

ARTICLE

The Use of “Non-Fiction Novels” in a Sensation and Perception Course

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Scientific material can be difficult to relate to everyday knowledge. Textbook facts can be abstract. This Study of Teaching and Learning project examined the use of “non-fiction novels” (biographies and other books that read like novels but are true) in an undergraduate Sensation and Perception course in order to increase the concreteness of the reading material and to give the students a story on which to hang the facts learned in lecture. In Phase I (Fall 2009) non-fiction novels were used for half of the units and a standard textbook for the other half. In Phase II (Fall 2010) only non-fiction novels were used. The Fall 2009 class was very positive about the use of non-fiction novels, but exam scores did not mirror this enthusiasm, either on semester exam scores or on a four-month re-take of the

cumulative final exam. In contrast, the Fall 2010 class missed having a textbook, but exam performance significantly improved over prior semesters, and performance on the four-month re-take of the cumulative final exam showed performance equivalent to the Fall 2009 class’s four-month performance on questions from textbook units. In both semesters, the effectiveness of the instructor in stimulating student interest was significantly higher than in prior years where only the textbook was used. In addition, 68% of the students said that reading the non-fiction novels made them want to learn more about our sensory systems.

Key words: sensation; perception; biography; autobiography

Scientific material can be difficult to relate to everyday knowledge and it can be difficult to form a mental image of scientific facts (Graesser et al., 2002). Textbook facts can be abstract. The use of books with more of a narrative can bring the textbook material to life. A much more concrete experience comes from reading about, for example, someone as he is learning to hear again after receiving a cochlear implant (Chorost, 2005). Martin and Brouwer (1991) have argued that “. . . the narrative is a useful (and at times powerful) form of expression that is too often neglected in science education, [and] . . . students must have a personal engagement with the ideas they are to learn” (p. 708). The current Study of Teaching and Learning (SoTL) project examined the use of “non-fiction novels” (biographies, autobiographies, and other books that read like novels but happen to be true) in an undergraduate Sensation and Perception course, in order to give students a scaffold on which to hang the facts presented in class lecture and content gleaned from assigned scientific articles.

Several researchers have explored the effects of the concreteness of reading material on learning. Sadoski and colleagues (Sadoski et al., 1993), using sentences and paragraphs (but not full non-fiction novels) about historical figures, found that students rated concrete sentences and paragraphs as more comprehensible than abstract ones. (Sadoski, Goetz, and Rodriguez [2000] found similar results for scientific texts.) Further, Sadoski, Goetz and Fritz (1993) found that concrete sentences and concrete long paragraphs (around 265 words) were recalled approximately twice as well as were abstract ones, on both immediate and five-day delayed recall. Concrete short paragraphs (around 110 words) were recalled five times better than were abstract ones five days later. Ransdell and Fischler (1989) also found, with immediate recall, that

concrete paragraphs were recalled better than abstract ones. However, when abstract material was put into a context, it was recalled as well as was concrete material (Bower and Clark, 1969; Marschark, 1985; Wattenmaker and Shoben, 1987), with fewer demands on working memory (Miller et al., 2006), in accordance with the context availability model (Kieras, 1978). In addition, facts from stories with a theme (Baylor and McCormick, 2003; Janit et al., 2011), context (Bransford and Johnson, 1972), or from texts that have been manipulated to increase interest (Cordova and Lepper, 1996) were recalled better than facts from stories without these features. Willingham (2004) referred to stories as being “psychologically privileged,” as they are easy to understand and thus to remember. Thus, given that the material in a textbook or lecture may seem dry, abstract, or irrelevant to daily life, the use of non-fiction novels can give an interesting context for the facts presented in class lectures. Consistent with this, Sadoski et al. (1993) found that student ratings of concreteness correlated highly with their ratings of comprehensibility and interestingness, and Wade and Adams (1990) found that interesting facts were remembered better than were facts judged to be important. The use of non-fiction novels in this Sensation and Perception class is an attempt to build a bridge between what is interesting and what is important and thus improve student retention.

In addition to objective measures of retention, students have subjectively reported that they find textbooks with more of a narrative to be more enjoyable to read (Fernald, 1987, 1989), that they are more “transported” into the topic (Janit et al., 2011), and that autobiographies are more interesting than textbooks (Banyard, 2000). Students have also reported that they are more motivated to learn about the field when reading autobiographies (Banyard, 2000). When choosing their own reading material, biographies are

amongst the most favorite non-fiction genres (Gallik, 1999), and case studies (brief biographies) are increasingly being used in neuroscience courses (Meil, 2007). However, students also feel that textbooks are better at some things, such as describing the etiology of abnormal psychological conditions (Banyard, 2000). Biographies and autobiographies seem to be rarely used in isolation, but rather as a supplement to a textbook (Boyatzis, 1992; Banyard, 2000; Norcross et al., 2001; Meil, 2007; Janit et al., 2011). In order to keep student book costs down, I have chosen to supplement non-fiction novel reading assignments with class lectures on sensory physiology and behavior, and class discussions of scientific articles related to the readings (see the Appendix for non-fiction novel/article pairings – the same articles were used Fall 2009 and Fall 2010), but starting with the Fall 2010 semester, I will use only non-fiction novels, no textbook.

In addition, the use of non-fiction novels may have the added benefit of making reading more enjoyable, and thus increase the likelihood that students will read voluntarily. In 2007, the National Endowment for the Arts (NEA) published *To Read or Not To Read* in which they stated that reading rates are decreasing amongst Americans, especially young males (a point particularly relevant for all-male Wabash College, where this study was conducted) (see also van der Voort [2001] for similar statistics – including the gender effect – in the Netherlands). NEA found that one-third of college seniors did not read at all for fun, reading rates were declining in college graduates, and reading comprehension was decreasing. In addition, writing ability has been shown to be correlated with frequency of reading. In their 2008 survey (NEA, 2009), however, NEA found that rates of reading literature (novels, short stories, poetry, and drama), especially amongst 18-24 year olds, men, and Hispanics, had increased by 9, 11, and 20%, respectively, since the 2002 survey (NEA, 2004). In contrast, the 2008 survey found that the rate of voluntarily reading books (including non-fiction, not just literary texts) is still decreasing for all adults under the age of 55 years. Although literary reading rates appear to now be on the rise, given the recent decline in reading books (literary and non-fiction), encouraging reading in our youth is necessary to maintain this upward trend.

I have been unable to find any examples of the use of non-fiction novels in Sensation and Perception courses. (Beins [1984] used slides in a Sensation and Perception course in order to improve understanding especially of sensory anatomy, but he did not use non-fiction novels.) There are examples of the use of non-fiction novels in the psychology of science (Mori and Larson, 2006), developmental psychology (Boyatzis, 1992; Neysmith-Roy and Kleisinger, 1997), personality (White, 1974; Mueller, 1985), and many examples in abnormal psychology (Gorman, 1984; Chrisler, 1990; Banyard, 2000; Norcross et al., 2001). Others have used science fiction in developmental psychology courses (Kirsh, 1998) or in teaching gender issues (Lips, 1990). Thus, a SoTL study of the use of non-fiction novels in Sensation and Perception will broaden our experience with this alternative

to a standard textbook.

Most of the SoTL articles in the literature that report on the use of non-fiction novels only include subjective student enjoyment or subjective student feelings that the non-fiction novels aided in their learning (Gorman, 1984; Boyatzis, 1992; Kirsh, 1998; Banyard, 2000; Norcross, et al., 2001). (Janit et al. [2011] did examine recall from a story versus standard text in an abnormal psychology course.) Rather than relying only on students' gut feelings of academic improvement, the current study also objectively measured student exam performance in addition to subjectively measuring students' preferences.

This study thus had three aims. 1) To give students a concrete story (the non-fiction novels) on which to hang the scientific facts from lecture, in an effort to increase student retention of the material. 2) To objectively measure retention, not only subjectively measure it by asking students if they felt that this manipulation improved their memory for course material. 3) To increase student interest in reading. Graesser et al. (2002) have lamented that alternative pedagogies have little been studied empirically, a hole that the current study intends to help fill.

MATERIALS AND METHODS

Participants: The Fall 2009 course consisted of nine male students (Wabash has an all-male student body). Eight of these also took the April 2010 recapitulation of the cumulative final exam to test long-term memory. The Fall 2010 course consisted of ten male students. Seven of these took the April 2011 recapitulation of the cumulative final exam. This SoTL project was approved by the Wabash College Institutional Review Board, and all students gave informed consent.

Procedure and materials: In Fall 2009, Sensation and Perception was taught with units alternating between the two book formats – one unit used the textbook as the reading material, the next unit used a non-fiction novel, the next the textbook, etc. In Fall 2010 (Sensation and Perception was only offered in the fall these two years) only non-fiction novels were used. For the Fall 2009 semester, the non-fiction novels were: *Island of the Colorblind* (Sacks, 1997), about a population with a high incidence of rod monochromacy (a form of complete colorblindness); *The Emperor of Scent* (Burr, 2002), about Luca Turin, who developed an alternate explanation for how we smell, but he non-tactfully informed the rest of the olfactory scientific community that they were wrong, he was right, and was (not unsurprisingly) ostracized from that community; and *Beyond Pain* (Mailis-Gagnon and Israelson, 2003), about what causes pain, overcoming pain, and how culture, gender, and genetics can influence our perception of pain. The textbook used for comparison was Wolfe et al.'s *Sensation and Perception* (2006). I do want to make it clear that I think this is a good textbook – it is, in fact, the one I had chosen to use in my classes before switching to the non-fiction novel format. For the Fall 2010 semester, three additional books were used: *Rebuilt: My Journey Back to the Hearing World* (Chorost, 2005), about a man who lost all hearing in his early 30's and received a cochlear implant; *Pride and a Daily Marathon* (Cole, 1995),

about a man who had a bizarre autoimmune response to stomach flu and lost all proprioception (knowledge of body part location); and *The Psychology of Eating and Drinking* (Logue, 2004), a textbook specializing in gustatory behaviors.

Assessment: The SoTL articles on the use of non-fiction novels (Gorman, 1984; Boyatzis, 1992; Kirsh, 1998; Banyard, 2000; Norcross et al., 2001) all assessed their success via student subjective ratings of comprehensibility, interest, or motivation to learn. Some studies that were mentioned in the introduction (Marschark, 1985; Wattenmaker and Shoben, 1987; Ransdell and Fischler, 1989; Sadoski et al., 1993; Sadoski et al., 2000) did objectively measure retention of material but not in a SoTL context.

The assessment of this SoTL project had multiple components. First was subjective student assessment, both specific to this SoTL project and the course evaluations that I have used in previous classes, thus allowing for cross-format comparisons. In the subjective assessments in the literature (Gorman, 1984; Boyatzis, 1992; Kirsh, 1998; Banyard, 2000; Norcross et al., 2001) the students enjoyed reading biographies and autobiographies.

Second was a measure of attitudes towards literacy. The Wabash National Study of Liberal Arts Education (<http://www.Liberalarts.wabash.edu/study-overview/>), a longitudinal study of the factors affecting liberal arts education, has shown that freshman entering Wabash College have a significantly more negative attitude towards literacy than do students at the other small institutions in the study (but equal to the average of all institutions in the study, large and small). Participants in the current SoTL were asked how this course affected their feelings about the six statements that comprise the Attitude Toward Literacy measure (see "Literacy" section of the results for the individual questions).

The other four methods of assessment were objective. The first three measured retention of the material over increasingly longer periods of time. First, class average exam performance was compared across units in the Fall 2009 version of the course (textbook versus non-fiction novel). Second, performance on the end-of-semester cumulative exam was compared across formats. Third, retention tests were given in April, four months after the Fall course was completed. Fourth, class average exam performance from Fall 2007 and 2008 (when I used the Wolfe et al. textbook alone) was compared with class average exam performance from the non-fiction novel units in Fall 2009 and 2010.

The first objective assessment was comparison across formats within the Fall 2009 semester. I alternated assigned readings from the textbook or the non-fiction novels from unit to unit. (None of the students complained about this alternation being jarring.) I gave exams at the end of each unit, and have compared exam performance across the two formats. The second objective measure reflected medium-term memory retention. Cumulative final exam questions from the two book formats (Fall 2009 class) were compared.

For the third objective measure, in April (Sensation and Perception has been taught in the fall) I brought the students back (students were compensated for their time by a pizza lunch) and gave them the same cumulative final exam that they had taken at the end of the fall semester (in December). I specifically asked them to not study for this exam re-take, to test how well the material was retained over four months. This final exam re-take did not affect their grades. I compared four-month retention between the two teaching formats. For the Fall 2009 class, this was a within subjects, cross book format comparison. For the Fall 2010 class, this was a between subjects comparison with the Fall 2009 class's four-month retention exam, seeing if the non-fiction novels improved retention for the Fall 2009 textbook units.

For the fourth method of assessment, comparison across semesters, I have an Excel database of questions I have asked on previous exams and student performance on those questions. I thus re-used these same questions, and compared performance. The lectures are essentially the same between formats, so this comparison revealed the effects (if any) of changing the reading material. This was done for all Fall 2010 units and for the non-fiction novel units from Fall 2009. I also analyzed the questions from the textbook format for the Fall 2009 class as a control to ensure that the Fall 2009 students did not in general perform better or worse than the Fall 2007 and 2008 students, but that any observed differences were due to the manipulation of the book format.

RESULTS

Subjective student responses: The students were in general quite positive about the new, non-fiction novel, format. Several of their rankings on the end-of-semester evaluation increased over previous years. Results for all sixteen questions are presented as changes in evaluation score from the weighted average of the two years (Fall 2007 and 2008) I taught Sensation and Perception at Wabash before implementation of the non-fiction novel format (see Table 1). This evaluation uses a 5-point Likert scale: 1 = poor, 2 = marginal, 3 = average, 4 = very good, 5 = excellent. One-way ANOVAs were computed for each question, comparing the pre-non-fiction novel scores (averaging across Fall 2007 and Fall 2008) with the Fall 2009 (combination of textbook and non-fiction novel format) and Fall 2010 (only non-fiction novel) scores. Statistics were performed on the raw scores, not the change scores. Upon implementation of the non-fiction novel format, two of the sixteen questions yielded significant increases (following a Bonferroni correction for multiple comparisons, critical $p = \alpha/n = .0031$). In both cases, the difference was driven by the presence of the non-fiction novels – post-hoc analyses revealed that the scores for Fall 2007/2008 were significantly lower than for either Fall 2009 or Fall 2010, but the latter two were not different. One of these significant questions was #12, the effectiveness of the instructor in stimulating students' interest in the course, which was one of the main goals of the use of non-fiction novels. The overall ratings of the course (question #7) and of the instructor (question #16)

Question	Δ Fall 2009	Δ Fall 2010	F	p
1. Rate the pace of the course compared to others you have taken at Wabash.	-0.22	-0.14	.404	.671
2. Rate the suitability of the textbook.	-0.25	-0.39	1.143	.331
3. Rate the course requirements compared to others you have taken at Wabash.	-0.41	-0.03	.937	.402
4. Rate how well the class was organized.	0.31	0.51	1.815	.179
5. Rate the value of the lectures.	0.58	0.79	2.363	.110
6. Rate the effectiveness of the class in challenging you intellectually.	0.88	0.54	.896	.418
7. Give an overall rating of the course.	0.91	0.44	4.171	.025
8. Rate the clarity of the instructor's explanations.	0.67	0.36	2.128	.136
9. Rate the instructor's level of interest in the material.	0.44	0.14	2.929	.068
10. Rate the instructor's level of preparation.	0.58	0.29	2.923	.068
11. Rate the helpfulness of the instructor outside of class.	0.36	0.35	.535	.591
12. Rate the effectiveness of the instructor in stimulating your interest in the subject.	1.27	1.24	9.479	.001*
13. Rate how well the exam questions reflected the content and emphasis of the course.	1.37	1.12	7.222	.003*
14. Rate how fairly the exams were graded.	1.13	0.83	3.849	.032
15. Rate the grading standards of this course compared to others you have taken at Wabash.	-0.32	-0.28	.753	.479
16. Give an overall rating of the instructor.	0.88	0.55	4.979	.013

Table 1. Statistics on course evaluations. Significant differences from the weighted average of Fall 2007 and Fall 2008, at the Bonferroni-corrected $\alpha = .0031$ level, are indicated in bold and with an asterisk. Note, as mentioned in the text, that statistics were performed on raw evaluation scores, not the change values, comparing the average of Fall 2007 and 2008 vs. Fall 2009 vs. Fall 2010.

both increased substantially as well, but did not reach significance with the Bonferroni correction. It is a bit surprising that the construction of the exams (#13 – significant with the Bonferroni correction) also increased – nothing was changed here from 2007 and 2008. It is possible that some of this increase is attributable to my increasing experience in teaching Sensation and Perception – I had taught it only twice before coming to Wabash (evaluations in my other courses have also trended upwards). The rating of the suitability of the textbook (question #2) went down non-significantly upon implementation of the new format – both in 2009 when the textbook and non-fiction novels were used, and in 2010 when only non-fiction novels were used.

Students in both Fall 2009 and Fall 2010 also filled out an evaluation specifically for this SoTL project. On a 5-point scale, they rated the use of biographies in this course as slightly above a “good idea” on average in Fall 2009 (choices were horrible idea, bad idea, neutral, good idea, great idea), but slightly below a “good idea” on average in Fall 2010 (when only non-fiction novels were used). In Fall 2009, 67% percent of the students preferred the non-fiction novels to a textbook (22% preferred the textbook, 11% liked the combination of formats), but only 20% in Fall 2010 (60% would have preferred a textbook, 20% preferred a mix). When asked if the students would like to have only non-fiction novels assigned, supplemented by class

lectures, three students in Fall 2009 said it was a great idea, three said a good idea, two were neutral, and one student said that it was a bad idea. In Fall 2010, one student said it was a great idea, two said good idea, one was between neutral and good idea, and six were neutral (despite six students preferring the textbook). The average was slightly below “good idea” both years. When asked how well the non-fiction novels helped in understanding the course material, the average was “good” (poor, so-so, neutral, good, excellent) in Fall 2009, and slightly below “good” in Fall 2010. Figure 1 (top panel is Fall 2009, bottom panel is Fall 2010) shows average responses on three other questions on this evaluation, rating each book separately. The first question was “How would you rate [X book]?” with the options “very abstract,” “somewhat abstract,” “neutral,” “somewhat concrete,” and “very concrete.” These were given values 1 through 5, respectively, and those values were averaged and are plotted in Figure 1, along with standard error bars. The second question was “How interesting did you find [X book]?” with the options “very boring,” “somewhat boring,” “neutral,” “somewhat interesting,” and “very interesting.” Increased reader interest has been shown to improve learning of abstract material (mathematical functions) (Cordova and Lepper, 1996). The third question was “How understandable did you find [X book]?” with the options “completely confusing,” “mildly confusing,” “neutral,”

“somewhat clear,” and “very clear.”

Although the non-fiction novels scored higher than the textbook on all three questions in Fall 2009 (with the exception of *The Emperor of Scent* on concreteness), none of the questions yielded significant differences (concreteness $F(3,32) = 1.322, p = 0.284$; interest $F(3,32) = 1.817, p = 0.164$; understandability $F(3,32) = 1.919, p = 0.146$). For Fall 2010, concreteness did yield significant differences, $F(5,53) = 3.065, p = .017$. This difference was due to *The Island of the Colorblind* being judged significantly more concrete than either *The Emperor of Scent* or *The Psychology of Eating and Drinking*. For Fall 2010, interest also yielded significant differences, $F(5,53) = 2.852, p = .024$, this time driven by *The Island of the Colorblind* being rated as significantly more interesting than *The Psychology of Eating and Drinking*. Understandability did not yield significant differences, $F(5,53) = 2.121, p = .077$. It is possible that the significant results were due in large part to an order effect - *The Island of the Colorblind* was read at the beginning of the semester, when students are fresh and excited to embark on new courses, while *The Psychology of Eating and Drinking* was read during the last two weeks of the semester, when students commented that they were tired and feeling behind.

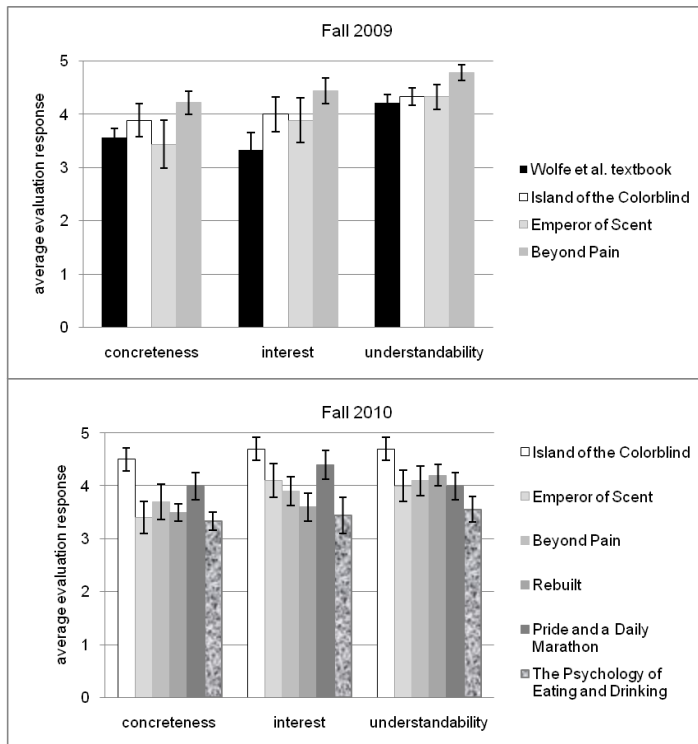


Figure 1. Average class response on evaluations of abstractness/concreteness, interest, and understandability for the books that were used. Means ± SEM are plotted.

One of the aims of this SoTL was to increase interest in reading. In response to the question “Did reading the biographies make you want to learn more about our sensory systems?” in Fall 2009, three chose “very much,” five chose “yes,” and one chose “somewhat.” The average response was 3.22, between “yes” and “very much.” For Fall 2010, they were not as positive: one chose “very

much,” four chose “yes,” and five chose “somewhat,” averaging 2.60, between “somewhat” and “yes.” No one chose the option “no” in either semester.

For the unit in which we read Oliver Sacks’ *The Island of the Colorblind*, we also read the article which identified the mutation that caused these islanders to be colorblind (Sundin et al., 2000). In addition to reading Sacks’ book, I had one lecture on the molecular genetics of color vision, in order to prepare the students for the Sundin et al. article, and crossed out some of the more technical parts of the article so that they would not be impeded by the molecular methodology. Although the students found this article difficult, the Fall 2009 class unanimously agreed that it was worth the pain to read a “real” article about the people they had read about in the non-fiction novel. Thus, this format can enhance student motivation to tackle even difficult material. However, the Fall 2010 class unanimously agreed that this article was too difficult. Perhaps Fall 2011 will be the tie-breaking class to determine the future inclusion of this article.

Literacy: Students were asked how the six questions from the attitudes towards literacy measure from the Wabash National Study had changed as a result of using biographies in this course. Response possibilities were 1 = much less than before this course, 2 = a little less than before this course, 3 = neutral, 4 = more than before this course, and 5 = much more than before this course. One-sample *t*-tests were computed comparing mean student ratings with a value of 3 (neutral). Statistics are reported across all 19 students (9 from Fall 2009 and 10 from Fall 2010). Question 1 (I enjoy reading poetry and literature) averaged 3.00 ($t(18) = 0.0, p = 1.0$). This course did not discuss poetry or literature (other than the non-fiction novels), so it makes sense that this remained unchanged due to the manipulations in this course. Question 2 (I enjoy reading about science) averaged 3.89 (close to “more than before this course,” $t(18) = 5.288, p < .001$). One of the goals of this SoTL is to increase interest in reading, thus this is a very good outcome – especially since this is a science course. Question 3 (I enjoy reading about history) was also not addressed in this course, but averaged 3.26, somewhat above “neutral,” $t(18) = 2.535, p = .021$. Question 4 (I enjoy expressing my ideas in writing) averaged 3.37, also slightly above “neutral,” $t(18) = 2.348, p = .031$. Students were required to write one term paper, four mini-labs, and all exams contained essay questions, but this was not a writing intensive course. Question 5 (after I write about something, I see that subject differently) averaged 3.79 (close to “more than before this course,” $t(18) = 3.750, p = .001$). Finally, question 6 (if I have something good to read, I’m never bored) averaged 3.37, $t(18) = 2.111, p = .049$. In summary, other than for poetry and literature, students said that this course increased their attitudes towards both reading and writing. The Wabash National Study of Liberal Arts Education began in 2006. Thus, the first cohort has now graduated from college. From beginning to end of college, 47% of Wabash men showed a moderate to high increase in attitude toward literacy, compared with 36% of students at all of the institutions in the study (Charlie Blach, Wabash National

Study, personal communication). From the results reported here, the use of non-fiction novels in this Sensation and Perception course appears to be contributing to this increase in attitude toward literacy.

Objective exam performance: In addition to student enjoyment, it would be desirable if the use of non-fiction novels improved student performance. Multiple analyses were thus conducted on exam performance. Note that all exams consisted of multiple choice, fill-in-the-blank, and essay questions. These three question formats were analyzed separately, in addition to an overall combined score.

For the Fall 2009 students, performance across formats in general yielded moderately better performance on exams covering material studied under the non-fiction novel format. There were two exams in the non-fiction novel format, two in the textbook format, and Exam 4 covered both smell (*The Emperor of Scents*) and taste (from Wolfe et al.). My exam question database has class performance on each question but not individual student performance. Thus for Exam 4 I can no longer parse out individual student performance on the taste versus smell questions. For this reason, the analysis of cross-format performance within the Fall 2009 semester was performed on class averages, yielding only three exam scores for each format. This analysis thus did not have enough power to reach statistical significance. The average performance for the within-semester comparison is shown in Table 2.

	non-fiction novel	textbook
multiple choice	78%	72%
fill-in-the-blank	75%	72%
essays	83%	86%
overall	78%	76%

Table 2. Within semester (Fall 2009), across book formats exam performance comparisons.

The non-fiction novel format yielded slightly superior performance on all parts of the exam other than the essays. Overall, student performance on the non-fiction novel exams came out slightly higher than on the textbook format exams: 78 versus 76%. This analysis was not possible for the Fall 2010 students, as only non-fiction novels were used.

Medium-term memory effects (cumulative final exams, Fall 2009 class): Table 3 shows independent *t*-tests on performance across the two formats on the cumulative final exam for the Fall 2009 class. As can be seen, there was not much difference in performance from the two formats. There was a trend for better performance on the fill-in-the-blank questions from the non-fiction novel format, and better performance on the multiple choice exams from the Wolfe et al. textbook, but neither of these reached statistical significance. Essays were not included in this analysis because they are broad and cover multiple sensory systems, thus covering both book formats. Table 3 shows performance on all questions from each format type that appeared on the cumulative final exam, thus, the sample sizes (*n*) from the two formats sometimes differ.

Another possible comparison on the cumulative final

exams is across semesters. However, the cumulative final consisted of one multiple choice or one short answer from each lecture, and as I hand back exams for students to keep, too few questions from previous cumulative finals were re-used. Thus, no comparison is possible here. Some of the questions on the cumulative final had been used on unit exams, but this is not a fair comparison because the memory duration is different.

	non-fiction novel	textbook	<i>t</i>	<i>p</i>
multiple choice	65±28% (n=8)	77±23% (n=8)	-0.870	0.399
fill-in-the-blank	82±17% (n=6)	76±17% (n=8)	0.642	0.533
overall	73±24%	76±20%	-0.482	0.634

Table 3. Cumulative final exam cross-format comparison. Fall 2009 class only. Independent *t*-tests were performed.

Long-term memory effects (April cumulative final exam re-take): Most other SoTL publications that use non-fiction novels in courses only report the subjective impressions of students that the use of such books provides a valuable learning experience (Boyatzis, 1992; Neysmith-Roy and Kleisinger, 1997; Banyard, 2000; Norcross et al., 2001; Meil, 2007). In the present SoTL project, long-term memory was objectively measured, with a repeat administration of the cumulative final exam approximately four months later. Students were instructed *not* to study, to test long-term retention. Thus, with no further studying, students remembered more than half of the course material that they were tested on.

For the Fall 2009 semester (see Table 4), an independent *t*-test on exam results for this four-month long-term memory test (in eight students – one student did not return for the four-month re-take) yielded no significant memory benefits from the use of non-fiction novels. Again, sample sizes sometimes differ across formats.

	non-fiction novel	textbook	<i>t</i>	<i>p</i>
multiple choice	52±29% (n=8)	64±26% (n=8)	-0.888	0.390
fill-in-the-blank	51±33% (n=6)	63±32% (n=8)	-0.694	0.501
overall	51±30%	63±28%	-1.148	0.261

Table 4. Long-term (four-month) retention, Fall 2009. Exam performance on cumulative final re-taken four months after the Fall 2009 semester ended. Independent *t*-tests were performed.

For the Fall 2010 class (see Table 5), seven students returned for the four-month re-take. Their data are presented in the middle column of Table 5 (the column to the left of this are the data from Table 4 re-printed). The reduced (although not statistically significant) performance by the Fall 2009 class on the non-fiction novel unit questions is not evident in the Fall 2010 class – in fact, the Fall 2010 class performed significantly better than the Fall 2009 class on questions from these units (these were not identical questions, but on the same topics). The bottom half of Table 5 compares performance by the Fall 2010 class with questions from the units where the Fall 2009

class used the textbook – the Fall 2010 class only used the non-fiction novels. Performance was comparable across the two semesters and formats – thus the apparent reduction in long-term memory following the use of non-fiction novels in the Fall 2009 class is not supported by the performance of the Fall 2010 class.

non-fiction novel units	Fall 2009	Fall 2010	t	p
multiple choice	52±29% (n=8)	75±21% (n=7)	-1.758	0.102
fill-in-the-blank	51±33% (n=6)	66±12% (n=6)	-1.046	0.320
overall	51±30%	71±18%	-2.078	0.048*
textbook units	Fall 2009	Fall 2010	t	p
multiple choice	64±26% (n=8)	76±30% (n=3)	-0.667	0.522
fill-in-the-blank	63±32% (n=8)	57±42% (n=5)	0.280	0.784
overall	63±28%	64±37%	-0.069	0.945

Table 5. Long-term (four-month) retention, comparison between Fall 2009 and Fall 2010 classes. Exam performance on cumulative final re-taken four months after the semester ended. Independent t-tests were performed.

Cross-semester comparison: Analysis of performance across semesters on exam questions that were re-used yielded interesting results. The percentage correct was calculated for each question over all students who took the exams. For questions that had appeared on multiple prior exams, a weighted average was calculated. Results of paired t-tests are shown in Table 6, separately for Fall 2009 and Fall 2010 because different questions were repeated on the exams those two years.

Fall 2009	non-fiction novel	textbook	df	t	p
multiple choice	82±26%	79±18%	7	0.365	0.726
fill-in-the-blank	68±13%	54±29%	6	1.883	0.109
essays	43%	75%	1	-13.99	0.045*
overall	71±23%	68±25%	16	0.584	0.567
Fall 2010	non-fiction novel	textbook	df	t	p
multiple choice	82±19%	66±18%	14	2.830	.013*
fill-in-the-blank	88±19%	66±34%	7	2.527	.039*
essays	83±12%	83±8%	4	0.072	.946
overall	84±18%	69±23%	27	3.597	.001*

Table 6. Exam performance across semesters, on re-used questions, non-fiction novel units only (all units for Fall 2010). Paired t-tests were performed.

Interestingly, in Fall 2009, when the students were more favorable to the non-fiction novel format, the only significant difference was on the essay questions, in the wrong direction. However, in Fall 2010, when the students were less favorable to the non-fiction novel format,

performance on everything other than the essays was significantly better than when these same questions were used in previous years with the Wolfe et al. textbook. End of the semester overall course grades (including exam performance, term paper, discussion participation, etc.) were only slightly higher Fall 2010: Fall 2010 class average = 83%, Fall 2008 = 79%, Fall 2007 = 76%. As the semester grade includes measures of student performance other than exam performance, it does not look like the Fall 2010 class consisted of unusually high-performing students.

Students in the Fall 2009 semester did not perform well on the essay questions regardless of format – I do not know why they performed so poorly this year. Again, this comparison was of the same questions across semesters. For the material covered in these particular questions, I gave essentially the same lectures in 2009 as in previous years – the difference was the reading material.

The Fall 2009 comparisons that failed to reach significance may have been due in part to the low numbers of questions that were repeated across exams, or because of the large variances (around 15-30%). I believe that students learn from their mistakes. Therefore, I do hand back graded exams and let the students keep them. Because of this, I try to reuse questions for less than half of the exam and design new questions for the remainder. Thus, the number of questions available for this analysis is small. The large variances are likely due to the nature of exam construction, where we create some questions we expect all students to get correct and other questions designed to separate out the A students. However, despite the lack of significance, all of these comparisons (except for the essays) were in the direction of superior performance with use of the non-fiction novels, and most did reach significance for the Fall 2010 class.

As a control to show that the Fall 2009 class performed on par with previous years, the same comparisons as in Table 6 were performed for the questions from units using the standard textbook. As can be seen in Table 7, on questions not from the new format, the Fall 2009 students performed comparably to students in previous years (although again lower on the essays). The Wolfe et al. textbook was not used in Fall 2010, thus this comparison was not repeated for that semester.

Fall 2009	textbook (Fall 2009)	textbook (prior years)	df	t	p
multiple choice	68±26%	71±22%	13	-0.420	0.681
fill-in-the-blank	72±21%	69±21%	20	0.977	0.340
essays	67%	81%	2	-0.609	0.604
overall	71±23%	70±21%	37	0.121	0.905

Table 7. Exam performance across semesters, on re-used questions, textbook units only. Paired t-tests were performed.

DISCUSSION

The objective measures in this study yielded promising results. In Fall 2009, when both book formats were used, most cross-format comparisons did not yield significant

results. As mentioned above, some of the failure to obtain significant results may have been due to low numbers of reused questions and the high variability inherent in exam construction when we attempt to separate the good from the mediocre students. However, in Fall 2010, when only non-fiction novels were used, significant improvements in exam performance were seen over prior years when only a textbook had been used (see Table 6). These improvements were from comparisons of performance on the exact same exam questions.

One of the goals of the current study was to increase student interest through increasing the concreteness of the course material. Student reports of how well the course stimulated their interest in Sensation and Perception was significantly higher than when non-fiction novels were not used (Table 1, question #12). Although not all of the non-fiction novels were judged by the students to be more concrete than the textbook (Figure 1, top panel), all showed trends of being more interesting. Other SoTL studies have used methods other than non-fiction novels to increase the concreteness of the material being taught. Raphelson (1987) used slides and found that performance on a slide recognition test correlated with exam performance, but he did not assess whether the use of slides improved performance. Anderson (1992) used feature films to help students increase their understanding of forensic psychology. Burkley and Burkley (2009) used clips from the television program *Mythbusters* to illustrate research methods concepts, and found that they did improve exam performance for the concepts addressed by these clips.

Another goal of the current study was to show students that reading can be fun. Reading time experiences competition from time spent on the computer and watching television. Liu (2005) found that 113 survey respondents, ages 30-45 years, are reading more now (computer and print formats) than ten years ago. However, much of this increase is the reading of electronic sources, where readers are more likely to skim, browse, or search for keywords, and less likely to concentrate on reading extensive passages. Koolstra and van der Voort (1996) found that television viewing negatively affects children's ability to concentrate on reading. Thus, the skill of sustained attention while reading is being lost, another reason for the need to encourage more book reading.

The evaluations from the Fall 2010 class, when only non-fiction novels were used, revealed that the students felt it was more difficult getting basic sensation and perception information from the non-fiction novels than it would have been from a textbook (although their exam performance in Table 6 does not support their fears). As the book format changed over the years from all textbook to mixed, to all non-fiction novels, there was a non-significant decrease in the student assessment of the suitability of the book assigned for the class (Table 1, question #2). On the course evaluations, some students suggested usage of a mixture of textbook and non-fiction novels, perhaps even just reading excerpts from the novels. Students who prefer textbooks state that the information is clearer and more straightforward, while those

who prefer the non-fiction novels say that they are more interesting, more exciting, easier to read, and "give me anecdotes I can pull up during tests." (The latter comments are consistent with research that has shown that allocation of attentional resources is automatic and less effortful with more interesting reading material [McDaniel et al., 2000].) However, requiring both formats would make the course prohibitively expensive for students (the non-fiction novels in Fall 2009 were purchased through a grant from Great Lakes College Association Pathways to Learning Collegium, a program funded by the Teagle Foundation). Instead, next year I will post my lecture notes for students to access, a practice I have not been engaging in, to see if this makes them more comfortable in being able to find the basic facts they are seeking. In the Fall 2010 class, the students were not reading the non-fiction novels consistently throughout the semester. Thus, next year I will give frequent reading quizzes. My intent in assigning these books was to give the students a cohesive, concrete story on which to hang the facts I present in lecture. If they are not reading the books, they do not have this scaffolding.

Although the results were mixed between the two classes on whether the use of non-fiction novels improved retention of material, 68% of the nineteen students reported that reading the biographies made them want to learn more about our sensory systems. Facts are easy to look up, especially via the internet. Enduring interest is harder to generate. Hidi and Renninger (2006) proposed a four-phase model for the development of interest. First is *triggered situational interest*, an externally driven spark that can capture a person's interest in the short term. The second phase is *maintained situational interest*, where the spark is still external, but interest is maintained due to meaningfulness or personal relevance of the material. Phase three is *emerging individual interest*, where the spark of interest begins to be internalized. Finally, if interest is really captured, people reach phase four, *well-developed individual interest*, where the spark is internally motivated and endures for a long time. The subjective student responses in the current SoTL indicate that the students' interest in our sensory systems may have reached phase three, emerging individual interest. Thus, this increased intrinsic motivation for future exploration of the senses may be one of the more powerful outcomes of this project. Given the highly significant increase in stimulation of student interest, and the significant increases in objective exam performance seen in the Fall 2010 class (Table 6), the use of non-fiction novels in addition to or instead of a standard textbook is recommended. Whether these students reach phase four of interest development, well-developed individual interest, will have to await a 5- or 10-year follow up study.

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Appendix: Non-fiction novels and articles used

book	article
<i>The Island of the Colorblind</i> Oliver Sacks 1998	Sundin OH, Yang J-M, Li Y, Zhu D, Hurd JN, Mitchell TN et al. (2000) Genetic basis of total colourblindness among the Pingelapese islanders. <i>Nature Genetics</i> 25:289–293.
<i>The Emperor of Scent</i> Chandler Burr 2004	Keller A, Vosshall LB (2004) A psychophysical test of the vibration theory of olfaction. <i>Nature Neuroscience</i> 7(4):337-338. Editorial on this article, p. 315 of the same issue.
<i>Beyond Pain</i> Angela Mailis-Gagnon and David Israelson 2005	Bannon AW, Gunther KL, Decker MW (1995) Is epibatidine really analgesic? Dissociation of the activity, temperature, and analgesic effects of (±)-epibatidine. <i>Pharmacology, Biochemistry, and Behavior</i> 51(4):693–698.
<i>Rebuilt: My Journey Back to the Hearing World</i> Michael Chorost 2005	Müller M, vonHünerbein K, Soidis S, Smolders JWT (2005) A physiological place-frequency map of the cochlea in the CBA/J mouse. <i>Hearing Research</i> 202:63–73.
<i>Pride and a Daily Marathon</i> Jonathan Cole 1995	Ingram HA, vanDonkelaar P, Cole J, Verche J-L, Gautheir GM, Miall RC (2000) The role of proprioception and attention in a visuomotor adaptation task. <i>Experimental Brain Research</i> 132:114–126.
<i>The Psychology of Eating and Drinking</i> Alexandra Logue 2004	Rozin P (1967) Specific aversions as a component of specific hungers. <i>Journal of Comparative and Physiological Psychology</i> 64(2):237–242.

NOTE: The Logue book, although quite interesting, is a textbook. I have since learned of *Tastes of Paradise* (Schivelbusch, 1993) and will use this next fall instead.

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