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Illusion of Confirmation from Exposure to Another's Hypothesis

DEREK J. KOEHLER* and T. ALEXANDRA BEAUREGARD
University of Waterloo, Canada

ABSTRACT

We examine the influence of exposure to an advisor's hypothesis, in the form of a point estimate of an uncertain quantity, on subsequent point estimates and confidence judgments made by advisees. In three experiments, a group of unexposed advisees produced their own estimates before being presented with that of the advisor, while a group of exposed advisees were presented with the advisor's estimate before making their own. Not surprisingly, exposed advisees deliberately incorporated the information conveyed by the advisor's estimate in producing their own estimates. But the exposure manipulation also had a contaminating influence that shifted what the advisees viewed as their own, independent estimates toward those of the advisor. Seemingly unaware of this influence, exposed advisees were subject to an *illusion of confirmation* in which they expressed greater confidence in the accuracy of the advisor's estimate than did unexposed advisees. Copyright © 2006 John Wiley & Sons, Ltd.

KEY WORDS confidence judgments; advisors; advisees; opinion change

INTRODUCTION

When making decisions, whether it is buying a new sweater, selecting mutual fund investments, or choosing a career path, people frequently rely on the advice and opinions of others. Advice solicited from friends, family, and colleagues is arguably one of the most commonly used and heavily weighted sources of information in many of the decisions people make in life. In a survey by Heath and Gonzalez (1995), for example, over 90% of their university student respondents indicated that they consulted with others when making important decisions; the students cited the information they obtained as the chief benefit of such consultation.

While the study of group decision making has been a topic of intensive investigation for many years, only recently has the use of input from others in individual decision making been investigated as a topic in its own

* Correspondence to: Derek J. Koehler, Department of Psychology, University of Waterloo, Waterloo, Ontario N2L 3G1, Canada. E-mail: dkoehler@uwaterloo.ca

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right. A number of studies (e.g., Harvey & Fischer, 1997; Harvey, Harries, & Fischer, 2000; Harvey, Koehler, & Ayton, 1997; Koehler, 1994; Koehler & Harvey, 1997; Sniezek & Buckley, 1995; Soll & Larrick, 2004; Yaniv, 2004; Yaniv & Kleinberger, 2000) have investigated the influence of the simplest possible form of advice from another person, namely a single hypothesis nominated by the other person as his or her own favored candidate. In the experiments we will report, this comes in the form of a point estimate of an uncertain quantity. The design of such experiments intentionally precludes any direct interaction between the person providing his or her hypothesis (the advisor) and the person receiving the hypothesis as a potential source of information (the advisee). This simplified situation allows us to investigate basic factors influencing use of advice before attempting to address the additional complications that arise when the advisor and advisee are allowed to interact.

Several factors have been identified that influence the extent to which people use such advice when making judgments and decisions. Sniezek and Buckley (1995), for instance, reported that decision makers were more likely to rely on advice that came from a highly confident advisor than from a less confident advisor. Harvey and Fischer (1997), as another example, showed that people are more likely to use advice when it comes from an experienced (and hence credible) source, particularly when the decision they face is an important one. One general finding that has emerged from this research is a tendency for people to place greater weight on their own opinion than on the opinion provided by another person (e.g., Harvey & Fischer, 1997; Yaniv, 2004; Yaniv & Kleinberger, 2000).

In the present research we distinguish and investigate two ways in which a judge can be influenced by exposure to another's hypothesis (i.e., advice), in this case, another person's estimate of an uncertain quantity. Exposure to another's estimate can have an influence through the judge's deliberate attempt to use it as a source of information, which has been the primary focus of previous research on the use of advice in judgment under uncertainty. As shown in the present research, however, exposure to another's estimate can also have a contaminating influence on the judge's ability to produce an independent estimate, a possibility suggested but not tested by Koehler and Harvey (1997). That is, an advisee may be more influenced by exposure to advice than he or she recognizes. We consider these two influences in turn, and then present the results of several experiments that demonstrate their joint effects on judgment.

Deliberate use of another's estimate as a source of information

When presented with another person's estimate, we would expect the judge to make a deliberate attempt to incorporate it as a source of information in making his or her own final estimate. All else being equal, the fact that another person gave a particular value as his or her estimate constitutes a new piece of evidence supporting that value as a possible estimate. As such, the judge is warranted in taking it into account in rendering a final estimate. We assume that any deliberate attempt on the part of the judge to use the other person's estimate as a source of information is available to the judge's awareness.

There are a number of methods by which to incorporate such information in arriving at a final estimate, the most straightforward of which is an averaging strategy: The judge produces his or her own initial estimate, then combines it with the other person's estimate via some weighted averaging formula to produce a final estimate. The relative weight placed on the judge's own and the other person's estimate will depend on a number of factors such as their expertise with respect to the issue at hand.

Indeed, it can be shown that under some fairly general conditions, any averaging strategy of this sort will generally improve estimation accuracy. Taking this normative justification as a starting point, a number of theorists have explored the efficacy of different types of averaging strategies as methods for improving judgmental accuracy, both analytically and empirically (for overviews, see Clemen, 1989; Cooke, 1991; Genest & Zidek, 1986; Wallsten, Budescu, Erev, & Diederich, 1997). While the identification of conditions determining the expected gain in accuracy from aggregation of multiple opinions and the selection of optimal aggregation methods for different judgment tasks remain active topics of investigation, the general usefulness of combining judgments from several people as a means of improving judgmental accuracy is widely accepted. Note that this is a basic statistical principle regarding the reduction in error variance achieved by aggregation of independent estimates; whether group interaction helps or hurts estimation accuracy is a separate issue.

While an averaging strategy may often be the normatively appropriate method for combining the information from two estimates, it may not be the strategy that people actually adopt when attempting to integrate their own estimate with that of another in arriving at a final estimate. Soll and Larrick (2004), for example, suggest that people are more likely to attempt to choose the better of the two estimates (e.g., based on perceptions of relative expertise) than to average them, even though averaging typically yields greater accuracy. When we refer to deliberate attempts to incorporate another's estimate in making one's own, we leave as an open issue the specific strategies by which people may deliberately attempt to use the other person's estimate as a source of information.

Contaminating influence of exposure to another's estimate

In addition to deliberate attempts to use the information conveyed by another person's estimate, exposure to another's estimate may have an additional ''contaminating'' influence (following the terminology introduced by Wilson & Brekke, 1994) of which the judge is not aware. Support for this possibility comes from previous research indicating that people often have difficulty segregating the impact of different sources of information on their judgments. Examples include hindsight bias (Fischhoff, 1975; Fischhoff & Beyth, 1975) and the knew-it-all-along effect (Begg, Robertson, Gruppuso, Anas, & Needham, 1996; also Hasher, Attig, & Alba, 1981), as well as jurors' inability to disregard inadmissible evidence in rendering legal judgments (e.g., Sue, Smith, & Caldwell, 1973; Thompson, Fong, & Rosenhan, 1981).

Once a piece of information is known to the judge, apparently, it is often difficult or impossible not to use in making subsequent judgments. Studies suggest that this is true even when it is in the judge's own best interest (in terms of judgmental accuracy) to completely ignore a particular source of information. One example comes from a study by Kelley and Lindsay (1993), in which participants answered a set of general knowledge questions following presentation of a list of plausible answers that they were explicitly told were incorrect; participants nonetheless tended to provide items from the list more frequently and with greater confidence than they would have in the absence of exposure to that list (see also Begg, Anas, & Farinacci, 1993). Another example comes from Camerer, Loewenstein, and Weber's (1989) investigation of the ''curse of knowledge,'' in which they found that traders in an experimental market were not able to ignore information in their possession despite knowing that the information was not relevant for assessing the value of the commodities they were trading, losing money as a consequence (see also Keysar, Ginzel, & Bazerman, 1995).

In the case of estimating an uncertain quantity, which is the focus of the present research, research on anchoring effects shows that estimates can be influenced by exposure to a numerical value even when it is known to be irrelevant to the estimation task (Tversky & Kahneman, 1974; for reviews, see Chapman & Johnson, 1999; Epley, 2004). Given the observed anchoring effects in these studies, either participants are generally unaware of the anchoring influence, or they have some awareness of its existence but systematically underestimate its magnitude, or they are aware of its magnitude but are ineffective in their correction attempts. Research by Wilson, Houston, Etling, and Brekke (1996) has provided more direct evidence that anchoring effects are unintentional and occur outside of awareness by showing that they are not eliminated by incentives for accuracy or by warning people about the possibility of such effects.

In summary, previous research suggests that exposure to another's estimate may have a contaminating influence on the judge's attempt to generate his or her own, independent estimate of an uncertain quantity. To the extent that the judge is not fully aware of it, as will be discussed below, this contaminating influence can in turn affect confidence in the accuracy of the other's estimate as well as the judge's final estimate.

Separating deliberate use and contaminating influence of exposure

In the present research, then, we suggest that exposure to another's estimate can compromise the judge's ability to produce his or her own independent estimate of the uncertain quantity in question, even before the judge attempts to deliberately incorporate the information conveyed by the other person's estimate in producing a final estimate. We refer to this as the *contamination account*, as it posits a non-deliberate influence of exposure to another's hypothesis (cf. Wilson & Brekke, 1994), of which the judge is not fully aware. It can be contrasted with a purely *informational account*, in which the judge is viewed as an aggregator of information who simply averages (or in some other way deliberately integrates) the other person's estimate with his or her own independent (uncontaminated) estimate in arriving at a final estimate.

With these two accounts in mind, we conducted a series of experiments to assess the influence of exposure to another's estimate on subsequent judgments by the recipient of the estimate. We refer to the providers of the original estimates as *advisors*, and to the recipients of this information as *advisees* to reflect their access to the advisor's estimates. In all the experiments to be reported, we compare judgments of *unexposed advisees* who make their own estimate before being presented with the advisor's estimate to judgments from *exposed advisees* who are presented with the advisor's estimate before making their own. Table 1 shows the experimental design and procedure of the three experiments we report.

Exposed advisees have an additional source of information at the time they make their estimate, namely the estimate provided by the advisor. To the extent that they make a deliberate attempt to incorporate this information in making their own estimates, we expect the resulting estimates to differ from those of the unexposed advisees. On the purely informational account, that is the only critical difference between the two advisee groups. The contamination account, by contrast, implies that exposed advisees are also subject to a contaminating influence—of which they are not fully aware—that compromises their ability to produce an initial estimate independent of the advisor's to which they have been exposed, pulling the initial estimate toward that of the advisor.

It is difficult to distinguish between the two accounts solely on the basis of their predictions regarding the advisees' estimates, as both imply that the exposed advisee's final estimate should be influenced in the direction of the advisor's estimate. The difference is that, according to the contamination account,

Table 1. Design and sequential procedure of Experiments 1–3

Experiment 1 (3 yoked groups)			
	Advisor	*Unexposed advisee*	*Exposed advisee*
1.	make point estimate	make point estimate	see advisor's estimate
2.	—	see advisor's estimate	make point estimate
3.	*All*: assess confidence in (judge probability of target interval centered on) advisor estimate		
Experiment 2 (3 independent groups)			
	Unexposed advisee	*Exposed advisee*	*Exposed—Influence rating*
1.	make point estimate	see advisor's estimate	see advisor's estimate
2.	see advisor's estimate	make point estimate	make point estimate
3.	—	—	rate influence
4.	*All*: assess confidence in (judge probability of target interval centered on) advisor estimate		
Experiment 3 (2 independent groups)			
	Unexposed advisee	*Exposed advisee*	
1.	make own estimate	see advisor's estimate	
2.	see advisor's estimate	make own estimate	
3.	make final estimate	make final estimate	
4.	*All*: assess confidence in (judge probability of target interval centered on) advisor estimate		

exposure to the advisor's estimate exerts a contaminating influence on the exposed advisee's (initial, covert) generation of his or her own estimate prior to any deliberate attempt to incorporate the information provided by the advisor's estimate.

One straightforward way of attempting to separate the informational and contamination accounts is to elicit ratings or judgments that help to identify the extent to which advisees deliberately incorporated the advisor's estimate as a source of information when making their own. In the present investigation, we make use of this strategy in Experiment 2 by asking exposed advisees to rate the extent to which their own estimates were influenced by that of the advisor, and in Experiment 3 by eliciting separate ''own'' estimates (which are not supposed to incorporate the advisor's estimate) and ''final'' estimates (which can be made using the advisor's estimate as an additional source of information). A possible drawback, however, of directly asking participants to evaluate the influence of the advisor's estimate on their own, or to give an estimate both before and after seeing that of the advisor, is that it may interfere with the way in which such advice would be used in the absence of such questions.

The illusion of confirmation

A less direct means by which we attempt to test the informational and contamination accounts of any observed discrepancy between exposed and unexposed advisees' point estimates, therefore, is through subsequent assessments of confidence elicited from the two groups. In all of our experiments, both exposed and unexposed advisees are asked, after making their own estimates, to assess their confidence in the accuracy of the advisor's estimate by judging the probability that a fixed interval centered on the advisor's estimate includes the actual value being estimated (see Table 1). Higher probabilities therefore imply greater confidence in the accuracy of the advisor's estimate. In short, in the present research, we wish not only to provide evidence of the contaminating influence of exposure to advice on the advisee's ability to produce an independent estimate, but also to show how this contaminating influence affects the perceived accuracy or credibility of the advice and hence, presumably, the judge's willingness to use it in making decisions.

On a purely informational account, the discrepancy between estimates of exposed and unexposed advisees reflects the fact that the exposed advisees, but not the unexposed advisees, have the advisor's estimate available as a source of information at the time they make their point estimates. Because unexposed advisees are presented with the advisor's estimate immediately after making their own, however, unexposed and exposed advisees share an identical state of information at the time they give their confidence assessments. The informational account, then, predicts that there should be no systematic difference in confidence between the two advisee groups.

By contrast, if—as suggested by the contamination account—exposed advisees are subject to a contaminating influence caused by exposure to the advisor's estimate, and if they are not fully aware of this influence, a different prediction follows. On this account, what the exposed advisee produces and perceives as his or her own, independent estimate is closer than is that of unexposed advisees to the advisor's estimate, due to the contaminating influence of exposure, even before any deliberate attempt is made to incorporate the information conveyed by the advisor's estimate in arriving at a final estimate. As a consequence, compared to unexposed advisees, exposed advisees would be expected to express greater confidence in the accuracy of the advisor's estimate due to its closer proximity to what they view as their own, independent estimate. This could come about either because proximity of advisee and advisor estimates is used directly as a cue to accuracy, or simply because exposure to the advisor's estimate shifts the advisee's subjective probability distribution over possible values in the direction of the advice, which in turn is used to assess the accuracy of the advice. We refer to the resulting enhanced confidence in the accuracy of the advice as an *illusion of confirmation* produced by exposure to the advisor's estimate.

Experiments 1–3 offer a test of this basic prediction. Experiments 2 and 3, as mentioned above, also provide additional measures that allow further disentangling of deliberate and contaminating influences of exposure to another person's estimate. Taken together, the results from these experiments support the contamination account.

EXPERIMENT 1

Method

Participants

A total of 120 students at the University of Waterloo participated in exchange for extra credit in their introductory psychology course.

Materials

A set of historical events and dates, used by Koehler and Harvey (1997) in their studies with British participants, was modified for use with Canadian participants by replacement of several events likely to be familiar only to British participants with events from Canadian history. The final set consisted of 100 historical events. Most of the events were political or cultural in nature, and were selected from the *Hutchinson Pocket Factfinder* (1994), the *Universal Almanac* (1993), and the *Canadian Global Almanac* (1994). Examples include: ''Fall of the Roman Empire'' (476), ''Ming Dynasty begins in China'' (1368), ''The Hudson's Bay Company is formed'' (1670), ''Verdi composes *Aida*'' (1871), and ''Empire State Building in New York City completed'' (1931). The earliest event presented occurred in 54 AD (''Nero becomes Roman Emperor''); the most recent occurred in 1979 (''Nuclear reactor accident at Three Mile Island, USA''). The distribution of events was tilted toward relatively recent events: Approximately 65% of the events occurred after 1800 AD, and another 20% occurred between 1600 and 1800. This distribution could be viewed as producing a fairly representative test of our participants' historical knowledge, as they were assumed to have more detailed knowledge of relatively more recent historical events.

Design

Participants were assigned to one of three conditions (see Table 1). For each historical event, *advisors* ($n = 40$) generated their ''best guess'' (i.e., a point estimate) as to the year the historical event occurred. One *exposed advisee* and one *unexposed advisee* was paired with each advisor, yielding 40 yoked triplets. Participants in all three conditions assessed their confidence in the accuracy of the advisor's estimate, by assigning a probability to a designated interval centered on the advisor's estimate. Advisees were also asked to produce their own ''best guess'' or point estimate. Exposed advisees did so after seeing the estimate provided by the advisor, while unexposed advisees made their own point estimate prior to seeing the advisor's estimate. The 100 historical events were presented to all participants in the same fixed order.

Procedure

The task and instructions were presented on a computer. Advisees were provided with the following information:

> In a previous experiment, we asked subjects to estimate the year in which 100 well-known events occurred (e.g., when the first person walked on the moon). Each event occurred between 0 and 1995 AD. You have been paired with a randomly-selected subject from this previous experiment, and will be presented with his or her guesses.

No further information regarding the advisor with whom they had been paired was provided, presumably giving the advisees no reason to think that the advisor's estimates were likely to be any better or worse, on average, than their own.

Upon presentation of a target event, advisors and unexposed advisees entered their point estimate as to the year in which the event occurred. Exposed advisees were presented simultaneously with the target event and the advisor's point estimate, at which time they were asked to give their own point estimate. Unexposed advisees were presented with the advisor's estimate (simultaneously with the request for a probability judgment described below) only after giving their own. In making their estimates, participants were required to enter a value between 0 and 1995; if they entered a value outside this range, they were prompted by the computer to enter a new value. All participants were cautioned that they might find the task to be quite difficult, as they might have only a very rough idea of when many of the events had occurred.

Once the point estimate was entered, all participants were asked to assess the probability that the year the event actually occurred was included in a target interval created by the computer around the advisor's point estimate. Centering the target interval on the advisor's estimate ensured that yoked participants in all three experimental conditions evaluated the same target interval, facilitating direct comparisons of the probability assigned to that target interval across conditions. As in Koehler and Harvey's (1997) study, this interval was bounded by the advisor's estimate plus or minus an integer value E, where

$$E = (2000 - \text{advisor's estimate})/8 \tag{1}$$

The value of E was rounded to the nearest multiple of 5 for $E > 20$, and to the nearest whole number for $E \leq 20$. Whenever the resulting lower bound was less than zero, it was set to zero. Likewise, resulting upper bounds greater than 1995 were set to 1995. Equation (1) yields intervals that become wider the longer ago the event is believed to have taken place. For example, an advisor estimate of 1920 produces the interval 1910–1930, while an advisor estimate of 1520 produces the interval 1460–1580. This process of constructing intervals for judgment was used to avoid potential floor or ceiling effects that might result if a fixed interval width was used for all events. Because the interval was constructed on the basis of the advisor's point estimate, all three participants in each yoked triplet assessed the same interval for each event. Note that this interval might or might not include the estimate provided by advisees.

Participants gave their probability judgments using a scale running from 0% to 100% in intervals of 10%. This scale appeared on the computer screen with a box around the 50% mark; participants moved this box to the left or right using the arrow keys on the keyboard and pressed enter when it was on their selected probability judgment. Instructions regarding the probability judgment task were as follows:

> A probability of 100% means you're certain the actual year of the event is between the low and high bounds. A probability of 0% means you're certain the actual year is NOT between these bounds. Intermediate probability values indicate intermediate degrees of certainty that the actual year is between the low and high bounds. For example, a probability of 50% means you believe the actual year is as likely to be between the low and high bounds as is tossing a coin and having it come up heads.

The probability judgment can be interpreted as a measure of confidence in the accuracy of the advisor's estimate. Participants in the advisee conditions were not presented with the probability judgments provided by the advisors.

Results and discussion

Because our focus is on the comparison between judgments of exposed and unexposed advisees, we restrict our inferential statistical tests to these two groups, consequently providing better comparability to results from later experiments reported in this article in which we exclude the advisor group altogether from the experimental design. Basic descriptive statistics from the advisor group are provided for completeness.

(For an analysis of advisor–advisee differences in judgment, see Harvey, Koehler, & Ayton, 1997; Koehler, 1994; Koehler & Harvey, 1997). Because we use regression analyses in Experiment 3 to test mediation of the effect of exposure through a continuous variable, for consistency we use regression analyses to evaluate our results throughout the article.

Point estimates

As expected, presentation of the advisor's point estimate exerted a heavy influence on the point estimates provided by the exposed advisees. This can be seen by comparing the mean distance (i.e., absolute value of the difference) between the advisees' estimate and that of the advisor with whom they were paired. On average, the distance between the exposed advisee's estimate and that of the advisor ($M = 84$ years; median = 10; $SD = 252$) is much smaller than the distance between the unexposed advisee's estimate and that of the advisor ($M = 146$ years; median = 50; $SD = 281$). As suggested by the large discrepancy between mean and median distances, the distance measure is heavily skewed due to a small number of very large values, which were generally associated with historical events from the more distant past. A logarithmic transformation of the distance measure, which greatly attenuates the disproportionate effect of these large values and closely follows the median value, still reveals a significant effect of exposure (see Regression Model 1 of Table 2). Mean distance from the advisor's estimate following this logarithmic transformation, translated back into years, is 46 years ($SD = 4.0$) for the unexposed advisees and 12 years ($SD = 5.9$) for the exposed advisees.

Confidence assessments

All participants judged the probability that the actual year of the target event was included in a computer-generated interval centered on the advisor's point estimate. In fact, due to the considerable uncertainty associated with the estimation task, the target interval included the correct year with an overall relative frequency of only 18.5%. By this measure, accuracy varied widely among advisors: The most accurate advisor produced point estimates for which the resulting target interval included the correct year for 52 of the 100 historical events; for the least accurate advisor the target interval included the correct year for only 6 of the 100 historical events. Advisors assigned the target interval surrounding their point estimates an average probability of 46.8% ($SD = 26.6$), thus exhibiting substantial overconfidence in the accuracy of their estimates. This result is consistent with the many studies demonstrating overconfidence for difficult judgment tasks (e.g., Griffin & Tversky, 1992; Klayman, Soll, González-Vallejo, & Barlas, 1999; Lichtenstein, Fischhoff, & Phillips, 1982; Soll & Klayman, 2004; Suantak, Bolger, & Ferrell, 1996). Use of a response scale anchored

Table 2. Regression analysis results for Experiments 1 and 2

Model/Criterion	Predictor	B	SE_B	std. B
Experiment 1				
1. Distance	Exposure	−0.55*	0.02	−0.338
2. Probability	Exposure	4.94*	0.58	0.090
Experiment 2				
1. Distance	Exposure	−0.66*	0.01	−0.385
2. Probability	Exposure	3.41*	0.40	0.059

*$p < 0.01$.

Note: B = regression coefficient; SE_B = standard error of B; std. B = standardized regression coefficient; exposure = 1 for exposed advisor condition and 0 for unexposed advisor condition. Effects of experimental variables were estimated simultaneously with a subject variable to control for individual differences in general overestimation or underestimation and an item variable representing mean values for each historical event. Distance measure was subjected to logarithmic transformation prior to analysis.

at a starting value of 50% (a value well above the mean ''hit rate'' of 18.5% for the target intervals) is likely to have exacerbated the degree of overconfidence observed in the present experiment.

Our main concern regards the comparison of probability judgments by exposed and unexposed advisees, both of whom evaluated the same set of target intervals with the same information available to them (i.e., their own knowledge plus the estimate provided by the advisor). Despite having the same information, exposed advisees assigned the target intervals a higher probability ($M = 53.1\%$; $SD = 27.7$) on average than did the unexposed advisees ($M = 48.1\%$; $SD = 26.8$). As indicated in Table 2 (Regression Model 2), this difference is statistically significant. These results are consistent with the contamination account, according to which exposed advisees are subject to a contaminating influence of exposure to the advisor's estimate, producing an illusion of confirmation that enhances confidence in the accuracy of the advisor's estimate.

Summary

Exposed advisees produced estimates closer to those of the advisor than did unexposed advisees, a result expected on either the informational or the contamination account. Even when they had the same information, however, exposed advisees expressed greater confidence in the accuracy of the advisor's estimates than did unexposed advisees, exhibiting an illusion of confirmation predicted only by the contamination account.

EXPERIMENT 2

Experiment 1 demonstrated the illusion of confirmation using a yoked design. Experiment 2 represents an attempt to replicate Experiment 1's results using a non-yoked design. Estimates from a typical advisor in Experiment 1 were presented for evaluation to all participants in Experiment 2. In the resulting, more efficient design, all participants play the role of either exposed or unexposed advisees (see Table 1).

We attribute the illusion of confirmation observed in Experiment 1 to advisees not being fully aware of the contaminating influence of exposure on their own estimates. In Experiment 2 we test whether the illusion of confirmation is reduced or eliminated when exposed advisees are asked for an explicit rating of the extent to which their estimate was influenced by exposure to that of the actor prior to making their confidence assessments. Drawing attention to the influence of exposure might lead to greater correction for its effects in subsequent assessments of confidence. Influence ratings elicited from exposed advisees can also provide some descriptive data on the extent to which they are typically aware of having adjusted their estimates in light of the advisor's, as well as allowing an examination of how that measure relates to the distance between advisee and advisor estimates.

Method

Participants

A total of 151 students at the University of Waterloo participated in exchange for extra credit in their introductory psychology course.

Materials

The same set of historical events was used as in the first experiment.

Design

A single ''typical'' advisor was selected from Experiment 1, whose point estimates were presented for evaluation to all advisee participants in Experiment 2. This advisor had the median accuracy score from

Experiment 1, where accuracy is measured by mean absolute deviation from the correct answer across the 100 historical events. As in Experiment 1, all advisees judged the probability that the correct year of the historical event fell in a target interval centered on the advisor's point estimate. The target interval was constructed in the same manner as in Experiment 1, with the result that it included the correct year for 15 of the 100 historical events. Each advisee assessed the point estimates provided by the advisor for all 100 historical events used in Experiment 1.

Participants were randomly assigned to one of three experimental groups: unexposed advisees ($n = 50$), exposed advisees without influence ratings ($n = 50$), and exposed advisees with influence ratings ($n = 51$). Table 1 summarizes the experimental design.

Procedure

Instructions and procedure were essentially identical to those of Experiment 1. The only real change involved the influence rating task given to one group of exposed advisees. After being presented with the point estimate of the advisor and making their own estimate, these participants were asked: "To what extent was your guess influenced by that of the previous subject?" Influence ratings were made on an 11-point scale ranging from 0 ("not at all influenced") to 10 ("heavily influenced"). After making their influence ratings, they went on to judge the probability that the correct year was included in the target interval set by the computer around the advisor's estimate.

Results and discussion

Influence ratings

Exposed advisees who gave influence ratings did not differ significantly from those who did not give influence ratings on either point estimates (as measured by distance from the advisor's estimates), $F(1, 99) < 1$, $MSE = 10.55$, or probability judgments, $F(1, 99) < 1$, $MSE = 4.82$. Data from these two groups are combined into a single exposed advisee group in the analyses of point estimates and confidence assessments reported below. The modal influence rating was a 10 on the scale ("heavily influenced"), consistent with the suggestion that exposed advisees typically engaged in a deliberate attempt to incorporate the advisor's estimate as a source of information. Advisees used the full range of scale values, however, indicating some selectivity in the extent to which they deliberately relied on the advisor's estimate in making their own. As would be expected, the distance between estimates of advisor and advisee was smaller when exposed advisees claimed to have been heavily influenced by the advisor's estimate than when they claimed to have been less influenced ($r = -0.67$ using the log-transformed advisor–advisee distance measure).

Point estimates

As in the previous experiment, each advisee point estimate was assessed in terms of its distance (i.e., absolute deviation) from the corresponding point estimate of the advisor. The effect of exposure on this distance variable was highly similar to that found in the first experiment. On average, the distance between the exposed advisee's estimate and that of the advisor ($M = 60$ years; median $= 10$; $SD = 176$) is much smaller than the distance between the unexposed advisee's estimate and that of the advisor ($M = 158$ years; median $= 51$; $SD = 280$). Following log transformation (and then translating back to the original units for easy interpretation), the mean distance from the advisor's estimate was 53 years ($SD = 3.7$) in the unexposed advisee condition but only 11 years ($SD = 5.0$) in the exposed advisee condition. As indicated in Table 2 (Regression Model 1), this difference is statistically significant.

Confidence assessments

For each of the 100 historical events, the target interval centered on the advisor's point estimate was identical for all participants. Nonetheless, on average, exposed advisees assigned the target interval a higher probability ($M = 54.3\%$, $SD = 26.7\%$) than did the unexposed advisees ($M = 50.9\%$, $SD = 27.6\%$), exhibiting an illusion of confirmation. As indicated in Table 2 (Regression Model 2), this effect—replicating the results of Experiment 1—is statistically significant.

Summary

Exposed advisees were once again subject to an illusion of confirmation, in which they expressed greater confidence in the accuracy of the advisor's estimates than did unexposed advisees. This effect was replicated even when exposed advisees were explicitly asked to rate the degree of influence the advisor's estimate exerted on their own estimate prior to assessing confidence in the advisor's estimate. The influence ratings indicate that, most of the time, exposed advisees deliberately incorporated the advisor's estimates in making their own. We take these results as consistent with the claim that, although exposed advisees are aware of having adjusted their estimates in light of the advisor's, they generally underestimate the impact of being exposed to the actor's estimate.

EXPERIMENT 3

A third experiment was conducted in an attempt to further disentangle deliberate and contaminating influences of exposure to the advisor's estimate on the subsequent estimates produced by advisees. As shown in Table 1, the design is similar to that of the second experiment (without a group giving influence ratings), except that each advisee (exposed or unexposed) made two point estimates. Advisees were instructed to first give their ''own'' point estimate based exclusively on their own knowledge, independent of that provided by the advisor with whom they were paired, and then to give a second (''final'') estimate in which they could take into account the advisor's estimate if they wished. Unexposed advisees gave their ''own'' estimate prior to seeing the advisor's estimate, as in the previous experiment, thus ensuring truly independent estimates. In contrast to the previous experiment, though, they also gave a second ''final'' estimate after being presented with the advisor's estimate. Exposed advisees gave both their ''own'' estimate and their ''final'' estimate following exposure to the advisor's estimate.

The difference between exposed advisees' own and final estimates provides a measure of the extent to which they deliberately incorporated the advisor's estimate in making their own; the difference between own estimates of exposed and unexposed advisees provides a measure of the extent to which exposed advisees' estimates are contaminated by exposure to the advisor's estimate. Our interpretation of the observed illusion of confirmation rests on the assumption that exposed advisees underestimate the impact of exposure to the advisor's estimate; this assumption implies that exposed advisees' own estimates should fall systematically closer to that of the advisor than should unexposed advisees' own estimates. Furthermore, according to our account, the distance between the advisees' own estimate and that of the advisor should serve as a particularly good predictor of subsequently enhanced confidence expressed by exposed advisees relative to that of unexposed advisees, as it would be expected to reflect the contaminating influence of exposure to the advisor's estimate but not any deliberate attempt to use it as a source of information.

This design also tests an alternative interpretation of the results of the previous experiments. It could be argued that exposed advisees expressed greater confidence in the advisor's estimate because the procedure in that experimental condition implicitly endorses use of the advisor's estimate as a source of information by eliciting their estimates only after presenting the advisor's. By contrast, unexposed advisees were not presented with an opportunity to use the advisor's estimate in making their own estimate prior to giving their confidence assessment. Thus it is possible that it is the opportunity of the exposed advisee to *use* the advisor's estimate as a source of information in making his or her own estimate (which could be taken as a kind of experimenter endorsement), rather than the contaminating influence of exposure, that enhances confidence in the advisor's estimate. Experiment 3 tests this alternative interpretation by providing unexposed advisees with an opportunity to use the advisor's estimate in making their final estimate prior to giving their confidence assessment. On this alternative interpretation, the advisor's estimate now receives implicit experimenter endorsement for use by advisees in both conditions, and therefore ought to have equal impact on their estimates and confidence assessments, thereby eliminating what we have called the illusion of confirmation observed in the previous experiments.

Method

Participants

A total of 88 students at the University of Waterloo participated in exchange for extra credit in their introductory psychology course.

Materials

Experiment 3 used the same set of historical events as in Experiments 1 and 2.

Design

The same single "typical" participant selected from Experiment 1 to serve as the advisor in Experiment 2 was also used as the source of advisor estimates in Experiment 3. Thus the same set of target intervals evaluated in Experiment 2 was also evaluated in Experiment 3.

Participants were randomly assigned to the unexposed or exposed advisee group ($n = 44$ each). Unexposed advisees gave their own estimate prior to seeing that of the advisor and then gave a final estimate in which they could use the advisor's if they so wished. Exposed advisees gave their both own and final estimate after seeing that of the advisor.

Procedure

Instructions and procedures were essentially identical to those of Experiment 1, except that participants made two point estimates ("own" and "final") instead of just one. Instructions to unexposed advisees regarding their own estimates were identical to those given in the previous experiment. They were further instructed:

> After you have made your own guess, you will be presented with the guess of the previous subject for the event in question. You will then be asked to make a final estimate, in which you can take into account the guess of the previous subject if you wish. In other words, your final estimate can be based on the previous subject's guess as well as your own opinion.

Exposed advisees were given new instructions that distinguished their own estimate from their final estimate, both of which were made following presentation of the advisor's estimate. To make their own estimate, they were instructed:

> After reading the subject's guess, you will be asked to enter your own guess as to the year in which the event occurred. Your own guess should be made in a manner independent of the guess of the previous subject. That is, give what your own guess would be, had you not seen the guess made by the previous subject.

To make their final estimate, exposed advisees were further instructed:

> Once you've made your own independent guess, you will then be asked to make a final estimate, in which you can take into account the guess of the previous subject if you wish. In other words, your final estimate can be based on the previous subject's guess as well as your own opinion.

Results and discussion

Point estimates

Advisees' own and final estimates were assessed in terms of their distance (i.e., absolute deviation) from the corresponding estimate of the advisor. The exposure manipulation influenced both types of estimate. For advisees' own estimates, the distance between the exposed advisee's estimate and that of the advisor ($M = 96$ years; median = 20; $SD = 239$) is much smaller than the distance between the unexposed advisee's estimate and that of the advisor ($M = 172$ years; median = 55; $SD = 306$). The difference in advisor–advisee distance between own estimates in the exposed and unexposed conditions suggests that exposed advisees are not fully aware of the extent to which their estimates are influenced by exposure to the advisor's estimates. The same pattern held for advisees' final estimates; the distance between the exposed advisee's estimate and that of the advisor ($M = 73$ years; median = 12; $SD = 204$) is also much smaller than the distance between the unexposed advisee's estimate and that of the advisor ($M = 108$ years; median = 21; $SD = 255$). The decreased advisor–advisee distance for both groups in their final estimates relative to their own estimates presumably reflects their deliberate attempt to take the advisor's estimate into account in making their final estimates.

Once again, the distance variable was log-transformed prior to inclusion in subsequent regression analyses to prevent extreme values from having a disproportionate influence. Following log transformation (and then translating back to the original units for ease of interpretation), the mean distance of own estimates from the advisor's estimate was 57 years ($SD = 3.8$) in the unexposed advisee condition but only 22 years ($SD = 4.4$) in the exposed advisee condition. Comparable distance scores for final estimates were 22 years ($SD = 5.2$) in the unexposed advisee condition but only 14 years ($SD = 4.5$) in the exposed advisee condition. As indicated in Table 3, differences between exposure conditions for both own and final distance values are statistically significant (Regression Models 1 and 2, respectively). As noted above, final estimates were generally closer to the advisor's estimate than were own estimates, $F(1, 86) = 111$, $MSE = 3.6$, $p < 0.01$.

Confidence assessments

For each of the 100 historical events, the target interval centered on the advisor's point estimate was identical for all participants. Nonetheless, on average, exposed advisees assigned the target interval a higher

Table 3. Regression analysis results for Experiment 3

Model/Criterion	Predictor	B	SE_B	std. B
1. Own distance	Exposure	−0.40*	0.01	−0.272
2. Final distance	Exposure	−0.19*	0.01	−0.124
3. Probability	Exposure	5.52*	0.50	0.098
4. Probability	Exposure	0.26	0.49	0.005
	Own distance	−13.22*	0.37	−0.347

*$p < 0.01$.
Note: B = regression coefficient; SE_B = standard error of B; std. B = standardized regression coefficient; exposure = 1 for exposed advisor condition and 0 for unexposed advisor condition. Effects of experimental variables were estimated simultaneously with a subject variable to control for individual differences in general overestimation or underestimation and an item variable representing mean values for each historical event. Distance measures were subjected to logarithmic transformation prior to analysis.

probability ($M = 54.4\%$, $SD = 28.1\%$) than did the unexposed advisees ($M = 48.8\%$, $SD = 27.6\%$). As indicated in Table 3 (Regression Model 3), this difference—replicating the results of the first two experiments—is statistically significant.

Test of mediation

According to our account, the influence of exposure on confidence in the advisor's estimate is mediated by the contaminating influence it exerts on exposed advisees' ability to produce an independent estimate. That is, the illusion of confirmation is hypothesized to be attributable to exposed advisees' lack of awareness of the full influence of exposure on their estimates. On this account, then, advisor–advisee distance as calculated from the advisee's own estimates ought to be the critical mediating variable. This is because it is exposed advisees' lack of awareness of exposure's influence on what they view as their own, independent estimate (which pulls their "own" estimate closer than unexposed advisees' own estimate to that of the advisor) that leads them to subsequently express greater confidence than unexposed advisees in the accuracy of the advisor's estimate.

To test this account, we used multiple regression to examine the proposed mediated relationship (see Baron & Kenny, 1986). The log-transformed measure of the distance between advisees' own estimates and those of the advisor was used as the potential mediating variable because of the extreme skewness of the untransformed distance measure. Results of this analysis, displayed in Table 3, are consistent with the hypothesized mediating role of distance between advisees' own estimates and those of the advisor. As noted above, the exposure manipulation led exposed advisees to produce "own" estimates closer to those of the advisor than did unexposed advisees (Regression Model 1). The closer the advisee's own estimate to that of the advisor, the greater was the confidence expressed in the advisor's estimate, as measured by the judged probability of the target interval centered on the advisor's estimate (Regression Model 4). Taken on its own, exposure has a significant association with judged probability such that exposed advisees tend to give higher probability judgments than unexposed advisees (Regression Model 3). The effect of exposure on judged probability is completely eliminated, however, once the mediating effect of exposure on advisor–advisee distance is taken into account (Regression Model 4), $z = 25.4$, $p < 0.001$. In short, consistent with our account, advisor–advisee distance calculated from own estimates completely mediates the influence of exposure on confidence in the advisor's estimate (i.e., the illusion of confirmation).

Weighting of own and advisor estimates

Exposed advisees' final estimates were closer to those of the advisor than were unexposed advisees' final estimates. We attribute this finding, as well as the illusion of confirmation, to the contaminating influence of exposure to the advisor's estimates on what exposed advisees view as their own, independent estimates. An alternative interpretation might invoke a primacy effect explanation. Studies of information integration have shown that, when combining the implications of multiple pieces of information in a final judgment, information encountered early in the sequence is often given greater weight than information encountered later (e.g., Anderson, 1979; Hogarth & Einhorn, 1992). According to a primacy effect interpretation, exposed advisees place greater weight on the advisor's estimates than do unexposed advisees because it is encountered earlier in the judgment sequence. We can test this interpretation using a measure reflecting the relative weight placed on the advisee's own estimate versus that of the advisor in rendering a final estimate.

Following previous research (Harvey & Fischer, 1997; Soll & Larrick, 2004; Yaniv, 2004; Yaniv & Kleinberger, 2000), we calculated for each final estimate produced in Experiment 3 a measure (*WS*), representing the weight placed on the self-generated "own" estimate relative to that placed on the advisor's estimate in arriving at the final estimate, as the distance between advisees' final and advisor estimates divided by the distance between their final and own estimates. The value of *WS* is well-defined except when the advisee's own estimate equals the advisor's estimate, and ranges between 0 and 1, inclusive, when the advisee's final estimate falls between his or her own estimate and that of the advisor, inclusive; cases for which these conditions do not hold (17% of the observations in the present study) are ignored in the analysis. The value of $WS = 1$ when one effectively ignores the advisor's estimate and stays with one's initial estimate as a final estimate; $WS = 0$ when one's own initial estimate is effectively ignored and the advisor's estimate is given as a final estimate. A mean value of *WS* was calculated for each participant. In the present study, consistent with previous research suggesting that greater weight is typically placed on one's own than on another's estimate, the mean value of *WS* was 0.62 for unexposed advisees and 0.68 for exposed advisees. The weight placed on own estimates did not differ significantly between the two conditions, $t(86) = 1.41$. Contrary to the primacy effect interpretation, exposed advisees did not place greater weight than unexposed advisees on the advisor's estimates (relative to that placed on their ''own''); indeed, the nonsignificant difference was in the opposite direction to that expected on this alternative interpretation.

Summary

The illusion of confirmation was replicated, even though unexposed advisees as well as exposed advisees had an opportunity to use the advisor's estimate in making final estimates, suggesting that mere use of the advisor's estimate as a source of information in making final estimates by exposed but not unexposed advisees was not the source of the illusion of confirmation observed in the previous two experiments. Consistent with the contamination account, furthermore, exposed advisees' own estimates—which were not supposed to take into account the advisor's estimate—fell substantially closer to those of the advisor than did unexposed advisees' truly independent own estimates. Regression analyses showed that the discrepancy between exposed and unexposed advisees' own estimates in terms of their proximity to the advisor's estimate (which should reflect only the contaminating influence of exposure) completely mediated the influence of exposure on advisees' confidence in the advisor's estimates, as expected on the contamination account.

GENERAL DISCUSSION

When provided with advice in the form of another's estimate of an uncertain quantity, advisees quite sensibly attempt to incorporate this information when making their own estimates. Indeed, the influence ratings from Experiment 2 indicate that, in most cases, advisees acknowledge that their estimates were heavily influenced by that of the advisor. When exposed to the advisor's estimate before making their own, however, advisees are subject to a contaminating influence on their ability to produce an independent estimate of which they do not seem to be fully aware. Experiment 3 provides direct evidence for this contention by showing that what advisees view as their own, independent estimate falls closer to that of the advisor when they were exposed to the advisor's estimate before rather than after producing their own. As a consequence, exposed advisees experience what we have called an illusion of confirmation in which the contaminating influence of exposure to the actor's estimate enhances confidence in its accuracy. This effect was observed in all three experiments. Analysis of data from Experiment 3 indicates that the impact of exposure on confidence in the actor's estimate is fully mediated by its effect on what advisees report as their own, independent estimate. To the extent that it influences the perceived credibility of advice, the illusion of confirmation may exert a significant influence on the advisee's willingness to use the advice in making judgments and decisions.

Previous research by Block and Harper (1991) and Sniezek and Buckley (1995) also investigated the influence of exposure to another person's hypothesis on confidence in judgment. Block and Harper's task involved estimation of uncertain quantities; Sniezek and Buckley's involved responses to two-alternative general knowledge questions. In a comparison analogous to that between our advisor and exposed advisee group in Experiment 1, Block and Harper (Exps. 3 and 4) observed that participants presented with another's estimate subsequently set more overconfident credible intervals than did participants who did not receive another's estimate. In a comparison analogous to that between our exposed and unexposed advisees, Sniezek and Buckley (1995) found that participants presented with the answers to general knowledge questions given by two advisors (previous participants) prior to giving their own were more overconfident in their answers than were participants who gave an initial answer before seeing those of the advisors. While the results from both these previous studies are consistent with the observation of the illusion of confirmation reported here, their methodology differs from ours in one important way: Participants in their studies assessed confidence in their own final hypotheses (choices or estimates), which varied across experimental conditions, while in the present experiments all participants assessed confidence in an identical set of estimates (i.e., those of the advisor). As such, it is more difficult in the Block and Harper (1991) and Sniezek and Buckley (1995) studies to directly compare confidence assessments from the different conditions, as they are associated with hypotheses that may also differ in accuracy.

From the perspective of a statistical or economic analysis, access to valid information can only help the decision maker. As long as the value of having the information exceeds the cost of collecting it, any model presupposing a perfectly rational agent will always favor collection and use of that information. The present results, by contrast, suggest that having access to information at a particular stage in the judgment process can potentially have deleterious effects on the resulting judgment. Specifically, if the judge is exposed to somebody else's estimate before having attempted to generate his or her own independent assessment, our results indicate that the judge's own estimate is susceptible to a contaminating influence from exposure to the other's estimate of which the judge is not aware. The judge's apparent inability to discount this contaminating influence in our studies produces an unjustified increase in confidence in the provided estimate, which we refer to as an illusion of confirmation. This finding complements a growing body of research, reviewed in the introduction, converging on ways in which exposure to a source of information can contaminate subsequent judgments.

Much of this previous research is consistent with the assumption we have made in interpreting our own results, namely that the observed influence of exposure to information on judgment arises from the judge being unaware of having been influenced (cf. Wilson et al., 1996). If people generally do not have conscious access to the processes underlying their judgments, it will be impossible for them to directly correct their judgments for any unwanted influence. In the absence of such awareness, people must rely on their evaluations of the output of mental processes (e.g., Jacoby, Kelley, Brown, & Jasechko, 1989), interpreted in light of their intuitive theories regarding sources and causes of unwanted influences (Wilson & Brekke, 1994), in an attempt to correct their contaminated judgments.

Identification of the conditions under which people can successfully carry out such corrections, thereby avoiding the illusion of confirmation and other contaminating influences of exposure to information, could have both theoretical and applied benefits. Another promising area for future research concerns the costs and benefits of the biasing effects of such exposure: If people generally place too much weight on their own judgments and opinions relative to those provided by others, as suggested by the previous research reviewed in the introduction, the contaminating effects of exposure could actually help to offset the impact of this egocentric weighting bias and possibly lead to more accurate judgments.

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Authors' biographies:

Derek J. Koehler is associate professor of psychology at the University of Waterloo. His research concerns the determinants of intuitive judgments and predictions made under conditions of uncertainty. With Nigel Harvey, he recently edited the *Blackwell Handbook of Judgment and Decision Making*.

T. Alexandra Beauregard is lecturer in Industrial Relations at the London School of Economics. Her research interests include work-life conflict and enhancement; development and consequences of organisational role expectations; implications of flexible working practices for workplace relationships and career progression; and individual coping strategies for work-life stressors.

Authors' addresses:

Derek J. Koehler, Department of Psychology, University of Waterloo, Waterloo, Ontario N2L 3G1, Canada.

T. Alexandra Beauregard, Industrial Relations Department, London School of Economics, Houghton Street, London, WC2A 2AE, UK.

