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PROSE PRIMARY — PROSE SUBSUMED — FULLY INTEGRATED

Exaggeration

THE INTEGRATION
OF TEXT AND IMAGE
IN MEDIA AND ITS
IMPACT ON READER
INTEREST

Matthew O. Peterson, Ph.D.

May 2014

High . H_2

Attention-grabbing

Sensationalist

Young

DIFFURE

Medium . M_1

Academic

Formal

Serious

DIFFURE

Low . L_2

Calm

DIFFURE

TYPOGRAPHIC
LAYOUT AND FIRST
IMPRESSIONS

Jeanne-Louise Moys

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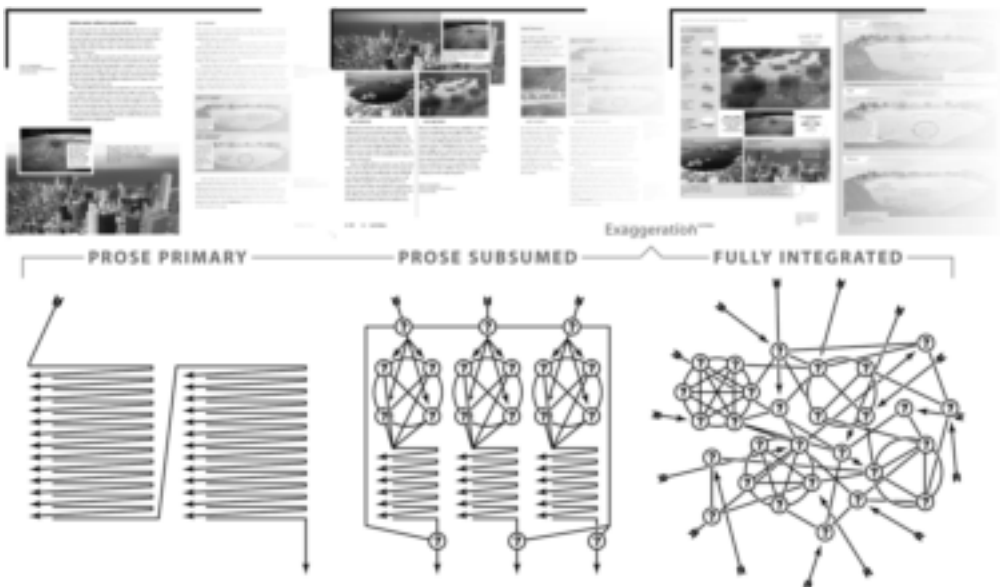
The Integration of Text and Image in Media and Its Impact on Reader Interest

2

Matthew O. Peterson, Ph.D.

A B S T R A C T :

This paper addresses the design of instructional media both holistically and authentically by focusing on text–image relationships at the level of design strategy. The schema used is sensitive to working memory and cognitive load theory. Three text–image integration strategies are proposed and illustrated: prose primary (PP), with a central prose column and marginal imagery; prose subsumed (PS), with shorter prose segmented by imagery; and fully integrated (FI), where smaller textual chunks populate imagery. One hundred and thirty-seven (137) middle school students rated their interest in science textbook pages designed according to the outlined strategies. Interest measures are closely aligned with the situational interest construct in psychology. The subjects' selections favored higher levels of text–image integration, such that FI was rated more interesting than PS, which was in turn more interesting than PP. Results were rated reliable and significant at a 95% confidence level. Comprehension and sense of task difficulty are briefly addressed.

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K E Y T E R M S :

Text-image integration, Design strategy, Page layout, Situational interest, Graphic design, Instructional design,   Science instruction

1.

INTRODUCTION

The integrated combination of text and image—in science textbooks, assembly instructions, informational websites, and other media—is often exquisitely complex, requiring highly developed but seemingly automatic faculties for constructing meaning from interconnected parts. Work in psychology has isolated design principles at play in layouts, but much more can be done to understand media in holistic terms, with its complexities intact. This paper addresses complex layout in terms of the implicit strategy that was used to create it. In particular, the focus is on text, image, and their interactions. The integration of text and image in media should impact the reader's approach, or interest level, and subsequent comprehension processes. This paper focuses on the former aspect of reader experience whilst considering the latter. The design of the science textbook (a good example of instructional media that can benefit from imagery) is considered in terms of the degree to which text and image might be integrated.

The literature on text and image in layout is reviewed next and followed with a proposal to evaluate media in terms of the text–image integration strategy employed in its creation. Three types of text–image integration strategy are established: *prose primary, prose subsumed,* and *fully integrated*. These strategies were variables in a post-test for the author's doctoral study (Peterson, 2011), which inquired into the interest level of 137 middle school students for instructional media according to the integration of text and image. The description of the post-test is followed by a call for future work and notes on outstanding issues.

The study referenced herein was conducted with oversight from a committee of Meredith Davis (chair), Nilda Cosco, James Minogue, and John Nietfeld, all at North Carolina State University. Rachael Huston Dickens assisted in its execution. The study was approved by both the North Carolina State University Institutional Review Board (IRB#1359) and the Wake County Public School System Research Review Committee. It was conducted in the spring of 2011.

2.

PAST ANALYSES OF TEXT AND ILLUSTRATION IN LAYOUT

Much of the early literature concerning text and illustration in layout is centered on textbook design, often for science, a field of study requiring frequent visual explanations (*illustration* and *picture* are more common terms than *image* in the literature). While early "transmission" models of learning would suggest a focus on content only, it is long accepted that learners—and so readers—construct knowledge with the resources available to them. A textbook then, is seen in a *generative* capacity: "In a generative theory of textbook design, learning is viewed as a constructive process in which learners select and build cognitive connections among pieces of knowledge"

(Mayer et al., 1995: p 32). A reader integrates information between verbally and visually based models—that is, text and illustration *(figure 1)*—and forms referential connections. This integration must happen in working memory.
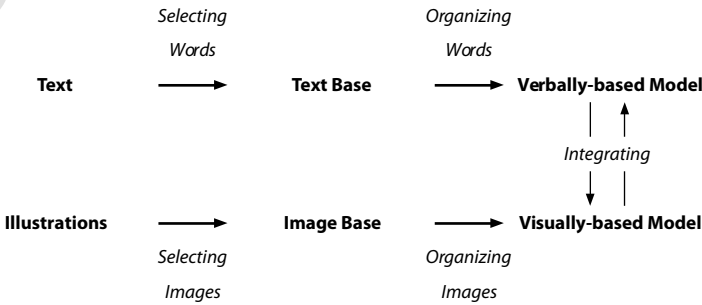
Visual–verbal integration, copied from Mayer et al. (1995: p 32), after Paivio (1986). Text and illustrations exist in media; the remaining components and processing are internal to the reader.

Working memory (Baddeley, 1998) is the cognitive architecture that contains and manages conscious thought. Separate but complementary components exist for processing language and image, with a third component managing the first two. Together these components act as a system of conscious awareness. Representations of encountered objects are "bound together" in a "unitary experience" (p 168). These are then structured into episodes within long-term memory, from which they may subsequently be recollected (ibid). Selective attention is a function of working memory that allows for discriminable amounts of information to be extracted from the cacophony of sensory experience. Working memory also supports a reflective capacity, so that material, presently experienced or recalled, can be evaluated for efficacy and treated accordingly. One of the defining characteristics of working memory is its profoundly limited capacity. Past experience with particular types of knowledge (schema automation) allows an individual to seemingly function beyond working memory limitations, where a familiar and schematic structure of information is only as taxing as an unstructured single element (Van Merriënboer and Sweller, 2005: p 149). When faced with new knowledge, the presentation of that knowledge (that is, design) can serve to increase mental function. Efficiency is key when capacity is limited. Thus, we cannot evaluate information solely in terms of underlying content. Structure and representational methods are in practice inseparable from content.

When illustration and text are more integrated *on the page*, it is easier for the reader to integrate them mentally (Mayer et al., 1995: p 33)—this is the *contiguity principle*. The contiguity principle holds that "in order to minimize the cognitive load associated with mental integration of information, new material should be provided in different modalities and coordinated in space and time" (Vekiri, 2002: p 275). Too much separation of illustration and text requires the reader to hold one component in working memory while attending to the other—and it is more difficult to

hold textual information in working memory (p 276; p 295). Integration in media reduces the visual demands of text by limiting the need for short-term retention. Shorter textual explanations enjoy greater retention and information transfer than longer text if the textual segments are "coordinated" with visuals (p 272). Processing demands are decreased when different kinds of representation are integrated into a single representational system, as in text embedded in graphical displays (p 303). Coding simultaneously in both representational formats (linguistic and pictorial) provides the reader with richer detail (Hannus & Hyönä, 1999: p 96). There are indications that one representational code can be co-opted for the other's use (Vekiri, 2002: p 269). Utilizing two codes in instructional material increases retention because visuals increase concreteness and they lead to better generation of mental imagery (p 267). These findings call for exploration into the integration of text and illustration.

Hannus and Hyönä (1999) criticize much of the research literature on textbook illustration as inauthentic, because experiments often present a text passage with a single illustration, where authentic textbook materials present readers with more complex collections of textual units and related illustrations (p 97). Authentic materials require the reader to make constant decisions regarding engagement within "highly complex stimulus environments" (p 98). Such stimulus environments face readers with integration and synthesis activities, determination of sequence (reading strategy), and the difficulty inherent in interpreting visual material (such as diagrams) (ibid). The reader must attend to the relevant components of an illustration and cross-reference them with separated textual content. The reader must determine if and when to depart a continuous prose and attend to marginal illustrations. The literature on textbook illustration makes conflicting claims as to whether frequent or infrequent shifting from text to illustrations is more successful for learners (p 107).

Illustrations are more effective when *explicit* instructions for engagement are given, since it appears that text drives reading strategy (Duffy, 1992; Hannus & Hyönä, 1999; Carney & Levin, 2002). Directives for reading illustrations have variable results. In order to improve learning, illustrations need to be directly relevant to text (and vice versa), rather than being arbitrary or isolated (Hannus & Hyönä, 1999: p 97)—that is, the relationship between text and illustration should be meaningful.

Understanding of scientific text and problem-solving transfer improves with "multi-frame illustrations" for cause–effect systems (Mayer et al., 1995: p 40). Though cause–effect systems are predominant in science, such illustrations are uncommon in textbooks. Even "modest" annotative adjustments to current textbook illustrations could improve comprehension (p 39).

Clearly the value of integrating text and illustration in layout is well established, and many isolated prescriptions exist for doing so. But no complete model of layout exists that differentiates integration.

This paper outlines the beginning of such a model, with an emphasis on design strategy, or how a designer produces the outcomes under discussion. While future work might tease out further implications of general strategies, the current concern is acknowledging that designers employ strategies for treating text and illustration, which hold sway on the resultant media design. Different strategies produce different outcomes, and those outcomes influence readers differentially.

The literature on textbook layout uses the terms *illustration* and *picture* to indicate representational imagery in print or on screen. The term *image* often specifically refers to mental imagery. Thus, an illustration on a page is experienced as an image. *Illustration* was used in this section to better align with the literature. Graphic designers, on the other hand, tend to use the term *image*, at its most general, to refer to physical representations. This paper focuses on the experience of illustrations and pictures as imagery, and is written for a design audience, so the term *image* will henceforth be used in its most inclusive sense.

T E X T – I M A G E I N T E G R A T I O N   A N D   T H E S C I E N C E   T E X T B O O K

Science textbooks utilize text and image to explain complex relationships. Some information is more efficiently encoded linguistically (as text), and some is more efficiently pictured. The study detailed herein focuses on the main components of visual design: text and image, and especially their interrelationships. Human working memory, with its separate components for processing verbal and visual information, supports this distinction.

Psychological studies that address layout are experimental and tend to isolate one aspect of text–image relationships (Hannus & Hyönä, 1999: p 97). But the experience of layout, in print or in a more dynamic screen-based environment, is that of an interconnected system, where each part exists in relation to the whole. The experience of complex information design is not just holistic in terms of the *reader's* relationship to media, but in terms of the *designer's* relationship to it as well. Studies that isolate one aspect of layout present difficult prescriptions to designers, who generate form in a more holistic manner. When complex information design has so many interlocking pieces, it's impossible to develop those pieces in isolation according to simple rules. Designers typically find it difficult to explain their own methods and feel they work by instinct. Instinct is of course just the designer's sensation of creativity; there are implicit strategies driving all form generation. While strategy does not predetermine form, it certainly constrains it. Any given strategy produces a restricted range of results. A designer's conception of the role of text and image constrains manipulation of those resources, including favoring one over the other when possible.

The production model of a textbook exerts influence on the visual product's text–image relationships as certainly as the

designer's strategies. The textbook production model, as with most editorial production, is text-driven. This means that illustration decisions follow a written text–image making can't practically suggest changes to the text for better overall communication, but rather must be solely reactive. The text is set, and illustration becomes secondary. The outcome is a continuous prose with separate, or marginal, supporting imagery.

A strategy that presents a central prose column with references to marginal images will be called *prose primary*. Prose primary is seen both as a final layout and the strategy that produced it, in that layout embodies strategy. Images in a prose primary strategy appear as secondary to the text. The text, being linear in aggregate, has one logical reading order, which must be broken to attend to imagery. It is a serial system of meaning. A more heavily prose-driven strategy would be *prose exclusive*, as seen in the typical novel, where images never (or very rarely) inhabit the space reserved for the continuous text.

The prose exclusive strategy is ignored here because it does not feature any text–image integration; so too is a conceptual (but surely impractical) strategy of *image exclusive*. (Imagery, lacking the propositional specificity of text, is not a valid substitute for much information.)

A *fully integrated* strategy for text–image integration flips the primary relationship from the prose primary strategy. Fully integrated layouts include text, but break up the strict sequencing of a continuous prose. Text exists in discrete "chunks," either embedded in an imaginal space (within an image) or associated with individual images. Fully integrated layouts are parallel systems of meaning. There is no correct reading order. The reader determines any sense of sequence, if indeed there is one. It must be noted, however, that a fully integrated layout is a complex set of meaningful systems and may include sub-systems that themselves are serial in nature. It is a parallel system overall, not necessarily in every possible relationship.

A midpoint between the prose primary and fully integrated strategies is *prose subsumed*. Prose subsumed layouts retain prose, but break it down into discrete and separated sections. Each section of prose is anchored to an image (or integrated diagram), which serves as the entry point to the text. That is, there is a lesser sense that prose sections need to be read in a particular sequence. A prose subsumed layout is a series of image–caption systems.

It is the author's belief that the terminology *prose primary, prose subsumed,* and *fully integrated* are unique to this work, at least as a system (certainly the terms in isolation have been used elsewhere). Mayer et al. (1995) discuss the integration of text and illustration, and identify relationships as either *integrated* or *separated*. *Prose primary* to *fully integrated* represents a dimension of text–image integration, where Mayer et al.'s framework is binary. Holsanova et al. (2008) identify *text–picture integration* and *text–graphic integration*, but utilize the same duality of

integrated versus *separated*. *Prose primary* is conceptually similar to *separated*, but it is probably inappropriate to force the two basic frameworks (declaration of integration and degree of integration) to correspond.

Layouts consistent with the three text–image integration strategies are shown in Figure 2. The following section asks the question: How does text–image integration strategy—expressed as prose primary, prose subsumed and fully integrated layouts—affect reader approach to instructional media?

F I G U R E 2 .

Three text–image integration strategies embodied in test forms. These particular alternate forms, each presenting the same information, were used in the referenced study's second treatment test (Peterson, 2011). Adapted from *MCDOUGAL LITTELL SCIENCE, North Carolina Edition, Student Edition, Course 3, by Trefil, et al. Copyright © 2005 by McDougal Littell. All rights reserved. Adapted and reprinted by permission of the publisher, Houghton Mifflin Harcourt Publishing Company. Any further use is strictly prohibited unless written permission is obtained from Houghton Mifflin Harcourt Publishing Company*

PP _ Prose Primary

PS _ Prose Subsumed

FI _ Fully Integrated
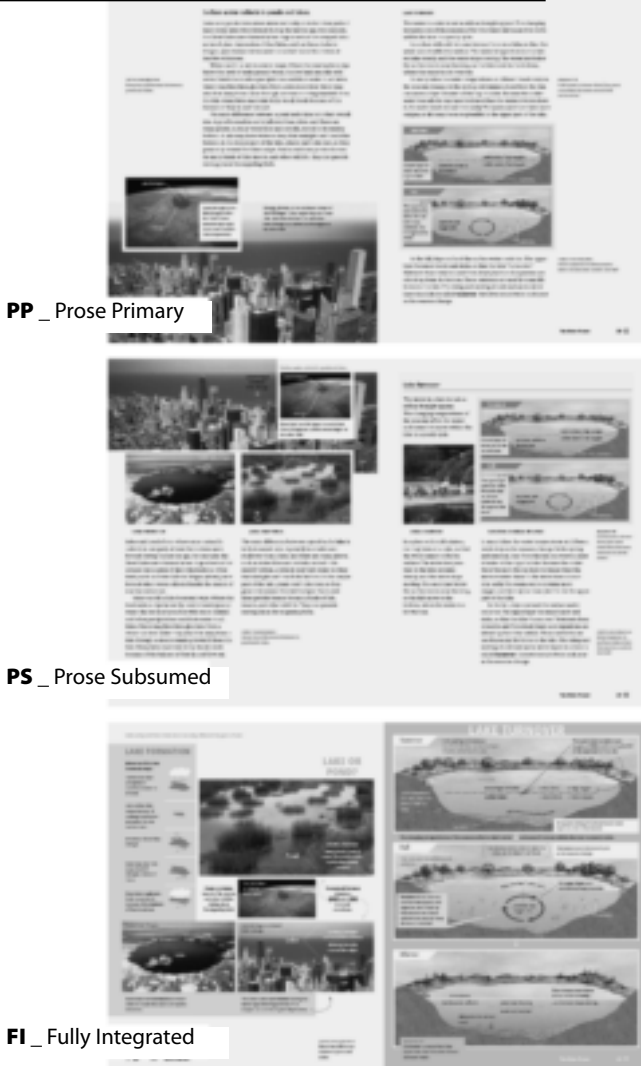
READER APPROACH
TO TEXT–IMAGE
RELATIONSHIPS

....

RESEARCH DESIGN AND
DEFINITION OF INTEREST

The question of reader approach and text–image integration strategy was addressed in the author's doctoral study as a post-test (Peterson, 2011; summarized in Peterson, 2014). This paper does not address the pre-test and primary treatment tests of the doctoral study in much detail.

The quasi-experimental study was conducted at a middle school in Raleigh, North Carolina. The school's population was fairly diverse according to national averages, with a white population roughly 15% below the national average. Every seventh grade student at the school (199) was available within their science classes, and data was collected on the 167 consenting subjects. After various exclusions, data was analyzed on 158 subjects. The post-test discussed in this paper used data from the 137 consenting subjects who attended that individual session and successfully employed the instrument. The treatment forms—textbook spreads according to the three strategies (one of the three treatment series was shown in *figure 2*)—utilized content from the eighth grade textbook, ensuring that the students were unfamiliar with the content in the school environment (participating teachers confirmed this). Group assignment was handled as cluster sampling, for the sake of ecological validity, with each of 8 classes as the clusters. Within each class, students were randomly assigned to one of 6 order-based groups.

Each subject, over three treatment sessions, received one apiece of spreads generated according to prose primary (**PP**), prose subsumed (**PS**), and fully integrated (**FI**) text–image integration strategies. Each treatment session (one week apart) presented material with particular content: divides and drainage basins; lakes and ponds; and fossil fuels. Thus each subject experienced each content area once in one randomly assigned form, and due to order-based group assignment, worked with each type of form (PP, PS and FI) once. The subjects used these forms in an open-book scenario to complete comprehension tests on the material.

The comprehension results (Peterson, 2011: pp 149–183), though obviously important to the concerns of this paper, are not addressed here in detail. This is done in part for brevity, but also because the interest results (favored here) proved to be the lone unequivocal results of the study. In all three comprehension tests the subjects performed better (that is, exhibited higher comprehension) with the fully integrated form than its prose primary counterpart (prose subsumed was not above prose primary in each, however). In the second treatment test, with the forms shown in Figure 2, statistical analysis suggested that the comprehension results for

fully integrated were significantly higher than the prose primary results. The consistent performance of fully integrated is encouraging, but the differences were significant only once in three treatments. The results were thus suggestive and not definitive.

The other major findings from the treatment tests were that there is no evidence of a relationship between text–image integration strategy and either sense of task difficulty or interest in subject matter (other variables of interest). It was conceived that a fully integrated layout may seem intimidating to subjects, but they did not rate it differently from prose primary or prose subsumed. It was also predicted that layout would render subject matter more or less interesting. It is still certainly conceivable that text–image integration strategy impacts sense of task difficulty and interest in subject matter, in addition to comprehension, but a more sensitive study is needed to tease out any such relationships. The post-test of the study did enjoy strong results.

The post-test occurred immediately after the final treatment test. The post-test measured interest level in text–image integration strategy (interest level is the dependent variable and strategy the independent variable). *Interest* in this study is most closely aligned with the *situational interest* construct in psychology. Interest affects the "use of specific learning strategies," attention level, emotional engagement, and the depth of processing (Schraw & Lehman, 2001: p 23). Thus interest holds sway over subsequent comprehension. Situational interest is spontaneous and environmentally activated (here the "environment" is the textbook spread), while personal interest is intrinsic to the individual and persistent (ibid: p 24). Subjects compared different strategies through pages, and in turn identified the most interesting and the least interesting, resulting in interest level scores for each strategy.

For the post-test, individual pages were "cut" from their full spreads, resulting in two opportunities (as pages) per treatment. These pages were reduced in size to thumbnails, such that only the largest titles were in any way legible. This reduction in size (and thus detail) was done to ensure that subjects could judge little more than the "gist" of each "scene," which simulates the initial approach of a reader to a complex layout (see Carroll et al., 1992, for more information on processing the gist of scenes).

Using an online tool called Survey Gizmo on laptops provided by the school, subjects were faced with three pages at a time, each representing one strategy and all with the same content (*figure 3*). Because of their experience with the treatment tests, each subject would recognize one of the pages in each set (though there was no evidence that this familiarity colored selection). Over the first 6 items, subjects selected the one page they found to be the most interesting, by clicking on its image. The selected image then displayed a check mark. Subjects were then faced with the same page sets and asked to select the least interesting. Both the order of the items and the pages displayed within each item were randomized per subject.

FIGURE 3.

6. Which textbook design is the MOST interesting? *

Interest item display in Survey Gizmo, from a scrolling web page with multiple items displayed in succession, in randomized order. Item #2.1 is shown here, being the left-hand page from the second treatment test, with randomized order of images (PP, FI, PS, left to right, in this example).

For both sets, one item displaying the same particular page failed to load the images for unknown technical reasons, resulting in 5 selections of most interesting and 5 selections of least interesting pages. Scoring was simple: scores for each strategy started at 5, and every selection as most interesting resulted in an additional point, while a selection of least interesting reduced the score by a point. This produced bounded aggregate scores for each strategy in the range of 0–10.

— 4 . 2 ....

R E S U L T S

The post-test raw ratings exhibit a general profile where most interesting selections favor fully integrated over prose subsumed media, which in turn is favored over prose primary: FI > PS > PP. Least interesting selections mostly mirror the trend sensibly: PP > PS > FI. In both sets there is one exception to this rule: item #3.1, displaying the left-hand page from the third treatment session form. (Item #3.1 only noticeably affected the scored result in the negative "least interesting" version.)

Upon inspection, item #3.1 is the proverbial exception that proves the rule, as that individual prose primary page is especially diagram-heavy (see *figure 4*). In the context of the spread it is just the half that carries much of the image load, but when isolated it appears more text–image integrated than the corresponding prose subsumed page.

Adjusted response values per subject were calculated to estimate reliability. The adjusted scores assume that the prose subsumed strategy is in fact a midpoint between prose primary and fully integrated strategies. Because of this assumption, this measure is best conceptualized as one of comparison between FI and PP. Each item was scored such that positive interest in FI was +1, PS was 0, and PP was −1. Reverse scoring was used for negative interest items. Thus, each subject's adjusted response value, or preference score, fell in the range of −10 to 10 (*figure 5*). A high score indicates a preference for text–image integration (FI over PP).

9. Which textbook design is the LEAST interesting? *
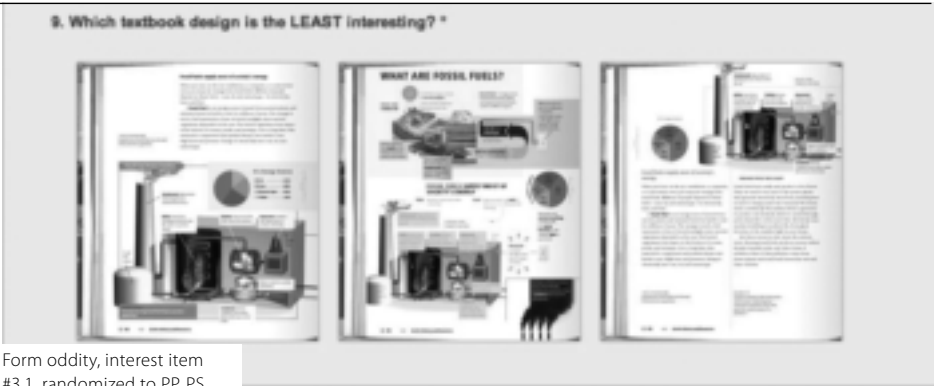
Form oddity, interest item #3.1, randomized to PP, PS, FI (left to right) here. The center image is from the fully integrated form, and appears dense in imagery. The prose primary page (left) appears more image-heavy and more text–image integrated than the isolated prose subsumed page (right), contrary to the general trend. When viewed as a full spread, with its text-heavy facing page, the prose primary design appears more prototypical.

The results reflect a general preference for higher text–image integration in media. All correlations for the adjusted response scores are positive and deemed statistically significant ($P \leq 0.05$). The mean pairwise correlation for all items is 0.40, which means that individual subjects' preferences tended to align across items: if a subject preferred prose primary for one page, he or she regularly preferred prose primary for other pages.

The reliability estimate for the adjusted scores, using Cronbach's alpha for internal reliability, is $\alpha=0.86$. This rating suggests that the scores are stable and as such, in a sense, trustworthy. The threshold for personality tests—the appropriate standard for this inventory—is

Preference for high text–image integration. Adjusted per-subject interest level scores began at zero (0). Each selection of "most interesting" for FI or "least interesting" for PP increased the score by one, indicating preference for FI over PP. The opposite selections decreased the score by one. Any selections of PS did not affect the score (+0). The histogram indicates general preference for higher text–image integration.

3 3
. . . .
Integration of Text + Image

Peterson
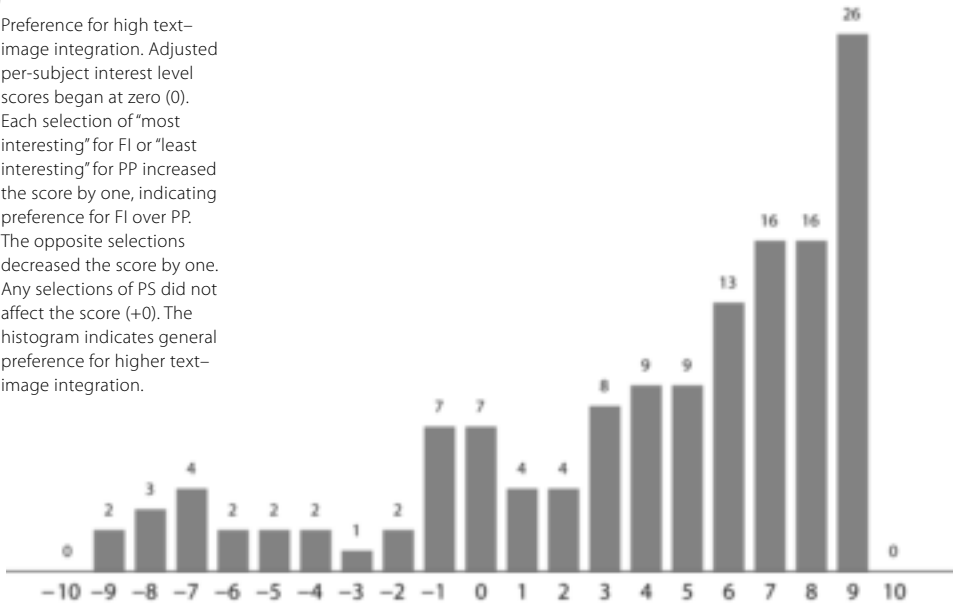
α=0.80. With a theoretical limit of α=1.00, this is a very strong rating. (Standards were adopted from Reynolds et al., 2006.)

Returning to the aggregate strategy ratings derived from the data—values for each strategy in the range of 0–10—the results were apparently regular, as the histograms suggest (*figure 6*). The modal value, the most common individual value, for prose primary is 1, while prose subsumed is 4, and fully integrated is 10. Mean values are 3.19, 4.57, and 7.24, respectively.

FIGURE 6.
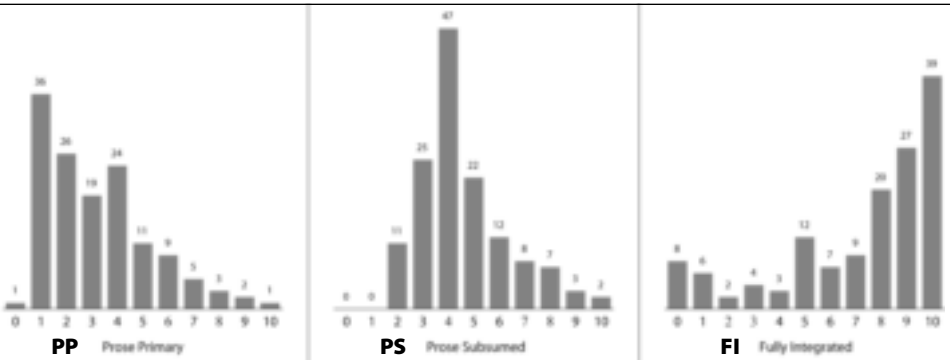
Preference ratings for each text–image integration strategy. Aggregate strategy interest level ratings began at five (5). When a strategy was selected as "most interesting," its rating increased by one. When it was selected as "least interesting," its rating decreased by one. Each subject's three ratings (PP, PS, FI) are bounded and add up to 15.
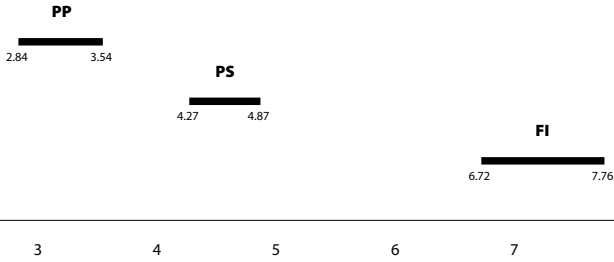
Confidence intervals (at 95% confidence level) were calculated for the three strategies. Confidence intervals are estimations of the agreement between sample means (the scores of the 137 middle school students participating in the post-test) and the population mean (middle school students in general), which determines the generalizability of results. The sample mean is unlikely to perfectly capture what would be a larger population mean, but the distribution of values allows us to estimate its accuracy. The confidence interval for each strategy is 95% likely to capture the actual population mean. Since none of the intervals overlap, the true means appear to be separated (with 95% confidence), and the rank ordering can be trusted. The dramatic separation is visualized in Figure 7. Higher levels of text–image integration appear more interesting to middle school students. Detailed data tables are available in Peterson (2011).

4 . 3

DISCUSSION

This study inquired into the responses of middle school students using science textbook pages. Many psychological studies focus on undergraduate subjects through convenience sampling—such subjects are eminently available to university faculty. As such, it is a strength of this study that its subjects represent a distinct and less-studied audience of science textbooks. But this is also a limitation: its results cannot be generalized to older subjects, as it is entirely sensible that preference for layout might change as literacy increases.

FIGURE 7.

PP

2.84   3.54

PS

4.27   4.87

FI

6.72   7.76

3   4   5   6   7

True mean estimates for interest level ratings of text–image integration strategies. Values are preference level ratings per strategy (from Figure 6). Black lines represent 95% confidence intervals of true means: where the mean of the full population of American middle school students would be expected to fall. The separation of values indicates statistically significant differences.

The focus on instructional science media represents another paired strength and limitation. The results are most directly suggestive for science education. While it's reasonable to assume that the interest results would apply across areas of study (instructional history media, for instance), the implications are limited per content. Much scientific information can be pictured, so it is not difficult to imagine the adoption of fully integrated practice in instructional science media. But far less information in language arts, for instance, can be "pictured." Fully integrated as a viable text–image integration strategy is dependent upon media content (the information that will be represented in linguistic or imaginal codes).

The situational interest results are strong. Subjects found fully integrated media to be significantly more interesting than prose primary media. Interest, of course, is not the only measure of functional design. But a reader's approach to media certainly colors his or her immediate experience of it. Furthermore, in certain cases interest is especially critical for design. One such case is the middle school textbook, a particular kind of book that is not selected by, but rather forced upon, its readership.

Reader interest goes well beyond *liking*. The reader's approach to media will affect his or her level of investment in that media. In the case of instructional media, where there is a clear agenda for its producers—learning certain concepts—any promotion of reader investment has value. Of course, quantifying the impact of interest on mental effort or comprehension is no small task.

The subjects' ratings position prose subsumed between the more extreme strategies, consistent with (but not proof of) the assumption that PP, PS, and FI represent a linear relationship of increasing text–image integration. This logical finding supports the distinction of text–image integration strategy as being psychologically "real." It appears to describe illustrated media. If the text–image integration strategy distinction is apparent to readers, then it is certainly apparent to trained designers. Any understanding of the implications of text–image integration strategy (here in terms of interest level) can serve to affect the production process. Designers can understand text and image in layout in terms of visual outcomes, and their largely intuitive design process can reasonably be expected to produce outcomes according to a general "picture" of a strategy.

FUTURE WORK

The evidence for the relationship of fully integrated over prose subsumed over prose primary is compelling here. However, the precise source of those results cannot be teased out from the data. Did subjects favor the fully integrated strategy because of the complexity of layout? Or is it simply about the apparent quantity of imagery? Or were selections made based on the amount of text? Liking imagery is not the same as disliking text.

While future work may seek to identify the cause of these selection preferences, audience must be considered. The subjects of this study were seventh grade students. As people become more sophisticated readers, do they begin to favor text-driven layouts? Might college students favor prose subsumed over fully integrated media? As the textbook industry transitions away from expensive printed textbooks to online interactive material and print-on-demand resources, what might sensitivity to interest in text–image integration strategy suggest for new production methods? The transition may provide opportunities for adopting a new model that pairs designers with writers during content development.

These questions concern interest level in media produced with different text–image integration strategies. Reading is a complicated process. Studying the reader experience with highly text–image integrated media is a daunting task. Comprehension is a critical part of reader experience. The study referenced here does provide a viable means to assess comprehension with variable-strategy media. That work should be continued. The question of learning, a problematic "outcome" of comprehension, can be addressed through similar testing. Interest, comprehension and learning represent stages of a reader's experience, and text–image integration may impact all of them.

Despite the basis of this study in printed forms, it is relevant to interactive media. Much of the time a reader spends with interactive media involves largely static screens, which—though they exhibit no movement at those times—still present the reader with a complicated collection of elements constituted and arranged according to some implicit strategy. Interactive media complicates the concerns of this study; it in no way supersedes them. E-books provide minor challenges to conceptualizing text–image integration strategies in relation to interactive media: swiping across digital pages rather than turning leaves of paper needn't affect interpretation of those pages dramatically. But a video playing in place of a still image certainly does. As does the reader's understanding that particular elements represent distinct interactive moments, or optional pathways to other pages and experiences. How might the framework of text–image integration detailed here resolve with recent theories and principles of interaction design?

Layout is typically considered to be a matter of the location of elements. But text–image integration strategy, as understood here, is not simply about arrangement. Strategy goes deeper and considers

alterations to the elements themselves, always in relation to one another and the meaningful space they create and inhabit. The focus on media at the level of design strategy is an acknowledgment that the designer matters. Design, in contrast to art, does not function in practice according to the reader's knowledge of the media's creator. But the acknowledgment of design strategy's impact on media and reader experience does save a place for the designer in a model of visual interpretation. For something as complicated as the visual page or screen, we need a way to understand it that is both holistic and authentic. Text–image integration strategy is one way to view design on its own terms.

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A B O U T   T H E   A U T H O R

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