

Decision making biases in children and early adolescents: Exploratory studies

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Note: This is the last copy I have before the published version, which probably is different.

Abstract

In Study 1, a ‘gifted’ group and an ‘underprivileged’ group of subjects, ages 7 to 15, were questioned about vignettes raising various issues in decision making: the precedent-setting effect of choices, the role of probability and frequency in choice, actively open-minded thinking (i.e., considering more than one goal and arguments on both sides of a controversial question), the sunk cost effect, and omission bias. Subjects were often inattentive to precedent setting and probability. Age difference were found only in an item concerning search for goals and an item concerning use of frequency. The gifted group showed better performance on some items but worse performance on the omission-bias item. In Study 2, children aged 5 to 12 were interviewed about items concerned with actively open-minded thinking, precedent setting, sunk cost, and omission bias. We also examined bias in the classification of arguments as being for or against one’s position. Errors in this task showed a ‘myside’ bias: arguments were erroneously classified as supporting the subject’s favored option. Consistent age effects were absent. Study 3 found that seventh graders showed less omission bias than second graders, contrary to Studies 1 and 2.

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1 Introduction

A number of studies (reviewed in Arkes & Hammond, 1986; Baron, 1988; Dawes, 1988) have found apparent errors or biases in thinking about decisions. People violate a variety of principles of rational decision making, such as the principle that only future consequences matter, not sunk costs (Arkes & Blumer, 1985; Thaler, 1980). Often, these violations result from the use of certain heuristics, such as trying to avoid waste. These heuristics may be overgeneralized to cases in which they do not serve their purpose. For example, the fact that money has already been wasted gives us no reason to ‘throw good money after bad.’ Such violations are errors in the sense that they prevent us from achieving our goals. Throwing good money after bad truly causes us to waste more money and thereby fail to achieve, as well as we could, those goals that we could achieve with more money.

Most studies of heuristics and biases in decision making have used college students as subjects. Some have used experts. Few have used children or adolescents. Klayman (1985) did examine children’s decision making in a multiattribute choice task. He found few developmental differences. Although children did tend to use simpler strategies than adults, Klayman (rightly) does not conclude from this finding that children are more biased. The simplest interpretation of this finding is that children are appropriately sensitive to the cost of thinking, which is, because of their lack of experience (and other factors), higher for them than for adults.

The present study grew out of a project concerned with the teaching of personal decision-analysis to children (see Baron & Brown, 1991). Design of such instruction would be informed by knowledge of the decision-making errors of the target group. Because our concern was practical, we did not limit ourselves to errors already documented in the adult literature. We also sought evidence of the existence of errors that we felt might impair everyday decision making, on the basis of media reports, discussions with others, and our own knowledge of children. Many of these errors involved failure to attend to certain considerations that are relevant in decision making, such as probability, or the setting of a precedent. The studies we report here are the first, to our knowledge, of whether these factors are considered.

We assume that decisions should be made at least in part on the basis of the probability and relative desirability of the consequences of each option. We ask whether children and young adolescents *consider* consequences and probabilities in appropriate ways when they think about various decisions. We do *not* make the stronger assumption that consequences are the *only* relevant considerations. Two of our test items, however, were concerned with whether subjects consider certain factors, other than consequences, which we deem to be irrelevant: the distinction between acts and omissions, and sunk cost.

An issue throughout the three studies we report is the existence of age differences in decision biases. (The first study also examines children of different academic abilities.) Three general hypotheses about development of decision-making biases are suggested by different understandings of the nature of these biases and the nature of development. First, decision biases could resemble logical errors. Both decision biases and logical errors have been explained as overgeneralizations of decision rules that are generally beneficial (Baron, 1973, 1990a). Older children would presumably learn to avoid such

overgeneralizations, just as they do in other cognitive and linguistic domains (Baron, 1973). In this case, we would expect strong developmental effects (and strong effects of educational level) on the basis of previous results using logical tasks (e.g., Agnoli, 1991; Baron, Badgio, & Gaskins, 1986; Braine & Romain, 1983).

Second, a number of findings suggest that the main determinant of performance on logical and problem-solving tasks is not age as such but, rather, exposure to Western education (e.g., Sharp, Cole, & Lave, 1979; Wagner, 1978). If the effects of schooling are (somehow) general across a variety of tasks that include decision making, then we would still expect improvement with age (as well as with academic ability) in our sample. If, on the other hand, the effects of schooling are more specific to the kinds of tasks taught in school, and if Western schools do not teach people to avoid errors and biases in thinking decision making, then we would expect no age differences, by analogy with the findings in populations without exposure to Western schooling. Indeed, Perkins (1985b) has found little evidence for the development of actively open-minded thinking (in the sense of Baron, 1988), as measured by the tendency to think of arguments against one's view when thinking about a controversial question.

Third, sufficiently young children might not display biases at all. For example, the error of taking sunk costs into account, rather than thinking only about future consequences, could be an overgeneralization of a rule against wasting time or money. Sufficiently young children might not have learned this rule, so they would show no bias, and the bias might therefore increase with age. Of course, once children begin to learn this rule, they could begin to unlearn its overgeneralization too, so that the error could first increase and then decrease with age. We do not examine this inverted-U hypothesis here because we do not know what ages to examine.

2 Study 1

The first study examines a number of different decision biases, as well as two measures of actively open-minded thinking, in two groups of subjects that differ in academic achievement.

2.1 Method

Subjects. The 'Discovery' group consisted of 21 students (9 males) enrolled in a summer program for 'gifted' students at the University of Pennsylvania. Students in this program had to be in the top 10% of their classes academically. (One of the author's children was included in this group, as he would have qualified for it.) Ages ranged from 7 to 15: mean = 10.8, s.d. = 1.7. The majority of this group was White. The 'Camp' group consisted of 82 children (65 males) attending a summer sports camp on the campus of the University of Pennsylvania sponsored by the National Collegiate Athletic Association. To be admitted to the camp, a child had to live in a designated poor area of Philadelphia. All but two of our subjects in this group were Black. Ages ranged from 9 to 15: mean = 12.1, s.d. = 1.6. Subjects volunteered and were selected haphazardly, one at a time, during activities that were of relatively low interest, so that many volunteers could not be accommodated during the time available.

Questionnaire. We presented these subjects with a questionnaire consisting of nine items. The items were intended to describe realistic situations that might actually occur in our subjects' lives or in the lives of people they knew. These items addressed the following issues:

2.2 Consideration of consequences.

Do subjects make reference to consequences when justifying choices? We suggested in the introduction that attention to consequences is necessary for the avoidance of bias at any age.

2.3 Precedent setting.

Choices have immediate consequences, but they also have indirect or delayed consequences. One type of consequence that is particularly relevant is that choices set precedents for future choices. Each choice establishes, so to speak, a principle (Hare, 1952, ch. 4) that guides future choices. Other things equal, the next time the same situation comes up, the same choice will be made. Of course, situations are never exactly the same, but often the differences are not relevant, or, even when they are, people will rely on what has been done before. Precedents are relevant both to choices that affect the self alone (Ainslie, 1986) and choices that affect others (Singer, 1979). One argument for following rules (such as telling the truth) even when their violation would lead to better immediate consequences is that violation of a rule sets a precedent for future violations by oneself or (if the violation becomes public) by others. We ask here whether our subjects consider the precedent-setting aspect of choices as well as their direct consequences. If children are capable of thinking about precedents, then they can attend more heavily to consequences when making decisions, rather than blindly following rules (Baron, 1990b).

2.4 Probability dominance.

A common type of decision has some probability of leading to an undesired outcome no matter which choice is taken. Other things being equal, one should take the choice with the lowest probability of this outcome (or the highest probability of a desired outcome). Do our subjects spontaneously follow this rule?

2.5 Frequency as a guide to probability.

In judging the probability of some outcome, frequencies of similar cases are one useful guide. Do our subjects spontaneously consider this?

2.6 The sunk-cost effect.

One irrelevant factor in decision making is the past, which our decisions cannot affect (however much we wish otherwise). In the sunk cost effect (Arkes and Blumer, 1985; Thaler, 1980), subjects choose courses of action into which the most costs have been

sunk, even when the future consequences of these courses are less desirable than the alternatives. The effect could result from overgeneralization of a rule against waste, a rule that is applicable when the use of resources is controllable.

2.7 Omission bias.

Another irrelevant factor is the means by which a consequence is brought about (assuming that the means is not itself a relevant consequence). Spranca, Minsk, and Baron (1991; see also Ritov & Baron, 1990) have found that adults sometimes judge acts of commission with bad consequences as worse choices than omission with the same consequences, even when the intention of the chooser to bring about the consequences is identical. We assume (following Baron, 1986; Bennett, 1981; Kuhse, 1987; Singer, 1979; and others) that the distinction by itself is irrelevant in moral decisions just as it is in purely personal decisions. However, the distinction is sometimes relevant because it is correlated with other relevant but unknown features of decisions, such as intent to do harm. Again, use of a rule that considers harmful acts to be worse could result from overgeneralization of a rule that is valid in these cases.

2.8 Active open-mindedness.

Baron (1985, 1988) suggests that thinking that is well conducted may be described as *actively open-minded*. By this criterion, the thinker searches for additional possibilities, evidence, and goals, other than those that initially come to mind. Especially important is evidence against the first option to come to mind, and goals other than the goal in mind at the outset. Active open-mindedness is a virtue, like thrift, that may be carried to unnecessary extremes. It is, however, a true virtue in the sense that most people need reminding or education to carry it out enough. Two of our items measured the degree of active open-mindedness.

In addition, we included an item concerned with the justification of cooperation in social dilemmas (Dawes, 1980). We did not seek biases here, but, rather, we hoped to get some initial idea of the range of opinions.

The items in the questionnaire, and their scoring, will be described in the Results section. The questionnaire was read to each subject individually. A standard set of probes was included, but interviewers freely inserted other probes or modified the probes to make them appropriate to the context. Some questions were omitted for some subjects; questions 2, 5, and 9 were systematically eliminated for younger Camp subjects run later in the summer to save time, as it was felt that sufficient data on these had already been collected (given that almost all subjects gave the same answers). Other questions were omitted inadvertently, or were unanalyzable because of tape-recorder malfunction, etc. All available data from each subject were used in the analysis.

Subjects were told that our questionnaire concerned decision making, and that we were interested in how kids of their age and other ages thought about decision making. After all Camp subjects had been interviewed, J.B. gave all them (in eight groups) a lecture on decision making.

Scoring was done by Maureen Markwith and checked by J.B. from her notes. In addition, a number of items were scored blind by J.B. to check for reliability. Aside

from question 1, which had to be completely rescored by J.B. because of ambiguity in the scoring instructions, agreement was 87%.

2.9 Results

Here, we report the items used, their scoring, and the results, one by one. The tables (referred to as Table 1) show selected results for each question, by group, with total N. Missing or unscorable items are omitted. Statistical analyses are based on Kendall's τ , a measure of association for ordered classes that can be used for all the data. Age effects are assessed in the Camp group only. Sex did not correlate significantly with any of the responses, so it is not discussed further.

1. The coach of a basketball team says that everyone has to go to practices if they want to play in the games. Bill is the best player on the team. He missed three practices in a row, just because he felt like watching TV. Of course, Bill was so good that he would still help the team even though he had missed the practices. If you were the coach, how would you think about whether to let Bill play in the next game? (Probes: What would Bill do in the future if you let him play? What will the other kids do?)

The purpose of this item (as scored) was to determine the subject's understanding of the role of precedent, whatever else they considered. In particular, if the coach did not punish Bill, it would set a precedent for his not punishing anyone else, or not punishing Bill again. An answer scored 0 indicated (possibly after probing) that letting Bill play would not reduce the chance of Bill or anyone else coming to future practices; 1 recognized the effect of letting Bill play on Bill or others after probing, but not spontaneously; and 2 recognized the effect spontaneously.

As shown in Table 1, most subjects did not consider precedent spontaneously, and some subjects did not even recognize its role after probing. Age had no effect ($\tau = .12$, $z = 1.17$), but the groups differed in the level of their responses ($\tau = .28$, $z = 2.72$, $p = .007$). Of course, many other considerations were brought forward in answer to this question, on both sides. The idea of 'fairness' was frequently raised by subjects in both groups.

Question 1. Precedent setting for basketball team.

Response (acknowledgment of role of precedent)				
	0	1	2	N
	not acknowledged	not spontaneous	spontaneously acknowledge	
Camp	18%	73%	8%	60
Discovery	6%	61%	33%	18
TOTAL	15%	71%	14%	78

2a. Susan and Jennifer are arguing about whether they should wear seat belts when they ride in a car. Susan says that you should. Jennifer says you shouldn't. What do you think about this? What are the reasons for wearing them or not?

The purpose of this question was to test for recognition of consequences as reasons to do something. Practically all subjects (54 out of 59 in the Camp group, 18 out of 19 in the Discovery group) mentioned some possible consequence spontaneously. Those who did not may simply have thought that 'it's safer' was a sufficient answer.

2b. Jennifer says that she heard of an accident where a car fell into a lake and a woman was kept from getting out in time because of wearing her seatbelt, and another accident where a seatbelt kept someone from getting out of the car in time when there was a fire. What do you think about this?

This question examined probability dominance (assuming that the consequences of flying through the windshield and those of getting caught are about equally bad - as all subjects seemed to assume). In scoring, 0 did not acknowledge the possibility that seatbelts can have negative effects, even after probing; 1 acknowledged negative effects, and their effect on the decision, but failed to draw an overall conclusion; 2 acknowledged negative effects, drew an overall conclusion, but failed to justify it spontaneously in terms of probability or frequency; and 3 spontaneously justified an overall conclusion in terms of probability or frequency.

Most subjects did not use probability justifications spontaneously. Again, age had no effect ($\tau = .13$, $z = 1.35$), but the groups differed in response level ($\tau = .46$, $z = 4.56$, $p = .000$).

The responses in category 1 are of some interest, for example:

Subject 20

A: Well, in that case I don't think you *should* wear a seat belt.

Q: How do you know when that's gonna happen?

A: Like, just hope it doesn't!

Q: So, should you or shouldn't you wear seat belts?

A: Well, tell-you-the-truth we should wear seat belts.

Q: How come?

A: Just in case of an accident. You won't get hurt as much as you will if you didn't wear a seat belt.

Q: OK, well what about these kinds of things, when people get trapped?

A: I don't think you should, in that case.

Subject 12

If you have a long trip, you wear seatbelts half way, ...

Q: Which is more likely?

A: That you'll go flyin' through the windshield ...

Q: Doesn't that mean you should wear them all the time?

A: No, it doesn't mean that.

Q: How do you know if you're gonna have one kind of accident or the other?

A: You don't know. You just hope and pray that you don't.

These subjects display a belief that they can choose whether to wear a seatbelt or not after they know the type of accident. Obviously this is erroneous, but subjects fail to base their decision on the probabilities of the different types of accidents.

Question 2b. Probability in seatbelt use.

	Response (acknowledgment of role of probability)				N
	0	1	2	3	
	no negative effect	no overall conclusion	no use of probability	use probability	
Camp	5%	11%	65%	19%	57
Discovery	5%	0%	16%	79%	19
TOTAL	5%	8%	53%	34%	76

2c. Alisha has never been in a car before. She goes for a ride in a car for the first time, and she doesn't put on her belt. She thinks to herself, 'It's just one ride. It won't make any difference.' What do you think?

This question concerned precedent setting. In scoring, 0 did not spontaneously (without specific probing) acknowledge habit formation as a relevant consideration, and 1 spontaneously acknowledged habit formation as a relevant consideration. Only 6 of 51 Camp subjects and 5 of 15 Discovery subjects spontaneously noticed the importance of precedent setting, even after such additional probes as, 'Is there anything special about the first time.' Very likely, precedent setting and habit were not salient issues for this item. Response was not affected by age ($\tau = -.08, z = .58$) or group ($\tau = .24, z = 1.72$). Most subjects simply noted that the first time was no different from any other time, and it was important to wear one's seatbelt at all times.

3. Suppose you are friends with an 8th grader who lives next door to you. He cuts classes in school almost every day so that he can spend four hours or more practicing basketball. When someone asked him why he did that, he said he wanted to be a professional basketball player so he could make lots of money. How would you help him think about this plan? (If probabilities aren't mentioned, ask about his chances of making it to the pros.)

This item (inspired by a story on a U.S. Public Broadcasting Service program) tested subjects' consideration of frequency information as a guide to probability. Part of the reason that the boy's plan is wrong is the low probability of becoming a professional. Understanding of the low probability requires thinking about the number of other similar children. In scoring, 0 was a response of 'don't know' or an expression of puzzlement when asked about probability; 1 was a probability judgment (verbal or numerical) but with no mention the number of others kids who are similar; and 2 considered explicitly the number of other kids in similar situations (frequency).

Most subjects did not mention frequency in their answers. Response level was affected by both age ($\tau = .25, z = 2.64, p = .008$) and group ($\tau = 23, z = 2.50, p = .012$).

Question 3. Probability, basketball player.

	Response (role of frequency)			N
	0 don't know	1 no frequency	2 frequency used	
Camp	16%	83%	4%	75
Discovery	5%	76%	19%	21
TOTAL	13%	80%	7%	98

4. Ellen saw an accident. A friend of hers ran into someone else's car. She hoped that the accident would not be blamed on her friend. She decided to lie to the police about whose fault the accident was, if they asked her. The police came. She expected that they would blame it on the other person, even though it was her friend's fault. They didn't ask her. She did not speak up and tell the truth. Is this just as bad as if she had lied?

This item concerns the relevance of omission vs. commission in moral judgment. In scoring, 0 indicated that failing to tell the truth is not as bad as lying, and 1 indicated that it is just as bad as lying (with other factors held constant). In the Camp group, 83% of the 77 subjects scored 1, but only 55% of the 20 discovery subjects scored 1 (77% for both groups combined). This score showed no effect of age ($\tau = -.016, z = -.15$) but a significant effect of group ($\tau = -.27, z = 2.41, p = .016$), with the Camp group *more* likely to ignore the distinction.

5. Some states have a law that says that all soda and beer have to be sold in returnable bottles. That means that you pay extra when you buy the soda, but then you get the money back when you return the empty bottle. What do you think about this idea for Pennsylvania? [If the subject did not say anything, the experimenter explained that the purpose of the law was reduce litter and waste. If the subject did not offer arguments on both sides, the experimenter asked, 'Can you think of any reasons on the other side?']

This item, drawn from Perkins, Bushey, and Faraday (1986) tested actively open-minded thinking in the search for evidence (i.e., arguments). In scoring, 0 did not offer other-side arguments after probing; 1 offered other-side arguments only after probing; and 2 offered other-side arguments spontaneously.

Most subjects did not offer other-side arguments spontaneously. The response level was not affected by age ($\tau = .06, z = 0.43$) or group ($\tau = .22, z = 1.77$).

Question 5. Otherside arguments, returnable bottle.

	Response (other-side arguments)			
	0	1	2	N
	none	on probe	spontaneous	
Camp	55%	38%	6%	47
Discovery	35%	41%	24%	17
TOTAL	50%	39%	11%	64

6. Jill's uncle Bert lives by himself. On the way home from work, he bought a TV dinner on sale for \$3. Then Bert had an idea. He invited his friend Bernie over to watch a game on TV, and he went back to the store to get another TV dinner. When Bert got to the store, he found that there were no more dinners on sale, so he had to spend \$6 for a dinner just like the first one. Bert put both dinners in the oven. Then Bernie called and said he wasn't feeling well and couldn't come. Bert couldn't eat both dinners, and he couldn't put one back in the freezer. He had to eat one and throw out the other one. Which one should he eat, or does it matter? Why?

This item, drawn from Arkes and Blumer (1985), measures the sunk-cost effect (answer '1'). In scoring, 0 favored \$6; 1 was uncertain or saw both sides (possibly with probing); and 2 thought it didn't matter. No subject favored \$3. The response level was unaffected by age ($\tau = .03, z = 0.32$) and unaffected by group ($\tau = .12, z = 1.36$).

Question 6. Sunk cost, TV dinners.

	Response (sunk-cost effect)			
	0	1	2	N
	effect	uncertain	no effect	
Camp	28%	30%	42%	81
Discovery	20%	20%	60%	20
TOTAL	27%	28%	45%	101

7. Alice's mother watches lots of programs on Channel 12, because she likes the programs, and because there aren't any ads. She gets a letter in the mail asking her to give money to the station. The letter says that people who watch the station should give money, because that's the only way the station can get the money it needs to stay on the air. Alice's mother thinks that she could really afford to give some money. But then she decides not to give. She thinks to herself that enough other people will give, so that she doesn't really need to. What do you think? What if Alice's mother were sure that a lot of other people would give? What if she were sure that not many other people would give and the station would have to show fewer programs?

In scoring, 0 agreed with mother's reasoning; 1 thought she should give but only insofar as it helps the station; 2 thought she should give because it's unfair to others who do if she doesn't; and 3 gave a 'what if everybody thought that way' argument. Here the scoring categories reflect no ranking. The results in Table 1 show that the

pure consequentialist response was the most frequent in both groups. A chi-square test showed no age effects (chi-square = 17.1, 18 df).

Question 7. Cooperation, public TV.

	Response (type of justification)				N
	0 not give	1 helps	2 fairness	3 generalization	
Camp	3%	67%	19%	11%	79
Discovery	15%	50%	10%	25%	20
TOTAL	5%	64%	17%	14%	99

8. Bill’s friend Steve smokes cigarettes. One day, Steve offers Bill a cigarette. Bill has always wondered what cigarettes were like. He knows that they are bad for his health, and he doesn’t want to start smoking, but he thinks that just trying once won’t hurt. What do you think? Why?

This question, like questions 1 and 2c, addresses precedent setting. Like 2c, this question concerns the importance of a first occasion. In scoring, 0 did not spontaneously (without specific probing) acknowledge habit formation or addiction as a relevant consideration, and 1 spontaneously acknowledged habit formation or addiction as a relevant consideration. For this item, the precedent-setting or habit-forming aspect of the behavior was more apparent to both groups, perhaps because most people have heard of the possibility of cigarettes becoming habit forming. Of the Camp group, 54 of 78 scored 1, and of the Discovery group, 13 of 18. The response was not affected by age ($\tau = .17, z = 1.67$) or group ($\tau = .02, z = .25$).

9. Suppose you had to plan the meals in a school cafeteria for a week. How would you go about this? [If the subject did not respond, the experimenter asked, ‘What factors should you consider?’]

This item examines active open-mindedness in search for goals. In scoring, 0 mentioned only one factor (e.g., health, or preference, or ease), and 1 mentioned two or more factors spontaneously (or with a general probe like ‘anything else?’). A score of 0 represents single-mindedness, the failure to consider more than a single goal. In the Camp group, 66% of 47 subjects scored 1; in the Discovery group, 81% of 16 subjects did so (70% for the groups combined). Response level was affected by age ($\tau = .51, z = 6.21, p = .000$) but not by group ($\tau = .14, z = 1.28$).

In order to carry out an overall test of the effects of group and age on the items testing decision effects (consequences, precedent setting, probability, frequency, sunk cost, and omission) a total score was obtained by summing the scores for items 1, 2b, 3, 4, 6, and 8. (Item 2c was omitted because too few subjects answered it, but when it was included the results did not change.) This score was regressed simultaneously on age and group. The overall regression was significant ($R^2 = .13, p = .046, N = 48$ - many subjects had missing data on at least one item), group contributed significantly ($t = 2.57, p = .014$), but age did not ($t = 1.40$).

2.10 Discussion

The main results are the evidence for neglect of some important factors in decision making: precedent setting (#1), probability (#2b), and frequency (#3). Only when considering cigarette smoking did subjects show an appreciation of precedent, in the form of possible addiction. In addition, subjects showed a strong ‘myside-bias’ effect in the returnable-bottle item (#5). Evidence for omission bias and the sunk-cost effect was found, but the majority of subjects did not show these errors.

Two questions showed improvement with age, #3 (frequency in basketball) and #9 (search for goals in the cafeteria). Four questions showed group differences, the Discovery group performing better in #1 (coach’s precedent setting), #2b (probability dominance with seatbelts), and #3 (probability for the basketball player), and the Camp group performing better in #4 (omission bias). The remaining items showed no effects of either variable: #2a, consequences of seatbelts; #6, the sunk-cost effect with TV dinners; and #8, precedent setting of the first cigarette.

If actively open-minded thinking is a trait that correlates with school performance, we should not be surprised by the superior performance of the Discovery group on #5. More interesting is their greater sensitivity to precedent setting in #1, probability dominance in #2b, and frequency in #3. Although age effects were not significant for two of these items, the correlations with age were not much smaller than the correlations with group, so the group effects could be a function of intellectual development.

One possible account of these results is that actively open-minded thinking, as a trait, leads to more mature heuristics for probability judgment and decision making (as proposed by Baron, 1990a). For example, the importance of precedent setting could be discovered in the search for reasons about why the coach should or should not punish Bill, and the relevance of frequency to the judgment of probability could be discovered in a search for evidence. Against this possibility is the fact that the overall score on the decision items was not correlated with either item that measured actively open-minded thinking (#5, $r = .03$; #9, $r = .11$).

Although most group differences favor the Discovery group, the Camp group does better in ignoring the distinction between omissions and acts. One possible explanation of this result is that the distinction really is morally relevant, so that the Discovery group is, once again, getting the right answer more often. Perhaps because the authors are more impressed with the arguments that the distinction is morally irrelevant, we are led to suggest another explanation. Many subjects in the Camp group gave answers to this question and others suggesting that they had grown up in religious Christian homes, where morals were taken seriously. By contrast, some of the Discovery subjects were skeptical about the possibility of moral judgments, tending to think that moral questions are no more answerable than questions about whether one person’s experience of ‘redness’ is the same as another’s. Subjects with this attitude might have assimilated questions about morality to questions about legality or general legal principles. Laws against acts are much easier to enforce than those against omissions, so a legal distinction is reasonable. Thus, subjects who made a distinction frequently pointed out that if Ellen said nothing, nobody would know her intention. Another possible explanation of the group difference is that the Camp subjects were more inclined to ignore subtle distinctions. This cannot explain the fact that the Camp group was no less likely to

make a distinction on the basis of sunk cost in #6.

3 Study 2

A questionnaire concerning active open-mindedness, precedent setting, sunk cost, and omission bias was used to interview children aged 5 to 12 in a suburban private school affiliated with the Society of Friends. Those items dealing with active open-mindedness did so not only by looking at children's spontaneous arguments but also by asking subjects to classify presented arguments as 'for' or 'against' the proposition in question and by asking whether the arguments were good or bad. Myside bias could express itself through a tendency to classify arguments as favoring the subject's position even when they do not, and by a tendency to classify favorable arguments as good and opposing arguments as bad.

This task can be viewed as one that assesses coordination of theory and evidence in the sense of Kuhn, Amsel, & O'Loughlin (1988) and Kuhn (1989, 1991): the subject's opinion on the issue functions here as 'the theory,' and the arguments presented are evidence for or against the theory. Kuhn et al. (1988) found that the skills involved in coordinating theory and evidence are weak among children and that they show some development from middle childhood to adulthood. She reports that children and adolescents often interpreted identical evidence to mean one thing in relation to a theory that was favored and something else, often quite different, in relation to a theory not favored. Similarly, Moshman and Franks (1986) has found that 4th graders (his youngest Ss) were less likely to evaluate an argument as valid if its content was false than if its content was true; they had trouble in consistently responding to the task on the basis of logical form and incorporated elements of truth-falsity and relevance in making their judgments.

An alternative explanation, which we do not attempt to assess, is that myside bias is a result of motivation, specifically, wishful thinking in trying to convince oneself that one's initial view was correct (so that that one can maintain one's self-concept as a good intuitive thinker); see Baron (1988, ch. 15) and Kunda (1990) for recent discussion.

3.1 Method

Subjects were 63 students from a school in suburban Philadelphia run by the Society of Friends (Quakers), all students from the sampled grades (except for the third, which was not completed) whose parents returned permission slips: 11 Kindergarteners, 12 first graders, 16 second graders, 7 third graders, and 17 sixth graders. They were interviewed by E. T., who took notes in addition to recording the interview on tape.

The basic items (some paraphrased) were as follows:

Uniform (myside bias): The principal of a private school, for Kindergarten through sixth grade, is wondering whether she should have a rule requiring students to wear uniforms to school or not. What do you think?

Homework (myside bias and precedent): A child threatens not to do his homework if he doesn't get his way. When the time comes to carry through the threat, he wants to do his homework after all. Should he carry out the threat?

Mother (myside bias and precedent): A mother threatens a misbehaving child that they will leave a dinner party if the child continues to misbehave. When the child continues, the mother does not want to leave. Should she leave?

Break (myside bias): The principal of a school must decide between four classes of 45 minutes each with a 15 minute break, and two classes of an hour and a half each with a 45 minute break. What do you think? [Given only to grades 2 and 6]

Train (myside bias and precedent): 'You are the conductor on a train. A woman gets on the train without a ticket. You tell her that the fare is \$2, plus \$1 for not buying a ticket at the station. The woman refuses to pay the extra dollar, although she has the money. She says that she didn't know the rule. You do not believe her. You have seen her many times riding the train, and you know that there is a sign posted in the station where she got on. The rules say that passengers must be made to pay or they must be put off the train, if necessary by calling the police. Calling the police would delay the train and make all the other passengers late. All the other passengers are listening to your conversation with the woman. Would you call the police?' [Given only to grades 2 and 6]

Ring (sunk cost): 'You are planning to give your mother a ring for Mother's Day. It costs \$200 and you are buying it by paying \$20 a week from the money you earn at a part-time job. You have paid \$100 already, so you have five payments left. One day, you see in the paper that a new jewelry store is selling the same ring for only \$90 as a special sale. You can pay for it the same way, except that you will have to pay only \$10 in the last week instead of \$20. The new store is across the street from the old one. If you decide to get the ring from the new store, you will not be able to get your money back from the old store, but you would save \$10 overall. How would you think about this?' [Not given to Kindergarten or grade 3]

Drawing (sunk cost): 'There is going to be a school exhibit of students' drawings. You have spent the last three art classes working on a drawing for the exhibit. At the end of the last session, you had an idea for a new kind of drawing that was much easier to do. You tried it, and, in a few minutes, you produced a new drawing. You liked it better than the one you had worked on for three classes. Which drawing would you hand in for the exhibit?' [Not given to grade 3]

Accident (omission): 'You saw an accident. A friend of yours ran into someone else's car. You hoped that the accident would not be blamed on your friend. You decided to lie to the police about whose fault the accident was, if they asked you. The police came. You expected that they would blame it on the other person, even though it was your friend's fault. They didn't ask you. You did not speak up and tell the truth. Is this just as bad as if you had lied?' [Not given to grade 3]

Tennis (omission): 'You are a tennis player. In the final game of a tennis tournament, you were to play Ivan. Ivan was a much better player than you, but you really wanted to win. You went out to dinner with Ivan the night before you played your match. You knew that Ivan would get a stomach ache if he ate cayenne pepper, and you also knew that the regular salad dressing in the restaurant had cayenne pepper in it. You decided to get Ivan to eat the regular dressing. You were about to tell Ivan that he should try the regular dressing, when Ivan ordered it himself. Of course, you did not tell Ivan that the dressing had cayenne pepper. Ivan got a stomach ache the next day, and you won the match. Was your behavior just as bad as if you had told Ivan to try

the regular dressing?' [Not given to kindergarten or grade 3]

Four variants of the basic questionnaire were used. They differed in which option was the status quo in the Uniform story and in whether the remaining stories were described from the subject's point of view ('you') or from another person's point of view. These variables did not affect the results, so they are ignored henceforth.

To look for myside bias in production of arguments (following Perkins, 1985b), we asked most subjects to give reasons after Uniform, Mother, Homework, Break, and Train. To look for myside bias in the *evaluation* of argument, we gave most subjects brief arguments to evaluate after these items. For example, for the Homework item the arguments were:

Now here are some things you might think about concerning this story.
Tell me whether you think each is a reason to do your homework or not to do it. Then tell me whether you think it is a *good* reason or not.

1. You really want to do your homework.
2. If you do your homework, your parents won't believe you the next time you threaten them.
3. If you don't do your homework, you will get in trouble at school.

3.2 Results

All measures of myside bias were generally consistent with the existence of such bias, but almost no measures showed consistent age effects in this study. The overall mean number of arguments that children gave on their own side and on the other side, respectively, was: 1.15 and 0.46 for Uniform ($t(51) = 7.42, p = .000$ two-tailed); 0.79 and 1.13 for Mother ($t(41) = -2.86, p = .007$); 1.08 and 0.52 for Homework ($t(47) = 4.89, p = .000$); 0.95 and 0.58 for Break ($t(18) = 2.11, p = .049$); and 0.89 and 0.56 for Train (N.S. with only 9 subjects). We cannot explain the reverse effect for Mother. Correlations of own-side and other-side arguments, respectively, with grade in school were: Uniform, .03 and -.01; Homework, -.03 and .17; Mother, .24 and .20; Break, -.08 and .33; and Train, -.25 and .32. None of these was significant at $p < .10$. (Those for Break and Train were based on only 19 and 9 subjects, respectively.) The total own-side arguments across Uniform, Homework, and Mother correlated .09 with grade, and the total other-side arguments correlated .11; neither was significant.

A measure of myside bias was constructed from the responses to the question about which side each presented argument was on: the proportion of arguments against the subject that were misclassified as favoring the subject minus the proportion of arguments in favor that were misclassified as opposing. In general, this measure was positive: 0.20 for Uniform ($t(41) = 2.86, p = .007$); 0.48 for Homework ($t(51) = 6.51, p = .000$); 0.14 for Mother ($t(40) = 1.56$); 0.33 for Break (N.S. with 22 subjects); and 0.08 for Tennis (N.S. with 17 subjects). (The myside bias measure was residualized on the subject's opinion before the statistical tests were done, except for the Homework item, where all subjects opined that the homework should be done.) Correlations between these measures and grade were (negative correlations indicating less bias in higher grades): Uniform, -.04; Homework, -.44; Mother, -.03; Break, .10; and Train,

.17. Only the correlation for Homework was significant. The sum of the measures for Uniform, Homework, and Mother correlated .18 with grade, which was not significant. In sum, subjects tend to misclassify arguments so as to favor their own position. They do this for all five cases. But this effect does not appear to change with grade.

A second measure was constructed by subtracting the average 'goodness' of the arguments against the subject from the average for the arguments agreeing. Again, this measure was generally positive (again, residualizing on the subject's opinion except for Homework): 0.24 for Uniform ($t(41) = 3.50, p = .001$); 0.13 for Homework ($t(51) = 2.76, p = .008$); 0.06 for Mother ($t(40) = 0.66$); 0.33 for Break ($t(20) = 2.08, p = .051$); and 0.08 for Train ($t(15) = 0.68$). In sum, subjects tend to judge arguments as better when the arguments favor their own view (as found by Baron, 1991, for college students).

The correlations between this measure and grade were: Uniform, .35; Homework, -.07; Mother, .24; Break, -.24; and Train, .45. Only the correlation for Uniform was significant ($p = .021$), but the total for Uniform, Homework, and Mother was also significantly correlated with grade ($r = .39, p = .033$). The direction of this correlation indicates an increasing bias with grade.

The proportion of subjects who mentioned precedent setting in their arguments was .16 for Homework, .17 for Mother, and .40 for Train. The correlations with grade were .02, .12, and .09, respectively, all nonsignificant (and their sum correlated .21 with grade, also nonsignificant).

A second index of sensitivity to precedent was the correct classification of arguments that concerned precedent. Correct classification of Homework argument #2, stated earlier, as being against doing the homework correlated .57 with grade ($p = .000$). This accounts for the change in myside bias described earlier. The relevant argument for Mother, 'If you stay, your child won't believe you the next time you threaten him,' correlated -.06 with grade. The arguments for Train, 'If you don't call the police, the other passengers will get the idea that they don't have to follow the rules,' and, 'If you don't call the police, the woman will get the idea that she doesn't have to follow the rules,' together correlated .00 with grade. A third index of sensitivity to precedent was the ratings of the arguments concerning precedent as 'good.' The correlations of these indices with grade were .12, -.06 and .00 for the Homework, Mother, and Train items, respectively. None was significant.

The proportions of subjects showing a sunk-cost effect in their stated opinion were 0.53 for Ring and 0.47 for Drawing. The two responses were not correlated ($r = .17$). Many justifications were consistent with the existence of a real sunk-cost effect in children, for example: (2nd grade) 'cause I already spent my money to the store'; (6th grade) 'since I've already spent \$100'; [for the Drawing item] (2nd grade) 'I spent so long, I don't want to waste it for nothing'; (6th grade) 'because you worked on it for 3 classes.' (Other justifications of buying the old ring involve the unfairness of letting the merchant keep the ring and the money. For the Drawing item, some subjects saw other reasons for completing the original drawing, such as reminding the teacher of the effort that had been put into it.) The sunk cost items showed no grade effects ($r = .11$ for Ring, .02 for Drawing, .22 for their sum, none significant at $p < .10$).

The proportions of subjects showing omission bias (saying that the act and omission were different) were 0.30 for Accident and 0.16 for Tennis. These proportions

were somewhat lower than those found in similar items used by Spranca et al. (1991) on college students, but similar to the proportions found in the Camp group in Study 1. Possibly, the results are affected by the fact that the present sample is from a school run by the Society of Friends (Quakers), which emphasizes moral training and responsibility (and, very likely, attracts students whose parents feel the same way). If so, this would agree with our suggested explanation of the low bias of the Camp group in Study 1. Kindergarteners gave no justification for their choices. Younger children tended to give justifications that did not address the distinction, e.g., 'lying is bad' used to justify *both* responses to the Accident item. Other justifications were, however, more specific, e.g., (grade 1) 'Lying is talking and not telling the truth; John, keep your mouth shut.' The omission bias items also showed no grade effects (as found in Study 1 - $r = .21$ for Accident, $-.09$ for Tennis, $.11$ for their sum, all nonsignificant).

4 Study 3

The third study further examined age effects in omission bias using additional items and a different format of presentation.

4.1 Method

Subjects were 20 second graders (mean age 7.3, 11 males) from an elementary school and 23 seventh graders (mean age 12.4, 8 males) from a junior high school. The two schools served the same upper-middle class geographical area in the Port Washington (New York) School District. Students were tested in fall, 1990. The second graders were read the questions and answered them verbally. Their responses were both written down and taped (as a precaution). The seventh graders read the questions and wrote their answers.

The first question was:

Tom purchases a candy bar for 50 cents. Tom hands the cashier a dollar to pay for the candy. The cashier makes a mistake and thinks Tom handed her ten dollars instead of one dollar. She begins to give Tom much more change than he should receive.

The cashier asks Tom if he gave her ten dollars or one dollar. He responds with the incorrect amount of ten dollars.

John, in the same situation, pays 50 cents for a candy bar and receives the wrong change too. If he is asked about it, he plans to also say the incorrect amount. The cashier does not ask him how much money he gave to her. John does not tell her she gave him too much change.

Is Tom's behavior, telling the cashier the correct amount, equally as bad as John not telling the cashier she gave him too much change? Why? (Or why not?) What is the difference?

Note that the story calls attention to the equivalence of intention by indicating what John would have done if he had the chance. In contrast to the omission items used in Studies 1 and 2, these items use two actors, so this explicit statement is necessary.

Five other scenarios were constructed in the same way, with two actors causing the same outcome, one through an omission and the other through a commission: a child, out of anger, causes his friend's new puppy to run away by opening (or not closing) a gate; a student overhears the answers to a math test, by following teachers as they discuss the answers (or by not moving); a child causes his competitor for a softball position to run into the woods and be stung by a bee, thereby missing the tryout, by throwing a ball into the woods (or not warning the competitor after a ball rolls into the woods); a child lies (or does not say anything) to protect a friend who broke a window; a child intentionally oversleeps by unplugging his alarm clock (or not plugging it in when it is accidentally unplugged).

4.2 Results and discussion

Responses were scored by L.G. and J.B. Agreement was 98% on whether the subject thought that the two actors behaved equally badly, or, if not, which behaved worse. (Only two out of 256 usable responses said that the omission was worse. The two raters agreed on these.) The raters also judged whether or not intention was mentioned as a justification. Interrater agreement was 93% for cases in which the subject judged the act worse and 92% for cases in which the subject judged the act and omission equal. (J.B.'s ratings were used throughout because they were slightly more conservative with respect to the hypotheses tested. J.B. also scored mention of consequences.) Sex was not related to any measures.

The two age groups differed in omission bias. The older subjects judged the act to be worse than the omission in 40% of the cases, the younger subjects, in 77% (Mann Whitney $U = 210$, $p = .000$). This age difference was present in all six stories. Although age effects were not found in Studies 1 and 2, the present study used more items.

The increase with age in the proportion of 'equal' judgments was accompanied by an increase in the tendency to justify such judgments in terms of the equality of intention. Older subjects were much more likely to say that the two children were equally bad because they both planned to do the bad deed, they both would have done it if they had the chance, they both wanted to do it, or they both knew that their behavior would have the same effect. Of the cases in which acts and omissions were judged equivalent, older subjects cited equal intention in an average of 37% of the cases, younger subjects, in 8% ($U = 58$, $p = .008$).

One interpretation of this result is that older children's increased sensitivity to equal intention distracts them from the act-omission difference. Another possibility is that their reference to intention is simply a reasonable justification for saying that the two children were equally wrong. (Subjects might realize that such equivalence of intention is rare, so that acts and omissions would usually differ in both intention and blameworthiness.) Are older children more sensitive to intention? Piaget (1948) found that intention cues were overwhelmed by outcome cues for young children, but Karniol (1978) points out that this could result from more attention to outcomes rather than less attention to intention. Studies of sensitivity to intention for equally harmful outcomes have

typically found no age effects (Karniol, 1978; Olthof, Ferguson, & Luiten, 1989, Table 3); Shultz, Wright, & Schliefer (1986, Figure 4) find some evidence for increasing sensitivity to intention with age, but even their five-year-olds were sensitive to it. In sum, prior evidence does not support the view that older subjects were distracted.

When younger children mentioned intention, it was more often a justification of the act being worse, and it was usually expressed in terms of the act being done 'on purpose.' (Of the cases in which acts were judged worse, younger subjects justified an average of 25% of their responses in terms of intention, older subjects, 27%; these did not differ.) This use of the language of intention could represent a true confounding of intention and action, or it could represent a misuse of the term.

Younger children were more likely to justify 'equal' judgments in terms of the equal consequences. Of cases in which act and omission were judged equal, this response was justified in terms of consequences for an average of 41% for younger subjects, 12% for older subjects ($U = 168, p = .035$)

5 General Discussion

Our findings suggest that many people enter adolescence without a readiness to take probabilities into account, to think of frequencies as relevant to probabilities, or to think about the precedent-setting effects of choices. These seem to be serious deficiencies when it comes to making decisions about drugs, contraception, health habits, or when it comes to understanding many public policy questions in which such issues arise. They do not seem to disappear by early adolescence. If instruction can be effective in making adolescents more aware of these types of arguments, then instruction is warranted. The fact that our oldest subjects are still making many errors suggests that schools could do more. Of course, further studies of training methods are needed, like that of Agnoli (1991).

The general lack of robust age effects for many of our measures suggests that many appropriate heuristics for thinking and decision making seem to develop only slowly in current U.S. students. In this respect, decision-making abilities could be analogous to many other logical abilities, mathematical and physical concepts, and informal reasoning abilities, which develop only slowly in cultures without appropriate schooling (Sharp, Cole, & Lave, 1979; Nisbett, Fong, Lehman, & Cheng, 1987; Perkins, 1985a). When these abilities are taught, however, they can transfer to new situations (Baron, Badgio, & Gaskins, 1986; Larrick, Morgan, & Nisbett, 1990; Nisbett et al., 1987). Western schools apparently do something to promote the development of many of these abilities as well.

Although observed developmental trends in logical and mathematical reasoning in Western cultures suggest that schools are teaching something that transfers generally within these domains, the weakness of such trends in informal reasoning, probabilistic reasoning, and decision making suggest that the schools are not doing much that transfers to these domains. This should not be surprising to those familiar with the standard curriculum of North American schools, at least. Although geometry, linguistics, and history are ensconced in the curriculum from Kindergarten through high school, probability has just gotten its foot in the door; decision theory - arguably one of the great

inventions of the modern social sciences - is absent except for some experimental programs (Baron & Brown, 1991); and informal reasoning, when taught at all, is often taught naively, with little understanding of its nature (Brown, 1991; Perkins, Bushey, & Faraday, 1986).

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