal twins do exhibit similarities comparable to those of separated identical twins). Even the more impressive data from the personality assessments are clouded by the reunion of many of the separated twins some years before they were tested.

Moreover, separated twins shared an environment for at least nine months. They share an appearance, and the responses it evokes. And adoption agencies tend to place separated twins in similar homes. When environments are similar, the impact of environment looks smaller relative to heredity. Nevertheless, the twin studies illustrate why scientific thinking has shifted toward a greater appreciation of genetic influences. Genes-R-Us.

Passage 3

(Myers, 2004, p. 144-146)

Piaget's Theory and Current Thinking

Piaget's Theory and Current Thinking

Cognition refers to the mental activities associated with thinking, knowing, remembering, and communicating. Piaget described cognitive development in four stages believed that children experience spurts of change followed by greater stability as they move from one developmental plateau to the next. Each plateau has distinctive characteristics that permit specific kinds of thinking. To appreciate how a child's mind grows, let's look at Piaget's stages in the light of our current thinking about cognitive development.

SENSORIMOTOR STAGE During Piaget's **sensorimotor stage**, from birth to nearly 2, babies take in the world through their sensory and motor interactions with objects – through looking, hearing, touching, mouthing, and grasping.

Very young babies seem to live in the present: What is out of sight is out of mind. In one of his tests, Piaget would show an infant an appealing toy and then flop his beret over it to see whether the infant searched for the toy. Before the age of 6 months, the infant did not. Young infants lack **object permanence** – the awareness that objects continue to exist when not perceived. By 8 months, infants begin exhibiting memory for things no longer seen. If you hide a toy, the infant will momentarily look for it. Within another month or two, the infant will look for it even after being restrained for several seconds.

But do children's cognitive abilities really grow through distinct stages? Does object permanence in fact blossom by 8 months, much as tulips blossom in spring? Today's researchers see development as more continuous. For example, they now view object permanence as unfolding gradually. Even young infants will look for a toy where they saw it hidden a second before.

Researchers believe that Piaget and his followers underestimated young children's competence. Piaget assumed that before age 2, infants cannot think. They can recognize things, smile at them, crawl to them, manipulate them. But they have no abstract concepts or ideas. Theirs is a life lived, not thought about.

Consider, however, some simple experiments that demonstrate baby logic:

○ Like adults staring in disbelief at a magic trick, infants look longer at an unexpected scene of a car seeming to pass through a solid object, a ball stopping in midair, or an object violating object permanence by magically disappearing (Baillargeon, 1995, 1998; Wellman & Gelman, 1992). Babies seem to have a more intuitive grasp of simple laws of physics than Piaget realized.

○ Babies also have a head for numbers. Karen Wynn (1992, 2000) showed 5-month-old infants one or two objects. Then she hid the objects behind a screen, and then visibly removed or added one . When she lifted the screen, the infants sometimes did a double take, starting longer when shown a wrong number of objects. But were they just responding to a greater or smaller mass of objects, rather than a change in number (Feigenson & others, 2002)? Later experiments showed that babies' number sense extends to such things as drumbeats and motions (Spelke, 2000; Wynn & others, 2002). If accustomed to a Daffy Duck puppet jumping three times on stage, they show surprise if it jumps only twice. Clearly, infants are smarter than Piaget appreciated.

○ By one year or shortly after, babies can evaluate and imitate others' actions selectively. Hungarian researcher Gyorgy and his co-workers (2002) report that when 14-month-olds watch a woman turn on a light with her forehead, they will imitate – unless her head is sticking out from a clutched blanket when performing the act. In the latter case, they apparently infer that her hands simply weren't free, and so they use their hands when turning on the light.

PREOPERATIONAL STAGE Piaget believed that during the preschool period and up to about age 6 or 7, children are in a **preoperational stage** – too young to perform mental operations. For a 5-year-old, the milk that seems "too much" in a tall, narrow glass may become an acceptable amount if poured into a short, wide glass. This is because the child focuses only on the height dimension and is incapable of performing the *operation* of mentally pouring it back. A child lacks the concept of **conservation** – the principle that quantity remains the same despite changes in shape.

Piaget did not view the stage transitions as abrupt. Even so, symbolic thinking appears at an earlier age than he supposed. Judy DeLoache (1987) discovered this when she showed children a model of a room and hid a model toy in it (a miniature stuffed dog behind a miniature couch). The 2 ½-year-olds easily remembered where to find the miniature toy, but they could not use the model to locate an actual stuffed dog behind the couch in the real room. Three-year-olds-only 6 months older – usually went right to the actual stuffed animal in the real room, showing that they *could* think of a model as a symbol for the room. Piaget probably would have been surprised.

Egocentrism Piaget contended that preschool children are egocentric: They cannot perceive things from another's point of view. They may think the Sun and Moon follow them around. Asked to "show Mommy your picture a 2-year-old Gabriella holds the picture up facing her own eyes. Three-year-old Gray makes himself "invisible" by putting his hands over his eyes, assuming that if he can't see someone, they can't see him. Children's conversations also reveal egocentrism, as one young boy demonstrated (Phillips, 1969, p. 61):

"Do you have a brother?"

"Yes."

"What's his name?"

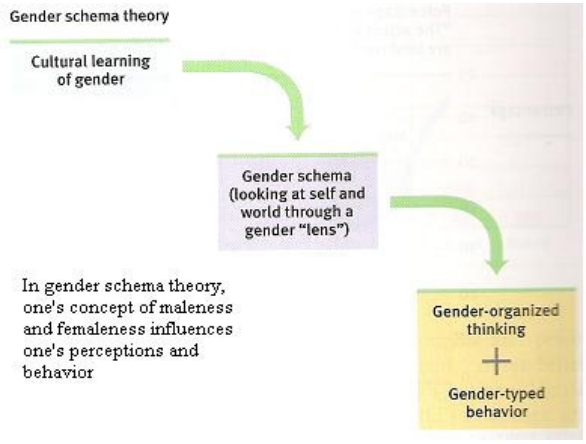
"Jim."
"Does Jim have a brother?"
"No."

Appendix B

Illustrations Used To Accompany Text for the Three Passages

Gender Roles

Explanatory illustration

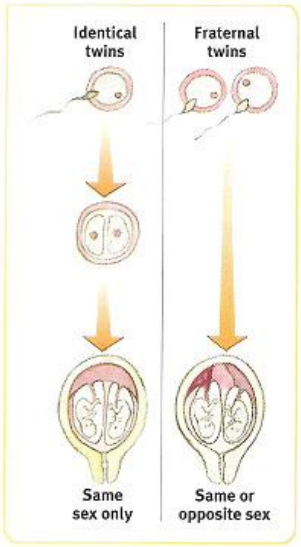


Non-explanatory illustration

Imitating the gender-related behaviors of parents is one way that children learn to act in gender-appropriate ways.

Twin Studies

Explanatory illustration

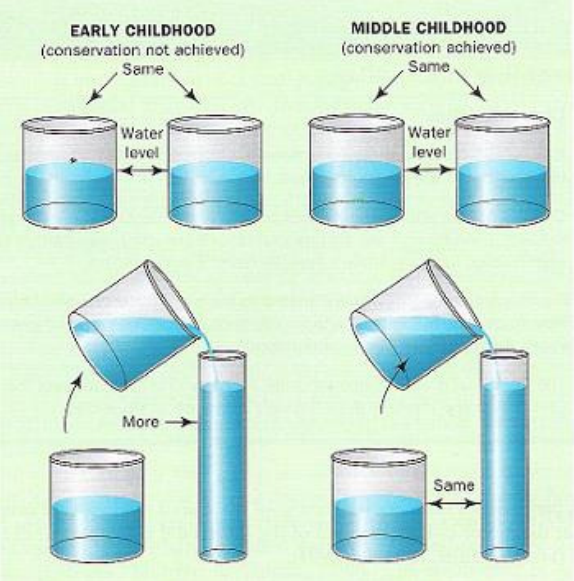


Identical twins develop from a single fertilized egg, fraternal twins from two.

Non-explanatory illustration

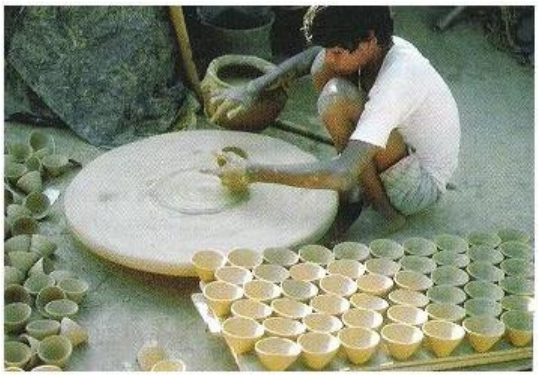
Because they developed from a single ovum that was fertilized by one sperm, these sisters are identical twins.

Explanatory illustration



An example of the acquisition of conservation. During early childhood, children are typically unable to tell that the tall glass and the short glass contain the same amount of water. By middle childhood, the child has acquired the principle of conservation and will be able to tell that the two glasses contain the same amount of water.

Non-explanatory illustration



Experience and culture influence cognitive development. Children who work with clay, wood, and other materials, such as this young potter in India, tend to understand the concept of conservation sooner than children who have not had this kind of experience.

Appendix C

Multiple Choice Comprehension Questions

(Definitional questions are in normal font. Conceptual questions are italicized. Target questions are marked with a *.)

Gender Roles

1. Ten-year-old Migdalia insists on wearing very feminine-looking clothes because she wants to appear ladylike. This best illustrates the impact of:

a. natural selection.
b. personal space.
c. sexual orientation.
d. gender-typing.

2. When his mother offered to play leapfrog with him, Jorge protested, "I'm not going to play a girl's game!" Jorge's reaction best illustrates psychological processes highlighted by:*

a. behavior genetics.
b. Freudian psychology.
c. gender schema theory.
d. natural selection.

3. When teased by his older sister, 9-year-old Waldo does not cry because he has learned that boys are not expected to. Waldo's behavior best illustrates the importance of:

a. temperament.
b. gender roles.
c. stereotypes.
d. gender identity.

4. The social roles assigned to women and men:

a. are virtually the same in all cultures.
b. have been virtually the same in all historical time periods.
c. differ widely across cultures.
d. differ widely across historical time periods but not across cultures.

5. On extended visits to foreign countries, you would be most likely to observe:

a. more men than women in leadership positions.
b. women earning approximately the same amount of money as a man.
c. men and women equally involved with child care.
d. men and women equally involved in violent crime.

6. Gender identity refers to:

a. one's biological sex.
b. the sense of being male or female.

c. the set of expected behaviors for males and for females.
d. how masculine a boy is or how feminine a girl is.

7. A boy who consistently exhibits traditionally masculine interests and behavior patterns demonstrates the impact of:
a. gene complexes.
b. heritability.
c. the X chromosome.
d. gender-typing.

8. A cluster of behaviors expected of those who occupy a particular social position is a:
a. norm.
b. role.
c. schema.
d. meme.

9. Social learning theorists emphasize that:
a. observation and imitation play a crucial role in the gender-typing process.
b. children will exhibit only those gender-typed behaviors for which they have been directly rewarded.
c. children will not learn gender-typed behaviors id the same-sex parent is absent from the home.
d. all of the above are true.

10. Mr. Eskenzi frowns when his son cries but hugs his daughter when she cries, Mr. Eskenzi's contribution to the gender-typing of his children would most likely be highlighted by:
a. twin studies.
b. social learning theorists.
c. adoption studies.
d. evolutionary psychologists.

11*. Children's tendency to classify behavior and personality traits in terms of masculine and feminine categories is of most direct relevance to:
a. Freudian psychology.
b. behavior genetics.
c. evolutionary psychology.
d. gender schema theory.

12. Gender role refers to:
a. one's biological sex.
b. the sense of being male or female.
c. the set of expected behaviors for males and females.
d. how masculine a boy is or how feminine a girl is.

13. Genetically female children exposed to excess testosterone during prenatal development subsequently exhibit more "tomboyish" behaviors than most girls. In order to avoid

overestimating the influence of prenatal hormones on these behaviors, it should be noted that these children:

a. have usually reactive temperaments.
b. may be treated more like boys because they frequently look masculine.
c. are affected by a variety of random errors in gene replication.
d. develop a more masculine brain-wiring pattern prior to birth.

14. A genetically female child who receives excess testosterone during prenatal growth is subsequently likely to develop:

a. an unusually strong heterosexual orientation.
b. a female gender role, but a male gender identity.
c. a male body with both X and Y chromosomes, unless there is corrective surgery.
d. more aggressive behavior patterns than most girls.

15. Maria has always taken responsibility for preparing family meals because she learned that this was expected of women. Her behavior best illustrates the importance of:

a. sexual orientation.
b. natural selection.
c. temperament.
d. gender roles.

16*. Gender schema theory combines ____ and ____

a. temperament, personal space.
b. cognition, temperament.
c. gender identity, cognition.
d. social learning theory, cognition.

17. The tendency to classify various occupations as masculine or feminine has often let men and women limit themselves to an unnecessarily restricted range of career options. This best illustrates dynamics emphasized by:*

a. evolutionary psychology.
b. behavior genetics.
c. gender schema theory.
d. Freudian psychology.

18. When Joe is picked on at school he acts as like a tough guy because he has believes that boys don't cry. Joe is behaving according to:

a. role.
b. gender schema theory.
c. gender role.
d. his instinct.

19. Joey has a very strong sense of who he is as a male. His ____ is high

a. temperament.
b. gender identity.
c. gender role.

d. gender schema

20. When Sam watches movies he often sees men and women filling certain roles. The viewing of these situations may lead to:
a. gender roles.
b. gender-typing.
c. gender identity.
d. sexism.

Piaget's Theory and Current Thinking

1. Cognition refers to:
a. an emotional tie linking one person with another.
b. the mental activities associated with thinking, knowing, and remembering.
c. any process that facilitates the physical development.
d. an awareness that we are constantly changing as we develop.

2. During which stage did Piaget suggest children are too young to perform mental operations?
a. concrete operational.
b. sensorimotor.
c. formal operational.
d. preoperational.

3. The awareness that things continue to exist when they are not perceived is known as:
a. attachment.
b. conservation.
c. assimilation.
d. object permanence.

4. According to Piaget, children in the preoperational stage are able to:
a. represent objects with words and images.
b. reason abstractly and test hypotheses.
c. understand the world only by observing the consequences of their own actions.
d. think logically about tangible things.

5. Lisa attempts to retrieve her bottle after her father hides it under a blanket. This suggests that Lisa has developed a sense of:
a. secure attachment.
b. object permanence.
c. conservation.
d. accommodation.

6. The discovery that 5-month-old infants stare longer at numerically impossible outcomes suggests Piaget:
a. underestimated the importance of imprinting of imprinting on infant attachment.
b. overestimated the impact of culture on infant intelligence.

c. underestimated the cognitive capacities of infants.
d. overestimated the continuity of cognitive development.

7*. The principle that properties such as mass, volume, and number remain the same despite changes in the forms of objects is called:
a. accommodation.
b. object equivalence.
c. conservation.
d. object permanence

8. When Tommy's mother hides his favorite toy under a blanket, he acts as though it no longer exists and makes no attempt to retrieve it. Tommy is clearly in Piaget's _____ stage.
a. sensorimotor.
b. formal operational.
c. concrete operational.
d. preoperational.

9. Current research on cognitive development indicates that:
a. Piaget overestimated the cognitive competence of young children.
b. mental skills develop earlier and more gradually than Piaget believed.
c. Piaget's theory may apply only to middle-class male children.
d. Piaget overlooked the importance of imprinting on cognitive development.

10. According to Piaget, an egocentric child can best be described as:
a. selfish.
b. conceited.
c. lacking self-esteem.
d. cognitively limited.

11. When Billy's mom takes his truck away he does not look for it. He has not yet developed:
a. theory of mind.
b. concept of conservation.
c. habituation.
d. object permanence.

12. Olivia understands her world primarily by grasping and sucking easily available objects. Olivia is clearly in Piaget's _____ stage.
a. preoperational.
b. concrete operational.
c. sensorimotor.
d. formal operational.

13. A child's realization that other may have beliefs which the child knows to be false best illustrates that the child is not completely:
a. assimilated.
b. egocentric.
c. imprinted.

d. habituated.

14. Five-year-old Tammy mistakenly believes that her short, wide glass contains less soda than her brother's tall, narrow glass. Actually, both glasses contain the same amount of soda. This illustrates that Tammy lacks the concept of:*

a. conservation.
b. egocentrism.
c. assimilation.
d. accommodation.

15. Mrs. Pearson cut Judy's hot dog into eight pieces and Sylvia's into six pieces. Sylvia cried because she felt she wasn't getting as much hot dog as Judy. Piaget would say that Sylvia doesn't understand the principle of:*

a. object permanence.
b. conservation.
c. assimilation.
d. accommodation.

16. I am 3 years old, can use language, and have trouble taking another person's perspective. I am in Piaget's _____ stage of cognitive development.

a. sensorimotor
b. preoperational.
c. concrete operational
d. formal operational

17*. If children cannot grasp the principle of conservation, they are unable to

a. deal with the discipline of toilet training
b. see things from the point of view of another person.
c. recognize the quantity of a substance remains the same despite changes in its shape.
d. retain earlier schemas when confronted by new experiences.

18. 4 year old Chloe says she has a sister but when asked if her sister has a sister she says no. Chloe answers this way due to:

a. object permanence
b. egocentrism
c. a schema
d. assimilation

19. Marissa is 6 months old and is interacting with objects through touching, mouthing, and grasping. She is at Piaget's ____ stage.

a. preoperational.
b. concrete operational.
c. formal operational.
d. sensorimotor.

20. When researcher Karen Wynn (1992, 1995) showed 5-month-old infants a numerically impossible outcome, the infants:
    a. stared longer at the outcome.
    b. displayed rapid habituation.
    c. demonstrated an obvious lack of object permanence.
    d. showed signs of formal operational reasoning.

Twin Studies

1. Twin studies suggest that emotional instability is influenced by:
    a. genetic predispositions.
    b. the Y chromosome.
    c. gender schemas.
    d. testosterone.

2*. Fraternal twins originate from the fertilization of _____ egg cell(s) by _____ sperm cell(s).
    a. a single; a single.
    b. two; a single.
    c. a single; two.
    d. two; two.

3. Compared to identical twins, fraternal twins are ____ likely to be the same sex and _____ likely to be similar in extraversion.
    a. less; more.
    b. more; less.
    c. more; more.
    d. less; less.

4. Taro and Kiichi are fraternal twins being raised by the same parents; Helene and Victiore are identical twins being raised by the same parents. Helene and Victoire are more likely than Tao and Kiichi to be similar in:
    a. personality.
    b. abilities.
    c. interests.
    d. all the above.

5. Studies of identical twins who had been reared apart most clearly highlight the importance of _____ in personality development.
    a. testosterone.
    b. gender schema.
    c. genetic predispositions.
    d. parental influence.

6. A researcher who assesses the hereditability of intelligence is most likely a(n):
    a. gender schema theorist.
    b. evolutionary psychologist.
    c. behavior geneticist.

d. Freudian psychologist.

7. Genetic influences on personality traits are most clearly highlighted by comparing _____ with _____.

a. identical twins raised together; identical twins raised apart.
b. fraternal twins raised together; fraternal twins raised apart.
c. identical twins raised together; fraternal twins raised together.
d. fraternal twins raised apart; identical twins raised apart.

8. Identical twins separated at birth and raised in completely different cultures would be most likely to have similar:

a. gender schemas.
b. religious beliefs.
c. temperaments.
d. memes.

9. The best reason to be cautious about attributing all the personality similarities of separated twins to genetic factors is:

a. home environments have less impact on personality than does peer influence.
b. adoption agencies tend to place separated twins in similar homes.
c. infant temperaments have a strong impact on personality development.
d. adopted children's personalities are highly similar to those of their adoptive parents.

10. Twin studies suggest that Alzheimer's disease is influenced by :

a. testosterone.
b. gender schemas.
c. heredity.
d. memes.

11*. Compared to identical twins, fraternal twins are _____ similar in neuroticism and _____ similar in attitudes toward organized religion.

a. more; less.
b. less; more.
c. more; more.
d. less; less.

12. Compared to fraternal twins, identical twins are much more similar in:

a. extraversion.
b. emotional stability.
c. risk of divorce.
d. all of the above.

13. Two individuals are most likely to share similar personality traits if they are _____ twins who were reared ____

a. fraternal; together.
b. identical; apart.

c. fraternal; apart.
d. identical; together.

14. My sibling and I developed from a single fertilized egg. Who are we?*
a. identical twins.
b. fraternal twins.
c. fraternal and identical twins.
d. we are not twins.

15. Several studies of long-separated identical twins have found that these twins:
a. have little in common, due to the different environments in which they were raised.
b. have many similarities, in everything from medical histories to personalities.
c. have similar personalities, but very different likes, dislikes, and lifestyles.
d. are no more similar than fraternal twins reared apart.

16. If you have a fraternal twin who has divorced, the odds of your divorcing go up to _____ times.
a. 2.2
b. 4.0
c. 1.6
d. 2.6

17. Joe's identical twin Brad has Alzheimer's. What's the risk of sharing
a. 50%
b. 70%
c. 90%
d. 60%

18. Mary and Kelly are identical twins. They are likely to be ____ similar in personality, abilities, and intelligence compared to Brianne and Ashley who are fraternal twins.
a. more
b. less
c. equally
d. none of the above

19. Frank and John have adoptive parents. Their adoptive parents are least likely to influence the ____ of their adopted children
a. personality traits
b. religious beliefs
c. political attitudes
d. moral values

20. My sibling and I developed from separate eggs in the same womb. Who are we?*
a. identical twins.
b. fraternal twins.
c. fraternal and identical twins.

d. we are not twins.

Appendix D

Post-Experiment Questionnaire

1. What is your gender? ____ Male ____ Female

2. What is your current college status?

Freshman Sophomore Junior Senior Other

3. How old are you? ____

4. What is your major? _____

5. What is your current estimated GPA? _____

6. Rate your level of comprehension for each reading:

A. Passage 1: [Topic of Passage 1]

Very Low Low Medium High Very High

B. Passage 2: [Topic of Passage 2]

Very Low Low Medium High Very High

C. Passage 3: [Topic of Passage 3]

Very Low Low Medium High Very High

7. How much knowledge did you have about the passages prior to reading them? (Please circle one answer for each passage)

A. Passage 1: [Topic of Passage 1]
1. Everything I read was new to me
2. Some information that I read was new and some I already knew
3. I already knew nearly everything in this passage

B. Passage 2: [Topic of Passage 2]
1. Everything I read was new to me
2. Some information that I read was new and some I already knew
3. I already knew nearly everything in this passage

C. Passage 3: [Topic of Passage 3]
1. Everything I read was new to me

2. Some information that I read was new and some I already knew
3. I already knew nearly everything in this passage

Please circle one answer for each of the following questions:

8. I find that pictures are helpful in comprehending text when reading textbook chapters for class.

Strongly Agree Agree Neutral Disagree Strongly Disagree

9. I find that pictures are distracting when reading textbook chapters for class.

Strongly Agree Agree Neutral Disagree Strongly Disagree

10. When reading a textbook how often do you utilize illustrations to understand the text material?

Always		Often		Never
5	4	3	2	1

Appendix E

Informed Consent Form

Investigator: Darlene M. Kuhen Contact information: kuhend@marietta.edu
Faculty Advisor: Dr. Jennifer McCabe Contact information: jam002@marietta.edu

This study involves research with the purpose of contributing to the current research investigating illustrations in textbooks. This study has been approved by the Marietta College Human Subject Committee and is expected to last 90 minutes.

Participation will consist of reading three separate passages, completing math problems between each reading, answering multiple-choice questions for each reading, and completing a short questionnaire at the end of the study. Participants will receive 90 minutes of research hour participation for this study.

All research and results will be kept confidential. Only the investigator and faculty advisor will view the information collected from participants. No participant will be identified by name; each will be assigned a number, keeping their identity confidential from the time of data collection.

Exhaustion may occur from reading. Participation is voluntary and therefore, participants may discontinue participation at any time without a penalty or loss of research credit.

Upon completion of the study participants will be provided with an explanation of the research and will be given the name and telephone number of an individual to contact if there are any questions about the research.

By signing this form I understand the above information and consent to participate in this study.

Name (Please print): _____
Signature: _____ Today's Date: _____

The investigator would like to collect additional information including SAT/ACT scores and current PSYC 101 exam scores.

By signing below I agree to allow the investigator to view my SAT/ACT scores.

Signature: _____ Today's Date: _____

By signing below I agree to allow the investigator to view my current PSYC 101 exam scores.

Signature: _____ Today's Date: _____

Any questions may be directed to Dr. Jennifer Mccabe, Marietta College Human Subjects Committee Chair, (740) 373-7894, Jennifer.McCabe@marietta.edu

Table 1

Means (Standard Deviations) for Participant Characteristics

Participant Characteristic	*M (SD)*
Age (In Years)	18.97 (0.99)
Exam performance	75.17 (11.73)
GPA	2.88 (0.37)
ACT score	22.33 (5.86)

Table 2

Means (Standard Deviation) for Test Performance, Measured As Number of Questions Answered Correctly Out of 10 for Each Condition

Reading Condition	Definitional	Conceptual
Text-only	6.97 (1.72)	7.56 (1.44)
Text/Explanatory	6.11 (2.09)	7.08 (1.86)
Text/Non-Explanatory	6.56 (2.03)	7.50 (1.86)