The locus of the myside bias in written argumentation

Christopher R. Wolfe
Miami University, Oxford, OH, USA

M. Anne Britt
Northern Illinois University, DeKalb, IL, USA

The myside bias in written argumentation entails excluding other side information from essays. To determine the locus of the bias, 86 Experiment 1 participants were assigned to argue either for or against their preferred side of a proposal. Participants were given either balanced or unrestricted research instructions. Balanced research instructions significantly increased the use of other side information. Participants' notes, rather than search patterns, predicted the myside bias. Participants who defined good arguments as those that can be "proved by facts" were more prone towards the myside bias. In Experiment 2, 84 participants of high and low argumentation ability read a text called "More Than Just the Facts" designed to contradict this fact-based argumentation schema. For high argumentation ability participants, the intervention reduced the myside bias, but for low ability participants it increased. The roots of the myside bias are underdeveloped argumentation schemata leading to misconceptions about research and argumentation.

At the heart of a good argumentative essay is a debatable thesis (Axelrod & Cooper, 1996; Hacker, 1994; Rottenberg, 1994). If the thesis of a written argument is obvious, banal, or widely accepted then there is no need for a persuasive essay (e.g., Druckart, 2006; Purdue University Online Writing Lab, 2006; Stevens, 2006). Similarly, if the thesis is universally perceived as untenable then no amount of argumentation will lead to persuasion.

The very nature of argumentative essays implies the potential for credible opposition and reasonable arguments on two or more sides of the issues. Thus, sophisticated writers (and readers) of arguments must consider a number of perspectives including those that support the positions being taken—myside—as well as other sides of the argument. Other side arguments present challenges to the authors of persuasive essays. Yet many student authors fail to address other sides of arguments, and thus exhibit what has been referred to as the myside bias (Baron, 1991, 1995; Perkins, 1985; Perkins, Bushey, & Farady, 1983; Perkins, Farady, & Bushey, 1991; Toplak & Stanovich, 2003).

The myside bias was first identified by Perkins and his colleagues (Perkins, 1985, 1989; Perkins et al., 1986, 1991) and has been studied by a number of researchers for more than two decades. Perkins uses the phrase myside bias to describe a tendency to ignore evidence against a position that a person already favours. However, it has been difficult to disentangle a phenomenon embodied in the myside bias from the underlying psychological mechanisms purported to lead to the myside bias, particularly in the context of argumentation.

When developing written arguments, skilful writers address positions on the other side of an issue whereas less skilful writers do not. For example, if we wrote an essay arguing that the death penalty should be abolished, it would suffer from a myside bias if we failed to address any arguments in favour of the death penalty. Skilled writers have a sense of their audience and know that they need to address certain issues. In addition to being open minded, authors include other side arguments for the following reasons, to rebut them, to increase author credibility, and to minimise the impact of other side points by framing them in the best possible light. Yet in our previous research, between half and two thirds of college student research participants consistently fail to include other side information in their argumentative essays (Wolfe & Britt, 2005). This finding is interesting, particularly when contrasted with "authentic" published essays.

Wolfe and Britt (2005) found that authentic arguments—those published for the purpose of persuading a real audience as distinct from materials developed for the classroom or the laboratory—generally included other side information. They conducted a content analysis of 35 published essays, 13 longer essays recommended by *New York Times* columnist David Brooks as the Hookie Awards, and 22 *USA Today* Editorials and Opposing Opinion pieces. These essays represented a range of ideological and disciplinary perspectives. Of the Hookie Award essays, 93% contained other side information. Of the *USA Today* editorials, 100% contained other side information, and of the shorter *USA Today* Opposing Opinion pieces, 70% contained other side information. Thus, the vast majority of these authentic written arguments included other side information (in other

words, very few exhibited the myside bias). Typically, the purpose of including other side information in the essays was rebuttal.

According to the typical operational definition of the myside bias, it occurs when research participants generate more arguments (reasons) in favour of a position they support than reasons on the other side (Perkins, 1985; Perkins et al., 1991; Toplak & Stanovich, 2003). For example, Toplak and Stanovich (2003) asked undergraduate participants to generate arguments on both sides of three issues. They found that people consistently generated more myside arguments than other side arguments. They also found that the discrepancy between the number of myside and other side arguments diminished significantly with years of education. However, Perkins (1985) found little change in the proportion of other side arguments generated as a result of educational experiences including high school, undergraduate liberal arts education, debate class, or even graduate school.

In two experiments on informal or everyday reasoning Perkins et al. (1986) found significant positive correlations between general intelligence, as measured by Quick Word scores, and myside arguments, but practically no correlation between general intelligence and the generation of other side arguments. Indeed, Baron (1991, 1995) found that many people expressed beliefs that one-sided arguments are better than two-sided arguments. Perkins and Tishman (2001, p. 234) ask, "Why, then, do student lawyers with high IQs and training in reasoning that includes anticipating the arguments of the opposition prove to be as subject to confirmation bias or myside bias, as it has been called, than anyone else?"

In research on informal reasoning, the argument generation task can be quite useful in elucidating biased reasoning. However, with respect to written argumentation, it is not at all clear that the tendency to generate more arguments on myside is an adequate definition of the myside bias, or if it even constitutes a bias of any kind. Indeed it would be surprising and generally counterproductive for authors to write more other side arguments than myside arguments. An argument is, at minimum, a claim supported by data (Toulmin, 1958) or "reasons" in the parlance of Voss and his colleagues (Voss, 2005; Voss, Fincher-Kiefer, Wiley, & Silfes, 1993). In the case of written argumentation, it is probably adaptive to present more and better reasons on the myside of an issue. Our approach is to define the myside bias in written argumentation as the failure to include any reference to other side arguments or positions. Thus, essays that rebut, contest, or concede other side arguments would not be guilty of the myside bias, nor would those that have more arguments on one side than on another side. For these reasons, the phenomena we identify as the myside bias in argumentation involves entirely excluding other sides from argumentative essays.

It may be useful to highlight the distinction between two related yet distinct settings in which the myside bias has been observed: informal reasoning and argumentation. To illustrate, consider the idea of entering voters into a million dollar lottery to increase voter turnout. In the case of informal reasoning, a person may reason about the desirability of this particular policy or course of action. Here a reasoner ought to spend considerable effort developing a rich model of the situation (Perkins, Allen, & Hafner, 1983) and could be considered guilty of the myside bias if she or he failed to consider the positive and negative consequences of such a policy regardless of his or her initial position. In the case of writing argumentative essays, however, although authors occasionally write to discover a thesis, it is presumed that one has already arrived at a position (based on personal belief, the dictates of an assignment, financial incentive, or some other motive) and that the purpose of the argumentative essay is to advance that position. Thus it would be quite reasonable for an argumentative essay to have more and better arguments on the myside rather than the other side. However, it would be problematic for the author to ignore the other side completely. While the optimal mix of myside and other side arguments is affected by a variety of factors including the topic, intended audience, context, style, and objectives, a complete lack of other side information is generally problematic and thus a good way to operationalise the myside bias in the context of written argumentation.

The primary question that we sought to address in this research concerns the locus of the myside bias in argumentation. It may be that the locus of the myside bias is a confirmation bias meaning the suboptimal tendency to look for data that confirms one's hypothesis rather than data that might falsify it, or the belief that one-sided argument is better (Baron, 1991, 1995). We sought to address these empirical questions by examining the conditions under which writers of argumentative essays fail to include any other side information in their essays. The empirical research literature suggests several possible explanations for the myside bias in argumentation. Biased research strategies, the notion that people may be biased in the information they seek out prior to writing essays, represents a possible locus of the myside bias. Wolfe (1995) found systematic biases in search strategies in the context of probability problems. A particular search bias is the confirmation bias, the idea that people generally restrict their research to sources of information on their side of an argument. Although the veracity of the confirmation bias has been effectively challenged (see Evans, Newstead, & Byrne, 1993) some researchers continue to believe that "human beings have a fundamental tendency to seek information consistent with their current beliefs, theories or hypotheses and to avoid the collection of potentially falsifying evidence" (Evans, 1989, p. 41). The notion of a confirmation bias suggests that the locus of the effect may be a biased research process in favour of information

that confirms the myside of an argument. It may be that when conducting research many authors only look for information that supports, rather than opposes, their positions.

Is the myside bias a matter of personal belief or does it generalise to externally assigned positions? Whether rooted in research, planning, or writing, it is unclear whether the bias is one of private beliefs; i.e., a bias towards positions with which one personally agrees, or whether the bias holds even when an author is asked to write an essay in favour of a position that he or she personally opposes. In other words, the locus of the bias may be an aversion to sources advancing claims with which they disagree. The second hypothesis is that the locus of the myside bias is personal belief; that people tend to include only claims and reasons with which they personally agree (Nussbaum & Kardash, 2005).

A misconception about the nature of argumentation is a third hypothesis; that some people think they should not "let on" that there is another side of an issue. It may be that the locus of the myside bias is "beliefs about thinking" (Baron, 1991, 1995); the notion that other side information weakens the case. In a similar vein, it may be that many people have weak, underdeveloped, or faulty argument schema, i.e., beliefs and expectations about what makes a good argument. Some individuals may have a fact-based argument schema, emphasising the need for factual support to the exclusion of considerations such as counterarguments. When writing argumentative essays, individuals with poorly developed argument schemata may exclude other side information from their arguments (i.e., exhibit the myside bias) either because they erroneously believe that other side information would weaken the essay, or because in preparing to write the essay they fail to register counterarguments and generate strategies to rebut them.

OVERVIEW OF THE EXPERIMENTS

Having identified some potential sources of the myside bias in the empirical literature we conducted two experiments to ameliorate the bias. In Experiment 1 we brought individual participants into the laboratory and introduced them to a Web-based research environment where they conducted research by selecting Web pages to visit from a menu, and took notes, before writing argumentative essays. We could thus see what they chose to read, what went into their notes, and what they wrote in their final essays. We experimentally manipulated both the research instructions and the essay assignment to test various explanations of the myside bias. To test the hypothesis that the bias is rooted in personal beliefs, we designed materials to elicit one-sided personal beliefs. The proposal was for a 2-year math requirement for every student at the university (see Appendix A).

This topic was created and piloted based on three criteria: (a) The domain or theme does not require any specialised knowledge; (b) it is written in a way that few, if any, participants would agree with, enabling us to "tease apart" the effects of personal belief as opposed to side assigned; and (c) it is, none the less, possible to generate eight relatively strong arguments in favour of the proposal and eight against it.

In Experiment 2 we used the same materials under conditions very favourable for including other side information to further test two hypotheses about the locus of the myside bias. Participants read a text called "More Than Just the Facts" designed to contradict a fact-based argumentation schema identified in Experiment 1. We provided participants of high and low argumentation ability with brief lessons in a laboratory environment. The intervention texts were designed to reduce the myside bias by addressing either a fact-based argument schema or the suboptimal belief that other side arguments are unimportant.

EXPERIMENT 1

Our basic approach to this experiment was to use a $2 \times 2 \times 2$ experimental design with additional post hoc measures to address specific research questions. Because the myside bias in informal reasoning has been described as a confirmation bias (Perkins & Tishman, 2001) we made particular efforts to manipulate the conditions under which authors searched for information on the topic. If participants are biased towards researching only on the side they are assigned to support, then assigning the side (pro or con) after the research phase should reduce or eliminate any bias in research, since participants are not sure which side they will be arguing for—which in turn should reduce the myside bias in the essays. If biased search is the locus of the myside bias then instructions to conduct a balanced search on both sides of the issue should reduce search bias, and therefore the myside bias in the essays. Thus, crossed with when the essay was assigned were research instructions to conduct either a balanced search or simply to read as many or few sources as they deemed necessary to write the essay.

Crossed with both of these variables, half of the participants were assigned to the popular con side, arguing against the math requirement, and the other half were assigned to the unpopular pro side arguing for the requirement. If the locus of the myside bias in essays is personal beliefs then the myside bias should differ by side assigned, increasing when participants are assigned to a side they agree with, and reduced or eliminated when they are asked to write essays against positions they hold themselves. Of these eight experimental conditions, being assigned to the con side before the research phase with instructions to search for as many or few sources as necessary may be considered the typical essay condition. Here, one knows

what one is writing about in advance and is writing to support claims with which one agrees. The other conditions are manipulations designed to reduce the myside bias depending on the locus of the effect.

Although biased research may be an explanation for the myside bias in essays, it is also possible that participants are relatively unbiased in their search for information, but selective in how they use the information they find. It may be that some participants seek out information on both sides of an issue but consider only myside information as important and thus only include myside information in their notes. Finally, the experimental manipulations, and other factors outlined below, may impact essay writing directly without the mitigating influence of search or note-taking behaviour.

After the other tasks were completed (including a filler task), we asked participants to provide a brief, written answer to the question "What is a good argument?" We hypothesised that some participants would include other side information in these descriptions such as a need to be "fair to both sides" and to "look at all sides of an issue." We hypothesised that those participants who explicitly mentioned other side information would be less likely to exhibit the myside bias. We also hypothesised that some participants reason with a "fact-based" argumentation schema. In essence, people reasoning with a fact-based argumentation schema view argumentation largely as a matter of simply stating facts, with the side having the most facts "proving" that one side is right. In thinking about argumentation, some people emphasise factual support to the exclusion of important considerations such as audience, rhetoric, and other side arguments. This is a simpler schema than the more sophisticated view of "support" or "evidence" for claims and assertions that characterises more complex thinking about argumentation. As Kuhn and Udell (2003) note, such an "evaluativist" epistemology develops relatively late. We hypothesised that this fact-based schema may lead to the myside bias. Thus we coded the responses to this open-ended question for the words "fact, facts, and factual" and compared the performance of those who provided evidence of a fact-based argumentation schema with that of those who did not.

In sum, this experiment tested five questions about the locus of the myside bias in written argumentation. First, is the myside bias a bias of personal belief, or a bias towards whichever side of an issue a person is assigned to support? Second, is the locus of the myside bias an unwillingness to look at other side information? Third, is the myside bias a function of an attentional or selection bias? Do some authors only include myside information in their preparation notes? Fourth, do some people harbour the suboptimal belief that other side information is unimportant, thus exhibiting the myside bias? Finally, do some individuals have a fact-based argumentation schema, and if so, does it account for the myside bias?

Method

Participants.   A total of 86 native English-speaking students from an introductory psychology class at Miami University participated for partial course credit.

Materials.   A total of 16 "web-based arguments" argued for or against a position on a controversy that students would find engaging and would lead almost everyone to the same side: Miami University should impose a 2-year math requirement for all students that includes at least two semesters of calculus and another year of mathematics training in linear algebra and number theory (see Appendix A). Half of the Web-based arguments supported the math proposal and half argued against it. These experimenter-produced arguments were concise, ranging from 65 to 151 words ($M = 103$). Each argument included a single well-elaborated reason to support its stance on the controversy. Each reason was backed with additional elaboration or evidence and presented from the standpoint of a stakeholder such as students, faculty, staff, alumni, and potential employers (see Appendix B for sample arguments). The arguments were presented in a Web environment starting with a source selection page that was a clickable table of contents listing the sources and restating the controversy (see Appendix C). The source included the author's name, author's credentials, and a three- to four-word overview of the argument. A click on the source link took the reader to the text of the argument, and only one argument could be displayed at a time.

Design.   This study employed a $2 \times 2 \times 2$ between-subjects design (balanced or unrestricted search instructions by supporting pro or con side by assigning side before or after research). Half of the participants were given balanced search instructions and the other half were given instructions to search for as many of few links as they wished. The unrestricted instructions read "You may follow as many or as few links as you wish" and the balanced instructions said "Read enough information so that you have a balanced understanding of the issue, including both pro side and con side positions. You may follow as many or as few links as you wish, but be sure to read information both in favour of the proposal and opposed to the proposal." Crossed with this factor, half of the participants were assigned to the popular con side, against the math requirement, and half were assigned to the unpopular pro side, in favour of the math requirement. Finally, crossed with both of these factors, half of the participants were assigned a side (pro or con) after they conducted their Web-based research, and the other half were assigned a side before conducting the research.

Procedure.   After giving their informed consent, participants read the proposal about the math requirement on-line and gave their opinions on the controversy on a 6-point agreement scale (see Appendix A). After reading the search instructions (balanced vs unrestricted) and reading the side they were to argue (pro vs con) in the before conditions, participants used a pull-down menu to determine the order of links on the source selection table of contents. They could choose to have the links in a random order, alphabetical order, pro to con order or con to pro order. Participants followed the links of their choosing, read the arguments, and took notes on sheets of paper provided by the experimenter. When participants felt they had done enough research they clicked on a link to continue. They were asked again to rate their personal agreement with the proposal on a 6-point scale. Participants were then asked to write an essay with only their notes available, taking the assigned position on the controversy. Participants typed their essay into the computer. The specific instructions were to "Use this page to write a brief essay of 200 – 1000 words (1 to 4 pages). You may refer to your notes but you may not return to the Web. Be sure to SAVE your changes frequently. Below is the wording of the proposed math requirement. Start your essay below the proposal."

The quality of essays was measured blind to condition with a rubric assessing argumentation and knowledge. Argumentation was assessed by the number and completeness of the arguments presented. The highest score was awarded to an essay with three or more arguments each consisting of a claim, supporting reason, and an explicit statement of the warrant explaining how the reason supports the claim. Essays with fewer arguments or with the warrant unstated systematically received lower scores. Knowledge was evaluated by the number of claims from the Web-based sources included in the essay, with the presence of at least one other side claim weighed higher.

Participants were then given additional tasks as part of an unrelated experiment. Next they were asked the open-ended question "What makes a good argument?" Participants were then asked to rate their agreement with the proposal for a third and final time. After completing the experiments participants were thanked and debriefed.

Results

Our procedure enabled us to examine a number of related variables. First, we were able to record which pages the participants visited including pro and con side arguments. We performed an analysis of their notes without knowledge of experimental condition. We also conducted an analysis of essays. This was also done blind to condition. Two judges independently

scored 40% of the essays and we established a high global level of inter-rater reliability, $IRR = 95\%$.

Participants typed essays averaging 470 words ($SD = 185$), corresponding to about one typed single-spaced page using 12-point font. The essays argued either for or against the math proposal depending on experimental condition. As an overview, it is useful to start with the incidence of the myside bias in the essays. The experimental condition most closely resembling those under which people typically write essays is the con side (that participants personally agreed with) assigned before research (rather than after they searched for information) under instructions to read as many or few essays on the topic necessary (as distinct from balanced search instructions). In this condition 50% of the participants included other side information and thus 50% exhibited the myside bias in their arguments. In the whole sample including all conditions, 52 of 86 essays contained other side information and thus 40% of the essays exhibited the myside bias. Thus the rate of the myside bias under typical essay conditions is comparable to that in our previous experience, and the overall rate is slightly lower.

Participants rated their agreement with the proposal on a 6-point scale three times, after their initial reading, after research, and after they had finished writing their essays. The scale ranged from 1 = Strongly Agree to 6 = Strongly Disagree (see Appendix A). Nearly all participants stayed on the negative side of the scale throughout the experiment, indicating that we were successful in generating an almost universally unpopular proposal. A total of 52% endorsed the rating 6 (strongly disagree) 36% rated their agreement as a 5, and 9% rated their agreement as a 4. Only two participants (2.3%) rated the proposal favourably, with one rating of 3 and one rating of 2. Excluding these two participants did not significantly change any results and their data were included in all analyses.

Of the 86 participants, 15 selected to have the links on the clickable table of contents in random order, 2 in alphabetical order, 40 in pro to con order, and 28 in con to pro order. The order was not recorded for one participant. Menu order was not predicted by experimental condition and did not predict any outcome measure.

The hypothesis that the locus of the myside bias is an unwillingness to read other side information was not supported by the data. All but one participant, 99%, visited one or more other side site, every site was visited by more than 80% of the participants, and all visited myside sites. Participants in the before conditions visited about as many other side sites, with a mean of 7.047 of 8 sites, than those in the after conditions, with a mean of 7.209 of 8 sites, $F < 1$. Nonetheless, in the before conditions, pro side participants visited more pro sites, averaging 7.68 of 8 sites, compared with an average of 6.38 of 8 con sites, $F(1, 41) = 6.67$, $p = .014$. In the before

conditions, con side participants visited more con sites, with a mean of 7.76 of 8 sites, whereas they visited a mean of 6.50 of 8 pro sites, $F(1, 41) = 5.69$, $p = .022$. These results suggest that participants are somewhat more inclined to search for information on the side to which they were assigned. However, all of the participants visited most of the sites on each side, suggesting that a lack of access to information about other side arguments is not the locus of the myside bias. The fact that the rate of search was about the same for the popular con side and unpopular pro side also suggests that any search bias is not a function of personal beliefs.

Turning to the essays, two judges independently scored the number of pro and con claims, reasons, and warrants in the essays and the judges agreed on 95.1% of their judgements. The plan of analysis was to first look at the global effects of manipulations with a 2×8 chi-squared followed by three 2×2 chi-squared examining the effects of search instructions, side assigned, and when the side was assigned. The global $\chi^2(7) = 14.07$, $p < .05$ indicated that the manipulations had a significant effect on the myside bias. To determine the specific locus of this effect we conducted three separate chi-squared analyses. The balanced search instructions led to a significant reduction in the myside bias (see Table 1). With the many or few search instructions, 50% of the participants exhibited the myside bias (50% in the before and after conditions) whereas significantly fewer, 27.5%, did so with the balanced search instructions (16% in the before and 38% in the after conditions), $\chi^2(1) = 4.53$, $p < .03$. These data suggest that a simple pedagogic intervention encouraging a balanced understanding can significantly reduce the myside bias. Neither side assigned (pro or con) or when assigned (before or after research) was significant, with each $\chi^2(1) < 1$.

TABLE 1
Percentage of essays without any other side information: The myside bias

	Many or few search instructions			Balanced search instructions			Total		
	Pro	Con	Total	Pro	Con	Total	Pro	Con	Total
Side assigned before research	50% n=12	50% n=12	50% n=24	30% n=10	0% n=9	16% n=19	41% n=22	27% n=21	35% n=43
Side assigned after research	33% n=9	62% n=13	50% n=22	55% n=11	20% n=10	38% n=21	45% n=20	44% n=23	44% n=43
		Total			Total			Grand total	
	Pro	Con	Total	Pro	Con	Total	Pro	Con	Total
	43% n=21	56% n=25	50% n=46	43% n=21	11% n=19	28% n=40	43% n=42	36% n=44	40% n=86

These data suggest that the locus of the myside bias is not personal belief. Participants assigned to the unpopular pro side exhibited slightly, but not significantly, more of the myside bias than those assigned to the side they agreed with. Assigning the side after participants conducted research also did not reduce the myside bias in the essays. Indeed slightly, but not significantly, more participants assigned the side to support after research exhibited the myside bias than those assigned the side before research.

To examine the interactions among manipulations, the myside bias was treated as a continuous variable and the effects of search instructions, side assigned, and when the side was assigned was measured with a $2 \times 2 \times 2$ ANOVA. Once again, the balanced search instructions significantly reduced the myside bias compared to the unrestricted many or few search instructions, $F(1, 78) = 4.96$, $p < .03$. Side assigned and when the side was assigned were not significant, $Fs < 1$. There was also a significant interaction between side assigned and search instructions, $F(1, 78) = 5.07$, $p = .027$. Those assigned to the popular con side (with which they agreed) were much less likely to exhibit the myside bias under balanced search instructions. Under the standard many or few search instructions, 56% of the con side participants exhibited the myside bias, whereas only 11% of the con side participants did so with balanced search instructions. Participants assigned to the unpopular pro side exhibited the same rate of the myside bias regardless of search instructions. The interaction of when the topic was assigned by search instructions interaction was not significant, $F(1, 78) = 1.45$, $p = .23$, and the other interactions were also not significant, $Fs < 1$. These analyses provide further evidence of the effectiveness of the balanced search instructions for reducing the myside bias in the essays— particularly under the typical condition of writing to support a position with which one personally agrees.

To examine the influence of note-taking behaviour on the myside bias notes were coded for the presence of pro and con side claims, reasons, and warrants blind to condition or task performance on the essays, and two judges independently scored 40% of the participants' notes. The judges agreed on 94.5% of their judgements. Only the before, "many or few" conditions (both pro and con) show many participants without any other side information in their notes, significantly less than other conditions. A total of 42% of the before, many or few participants had no other side information in their notes, versus only 4% of participants in the other conditions.

The lack of other side information in the notes was a good predictor the lack of other side information in essays. Of participants without other side information in their notes, 79% exhibited the myside bias in their essays. Of those with other side information in their notes 35% exhibited the myside bias in their essays, $\chi^2(1) = 6.15$, $p = .01$.

A post hoc multiple regression analysis adds the presence or absence of other side information in the notes and the number of other side Web pages visited to the three manipulations in predicting the myside bias in the essays. These results showed that search instructions had a significant predictive effect, $t(80) = 2.04$, $p = .045$, independent of the other side information in the notes which was also significant, $t(80) = 2.09$, $p = .040$. None of the other variables was significant. Both the balanced search instructions and assigning the side after research sharply reduced the proportion of participants who failed to include any other side information in their notes. This suggests that many participants have a tendency to conduct research from both pro and con sources, but to "mine" those sources for information on the side to which they were assigned. This tendency can be mitigated by either assigning side after the research phase of the project, or by simply providing balanced search instructions, instructing participants to "read enough information so that you have a balanced understanding of the issue, including both pro side and con side positions".

A belief in the importance of other side information also predicted the inclusion of other side information in the essays. At the end of the experiment, participants were asked what made a good argument, and whether including information from the other side was important. Of those who endorsed the proposition that other side information is good, 72% included other side arguments in their essays, and of those who did not endorse the proposition, 48% included other side information, $\chi^2(1) = 5.23$, $p = .022$. The rate of endorsing this proposition was not affected by any of the manipulations, nor was there an association between including other side information in the notes and endorsing the proposition that other side information is good.

We also examined participants' open-ended responses for evidence of a fact-based argumentation schema. A large number of participants, 22 of 86 or 25%, made reference to facts in their response. For example, one participant wrote, "A good argument is one that has plenty facts to back it up. Anyone can be won over if there are enough facts." We coded each of the open-ended responses to the question "What makes a good argument?" for the presence or absence of the words "fact, facts, or factual", blind to their responses to the essay prompt. We then looked at the relationship between exhibiting the myside bias in the essays with the presence or absence of the word "fact" in the descriptions. We found those excluding other side information from their essays were more than twice as likely to mention facts in their description of what makes a good argument, a significant difference $\chi^2(1) = 4.53$, $p < .05$. Of those who included other side information (and thus did not exhibit the myside bias) 8 of 35 (23%) mention "fact" in their description of what makes a good argument. Of those exhibiting the myside bias, 14 of 29 (49%) mentioned "fact" in their descriptions of a good

argument. The rate of including the word "fact" in descriptions of what makes a good argument was not affected by any of the manipulations, nor was the association between including other side information in the notes and having the word "fact" in the description of a good argument. This suggests that a fact-based argument schema also contributes to the myside bias.

Quality of the essays

The quality of essays was measured blind to condition with a rubric assessing argumentation and knowledge. Argumentation was assessed by the number and completeness of the arguments presented with a high score corresponding to an essay with three or more arguments each consisting of a claim, supporting reason, and an explicitly stated warrant connecting the reason to the claim. Knowledge was reflected by the number of claims from the Web-based sources included in the essay. Two judges independently rated 40% of the essays with the scoring rubric and agreed on 87.5% of their judgements.

With respect to argumentation, there was a significant effect for side assigned. Participants assigned to the con side produced significantly more arguments and their arguments were better elaborated than those assigned to the unpopular pro side, with a mean score of 16.93 (1.98) for con and 15.91 (2.00) for pro, $F(1, 78) = 5.51$, $p = .021$. Search instructions, when the side was assigned, and the interactions were not significantly associated with argumentation score.

With respect to knowledge scores, search instructions and the side assigned by search instructions interaction were significant. Side assigned alone was not significant, $F < 1$. Overall, essays written under balanced search conditions scored a mean of 18.4 (1.55) on knowledge and those with unrestricted "many or few" search instructions scored a mean of 17.7, $F(1, 78) = 4.49$, $p = .037$. The interaction between side assigned and when the side was assigned was significant, $F(1,78) = 4.03$, $p = .048$. Participants in the con balanced search condition had a mean knowledge score of 18.90 (1.63), those in the con many or few search condition had a mean knowledge score of 17.52 (1.56), those in the pro balanced condition had a mean of 17.95 (1.36), and those in the pro many or few condition also had a mean of 17.95 (1.63). For those assigned to the pro side the search instructions did not affect knowledge but for those assigned to the con side balanced search instructions helped improve knowledge score.

Considering the overall quality of the essays as measured by total score, participants given balanced search instructions wrote essays that scored significantly higher on total quality. With the balanced search instructions,

participants had a mean total quality score of 42.3 (3.59) and with the many or few search instructions, participants had a mean total quality score of 40.74 (3.26), $F(1, 78) = 4.77$, $p = .032$. These results suggest that the search instructions had a significant effect on the essays—despite a relatively smaller impact on search behaviour. Overall, participants assigned to the con side wrote higher-scoring essays, with a mean of 42.23 (3.50), than those assigned to the pro side, with a mean of 40.67 (3.32), $F(1, 78) = 5.55$, $p = .021$. When participants were assigned was not significant, $F < 1$, nor were the interactions. Thus, participants wrote better essays on the con side even though side assigned did not affect the myside bias. Indeed, participants wrote significantly longer essays on the con side with a mean of 549 words ($SD = 206$) compared to the pro side mean of 288 words ($SD = 115$), $F(1, 78) = 22.40$, $p < .0001$. None of the other manipulations significantly affected essay length.

Discussion

The empirical literature suggests several hypotheses about the locus of the myside bias in argumentation and data from Experiment 1 shed light on these hypotheses. Contrary to a biased search hypothesis, participants generally looked at sources on both sides of the controversial proposal. The number of other side sources read was not associated with excluding other side information from the essays. Moreover, the bias is not confined to the side participants personally favoured. Rather, the bias was found on whichever side participants were assigned to support. This contributes to our understanding of the myside bias and suggests that people's ideas about argumentation, rather than their ideas about particular controversies, are the locus of the myside bias.

Participants wrote longer and better essays on the popular con side, yet the fact that both pro and con participants in the before, many or few conditions failed to include other side information in their notes. This suggests that the myside bias is more than a bias towards information that confirms one's personal beliefs. Rather, it appears that these participants thought that this was appropriate to the task at hand regardless of their own personal opinions. The myside bias is rooted in both misconceptions about the nature of argumentation and the purpose of research. Participants who fail to include other side information in their notes also tend to fail to include other side information in their essays. Participants who do not endorse the proposition that good arguments include other side information tend not to include other side information in their essays. This suggests that questionable "beliefs about thinking" (Baron, 1991, 1995) accounts for some of the myside bias in argumentation. These effects are independent of one another.

Balanced search instructions significantly reduce the myside bias in essays. However, promoting the inclusion of other side information in the notes by assigning side after the research phase does not reduce the myside bias in essays. It appears that balanced search instructions reduce the myside bias by inducing a more fully elaborated argumentation schema. A simple reminder about including pro and con sides of an issue appears to be effective for participants who already have a relatively sophisticated argument schema. Yet interventions to reduce the myside bias should address misconceptions about both research and beliefs about the nature of good arguments. Participants begin developing their arguments well before they begin writing, indicating that interventions early in the process are likely to be most effective.

About a quarter of participants showed evidence of a fact-based argumentation schema in their response to the question "What makes a good argument?" These participants were significantly less likely to include other side information in their essays than other participants. The essence of the fact-based argumentation schema is that a claim is good if it can be "proved by facts". For people with this belief, facts and support are treated uncritically. The intended audience is not part of the schema and thus ignored. More importantly, arguments and information that may support another side are not part of the schema and are also ignored.

EXPERIMENT 2

Experiment 1 suggests that a fact-based argument schema may account for some of the myside bias in argumentation. Questionable "beliefs about thinking" (Baron, 1991, 1995) that fail to recognise the value of two-sided arguments was another explanation. In Experiment 2 we sought to develop simple educational interventions based on these hypotheses to reduce the myside bias in essays written under laboratory conditions. Rather than providing a Web-based research environment, in Experiment 2 we set up conditions that made it very easy for participants to include other side information in their essays: they wrote while conferring with a booklet of pro and con side essays. One of our goals was to assess the relationships among argumentation ability, argument schemata, and the myside bias. Our approach to measuring argumentation ability was to use items from previous Law School Admission Tests (LSAT). In our previous unpublished research we have found that performance on an 18-item instrument composed of publicly published items from previous versions of the LSAT is a good predictor of argumentation ability. Thus, we examined the influence of argumentation ability, as measured by this LSAT instrument, on the myside bias. We created two brief intervention texts, one

directly addressing the myside bias and one addressing the fact-based argumentation schema that did not mention other side information or the myside bias.

There were three specific research questions addressed in this experiment. The first tested the hypothesis that a fact-based argument schema is partially responsible for the myside bias in argumentation. We hypothesised that reading a brief text admonishing the writer to consider "More Than Just the Facts" would affect the myside bias by reducing the reliance on a fact-based argumentation schema. A second intervention was designed to directly contradict the belief that other side information does not strengthen arguments. This tests the hypothesis that reading a brief text inviting the writer to "Know the Opposition" would reduce the myside bias by directly encouraging the use of other side information. Finally, we examined how these interventions operate differently with writers of high and low argumentation ability as measured by the LSAT.

We also considered the particular uses of other side information. Wolfe and Britt (2005) found that authors of published authentic arguments used other side information in three ways. Sometimes authors presented other side information to rebut it, sometimes they would concede a point on the other side (i.e., agree with it) as a prelude to rebutting some other aspect of the argument, and occasionally they would dismiss the other side information without any further support. Thus we coded the essays for these uses of other side information to determine the effects of the interventions on specific uses.

Method

Participants.   A total of 84 native English-speaking students from an introductory psychology class at Miami University participated for partial course credit.

Materials.   Participants received a booklet containing the math requirement proposal used in Experiment 1 (see Appendix A), intervention materials, and the same 16 pro and con arguments used in Experiment 1. The booklet was titled "Arguments Pro and Con: A Collection of Brief Essays For and Against the Proposal". The intervention materials consisted of brief, one-paragraph lessons of 160 and 170 words titled "More Than Just the Facts" and "Know the Opposition" (see Appendix D). "More Than Just the Facts" invited the writer to go beyond the facts. It did not mention the myside bias or other side information. "Know the Opposition" included direct instructions to include other side information and discussed uses of other side information including rebuttal and concession. This text can be considered direct instruction against the myside bias. Participants were

given an instrument composed of 18 multiple choice items from previously published LSAT tests.

Design. This intervention study employed a 2×2 between-subject experimental design (presence or absence of the facts intervention and the presence or absence of the opposition intervention). Half of the participants received the "More Than Just the Facts" (see Appendix D) intervention and half did not. Crossed with this factor, half received the "Know the Opposition" intervention and half did not (see Appendix D). Thus one quarter of the participants received only the "facts" text, one quarter received only the "opposition" text, one quarter received both texts, and one quarter of the participants did not receive any intervention text. In addition, participants were categorised as either high- or low-LSAT based on a median split of their scores, and we looked at interactions among the experimental variables and LSAT.

Procedure. After giving their informed consent, participants read a hard copy version of the proposal about the math requirement, and read intervention texts depending on their experimental condition. Participants then received the booklet of 16 arguments divided into Pro and Con sections. Participants did not have to take notes because they referred to the booklet when writing their essays. This procedure made it very easy for participants to include other side arguments in their essays. When participants indicated that they had finished reading the arguments they were given the same intervention texts again and asked to briefly summarise the key points of the texts in their own words. This was done to ensure that participants comprehended the intervention texts. Using a pen and paper, participants wrote an essay following the prompt "Write a brief essay of about one page arguing either for or against the proposed math requirement. Assume that your essay will be read by a Miami administrator. Feel free to consult with the collection of essays." When they had finished writing their essays participants took the 18-item LSAT test. They were thanked and debriefed.

Results

Participants hand-wrote page-long essays arguing either for or against the proposed math requirement. Two judges rated 20% of the essays and agreed on all judgements. In the control condition where participants did not receive either intervention text, 14 of 21 (67%) included other side information in their essays and thus 33% exhibited the myside bias. In the sample as a whole 65.5% included other side information in their essays and thus 34.5% exhibited the myside bias. The lower rate of the myside bias

in this experiment compared to Experiment 1 is presumably a function of participants having the booklet of pro and con arguments at hand when writing the essays.

The effectiveness of the "More Than Just the Facts" and "Know the Opposition" manipulations on the myside bias for high and low argumentation ability, as measured by the LSAT instrument, was investigated with a $2 \times 2 \times 2$ between-subjects ANOVA. There were no significant effects or interactions for the "Opposition" intervention, $Fs < 1$. The main effect for the "Facts" intervention was also not significant, $Fs < 1$. However, there was a significant interaction between LSAT level and the Facts manipulation, $F(1, 76) = 8.59$, $p = .0045$. For high-LSAT participants, the intervention significantly increased the use of other side information in the essays from .455 to .714 (Fisher's PLSD Critical Difference = .198). For Low-LSAT participants the "Facts" manipulation actually decreased the use of other side information from .900 to .571 (Fisher's PLSD Critical Difference = .198). This first analysis suggests that the "More Than Just the Facts" intervention decreased the myside bias for high argumentation ability participants and increased the myside bias for low argumentation ability participants.

The impetus for these findings is clarified with additional analyses of the specific uses of other side information. Essays that included other side essays were coded for dismissal, rebuttal, and concession followed by rebuttal. An example of dismissal is "some say that the requirement would increase the value of a Miami degree, but this is nonsense". To illustrate concession followed by rebuttal, participant #7 wrote, "Implementing this proposed requirement would make the value of the degree go up, however, it would not only cut the graduation percentage but also limit potential student applications."

The "Know the Opposition" intervention did not affect any of these uses of other side information $Fs < 1$, nor did it significantly interact with LSAT or the Facts manipulation on any measure. The Facts manipulation did not significantly predict dismissal, $F(1, 76) = 2.77$, $p = .10$, LSAT did not significantly predict dismissal, $F(1, 76) = 2.94$, $p = .091$, and the Facts by LSAT interaction was not significant, $F < 1$.

However, the "More Than Just the Facts" intervention significantly predicted the use of concession with rebuttal, $F(1, 76) = 6.52$, $p = .013$, and the Facts by LSAT interaction was also significant, $F(1, 76) = 7.37$, $p = .008$. For high argumentation ability participants, the "Facts" intervention had no effect, differing only slightly between .409 without the intervention and .429 with the intervention (Fisher's PLSD Critical Difference = .206). However, for low-LSAT participants, the rate of concession with rebuttal dropped from .750 without the intervention to .238 with the "facts" intervention, (Fisher's PLSD Critical Difference = .206). The "More Than

Just the Facts" intervention significantly decreased the use of concession with rebuttal, an effect restricted to low-LSAT participants. The pattern is the opposite for uses of other side information besides concession. For other side information excluding concession the "Facts" intervention significantly increased the use of other side information from a rate of .095 without the intervention to .262 with the intervention, $F(1, 76) = 4.611$, $p = .035$. LSAT and the interactions were not significant, $Fs < 1$.

The "More Than Just the Facts" intervention had the effect of increasing the myside bias in argumentation for participants with low argumentation ability. The locus of this effect was in decreasing instances of conceding other side information as a prelude to rebuttal among low-LSAT participants. Yet the facts intervention significantly increased the inclusion of other side information for purposes other than concession.

Discussion

When participants with low argumentation ability used other side information, they usually conceded points on the other side before engaging in rebuttal. Indeed 75% of the low-LSAT participants did so. The Facts intervention significantly reduced this use of other side information for low-LSAT participants, but did not affect the rate of concession and rebuttal for participants with high-LSAT scores. Moreover, the Facts intervention significantly reduced the myside bias for high-LSAT participants, and increased the use of other side information for both high- and low-LSAT participants when they were not engaged in concession and rebuttal. The "More Than Just the Facts" intervention is clearly inadequate as a teaching tool, however it provides further evidence that a fact-based argumentation schema is partially responsible for the myside bias in argumentation. The intervention text made no mention of other side information, yet it significantly affected the use of other side information.

The strategy of concession followed by rebuttal is a reasonable move in an argumentative essay. Wolfe and Britt (2005) found that in those published authentic essays that used other side information, about 80% engaged in rebuttal and about 67% engaged in concession and rebuttal. Less than 5% made concessions without offering a rebuttal. Similarly, in the current experiment, only two participants (2.4% of the whole sample) made concessions without rebuttal. Of those participants who used other side information in this experiment, 84% engaged in rebuttal, 69% engaged in rebuttal and concession.

Nonetheless, conceding points on the other side may be a suboptimal strategy, particularly for people with low argumentation ability. For example, in this experiment low-LSAT participant #7 engaged in concession when he or she wrote, "Implementing this proposed requirement would

make the value of the degree go up" referring to the pro side essay *Enhancing Miami's Reputation* (see Appendix B). A more skilled writer might have been reluctant to grant this point, and might qualify or contest it rather than making a concession. For example one might write, "although some claim implementing this proposal would increase the value of the degree …" or "there is no evidence that implementing the proposal would increase the value of the degree". It may be that low-LSAT participants who operate with a fact-based argumentation schema tend to uncritically treat other side claims as facts. They may be too quick to concede matters of opinion as fact, and ambiguous facts as solid support for the opposition. Thus perhaps the effects of the Facts intervention for low argumentation ability participants may not be counterproductive. In any case, the finding that reading a simple 160-word text about facts significantly influences the use of other side information further implicates a fact-based argumentation schema as one source of the myside bias in argumentation.

We predicted a main effect for the "More Than Just the Facts" intervention, but found an interaction with argumentation ability, as measured by performance on the LSAT, and main effects limited to some uses of other side information. Thus although this result may be explained by the frequency with which participants engaged in concession with rebuttal, generalisations from Experiment 2 must be drawn with caution. The direct intervention "Know the Opposition" (see Appendix D) had no impact on the myside bias. Of course, it may be that the manipulation was simply weak or wrong-headed, yet it is striking that the other, shorter manipulations had more influence on the use of other side information.

It is likely that the presence of the booklet titled "Arguments Pro and Con: A Collection of Brief Essays For and Against the Proposal", and having both pro and con side information at hand while writing, evoked the more elaborate argument schema for some Experiment 2 participants in much the same way that the balanced searched instructions did in Experiment 1. This would eliminate most additional benefits of the "Know the Opposition" text. This would also account for the lower rate of the myside bias in Experiment 2 compared to Experiment 1. In Experiment 2 about 35% of the participants exhibited the myside bias, and in Experiment 1 under balanced search conditions about 28% exhibited the myside bias and 50% under unrestricted search instructions. This also suggests that for many people the myside bias is rooted in a deficient argumentation schema rather than an easily corrected misconception.

GENERAL DISCUSSION

Defining the myside bias in argumentation as the absence of other side information in written essays allows us to separate the phenomenon under

consideration from a psychological understanding of that phenomenon. In Experiment 1 we found that many participants failed to include other side information in their notes or essays regardless of their own personal opinions. Thus, the myside bias in argumentation is not the same as a personal opinion bias. Rather, the myside bias is rooted in misconceptions about the nature of argumentation. Participants who fail to include other side information in their notes also tend to exclude other side information from their essays. Participants who do not endorse the proposition that good arguments include other side information tend to exclude other side information in their essays. This suggests that questionable "beliefs about thinking" (Baron, 1991, 1995) account for some of the myside bias in argumentation. Yet directly addressing the benefits of including other side information had no effect in Experiment 2. Balanced search instructions significantly reduced the myside bias in essays, but they did so by reducing the myside bias in note taking, and the essays themselves, rather than affecting search behaviour per se. This suggests that the balanced search instructions induce a more fully elaborated argument schema. It may be the case that people have different motives of searching for myside and other side information. It is possible that people engage in selective exposure to information, seeking myside information to confirm their beliefs and weak or foolish other side arguments that would also strengthen their beliefs (see Baron, 1988, for a review of the literature on selective exposure). More research is needed to determine whether people seek out myside and other side information for different reasons.

Many people appear to reason with a fact-based argumentation schema. The essence of the fact-based argumentation schema is that a claim is good if it can be "proved by facts". Sophisticated writers have a deep and contextual understanding of the role and importance of support in argumentation. However, less sophisticated writers appear to believe that argumentation is simply a matter of lining up facts. The influence of a simple pedagogic intervention in Experiment 2 further supports the role of a fact-based argumentation schema. Like the fictitious *Dragnet* detective Joe Friday, people operating with a fact-based argumentation schema may focus on "just the facts" ignoring other aspects of argumentation, thus resulting in the myside bias.

The myside bias appears to occur due to deficiencies in the argument schema. These deficiencies concern the value of one-sided arguments, exaggerated beliefs about the ability of facts to "speak for themselves", and misconceptions about the nature of research. As research progresses in developing a more sophisticated model of argumentation, we are learning more about how argument schemata affect the representation of constituent parts of arguments (Britt, Kurby, Dandotkar, & Wolfe, in press; Britt, Kurby, & Wolfe, 2005). In the future, it will be important to gain a better understanding of the suboptimal argument schema used by many writers.

Then researchers and educators will be in a better position to help writers use other side information effectively and thus eliminate the myside bias in written argumentation.

REFERENCES

Axelrod, R. B., & Cooper, C. R. (1996). *The concise guide to writing* (2nd ed.). New York: St. Martins Press.

Baron, J. (1991). Beliefs about thinking. In J. F. Voss, D. N. Perkins, & J. W. Segal (Eds.), *Informal reasoning and education*. Hillsdale, NJ: Lawrence Erlbaum Associates Inc.

Baron, J. (1995). Myside bias in thinking about abortion. *Thinking and Reasoning*, *1*, 221–235.

Baron, J. (1988). *Thinking and deciding*. Cambridge, UK: Cambridge University Press.

Britt, M. A., Kurby, C. A., Dandotkar, S., & Wolfe, C. R. (in press). I agreed with what? Memory for simple argument claims. *Discourse Processes*.

Britt, M. A., Kurby, C., & Wolfe, C. R. (2005, July). *Memory for claims of simple arguments*. Paper presented at the 15th Annual Meeting of the Society for Text and Discourse, Amsterdam, the Netherlands.

Druckart, T. (2006). *Tracy Duckart's instructional website at Humboldt State University*. Retrieved 29 March 2006 from http://www.humboldt.edu/~tdd2/ThesisStatement.htm

Evans, J. St. B. T. (1989). *Biases in human reasoning: Causes and consequences*. Hove, UK: Lawrence Erlbaum Associates Ltd.

Evans, J. St. B. T., Newstead, S. R., Byrne, R. M. J. (1993). *Human reasoning. The psychology of deduction*. Hove, UK: Lawrence Erlbaum Associates Ltd.

Hacker, D. (1994). *The Bedford handbook for writers*, 4th ed. Boston: Bedford.

Kuhn, D., & Udell, W. (2003). The development of argument skills. *Child Development*, *74*, 1245–1260.

Nussbaum, E. M., & Kardash, C. M. (2005). The effects of goal instructions and texts on the generation of counterarguments during writing. *Journal of Educational Psychology*, *97*(2), 157–169.

Perkins, D. N. (1985). Postprimary education has little impact on informal reasoning. *Journal of Educational Psychology*, *77*, 562–571.

Perkins, D. N. (1989). Reasoning as it is and could be: An empirical perspective. In D. M. Topping, D. C. Crowell, & V. N. Kobayashi (Eds.), Thinking across cultures: The third international conference on thinking. Hillsdale, NJ: Lawrence Erlbaum Associates Inc.

Perkins, D. N., Allen, R., & Hafner, J. (1983). Difficulties in everyday reasoning. In W. Maxwell (Ed.), *Thinking: The expanding frontier*. Philadelphia, PA: Franklin Institute Press.

Perkins, D. N., Bushey, B., & Farady, M. (1986). *Learning to reason*. Unpublished manuscript, Harvard Graduate School of Education, Cambridge, MA.

Perkins, D. N., Farady, M., & Bushey, B. (1991). Everyday reasoning and the roots of intelligence. In J. Voss, D. N. Perkins, & J. Segal (Eds.), *Informal reasoning* (pp. 83–105). Hillsdale, NJ: Lawrence Erlbaum Associates Inc.

Perkins, D. N., & Tishman, S. (2001). Dispositional aspects of intelligence. In S. Messick & J. M. Collis (Eds.), *Intelligence and personality: Bridging the gap in theory and measurement* (pp. 233–257). Mahwah, NJ: Lawrence Erlbaum Associates Inc. Retrieved 17 May 2006 from http://learnweb.harvard.edu/alps/thinking/docs/Plymouth.pdf

Purdue University Online Writing Lab. (2006). *Writing about literature*. Retrieved 29 March 2006 from http://owl.english.purdue.edu/handouts/general/gl_lit.html

Rottenberg, A. T. (1994). *Elements of argument: A text and reader* (4th ed.). Boston: Bedford.

Stevens, J. R. (2006). *Teaching English composition*. Available on the Web 29 March 2006 at http://www.englishdiscourse.org/

Toplak, M. E., & Stanovich, K. E. (2003). Associations between myside bias on an informal reasoning task and amount of post-secondary education. *Applied Cognitive Psychology*, *17*, 851–860.

Toulmin, S. E. (1958). *The uses of argument*. Cambridge, UK: Cambridge University Press.

Voss, J. F. (2005). Toulmin's model and the solving of ill-structured problems. *Argumentation*, *19*, 321–329.

Voss, J. F., Fincher-Kiefer, R., Wiley, J., & Silfes, L. N. (1993). On the processing of arguments. *Argumentation*, *7*, 165–181.

Wolfe, C. R. (1995). Information seeking on Bayesian conditional probability problems: A fuzzy-trace theory account. *Journal of Behavioural Decision Making*, *8*, 85–108.

Wolfe, C. R., & Britt, M. A. (2005). *The use of other side information: Explaining the myside bias in argumentation*. Paper presentation to the 46th Annual Meeting of the Psychonomic Society, Toronto, Canada.

APPENDIX A

Screen shot from Experiment 1 presenting the proposal.

The Proposal

Miami University should impose a two-year (4 semester) math requirement for all students that includes at least two semesters of calculus, and another year of mathematics training in linear algebra and number theory. Students who are unprepared for these courses must take any prerequisites (such as pre calculus) before and in addition to these four courses. All students must earn at least a C in each course or the course will have to be repeated.

Please rate your initial agreement on the following 6 point scale where 1 = Strongly Agree and 6 = Strongly Disagree. When you have selected a rating click on the SUBMIT button.

○ 1 (Strongly Agree)
○ 2
○ 3
○ 4
○ 5
○ 6 (Strongly Disagree)

[submit]

APPENDIX B

Screen shots from the Web-based environment showing sample pro and con arguments.

Kristina Tannen, Miami University Alumni

Enhancing Miami's Reputation

Enacting the math requirement would boost Miami's reputation, further increasing the value of a Miami degree. This would yield major benefits not only to current Miami students, but to Miami alumni such as myself, who would see the value our degrees soar. Miami would be known as a progressive university with a rigorous curriculum that constantly challenges its students. The pride of present and future alumni would only grow, which would help the university in many ways. Enacting the math requirement would give Miami a national reputation as the leading public university dedicated primarily to undergraduate education.

Chuck Carter, Academic Personnel Officer

Hiring More Math Professors

The proposed math requirement would take a significant investment in new personnel. The Department of Mathematics and Statistics simply could not handle the new responsibilities with existing personnel. Miami currently has an enrollment of 16,000 students, which means the math department would have to provide at least 4 courses for all 16,000 students, which is equivalence to providing classes for 64,000 students (not counting remedial courses). If each class had 32 students, Miami would have to teach 2000 sections. If those sections were spread out evenly over 4 years then each year Miami would have to add 500 sections. A full time professor teaches 6 classes per year, and so Miami would have to hire 84 math professors to teach these classes. The cost of hiring new professors to teach these new courses would be significant.

APPENDIX C

Sample Web-based menu of pro and con arguments.

Information links

Below are a set of links to information about the proposed math requirement. Each page will be one paragraph long. Click on these links to gather information to help you build an argument. You should take notes on these pages because you may not return to the Web once you begin writing your essay. You may choose whichever links you wish to follow in any order. Use the BACK button on your browser to return to this window. When you are done collecting information click on the button marked DONE below. You may follow as many or as few links as you wish.

Karen Brice, Miami Admissions Officer, Assist Recruitment
Tyrone Dukes, Miami Sophomore, Money from Bill Gates
Aaron Haag, Paper Science Professor, Building Mental Discipline
Hugh Johnson, Dean of the Graduate School, Weed Out Weak Students
Robert Quin, CEO Quadrangle Solutions, Mathematics in the Workplace
Kristina Tannen, Miami Alumni, Enhancing Miami's Reputation
Jeff Toddler, Assistant Dean, Mathematics is a Liberal Art
Ying Wu, Professor of Mathematics, The Importance of Mathematical Thinking
Chuck Carter, Academic Personnel Officer, Hiring More Math Professors
Rick Dawson, Miami Freshman, Reduced State Aid
Chris Fox, Psychology Professor, One Size Fits All
Rebecca Long, High School Guidance Counselor, Undermine Recruitment
Kevin O'Brian, Attorney at Law, Good Jobs Without Mathematics
Barbara Vick, Dean of Students, Increase the Dropout Rate
Jen Walton, Miami Senior, Increase Time to Graduation
Grace Williams, Director of Liberal Education, Violating Liberal Education

The proposal (a reminder)

Miami University should impose a 2-year (four semester) math requirement for all students that includes at least two semesters of calculus, and another year of mathematics training in linear algebra and number theory. Students who are unprepared for these courses must take any prerequisites (such as pre calculus) before and in addition to these four courses. All students must earn at least a C in each course or the course will have to be repeated.

APPENDIX D

Text of intervention materials.

More Than Just the Facts

When making an argument it is important not to underestimate the importance of facts. However, facts alone are rarely enough to make a good argument. In writing a strong essay you need to have more than just the facts. This is true for several reasons. First, different people are likely to have a different interpretation of the same set of facts. Thus, the facts don't speak for themselves, and you need to spell out an interpretation of the facts for the reader. Second, other people may point to different facts to reach different conclusions. When you write a strong essay, you need to sort out the facts for the reader. You need to let the reader know about the significance—or lack of significance—of different facts. Finally, many good arguments don't rest on facts at all, but depend instead on principles, ideas, and even matters of opinion. Sometimes you can make an excellent argument without presenting a single fact. Writing a good essay requires more than just the facts.

Know the Opposition

The writer of a strong essay must know the opposition. When writing a good essay, the skilful writer thinks about the arguments on the other side and how they may influence the reader. Sometimes, it is best to take on the other side directly by laying out their arguments and rebutting them forcefully. Rebuttal is the art of refuting, disproving, or negating arguments on the other side. If the opposition has some small points on their side, sometimes it is better to concede them, to give them up, before proceeding with a rebuttal. Concession is the art of forfeiting small points to win the big ones. If you think arguments on the other side are likely to occur in the mind of the reader, then sometimes it is best to mention them and then reject and dismiss them. Rarely, if ever, is ignorance of the other side a good idea. The skilful writer of strong essays always knows the opposition.