

This draft was generated prior to acceptance and might differ in small detail from the published article

COGNITION

1996, Vol 59, No 1, 1-21

CONTAMINATION IN REASONING ABOUT FALSE BELIEF: AN INSTANCE OF  
REALIST BIAS IN ADULTS BUT NOT CHILDREN

P. Mitchell, E.J. Robinson, J.E. Isaacs and R.M. Nye

University of Birmingham

This research was supported financially by the Economic and Social Research Council, U.K.  
Address for correspondence: P. Mitchell, School of Psychology, University of Birmingham, P.O.  
Box 363, Birmingham, B15 2TT, U.K.

Running head: Realist bias in adults

### Abstract

Children aged around 5 and 9 years and adults were presented with stories and videos about a protagonist who heard a message purporting to provide factual information. Observing subjects knew whether the message was true or false. In some cases, this message contradicted the listener's existing belief based on what he or she had seen previously. Subjects judged whether the listener would believe or disbelieve the message. Child subjects frequently judged that a contradicting message would be disbelieved, irrespective of whether they (the child subjects) knew it to be true or false. In contrast, adult subjects made judgments that were contaminated by their own privileged knowledge of the truth. For three different scenarios, adult subjects judged more frequently that the message would be believed if they (but not the listener protagonist) knew it to be true, than if they thought it was false.

#### CONTAMINATION IN REASONING ABOUT FALSE BELIEF: AN INSTANCE OF REALIST BIAS IN ADULTS BUT NOT CHILDREN

Bias in reasoning is a ubiquitous phenomenon (Evans, 1989, for a review). It is evident in tasks which require logical inferences when the participants are adults (e.g. Wason & Johnson-Laird, 1972; Johnson-Laird, 1983) and when they are children (e.g. Braine & Romain, 1983; Donaldson, 1978; Russell, 1978). There is also a well established literature on social cognition, documenting bias in judgments about people's dispositions (for reviews, Schneider, 1991; Wilson & Brekke, 1994). Wilson and Brekke make an important distinction between biased judgments due to failure to apply a principle of logical inference and bias due to what they call 'mental contamination'. An instance of the latter is prejudice. Wilson and Brekke illustrate their argument with the example of a professor giving a low grade to a student who belongs to a minority group purely because the professor's prejudice contaminates her judgment of academic quality. Even though the professor might know about the insidious effects of prejudice, and even though she might strive to be free of prejudice, she will not know whether her score would have been different if she had been ignorant of the identity of the student. In this respect, mental contamination differs from bias that produces errors in logical reasoning. In the latter, we might agree on a principle of inference once it is explained to us, and avoid bias thereafter by systematic application of that principle. Mental contamination is different, because it cannot normally be eliminated by application of a principle (but see below).

We will suggest that adults' knowledge of what is true of reality can contaminate their judgments of what others might believe of reality. Bias in preschool children when they make judgments about belief is well documented in the developmental literature (e.g. Astington, Harris & Olson, 1988; Baron-Cohen, Tager-Flusberg & Cohen, 1992; Frye & Moore, 1991; Lewis & Mitchell, 1994; Perner, 1991; Wellman, 1990; Whiten, 1991) but as yet there has been no attempt to link this phenomenon with bias in adult judgments about mind. The main purpose of the research presented here is to examine the possibility of making such a link.

A finding from developmental research is that children aged around 3 or 4 years differ from older children in that they seem to have difficulty judging about beliefs independently of reality. This is apparent in the deceptive box task (e.g. Gopnik & Astington, 1988). We show a Smarties tube to the child and ask him/her what is inside. When s/he has said 'Smarties', we open the lid to reveal the unexpected content of pencils, return them, close the lid and ask the child what s/he had thought was in the tube when s/he first saw it. Many children aged around 3 or 4 years, but relatively few older children, give an incorrect realist response of 'pencils'. Moreover, these children have just as much difficulty judging what another person would think, who had not yet seen inside the tube. In this respect, young children are effectively denying that they were misled by the exterior of the tube, and also deny that another person would be misled.

Far-reaching conclusions have been drawn from this finding and other similar results. In particular, a prevailing view is that at around 4 years of age children experience a radical conceptual shift that equips them with a representational theory of mind similar in form if not content to that of an adult (e.g. Gopnik, 1993; Perner, 1991; Wellman, 1990). A widely held view (*pace* Chandler, 1988; Chandler & Hala, 1994) is that at around 4 or 5 years, children first begin to anticipate the behaviour of those around them according to the actor's belief, even if that belief happens to be false (e.g. Gopnik, 1993; Perner, 1991). In other words, children acquire a concept of the representational mind and as a direct consequence no longer

report what they themselves assume currently to be true when asked about another's belief. They are able to infer what an actor might wrongly believe by taking into consideration the actor's informational access.

A view put forward by Wimmer and colleagues (Sodian & Wimmer, 1987; Wimmer, Hogrefe & Sodian, 1988; Wimmer & Weichbold, 1994) is that at about 4 years of age, children begin to use the rule that people cannot know a fact if they lack informational access, particularly information in the visual modality (Sodian & Wimmer, 1987). Consequences of this are twofold. First, children aged 3 and below are unlikely to grasp the link between seeing and believing (Wimmer, Hogrefe & Perner, 1988; pace Pratt & Bryant, 1990). Second, they are likely to make tell-tale errors at age 5, revealing that they are applying and even over-applying the rule that people know if they see and do not know if they do not see. For example, children denied that a protagonist knew a fact, when she had not seen, even though she was likely to have inferred the information in question (Sodian & Wimmer, 1987). If we apply Wilson and Brekke's (1994) argument to these phenomena, we could say that the children aged around 5 years are no longer prone to mental contamination when judging about belief, and hence their realist errors vanish, because they have come to use a simple rule (seeing-believing) when judging belief. Wilson and Brekke suggested that mental contamination could occur if an individual does not use a rule in reasoning, but that such contamination would not intrude if a rule were applied. This process could explain the fading of realism between 3-5 years of age as the child begins to apply a rule to the task of judging belief (seeing-believing). If the child judged belief according to what the protagonist had or had not seen, then there would be no scope for the child to make a realist error in this context; there would no longer be opportunity for knowledge of reality to contaminate judgments of belief.

Results obtained by Perner and Davies (1991) also seem consistent with the suggestion that children aged around 4 years apply the rule that people believe what they see. Perner and Davies devised a story in which one character told another where a football was, and this information was either true or false. In two conditions (one true message and one false message) the listener had not previously seen where it was, so the utterance was the only source of information. In other conditions the listener had seen the football earlier, and held a firm belief (which was either true or false) about the ball's location, and the message contradicted this. The 4-year-olds tested by Perner and Davies tended to judge that the listener would ignore the message about the ball's location if she (the listener) had previously seen it elsewhere. In contrast, the child subjects judged that the listener would believe the message if she (the listener) had no prior knowledge. In both cases, children's judgments were not influenced by what they themselves knew about the true location of the ball. Consequently, children were acknowledging that the way in which a listener treated a given message depended on his or her prior state of informedness.

This led Perner (1991) to argue that acquiring a representational theory of mind at around 4 years of age conferred upon the child an understanding that beliefs are distinct from reality and that the mind interprets incoming information. Hence, Perner claimed that the 4-year-old possesses a theory of mind similar in form if not content to an adult in this respect (though he acknowledges the possibility of further development in the ability to acknowledge higher-order beliefs). More fundamentally, this seems like another instance of children applying the rule that people believe what they see. In this case they were apparently assuming that the belief based on seeing was held so firmly that it was resistant to updating by a

contradicting message.

In accordance with Wimmer and colleagues (e.g. Wimmer et al, 1988), then, we are suggesting that the children tested by Perner and Davies (1991) were using a seeing-believing rule for judging what a protagonist would believe when subjected to conflicting input. If children were using such a rule, it raises the possibility that their judgments could differ in interesting ways from those of older children or adults.<sup>1</sup> In real life there are occasions when a person would believe a message that contradicted earlier information based on seeing. For example, in some circumstances a listener might assume that the speaker could have moved the ball after he (the listener) saw it, and so the listener might believe the message. Indeed, this example helps to illustrate the point that in many cases, judgments about others' beliefs are based on an educated guess, and should not be inferred by applying a simple rule. It is likely that 4--5-year-olds are less aware than older children or adults of the various factors that might influence a listener's decision to believe or disbelieve what s/he is told. As awareness of the complexity of identifying another's belief increases, and the willingness to judge according to a rigid rule decreases, there might be more risk of bias due to mental contamination. This is precisely what we would predict from Wilson and Brekke's (1994) argument, that mental contamination can occur in reasoning when the individual does not apply a rule. One specific contaminant that might intrude when making judgments about belief, is the judge's own knowledge of reality. There is already evidence, which we shall summarize below, that what is known of reality intrudes as a source of contamination in adult judgments of belief and related matters.

One instance of realism in adulthood is what has been called a 'hindsight bias'. The classic example is given by Fischhoff (1975), who presented subjects with accounts of historical events, such as a battle between British and Gurkha armies in India. The subjects were told about a variety of factors that might advantage one or other side. Some were also informed of the 'outcome' -- either of a Gurkha or British victory, depending on which experimental condition the subject was assigned to. Finally, subjects were asked to rate the probability of various outcomes as if they had not known what really happened. Despite these instructions, subjects tended to give higher ratings to outcomes they were told had actually happened.

Fischhoff and Beyth (1975) replicated this finding in a more naturalistic context, in which subjects rated the probability of various events occurring during Nixon's visit to the USSR in 1972. After the visit, when subjects knew what had actually happened, they were asked to recall their earlier probability ratings. Again, the hindsight bias was evident: in their recall, subjects overestimated their rating of events that actually happened and underestimated their rating of events that did not.

Essentially, then, memory can be reconstructive. Conway (1990) demonstrated this in a study on students' prediction of their own performance in a forthcoming exam. Following the publication of exam results, subjects were unexpectedly requested to recall their predicted performance. Those who performed better than they had expected tended to 'recall' a higher predicted score, that they had worked harder and that they had attached more importance to getting a high score. In contrast, those who performed worse than they had anticipated judged the opposite.

A similar phenomenon was demonstrated by Snyder and Uranowitz (1978), though in this case the bias was in recall selectivity of information actually presented. Subjects read a biography of a character known as Betty K, which documented various events taking place

during her formative years. Subjects learned either that currently she was happily married or alternatively that she cohabited with another woman in a lesbian relationship. Subjects were then asked to recall the autobiographical information presented earlier. There was a tendency selectively to report information consistent with her present circumstances. For example, if informed that Betty K was involved in a lesbian relationship, subjects tended to concentrate on such things as Betty's lack of a steady boyfriend during her days at high school.

A common thread running through these examples is that what people know or assume to be true of reality contaminates their recollection of prior information. However, the term 'hindsight bias' could actually be a mischaracterisation of the phenomenon, and it might be more accurate to say that adults have a realist bias in some circumstances. This is highlighted by the third investigation of the series reported by Fischhoff (1975). Instead of being required to judge what they would have expected as an outcome as if they had not been informed, subjects were required to rate the probabilities other people would assign to the likelihood of various events, who were ignorant of reality. The same realist bias emerged. In other words, people judged that others would be inclined to expect an outcome that the judges themselves believed to be true. Superficially at least, this resembles the tendency of young children described above, to expect that a person who in fact holds a false belief will behave as if s/he has a true belief.

Another symptom which could be described as realism and which is found in both children and adults, occurs in their judgments of the appearance of an object. Flavell, Green and Flavell (1986) found that when children aged around 3 years realize that an object that looks like a rock is really a sponge, they tend to claim wrongly that it looks like a sponge. Older children in contrast were more likely to judge correctly that it looked like a rock but was really a sponge. Gopnik and Astington (1988) suggested that was another manifestation of the 3-year-old's failure to understand the distinction between reality and representations of reality, and supported their argument by reporting a positive correlation between performance of the rock-sponge task and performance on a standard test of false belief.<sup>2</sup> Their assumption is that the realist errors given by preschool children in theory of mind tasks arise by default because the child fails to understand the mind as representational. We shall question that interpretation of realist errors in the final discussion by reviewing evidence suggesting that young children are drawn to current reality in a way that masks their underlying grasp of false belief (Mitchell, 1994, for a review), but for the moment we wish to draw attention to similar behaviour among adults.

What is at least superficially a similar error in adults' judgments of appearance as distinct from reality was identified in classic research by Thouless (1931). He allowed subjects to view a shape they knew to be a circle from an oblique perspective and then asked them to select an ellipse from an array which approximated most closely to the shape as it appeared from their specific view point. Subjects consistently chose an ellipse that was more circular than the shape as they could actually see it. In this case, it seems people's knowledge that the shape they were looking at was really a circle biased them towards choosing a more circular ellipse. The realist bias young children show when making judgments about the appearance of a sponge bears a similarity to the realist bias evident in Thouless' subjects (though we do not know whether children's verbal judgments that the sponge looks like a sponge would be accompanied by errors in a visual matching task).

Although we have pointed out similarities between biases in adults' reasoning and that of children, there are obvious differences between adults and children in the circumstances

under which a bias appears. For example, adults judge that if somebody has not looked inside a Smarties tube, then s/he will continue with the erroneous default assumption that it contains Smarties (when in fact it contains pencils): adults can easily attribute a false belief in a deceptive box procedure without any risk of knowledge of reality contaminating their judgment. As mentioned above, this is not so in the case of young children (e.g. Gopnik & Astington, 1988).

The differences between the symptoms shown by adults and by children could suggest that what we have presented as similar realist biases, in fact arise from different underlying mechanisms. For example, as mentioned above the realist bias in children could arise simply as a default response symptomatic of failure to understand beliefs as distinct from reality. If so, any superficially similar bias in adults would clearly arise for a different reason, and it may not be useful to pursue the possibility of linking realist biases in adults and children. However, an alternative possibility is that differences arise because reality is more salient to young children than to adults (Mitchell, 1994), in which case the superficially similar symptoms in children and adults could arise from the same underlying processes. This possibility will be considered further in the final discussion.

A first step in deciding how far it is feasible to make a useful link between realism in children and adults is to find out whether adults do under some conditions make realist errors when judging about beliefs. Such errors might occur under conditions when it would be inappropriate to rely on a simple rule (such as 'people maintain their existing beliefs unless they gain new relevant information') to infer belief. In such circumstances, we might witness a realist bias akin to that reported in the hindsight research. The difference, however, is that people would be showing a realist bias when judging about simple factual beliefs. Hitherto, the adult research has shown only a proportionate reality bias in recollection of events and in distinguishing what is seen from what is known to be out there in reality. If adults' judgments of simple factual beliefs can also be contaminated by their knowledge of reality, then it will appear that our conception of mind is hampered by a reality bias more fundamentally and broadly than previously supposed.

Many simple factual beliefs we hold about the world are not straightforwardly linked to experiences, because the information we obtain can be contradictory. This brings us back to an example derived from Perner and Davies (1991), reported above: I might have seen the biscuits in the left hand cupboard, but you may later tell me they are in the right hand one. Whether I believe what I have seen or what I have been told will depend on a number of factors such as whether I think you have seen the biscuits more recently than I have, whether I think you want me to find the biscuits, whether I think you tend to confuse right with left, how accurate I think my own memory is, and so on. Predicting what another person will believe when s/he is exposed to such circumstances requires much more subtle insight into mind than can be derived from application of a simple seeing-knowing rule.

Nonetheless, it seems on the basis of Perner and Davies' (1991) results that children aged around 4 and 5 years do deal with this complex problem simply by assuming that a protagonist will give more weight to what s/he has seen directly and will disregard a conflicting message. This strategy would not inevitably lead to a correct judgment of belief, because, as pointed out above, it is conceivable that under some conditions a listener would believe the message.

It is likely, then, that adults will not operate with the simplistic assumption made by the children, and will feel uncertain whether or not the utterance would be believed under some

conditions. Because the adults felt unable to apply a simple rule for finding a right or wrong answer in this circumstance, it would present an opportunity to reveal contamination arising from the adults' knowledge of what is true in reality. If this occurred, we would be demonstrating a paradoxical case of a realist bias in adults but not children when judging simple factual beliefs. The possibility which we examine here, then, is that adults might be more prone than children older than about 4 years, to show a realist bias in their belief judgments.

### Investigation 1

In our first study we used conditions similar to those devised for different reasons by Perner and Davies (1991) and developed by Mitchell, Robinson, Nye & Isaacs (1994). Children and adults made judgments about what a person would think who (i) was only told something the subjects knew to be false, and held no prior contradicting belief (No belief, False message - NBFM); or (ii) was told something the subjects knew to be true, which contradicted a prior belief the subjects knew to be false (False belief, True message - FBTM); or (iii) was told something the subjects knew to be false, which contradicted a prior belief the subjects knew to be true (True belief, False message - TBFM). In FBTM and TBFM, subjects could either judge that the listener believed what s/he was told, or that s/he continued to believe the prior information based on seeing directly. In these contexts no simple rule can be applied to determine which judgment is correct.

Essentially, then, we were interested primarily in whether subjects treated the TBFM condition differently from the FBTM condition. If adults' judgments of listener belief are contaminated by what they know of reality, then they will judge that the listener will believe the contradicting message he or she hears when that is known by the subject (but not the listener protagonist) to be true (FBTM) more often than when known to be false (TBFM). In contrast, we might find that children judge in the same way across conditions if they are applying a simple rule to the effect that the listener protagonist will give more weight to seeing directly than hearing a message when the two are in conflict. Applying this simple rule might allow the children to resist the realist contamination apparent in the adults' judgments.

### Method

Subjects. The adults were 21 men and 97 women attending a university open day. Most of them were aged around 17 years. Four other adults were not included in the analysis because they ascribed two conflicting beliefs to the listener protagonist. The children attended a school in Worcestershire, UK, and formed two distinct age groups. One of these consisted of 53 boys and 45 girls aged 4;8 to 6;11 (mean 5;9). The second group consisted of 29 boys and 31 girls aged 8;0 to 9;7 (mean, 8;9).

Materials. (i) All subjects were presented with a scenario adapted from Perner and Wimmer (1985) that was supported by 4 cartoon pictures. In No belief, False message (NBFM), John was in the park near the ice cream van, which he saw (Picture 1). Then he left to go home (Picture 2). Meanwhile, the ice cream van moved to the church (Picture 3). John arrived home, learned that Susan was about to go out to get some ice cream, and told her that the ice cream van was at the park. The True belief, False message (TBFM) story was similar, except that before she heard John's message, Susan saw the ice cream van at its final location of the church while she was out walking. In False belief, True message (FBTM), Susan saw the van in its initial location of the park, so later had a false belief, whereas John saw it at its final location of the church. He told Susan that the van was at the church, which was a true message that contradicted Susan's earlier false belief based on her seeing. The ice cream story

was presented on a single sheet, which had a question printed at the bottom: 'Where does Susan think the ice cream van is?'

(ii) All subjects watched a video in which two adults, Kevin and Rebecca, return to their kitchen after buying some biscuits. The biscuits were first put away in a white cupboard, then moved to an adjoining green cupboard. Three versions of the video differed in the point at which Kevin left the kitchen to watch television in another room. In the No belief, False message version, Kevin left before the biscuits were put away at all, and subjects saw Rebecca put them in the white cupboard, take them out to have one, then put them back in the green cupboard. As Rebecca left to go to work, she called to Kevin, 'the biscuits are in the white cupboard'. Kevin returned to the kitchen to get a biscuit, and the subjects were asked 'Where does Kevin think the biscuits are?' In the 'False belief, True message' version, Kevin saw the biscuits put away in the white cupboard before he left the room, and Rebecca's subsequent message was 'the biscuits are in the green cupboard'. In the True belief, False message condition, Kevin saw the biscuits transferred from the white to the green cupboard before he left the room, and Rebecca's message was 'the biscuits are in the white cupboard'. In the versions in which Rebecca's message was false, the narrator described her as 'mixed up about where the biscuits are'. Children watched the video individually on a portable video with a 4 inch LCD colour screen, and adults watched it on a large screen in groups, as described below.

Procedure. Subjects in all three groups had both a biscuits video plus the ice cream van story. Each subject had the same version of each story (i.e. NBFM or TBFM or FBTM). Half watched the biscuits video first followed by the ice cream story and the rest had the opposite order. The adults answered questions printed on a sheet, and were tested in small groups of three or four (though discussion was forbidden). The children were tested individually, and questions were presented orally. In the cartoon story, adults followed the plot by reading captions under the four pictures, while in the case of children, the experimenter read these captions aloud. The subjects were asked where the listener thought the target object was (biscuits or ice cream van).

### Results and Discussion

Table 1 shows, as expected, that subjects in all age groups were strongly inclined to judge that a listener who had no prior belief would believe a false message (NBFM). In contrast, subjects frequently judged that the message would be ignored in the other two kinds of story. For FBTM and TBFM combined, all three age groups were significantly more likely than chance to judge in the same way for the biscuits and the ice cream stories, that is to judge on both occasions that the listener would believe or would disregard the message (Binomial tests, 4-6 year olds:  $p=.02$ ; 8-9 year olds:  $p=.002$ ; adults:  $p<.001$ ).

Because most people judged in the same way in the two stories, we combined data across stories to form a three point scale representing the number of times subjects judged that the listener believed the message (0, 1 or 2). We computed an analysis of variance on the resulting data set, of the design 3 (condition: FBTM versus TBFM versus NBFM) X 3 (age: young children versus old children versus adults), both factors between groups. There were significant main effects associated with condition [ $F(2,267)=68.42, p<.001$ ] and with age [ $F(2, 267)=5.59, p=.004$ ], plus a significant interaction [ $F(4, 267)=9.68, p<.001$ ].

-----  
 Insert Table 1 near here  
 -----

To help interpret the interaction effect (see Table 1), we conducted a series of one-way analyses of variance, to examine the condition effect for each age group independently. All three analyses yielded significant effects, though the locus of significance within these, as revealed by the Newman Keuls test, differed between children and adults. In the case of the youngest group [ $F(2,95)=21.16, p<.001$ ], children tended to judge that the listener would believe the (false) message when he had no prior belief (NBFM), more so than when he had either a prior true belief (TBFM:  $p<.001$ ) or a prior false belief (FBTM:  $p<.001$ ), with no significant difference between TBFM and FBTM. The data pattern, including the significance levels, was identical for the older children [ $F(2, 57)=15.48, p<.001$ ].

These results show that both groups of children were less likely to judge that a listener would believe a message when this contradicted a prior belief based on seeing, than when the listener had no prior belief, irrespective of whether the message was true or false. Indeed, the group of younger children judged that a contradicting message would be believed on fewer than 50 percent of occasions [ $t(64)=4.14, p<.001$ ], though no such preference for judging that the message would be disregarded was apparent in the sample of older children [ $t(39)=1.10, N.S.$ ]

These findings are consistent with those reported by Perner and Davies (1991), and extend their finding to an older group of children. However, in Perner and Davies' sample, a great majority of children judged that the utterance would be disregarded by a listener with a prior belief, whereas within our sample a substantial minority of children judged that the utterance would be believed. Nonetheless, on a group basis there was a significant preference in the group of younger children to judge that the message would be disregarded and additionally very many more children judged that the message would be believed in NBFM.

In contrast to the two groups of children, we found a different pattern in the adult data [ $F(2, 115)=70.89, p<.001$ ]. Like the children, they were significantly less likely to judge that the utterance would be believed in TBFM than in NBFM ( $p<.001$ ) and in FBTM than in NBFM ( $p<.001$ ), but for the adults there was also a significant difference between TBFM and FBTM ( $p<.001$ ). They tended to judge that a listener who held a prior true belief would disregard a false message (TBFM), but were much more likely to judge that the listener would believe a true message if his or her existing belief was false (FBTM).

It seems that what adults know about the truth status of a contradicting message contaminates their judgments of whether or not it will be believed. If they themselves assume the message is true, they tend to judge that it would be believed by a listener whom they know has no independent evidence of its truth. Conversely, if the message is assumed to be false, they tend to judge that it would be disregarded. In this respect, the data bear a similarity to those reported by Fischhoff (1975), which were interpreted as a hindsight bias, but which might actually signal contamination by one's own knowledge of reality when judging another person's belief.

## Investigation 2

In our next study we again asked adults to judge what a person would believe when he was exposed to contradictory information. The main aim of this replication was to create a closer match between a condition in which the contradicting message was true and one in which it appeared false. A secondary aim was to demonstrate that adults' judgments of a listener's belief continue to be contaminated by their (the adult subjects') knowledge of reality in a third scenario different from both the 'ice cream' and 'biscuits' scenarios used so far.

This time we used a 'jug' video, in which a person looked in a jug and the narrator

announced that he saw orange juice in there. In a subsequent scene the person was seen being told something about the jug, and the narrator announced that the speaker was saying there was milk in the jug. The video itself contained no information on whether the utterance 'There's milk in the jug' was true or false, and in principle subjects could assume that the jug's contents had changed between scenes. However, in practice it seems subjects assumed the utterance was false: pilot work showed that subjects took it that there really was orange juice in the jug even though they could not see in there themselves.

For half our subjects the video was interrupted just before the speaker pointed to the jug. At this moment, the experimenter stated that the speaker had put milk in the jug. Having the experimenter announce this critical information effectively helped to emphasise that it was available only to the subject (and not the listener protagonist). The contradictory information received by the listener was identical across conditions.

As in the previous two scenarios (biscuits and ice cream) the listener faces a dilemma of which information to weight more heavily in formulating his final belief of the jug's content, and there is no simple rule available to inform us on what would be his preferred decision. In this context, the subject's knowledge of reality might contaminate his or her judgment of what the listener would believe. Specifically, if there is contamination we would expect subjects to judge more frequently that the listener would believe the message when subjects knew the message was true, than when they assumed it to be false.

#### Method

Subjects. Seventy-three sixth formers (45 women and 28 men) who were attending a university open day took part in the study. They were aged 16-17 years.

Procedure. The subjects were tested in small groups of three or four in a quiet room. Alternate groups entered either the 'video only' or the 'additional information' conditions. The experimenter introduced the video by saying that sometimes there is milk in the jug and sometimes orange juice. Kevin was in the kitchen looking in the jug and the narrator announced that he saw orange juice in there. He then departed and a new scene appeared in which Rebecca was present in the kitchen. She gestured to the jug and the narrator said she was telling Kevin there was milk in it. This video served in both experimental conditions. For subjects in the additional information condition, between the scenes in which Kevin saw orange juice in the jug and Rebecca telling him there was milk inside, the experimenter said 'Rebecca has put milk in the jug now.' There was no interruption to the video for subjects in the video only condition.

After they had watched the video, all subjects were asked three questions during a final scene in which both Rebecca and Kevin were present and were about to pour drinks from the jug. The first two questions were the same in both conditions: 'What does Kevin think is in the jug?' followed by 'What does Rebecca think is in the jug?' Those in the video only condition were then asked 'What do you think is most likely to be in the jug?', and those in the additional information condition were asked 'What's really in the jug?' Participants wrote down their answers, and were well enough spaced not to be able to see what other members of their group were writing.

#### Results and Discussion

We begin by examining subjects' answers to the second and third questions, asking respectively what the speaker (Rebecca) thought was in the jug and asking what they themselves thought. All subjects in both conditions, bar one in the video only condition, judged that Rebecca thought there was milk in the jug, as she had said. The great majority of

those in the video only condition (30/36) judged that there was most likely to be orange juice in the jug, with 5 judging milk and one subject 'nothing'. That is, as we expected on the basis of pilot work, subjects assumed that what they were told Kevin (the listener) had seen remained an accurate reflection of reality even in the aftermath of Rebecca's contradicting message. In the additional information condition, in contrast, the majority (34/37) answered as expected, that there was milk in the jug. Two people thought there was both milk and orange juice, and one person thought orange juice. As we anticipated, then, subjects in the two conditions had different beliefs about the true contents of the jug. However, since the information available to Kevin (the listener in the video) was identical in the two conditions, his belief about the jug's contents should not have differed across conditions. If subjects' judgments about his belief differed across conditions, this would be an example of contamination.

-----

Insert Table 2 near here

-----

Table 2 shows how subjects judged Kevin's (the listener) belief under the two conditions. The majority of subjects in the video only condition, who tended to disbelieve Rebecca's utterance, judged that Kevin would believe what he had seen, rather than what Rebecca told him. In contrast, about half of those in the additional information condition, who themselves generally believed Rebecca's utterance, judged that Kevin would also believe what Rebecca said. In other words, subjects judged that Rebecca's message would be perceived as more believable when they had privileged knowledge indicating that it was true rather than false:  $\chi^2 = 17.04$  (corrected,  $df=1$ ,  $N=73$ ),  $p < .01$ . Hence, it seems that in a context in which there was no simple rule for inferring a listener protagonist's belief, subjects' judgments were contaminated by what they themselves believed of reality. The results support those of Investigation 1, and are consistent with hindsight research (Fischhoff, 1975) and more generally with the concept of mental contamination (Wilson & Brekke, 1994).

#### General Discussion and Conclusions

The results of these two investigations replicate and extend previous findings concerning children. To begin with, the results are consistent with those reported by Perner and Davies (1991) that children aged 4-6 years were less likely to judge that a listener would believe a message when it contradicted a prior belief based on seeing than when the listener had no prior belief. In making these judgments, children were not influenced by their knowledge of whether the message was actually true or false. In Investigation 1, we found that children aged around 8-9 years judged in that same way. It seems safe to conclude on the basis of our results coupled with Perner and Davies' that there is a tendency in middle childhood to apply a simple rule to the effect that people will believe what they see even if that conflicts with what they are told.

The pattern of responding we observed in adults was different from that in children. The adults' judgments were, however, consistent with expectations from previous research investigating a hindsight bias. Adults judged that the listener would believe a message that contradicted a prior belief based on seeing if they (the subjects but not the listener protagonist) knew independently that the message was true. In doing so, adult subjects failed to dissociate their privileged knowledge of what was actually true from the listener's partial state of ignorance.

Is it appropriate to describe this as a reality bias? The result that adults' judgments of

another's belief are biased in the direction of the adult judge's own belief, could be due to an egocentric tendency to confuse other's belief with own belief. We propose that the reality bias interpretation is the more powerful because it accommodates not only our data but also the results presented in the Introduction in which adults confused what they currently thought with what they used to think (research into hindsight bias, e.g. Conway, 1990; Fischhoff & Beyth, 1975; Snyder & Uranowitz, 1978). Furthermore, phenomenal regression to the real object (Thouless, 1931) can also be accounted for by a realist bias but could not be accommodated within an egocentrism explanation. Likewise, in the child literature, Gopnik (1993; pace Harris, 1992) argued that because young children have just as much difficulty acknowledging their own beliefs as those of others, it does not make sense to say that they are egocentric -- apparently, they have a more general problem.

Turning to developmental matters, there is already a great deal of evidence consistent with the view that preschool children are more prone to a realist bias than slightly older children. However, previous work has not made comparisons between children and adults, and our results require us to accommodate the finding that adults are also more prone to a realist bias than children aged 5 and 9 years. Our suggestion will be that these older children avoid making realist errors by rigidly applying newly learned rules about informational access and the consequent state of knowledge or belief. By adulthood, we shall suggest, our attempts to take into account the complexity of factors which lead a person to accept or disregard a source of knowledge, make us more vulnerable to error.

Children's rigid use of rules about informational access has been suggested by Sodian and Wimmer (1987). These authors report a series of studies in which the experimenter had a container full of identical choconuts. As the child watched, a doll transferred one of the choconuts to a bag, and then told another doll, who had not seen the transfer, 'I've just taken one of the things out of this box and put it into the bag.' Children judged whether this second doll knew what was in the bag, and those aged 4-6 years tended to judge that the doll did not know. Sodian and Wimmer (1987) interpret this finding as an example of 'inference neglect': they argue that the children did not understand inference as a source of knowledge, but assumed that direct access, such as seeing, was necessary for knowing. In other words, because the second doll had not looked in the bag, children seemed to assume that she could not know its contents. Sodian and Wimmer's (1987) interpretation was that children adhere too rigidly to a simple rule in making judgments about belief, in this case that not seeing leads to not knowing.

If we accept this interpretation of the judgments of our 5- and 9- year-olds as being based on inflexible application of simple rules about information access and consequent belief state, we are left with adults making realist errors which appear to have more in common with the typical judgments of preschoolers than either of these groups has with those in middle childhood. Does the realism that contaminates children's judgments at around the age of 3 years make a reappearance by adulthood, albeit in a different and more subtle form? As mentioned earlier, if realist errors by preschool children occur by default simply as a result of failure to understand the representational character of mind, as claimed by many (e.g. Gopnik, 1993; Perner, 1991; Wellman, 1990), then realist errors made by adults must have a different basis.

On the other hand, there is some evidence that preschool children's realist errors are not merely symptomatic of failure to understand the mind as representational, but rather are at least in part symptomatic of a preference for basing judgments of belief on reality (Fodor,

1992; Leslie & Thaiss, 1992; Mitchell, 1994; Mitchell & Lacohee, 1991; Mitchell & Saltmarsh, 1994; Robinson, 1994; Robinson & Mitchell, 1994, 1995; Russell, Mauthner, Sharpe & Tidswell, 1991; Saltmarsh, Mitchell & Robinson, 1995). The preschool child might have a weak grasp of the representational character of mind, which is masked when reality is more salient. For example, Russell et al (1991) argue that when belief and assumed reality are in conflict, reality wins because it is more salient to the young child. According to Fodor (1992), the fewer processing demands for making an inference about belief according to assumed reality are what makes it salient. A related point is that since simple factual beliefs would normally be true, a short cut to judging belief is to report reality (Leslie, 1994; Mitchell, 1994). Moreover, Mitchell (1994) suggests children are born with a higher value-weighting for assumed reality than belief as a useful heuristic that allows them efficiently to come to terms with the characteristics of their physical environment. The assumption is that it is more important to understand the physical world before we apply our limited information processing resources to the psychological environment. Hence, reality can be described as assuming a physical salience for the child that would mask any fledgling understanding of belief; beliefs would be less salient than reality by virtue of their lack of a physical existence. Note that this suggestion allows for development over the preschool years of understanding about the mind as representational, but in addition to a decline in susceptibility to seduction by reality (Saltmarsh et al, 1995.)

Superficially there seems to be an impediment to linking realism in adults' judgments of belief with those made by children. Bias in adult reasoning extends well beyond the domain of reasoning about beliefs (Evans, 1989, Wilson & Brekke, 1994), but if bias in children is limited to the case of false belief, that might suggest that realism in children is a default consequence of lacking an understanding of the representational character of mind. However, children also make realist errors in tasks that do not require judgments of belief. For example, young children make errors in the false photo task, in which they are asked to anticipate a scene in a developing photo. A correct judgment would be to say that it will show the scene that prevailed at the time the film was exposed rather than the current scene. In fact, children aged 3 years usually make a realist error (by reporting the current scene) in this task much as they do in a test of false belief (Zaitchik, 1990; also, Charman & Baron-Cohen, 1992; Leekam & Perner, 1991; Leslie & Thaiss, 1992; Robinson, Nye & Thomas, 1994). Furthermore, Hughes and Russell (1993) report another way in which young children's realism is apparent beyond the domain of false belief. Children could obtain the desirable contents of a box only if they pointed at the empty box alongside rather than at the box with the desirable contents. They tended to persevere in pointing to the latter despite repeated frustration at not getting the reward. Hughes and Russell suggest that children's realism in this context prevents them from disengaging from the object of their attention (the desirable contents). These findings are inconsistent with the realism in childhood arising (by default) specifically because of a lack of understanding of belief.

Evidence consistent with the reality masking hypothesis arises from Mitchell and Lacohee's (1991) 'posting procedure', in which children posted a picture of what they thought a deceptive box contained when they first saw it. Children were better able to recall their initial false belief under this condition than in a standard nonposting procedure. In the posting procedure, we argued that children's initial belief was highlighted by having a reality counterpart in the posted picture. Similarly, seeing a protagonist search in an empty location for a desired item is a physical token of that protagonist's false belief. Consistent with the

reality masking hypothesis, children may be better able to acknowledge the protagonist's false belief under these conditions than when no physical symptom of false belief is present (Bartsch & Wellman, 1989; Robinson & Mitchell, 1995).

Finally, children find it easier to acknowledge another's false belief when they themselves have seen the reality on which that belief was based, than when they have not: Saltmarsh et al (1995) showed this using a modification of Wimmer and Hartl's (1991) state change procedure. In the condition in which children saw the reality on which another's false belief was based, a Smarties tube was opened in front of the child and seen to contain Smarties. The child then saw the Smarties being exchanged for crayons. A puppet appeared and the child judged his belief about the tube's contents. In a comparison condition the tube contained crayons from the beginning, so the puppet's false belief (like the child's own initial belief) could be inferred only from the exterior of the Smarties tube - the false belief never had a counterpart in reality. Children were more likely to acknowledge the puppet's false belief in the condition in which there had really been Smarties in the tube, and more likely to make realist errors when there had not. It seems that seeing the expected content supports the false belief with a reality counterpart which then protects children against the salience of current reality.

According to this account, understanding of belief as distinct from reality is not installed in the child's mind at a specific point in development as the result of a radical conceptual shift. Rather, although it might be that development involves an increase in understanding about belief, there might be an equally important decline in the tendency to focus inappropriately on reality in preference to belief. This account allows the possibility that we might never rid ourselves of the realism apparent in early development. The realism we identify in adults could be a vestige of the more gross form evident in young children. However, that remains a speculative possibility until we are able to show a direct resemblance between early childhood realism and adult realism within a single task, which is the province of future research.

The present results do not fit comfortably with an account of continuous and gradual development. This would only have been the case if the children we tested also showed a realist bias when judging whether or not the listener would believe a contradicting message. Instead, most children seemed to use a simple strategy of judging that such a message consistently would be ignored, though some also judged consistently that it would be believed. Most of the children could have been using a simple rule that people believe what they see. The children could have applied the rule so rigidly that they were unable to acknowledge that sometimes people believe a message in preference to what they have seen. Such rigid application would also protect these children from the realist bias that younger children and adults are prone to, which is implied by Wilson and Brekke's (1994) suggestion that mental contamination can occur when reasoning does not involve rules (but not otherwise).

Although the adults showed a reality bias whereas the children did not in the present investigations, ironically, this might signal more sophisticated role-taking in the adults than in the children. If adults (but not children) correctly perceived limitations of applying simple rules linking seeing with believing, they may have tried to make progress by imagining how they would feel if placed in the listener's perspective. In other words, they would try to imagine what they would think if they had seen X, were subsequently told Y, and had no access to additional information indicating which was true.

Even so, the adults could apply a different simple rule in that they could ask themselves

how they would judge if they were denied access to reality. The following thought experiment suggests that such a rule might be difficult to apply in practice. We know that if adults are denied access to the truth of the message, as in the video only condition in the second investigation, then they usually judge that the listener would disregard that message. However, in judging in such a way, adults are effectively overlooking circumstances in which the message could actually be true and should be believed. Consequently if subjects were informed that the message was actually true and then judged that they would have disregarded the message as if they had not known that, they would be admitting that in a lesser informed state they would have overlooked conditions in which the message might have been true. Perhaps adults find it hard to accept that they would overlook such a fairly obvious contingency, and by analogy, find it hard to accept that anybody would overlook that contingency. In other words, while adults do apparently normally overlook circumstances under which the message could be true, it is yet another thing for them to recognize that they would commit such an oversight once the message's truth is known to them.

Both the suggested adults' strategy and the children's strategy for making judgments of the listener's belief in the dilemmas we presented could lead to errors. The trouble with the child strategy is that it involves rigid adherence to a rule rather than an attempt to imagine how one would reason if one were the listener. The trouble with the suggested adult strategy, on the other hand, is that although there is an attempt to imagine the listener's predicament, thereby liberating the adult from the restrictions of applying simple rules rigidly, this process is biased towards reality and concreteness. Perhaps most of us can never achieve an ability to infer others' thoughts that is not contaminated to some extent by what we ourselves assume to be true of reality.

### References

- Astington, J.W., Harris, P.L. & Olson, D.R. (1988). Developing Theories of Mind. Cambridge: Cambridge University Press.
- Baron-Cohen, S., Tager-Flusberg, H. & Cohen, D.J. (1993). Understanding Other Minds: Perspectives from Autism. Oxford: Oxford University Press.
- Bartsch, K. & Wellman, H. (1989). Young children's attribution of action to beliefs and desires. Child Development, *60*, 946-964.
- Braine, M.D.S. & Romain, B. (1983). Logical reasoning. In J.H. Flavell & E.M. Markman (Eds). Cognitive Development. Volume 3. Carmichael's Manual of Child Psychology. (4th edition). New York: Wiley.
- Chandler, M. (1988). Doubt and developing theories of mind. In, J.W. Astington, P.L. Harris & D.R. Olson (Eds.) Developing Theories of Mind. Cambridge: Cambridge University Press.
- Chandler, M. & Hala, S. (1994). The role of personal involvement in the assessment of early false belief skills. In C. Lewis & P. Mitchell (Eds.) Children's Early Understanding of Mind: Origins and Development. Hove: Erlbaum.
- Charman, T. & Baron-Cohen, S. (1992). Understanding drawings and beliefs: A further test of the metarepresentation theory of autism. Journal of Child Psychology and Psychiatry, *33*, 1105-1112.
- Conway, M. (1990). On bias in autobiographical recall: Retrospective adjustments following disconfirmed expectations. The Journal of Social Psychology, *130*, 183-189.
- Donaldson, M. (1978). Children's Minds. Glasgow: Fontana/Collins.
- Evans, J. St. B.T. (1989). Bias in Human Reasoning: Causes and Consequences. Hove: Erlbaum.
- Fischhoff, B. (1975). Hindsight is not equal to foresight: The effect of outcome knowledge on judgment under uncertainty. Journal of Experimental Psychology: Human Perception and Performance, *1*, 288-299.
- Fischhoff, B. & Beyth, R. (1975). "I knew it would happen": Remembered probabilities of once-future things. Organizational Behavior and Human Performance, *13*, 1-16.
- Flavell, J.H., Green, F.L. & Flavell, E.R. (1986). Development of knowledge about the appearance-reality distinction. Monographs of the Society for Research in Child Development, Serial No. *212*, 51(1).
- Fodor, J.A. (1992). A theory of the child's theory of mind. Cognition, *44*, 283-296.
- Frye, D. & Moore, C. (1991). Children's Theories of Mind. Hove: Lawrence Erlbaum Associates.
- Gopnik, G. (1993). How we know our minds: The illusion of first-person knowledge of intentionality. Behavioral and Brain Sciences, *16*, 1-14.
- Gopnik, A. & Astington, J.W. (1988). Children's understanding of representational change and its relation to the understanding of false-belief and the appearance-reality distinction. Child Development, *62*, 98-110.
- Harris, P.L. (1992). From simulation to folk psychology.: The case for development. Mind and Language, *7*, 120-144.
- Hughes, C. & Russell, J. (1993). Autistic children's difficulty with mental disengagement from an object: Its implications for theories of autism. Developmental Psychology, *29*, 498-510.
- Johnson-Laird, P.N. (1983). Mental Models. London: CUP.
- Leekam, S.R. & Perner, J. (1991). Does the autistic child have a metarepresentational deficit? Cognition, *40*, 203-218.
- Leslie, A.M. (1994). Pretending and believing: Issues in the theory of ToMM. Cognition, *50*, 211-238.

- Leslie, A.M. & Thaiss, L. (1992). Domain specificity in conceptual development: Neuropsychological evidence from autism. Cognition, 43, 225-251.
- Lewis, C. & Mitchell, P. (1994). Children's Early Understanding of Mind: Origins and Development. Hove: Erlbaum.
- Mitchell, P. (1994). Realism and early conception of mind: A synthesis of phylogenetic and ontogenetic issues. In C. Lewis & P. Mitchell (Eds.). Children's Early Understanding of Mind: Origins and Development. Hove: Erlbaum.
- Mitchell, P. & Lacohee, H. (1991). Children's early understanding of false belief. Cognition, 39, 107-127.
- Mitchell, P., Robinson, E.J., Nye, R. & Isaacs, J. (1994). Unmasking an understanding of the interpretive mind in false belief failers. Unpublished manuscript, University of Birmingham.
- Mitchell, P. & Saltmarsh, R. (1994). Communicating, reading one's own mind and resisting reality. Cahiers de Psychologie Cognitive, 13, 652-660.
- Perner, J. (1991). Understanding the Representational Mind. London: MIT Press.
- Perner, J. & Davies, G. (1991). Understanding the mind as an active information processor: Do young children have a 'Copy theory of mind'?. Cognition, 39, 51-69.
- Perner, J. & Wimmer, H. (1985). "John thinks that Mary thinks that...": Attribution of second order beliefs by 5- to 10-year-old children. Journal of Experimental Child Psychology, 39, 437-471.
- Pratt, C. & Bryant, P. (1990). Young children understand that looking leads to knowing (so long as they are looking into a single barrel). Child Development, 61, 973-982.
- Robinson, E.J. (1994). What people say, what they think, and what is really the case: children's understanding of utterances as sources of knowledge. In C. Lewis and P. Mitchell (Eds.), Children's Early Understanding of Mind: Origins and Development, Hove: Erlbaum.
- Robinson, E.J. & Mitchell, P. (1994). Young children's false belief reasoning: Interpretation of messages is no easier than the classic task. Developmental Psychology, 30, 67-72.
- Robinson, E.J. & Mitchell, P. (1995). Masking of children's early understanding of the representational mind: Backwards explanation versus prediction. Child Development, 66, 1022-1039.
- Robinson, E.J. Nye, R. & Thomas, G.V. (1994). Children's conceptions of the relationship between pictures and their referents. Cognitive Development, 9, 165-191.
- Russell, J. (1978). The Acquisition of Knowledge. London: MacMillan.
- Russell, J., Mauthner, N., Sharpe, S. & Tidswell, T. (1991). The 'windows task' as a measure of strategic deception in preschoolers and autistic subjects. British Journal of Developmental Psychology, 9, 331-350.
- Saltmarsh, R., Mitchell, P. & Robinson, E.J. (1995). Realism and children's early grasp of mental representation: Belief-based judgments in the state change task. Cognition.
- Schneider, D.J. (1991). Social cognition. Annual Review of Psychology, 42, 527-561.
- Sodian, B. & Wimmer, H. (1987). Children's understanding of inference as a source of knowledge. Child Development, 58, 424-433.
- Snyder, M. & Uranowitz, S.W. (1978). Reconstructing the past: Some cognitive consequences of person perception. Journal of Personality and Social Psychology, 36, 941-950.
- Thouless, R.H. (1931). Phenomenal regression to the real object, II. British Journal of Psychology, 22, 1-30.
- Wason, P.C. & Johnson-Laird, P.N. (1972). Psychology of Reasoning: Structure and Content. London: Batsford.
- Wellman, H.M. (1990). The Child's Theory of Mind. London: MIT Press.

- Wilson, T.D. & Brekke, N. (1994). Mental contamination and mental correction: Unwanted influences on judgments and evaluations. Psychological Bulletin, 116, 117-142.
- Whiten, A. (1991). Natural Theories of Mind. Oxford: Blackwell.
- Wimmer, H. & Hartl, M. (1991). Against the Cartesian view on mind: Young children's difficulty with own false beliefs. British Journal of Developmental Psychology, 9, 125-138.
- Wimmer, H., Hogrefe, G.-J. & Perner, J. (1988). Children's understanding of informational access as a source of knowledge. Child Development, 59, 386-396.
- Wimmer, H., Hogrefe, J. & Sodian, B. (1988). A second stage in children's conception of mental life: Understanding informational access as origins of knowledge and belief. In J.W. Astington, P.L. Harris, & D.R. Olson (Eds.) Developing Theories of Mind. Cambridge: Cambridge University Press.
- Wimmer, H. & Weichbold, V (1994). Children's theory of mind: Fodor's heuristics examined. Cognition, 53, 45-57.
- Zaitchik, D. (1990). When representation conflicts with reality: The preschooler's problem with false beliefs and "false" photographs. Cognition, 35, 41-68.

Table 1. Mean number of times children and adults judged that a listener would believe a message in each of three conditions (max. score 2).

	4-6 year olds	8-9 year olds	Adults
NBFM	1.61 (3,7,27)	1.85 (0,3,17)	1.97 (0,1,38)
TBFM	.59 (16,13,3)	1.10 (5,8,7)	.39 (28,10,3)
FBTM	.67 (17,10,6)	.60 (13,2,5)	1.39 (8,7,23)

Note. Figures in brackets show the numbers of people gaining scores of 0, 1 and 2.

Table 2. Answers to 'What does Kevin think is in the jug' in video only and additional information conditions in Investigation 2.

	Orange (seen)	Milk (told)
Additional information	19	18
Video only	34	2

Footnotes

<sup>1</sup>The possibility we raise here does not conflict with Perner and Davies' (1991) interpretation of children's judgments, since they aimed to show only that children aged around 4 years understand that listeners in different states of informedness treat a given message differently. However, the finding that children consistently judged that a message would be disregarded in favour of a prior belief based on seeing directly, suggests that children may still lack an adequate understanding of how people process contradictory information.

<sup>2</sup>Flavell et al report that when children made judgments of object identity, they tended to commit realist errors (denying that the object appeared like something it was not) whereas when they made judgments of object property, they tended to commit phenomenist errors (judging that the object really was as it appeared). This might actually be a spurious distinction, however. All we can say is that children made an assumption about what was the reality (correctly when making what Flavell et al call a 'realist error' but incorrectly when making what they call a 'phenomenist' error) and proceeded to deny that the object could be construed in any other way.