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Associations Between Myside Bias on an Informal Reasoning Task and Amount of Post-Secondary Education

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SUMMARY

One hundred and twelve undergraduate university students completed an informal reasoning task in which they were asked to generate arguments both for and against the position they endorsed on three separate issues. Performance on this task was evaluated by comparing the number of arguments they generated which endorsed (myside arguments) and which refuted (otherside arguments) their own position on that issue. Participants generated more myside arguments than otherside arguments on all three issues, thus consistently showing a myside bias effect on each issue. Differences in cognitive ability were not associated with individual differences in myside bias. However, year in university was a significant predictor of myside bias. The degree of myside bias decreased systematically with year in university. Year in university remained a significant predictor of myside bias even when both cognitive ability and age were statistically partialled out. Copyright © 2003 John Wiley & Sons, Ltd.

Most research on human reasoning has been conducted within the traditionally recognized domains of deductive and inductive problem solving where formal models of normatively correct performance are available as standards of performance (e.g. Evans et al., 1993; Johnson-Laird & Byrne, 1991; Manktelow, 1999). A smaller body of research has accumulated in the area of so-called informal reasoning where an attempt is made to simulate the type of everyday argumentation and hypothesis testing that goes on in non-school situations (see Baron, 1991, 1995; Hofer & Pintrich, 2002; Klaczynski, 2000; Klaczynski & Gordon, 1996; Klaczynski et al., 1997; Kuhn, 1991, 1993, 2000; Perkins, 1985, 1989; Stanovich & West, 1997).

Because one of the major goals of education is to teach individuals to be better thinkers, not only in school, but in many different settings, it is of considerable interest to determine whether increased education facilitates informal reasoning ability. Most previous research related to educational effects on reasoning has focused on improvements in formal reasoning performance (e.g. Jackson & Griggs, 1988). The little research that does exist on the association between education and informal reasoning skills is somewhat inconsistent. The purpose of the present investigation was to examine the association between educational experience and performance on measures of informal reasoning. An additional issue under examination concerned whether there was any degree of generality in informal reasoning across different content areas.

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Baron (1991, 1995, 2000) has championed a standard for informal reasoning tasks that seems to have general applicability across a number of reasoning tasks and domains. He has identified the lack of so-called actively open-minded thinking as an impediment to reasoning. A key indicator of the lack of actively openminded thinking, according to Baron (1991, 1995), is a so-called myside bias displayed on many informal reasoning tasks—that people generate more arguments and evidence in favour of a previously held position than they do for arguments opposing a previously held position. Many theorists would view the lack of a myside bias as one component of rational thinking in informal reasoning tasks (e.g. Dole & Sinatra, 1998; Nickerson, 1998; Perkins et al., 1993; Stanovich, 1999). In the present study of educational effects on informal reasoning ability, we will use the degree of myside bias as an index of non-normative responding.

The literature on education effects in critical thinking performance has been mixed; with some who have argued that reasoning improves as a result of higher education (e.g. Kuhn, 1991), while others have argued that education results in only negligible effects on reasoning performance (e.g. Perkins, 1985, 1989). Likewise, the association between cognitive ability and informal reasoning also remains somewhat ambiguous. While there have been some indications that informal reasoning was significantly related to cognitive ability (e.g. Kitchener et al., 1989), Klaczynski (2000; Klaczynski & Gordon, 1996; Klaczynski et al., 1997; Klaczynski & Robinson, 2000) has failed to find an association between myside bias and cognitive ability. Moderate associations between myside bias and cognitive ability were reported by Perkins (1985; see also Perkins et al., 1991).

In order to clarify the relation between informal reasoning skill and both education and cognitive ability, we employed an informal reasoning paradigm with some unique features. First, we studied informal reasoning using a variety of different real-life issues with varying tendencies to trigger emotional engagement. Participants were asked to present arguments both for and against their position on three different issues. One important aspect of our study, which has been given little attention in previous investigations using informal reasoning tasks, is a concern for the stability of myside reasoning tendencies across different reasoning issues. We examined reasoning performance across three very different contentious issues: increasing the cost of tuition, permitting the sale of human organs; and doubling the cost of gasoline to discourage people from driving.

METHOD

Participants

The participants were 112 students (39 males and 73 females) recruited through poster advertisements on the campus of a large Canadian university. The average age of the participants was 21.3 ($SD = 3.4$), and the modal age was 20 years. Our sample had a very good (i.e. relatively flat) distribution: 23 (20.5%) students were in the first year of their programme, 40 (35.7%) were in the second year of their programme, 31 (27.7%) were in the third year of their programme, and 18 (16.1%) were in the fourth year of their programme. Students were from diverse academic backgrounds. Forty-five (40.5%) students were enrolled in a social science programme, 28 (25.0%) students in a science or engineering programme, and 25 (22.5%) students in an arts programme. Fourteen (12.5%) students were enrolled in some other programme that was not easily categorized into the previous categories nor formed a coherent group of their own. Students in the

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other category included: speech pathology, business and finance, music, and cognitive science. Participants were paid $20 for their cooperation.

The argument generation task

Participants were presented with three different issues. These issues were selected because they were controversial, thought provoking, and had a number of potential arguments available both for and against each side of the issue. Participants were first asked to indicate their position on each of these three issues on a 6-point Likert-type scale (1 = disagree strongly, 2 = disagree moderately, 3 = disagree slightly, 4 = agree slightly, 5 = agree moderately, and 6 = agree strongly). The three issues were stated as follows:

(1) The real cost of a university education is $12,000 per year. Students are currently paying approximately $3500 per year in tuition. The difference is paid by the taxpayer. University students should pay the full cost of their university education.
(2) People should be allowed to sell their organs.
(3) The cost of gasoline should be doubled to discourage people from driving.

This prior belief measure was obtained in order to identify which arguments endorsed the participants' position (myside arguments) and which arguments did not endorse the participants' position (otherside arguments) when the participant subsequently generated arguments relevant to the these issues. The mean level of agreement (on the 6-point scale) with the tuition proposition was 1.6 ($SD = 1.0$), with the organs proposition was 3.6 ($SD = 1.8$), and with the gasoline proposition was 2.6 ($SD = 1.5$).

After administration of several other unrelated reasoning tasks, participants were again presented with the same three issues in the same order: tuition, organs, and gasoline. This time their task was to generate arguments both for and against their own position on each issue. For example, the verbatim instructions for the tuition issue were as follows:

> Think through the following issue carefully and feel free to take your time: *The real cost of a university education is $12,000/year. Students are currently paying approximately $3500 in tuition. The difference is paid for by the taxpayer. University students should pay for the full cost of their university education.* Please write down arguments both for and against this position. Try to write as much as you can, and remember to try and give reasons both for *and* reasons against your position.

This was followed by seven three-line sections labeled Reason #1, Reason #2, . . . , Reason #7. Students were to write their reasons on the blank lines.

Our study focused on the total number of arguments that participants generated which endorsed their prior beliefs (myside arguments) and the total number of arguments generated that did not endorse their beliefs (otherside arguments). For this purpose, it was necessary to collapse the prior belief scale into two categories: those who agreed with the proposition (at any level—slightly, moderately, or strongly) and those who did not. The level of prior agreement varied across the three issues: 17.9% of the sample displayed prior agreement with the tuition item; 56.3% of the sample displayed prior agreement for the organ item; and 27.7% of the sample displayed prior agreement for the gasoline item.

A coding for the arguments generated was developed from previous pilot data, and arguments were coded as either supporting or refuting the proposition. For example, the argument that 'taxpayers should not have to foot the bill for those who they don't even know' was classified as supporting the tuition proposition, whereas the argument that

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'many students would simply not be able to attend college' is an example of a refutational argument for the tuition issue. The arguments were classified as either myside or otherside depending upon whether the participants initially agreed or disagreed with the proposition. For example, the argument that 'taxpayers should not have to foot the bill for those who they don't even know' was classified as a myside argument if the participant initially agreed with the tuition proposition, but otherside if the participant initially disagreed with the tuition proposition.

A total of 1713 arguments were generated across the three issues for the 112 participants. Ninety-eight per cent of the arguments were coded as either supportive or refutational. Only 2% were coded in the other categories, and included: ambiguous arguments, irrelevant arguments, statements of lack of knowledge, reiterations of supportive or refutational arguments, and mere opinion with a supportive or refutational valence. Two coders used a scoring key composed of samples of each argument type. The coders coded all of the arguments independently and they were blind to the participant's prior belief on the issues. There was 91% agreement between the two coders. Discrepancies were resolved by having both coders discuss scoring differences and determine the most appropriate coding. Arguments on which the coders could not easily resolve the discrepancies were passed onto a third coder. There were a total of 25 arguments (0.015% of the total number of arguments) that required resolution by the third coder.

A myside bias index was also calculated for each issue, and was derived by subtracting the number of otherside arguments from the number of myside arguments. Composite myside, otherside, and myside bias scores for each participant were computed by summing these variables across the three issues.

Cognitive ability measures

Participants completed a short form of the Wechsler Adult Intelligence Scale-Revised (WAIS-R; Wechsler, 1981). The short form consisted of the Vocabulary (verbal measure) and Block Design (non-verbal measure) subtests. Sattler (1992) reports that the combination of the Block Design and the Vocabulary subtests provides the most reliable two-subtest estimate of Full-scale IQ (with reliability of 0.90). The mean prorated IQ of the sample was 112.4 ($SD = 12.3$).

In addition to the WAIS-R subtests, one other verbal and one other non-verbal measure of cognitive ability were also used. A checklist-with-foils vocabulary measure and a short-form version of Raven's Advanced Progressive Matrices (Set II, Raven, 1962) were employed as two additional cognitive ability measures (both are described in detail in Sá et al., 1999).

We formed a general cognitive ability composite score. This measure was formed by standardizing the scores from the WAIS-R Vocabulary Subtest, the WAIS-R Block Design Subtest, the Vocabulary Checklist, and the Raven's Progressive Matrices and then summing the standardized scores. The two verbal measures displayed a correlation of 0.68 and the two nonverbal measures displayed a correlation of 0.52.

Procedure

Participants completed the tasks during a single 3–4-hour session in which they also completed some other tasks not part of the present investigation. All were individually tested by the same experimenter. The order of tasks completed was: demographics

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questionnaire, prior belief questionnaire, a short battery of other unrelated tasks not examined in this study, the argument generation task, and the cognitive ability measures.

RESULTS

Argument generation task performance

Participants generated a mean of 5.61 ($SD = 1.71$) total arguments for the tuition issue, 4.79 ($SD = 1.69$) arguments for the organs issue, and 4.90 ($SD = 1.70$) arguments for the gasoline issue. The number of arguments generated across the three issues displayed a positive association. The total number of arguments generated for the tuition issue displayed a 0.58 ($p < 0.001$) correlation with the total number of arguments generated for the organs issue and a 0.63 ($p < 0.001$) correlation with the total number of arguments generated on the gasoline issue. The total number of arguments generated on each of the latter two issues displayed a 0.61 ($p < 0.001$) correlation.

Of particular interest in the current study was the comparison of the number of myside arguments (arguments consistent with the participant's prior belief) compared to the number of otherside arguments (arguments inconsistent with the participant's prior belief). The mean number of myside and otherside arguments for each issue is presented in Table 1. For the tuition issue, there were significantly more myside than otherside arguments generated [$t(111) = 7.60$, $p < 0.001$]. The same pattern was evident for the organ issue, $t(111) = 3.36$, $p < 0.001$, and the gasoline issue, $t(111) = 3.99$, $p < 0.001$. The third column of Table 1 shows the myside bias index (number of myside arguments minus the number of otherside arguments). A one-way analysis of variance conducted on the myside bias index scores indicated a significant effect of issue, $F(2, 222) = 7.16$, $p < 0.001$. As the means in Table 1 indicate, the myside bias was considerably higher for the tuition issue (perhaps not surprisingly given that the participants were all students!). Scheffé *post hoc* comparisons indicated that the myside bias on the tuition

Table 1. Mean number of myside and otherside arguments generated and the myside bias index on each of the issues in the argument generation task

Issue	Myside	Otherside	Myside bias index
Tuition	3.31 (1.29)	2.18 (1.02)	1.13 (1.58)
Organs	2.57 (1.10)	2.13 (1.08)	0.45 (1.41)
Gasoline	2.70 (1.17)	2.15 (1.02)	0.55 (1.45)

Table 2. Correlations between number of myside and otherside arguments generated

	1	2	3	4	5
1. Tuition myside					
2. Tuition otherside	0.07				
3. Organ myside	0.33***	0.42***			
4. Organ otherside	0.21*	0.33***	0.16		
5. Gasoline myside	0.39***	0.30**	0.46***	0.43***	
6. Gasoline otherside	0.29**	0.37***	0.36***	0.13	0.14

*$p < 0.05$, **$p < 0.01$, ***$p < 0.001$; two-tailed.

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issue was significantly higher than the myside bias on the organ issue and on the gasoline issue, but the mean myside bias on the latter two issues did not differ significantly.

Table 2 displays the correlations between the number of myside and otherside arguments generated for each of the three issues. Overall, these correlations demonstrate considerable cross-issue commonality in the tendency to generate arguments. For instance, the number of myside arguments generated for the three issues displayed significant correlations ($r = 0.33$, 0.39, and 0.46, respectively). Similarly, two of the three cross-issue otherside correlations were significant. Furthermore, all six of the myside/otherside *cross*-issue correlations were also statistically significant. In contrast to the significant myside/otherside correlations across issues displayed in Table 2, the number of myside arguments did not correlate with the number of otherside arguments *within* an issue ($r = 0.07$, 0.16, and 0.14, respectively). The reason that myside and otherside arguments are positively correlated across issues but display no correlation within issues is because two effects are cancelling each other out within an issue. The effect of argument generativity is operating within an issue just as it is across issues. However, this effect seems to be cancelled by the effect of the participants' initial opinion which serves to create a negative correlation between myside and otherside generativity which appears to cancel out the general tendency towards argument generativity.

Correlations between the myside bias indices were also performed. There were no significant associations between the myside bias indices for the three issues. Significant correlations would have indicated that those who displayed a myside bias on one issue displayed similar myside bias tendencies on the other two issues. This was not the case. The correlation between the myside bias for the tuition and organ issues was 0.03 (n.s.); between the tuition and the gas issues was 0.10 (n.s.); and between the organ and the gas issues was -0.11 (n.s.).

We also examined the relation between strength of belief and myside bias and found a positive correlation for each issue: tuition ($r = 0.15$), organ ($r = 0.14$), and gasoline ($r = 0.23$). However, only the last correlation was statistically significant.

Cognitive ability analyses

The cognitive ability composite failed to display significant correlations with the total number of myside arguments ($r = 0.08$) collapsed across issues, the total number of otherside arguments ($r = 0.15$), and the total myside bias index ($r = -0.05$). None of the disaggregated correlations with the cognitive ability composite score attained statistical significance either (highest correlation = 0.14).

Education effects[1]

Year in university effects were conducted by comparing performance across years one to four, and these results are displayed in Table 3. There was a tendency for myside bias to decrease across year in university. This trend was confirmed by conducting a 2×4 analysis of variance in which argument type (myside versus otherside) was a within-

[1]Education effects were also examined by comparing programmes of study and reasoning performance. The comparisons involved students enrolled in a social science programme, students enrolled in a science programme, and students enrolled in an arts and humanities programme (programme of study was equally distributed across year in university). There were no effects of programme of study on any of the variables in the Argument Generation Task, so this variable will not be considered further.

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Table 3. Mean performance on argument generation task by year in university

	Number of participants	Myside arguments *M* (SD)	Otherside arguments *M* (SD)	Myside bias index *M* (SD)
Year 1	23	9.44 (2.95)	6.00 (1.51)	3.44 (2.92)
Year 2	40	8.50 (3.08)	6.00 (2.52)	2.50 (2.62)
Year 3	31	8.52 (2.48)	7.39 (2.12)	1.13 (2.20)
Year 4	18	7.78 (1.87)	6.44 (2.20)	1.33 (1.82)

Table 4. Mean myside bias by year in university for each of the three issues

	Number of participants	Tuition	Organ	Gasoline
Year 1	23	1.91	0.13	1.39
Year 2	40	1.33	0.68	0.50
Year 3	31	0.61	0.29	0.23
Year 4	18	0.61	0.61	0.11

subjects factor and year in university was a between-subjects factor. The ANOVA revealed a significant main effect of argument type ($F(1, 108) = 83.1$, $p < 0.001$), no significant main effect of year ($F(3, 108) = 0.91$), and a significant year by argument type interaction ($F(3, 108) = 4.77$, $p < 0.01$). The significant interaction occurs because the difference between the number of myside and otherside arguments decreased as year in university increased.

Table 4 presents the myside bias as a function of university year for each of the three issues. From the table it is clear that two of the three issues displayed the tendency for myside bias to decrease with year, and this trend was confirmed by statistical analysis. Separate ANOVAs conducted on the myside bias scores indicated a significant effect of university year for the tuition issue ($F(3, 108) = 4.17$, $p < 0.01$) and for the gasoline issue ($F(3, 108) = 3.99$, $p < 0.01$), but not for the organ issue ($F(3, 108) = 0.95$).

Regression analyses were also performed in order to determine whether year in university would remain a significant predictor of myside bias after age and cognitive ability were controlled. In the hierarchical regression analysis displayed in Table 5, age was entered as the first step in the analysis because, as Table 5 reveals, it was a significant predictor of the myside bias score. When cognitive ability was entered as a predictor after age, it did not account for additional variance. Importantly, when year in university was entered as the third step after the other two variables, it accounted for a statistically

Table 5. Hierarchical regression analyses predicting myside bias index score on the argument generation task

Step	Multiple *R*	R^2 change	*F* change	Final beta weight
1 Age	0.247	0.061	7.163**	−0.152
2 Cognitive ability	0.247	0.000	0.001	0.021
3 Year of study	0.344	0.057	6.984**	−0.259**

**$p < 0.01$.

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significant proportion of unique variance. When all three variables were entered simultaneously into the regression equation, only year in university displayed a significant beta weight. In short, the association between myside bias and year in university is not entirely explained by age and cognitive ability.

Multiple regressions were also run on each of the issues separately.[2] Not surprisingly, given the results displayed in Table 4, year in university was an independent predictor in the final regression for the tuition (beta weight $= -0.278$, $F(1, 108) = 7.82$, $p < 0.01$) and gasoline (beta weight $= -0.259$, $F(1, 108) = 6.80$, $p < 0.01$) issues, but not for the organ issue (beta weight $= 0.101$, $F(1, 108) = 0.95$).

DISCUSSION

In our informal reasoning task, a myside bias—or the tendency to not give even-handed consideration to both sides of an issue—was found across a set of three issues. Year in university was found to be a predictor of myside bias. Specifically, lower myside bias scores were associated with length of time in university. The effect of year of university study was not due to differences in age or cognitive ability because year in university proved to be an independent predictor.

The cost of tuition item was included in the present study in order to provide an issue that would be highly salient to the student participants. Participants did in fact generate slightly more myside arguments pertaining to the tuition issue, as compared to myside arguments generated for the other issues. However, the participants' tendency to display a myside bias, that is, a tendency to endorse arguments favouring their own position, was found across all three issues. This ubiquitous display of a myside bias is consistent with other studies which have demonstrated people's general tendency to allow their prior beliefs to influence their reasoning (e.g., Klaczynski, 2000; Klaczynski & Gordon, 1996; Klaczynski et al., 1997; Sá et al., 1999; Stanovich & West, 1997).

Although there were consistent individual differences in the overall number of argument generated across issues, there was no association between the myside effects displayed across the different issues. That is, participants showing a large myside bias on one issue did not necessarily display a large myside bias on the other two issues. An explanation of this finding might found in the concepts of the emerging science of memetics—the science of the epidemiology of idea-sized units called memes that are analogized to genes (see Aunger, 2000; Blackmore, 1999; Dawkins, 1993; Dennett, 1991, 1995). Beliefs already stored in the brain are likely to form a structure that prevents contradictory beliefs from being stored (sometimes referred to over-assimilation). For the same reason that genes in our genome cooperate (Ridley, 2000), memetic theory suggests that resident beliefs are selecting for a cooperator—someone *like them*. This accounts for the ubiquitous belief bias effects found in this experiment and in many others cited above—beliefs contradicting previously residing beliefs are not easily assimilated (see Dole & Sinatra, 1998). Such an account can explain our individual difference finding that

[2]One possible alternative interpretation of our results is that year in university might be correlated with prior opinion and that there might be objectively more arguments on one side of an issue than another. For two of our issues, this was not a concern. Year in university failed to correlate with prior opinion on the organ ($r = 0.03$) and the gasoline issue ($r = 0.12$). However, for the tuition issue, there was a significant correlation between year in university and prior opinion ($r = 0.24$, $p < 0.05$). Thus, we ran an additional regression analysis on the myside bias on the tuition issue. In a regression equation including prior opinion, age, and cognitive ability, year in university remained a significant predictor (beta weight $= -0.257$, $F(1, 108) = 6.45$, $p < 0.025$).

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the degree of myside bias on one issue was unrelated to that displayed on another issue. A person showing high belief bias in one domain is not necessarily likely to show it in another. On the other hand, there are large differences between domains in how much belief bias people display in them. Thus, it is not *people* who are characterized by more or less myside bias but *beliefs* that differ in the degree of belief bias they engender—that differ in how strongly they are structured to repel contradictory ideas.

Thinking from multiple points of view is often a standard for good thinking that is stressed at higher levels of education. The results of the current investigation do suggest that consideration of the other side becomes more commonplace in more advanced years of study. However, cognitive ability was not associated with myside bias in any of our analyses. While these results are not consistent with those of Perkins (1985), they are consistent with the work of Klaczynski (2000; Klaczynski & Gordon, 1996; Klaczynski et al., 1997; Klaczynski & Robinson, 2000), who quite consistently finds no association between myside bias and effects of cognitive ability.

Together, the results of the present investigation suggest that the effects of higher education can be observed on informal reasoning tasks. Kuhn (1991) has suggested that school experience may foster critical thinking skills by providing opportunities to practise 'bracketing' one's own beliefs—what Stanovich and West (1998, 2000; Stanovich, 1999) have termed cognitive decontextualization. Our results are in agreement with Kuhn's conjecture that unbiasedness in argumentation may be a malleable cognitive skill that is a function of educational experience.

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