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The Three Faces of Overconfidence in Organizations

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Abstract: This paper reviews evidence on how overconfidence manifests itself in organizational life. There are three ways in which overconfidence has been studied: (1) overestimation of one's actual performance, (2) overplacement of one's performance relative to others, and (3) excessive precision in one's beliefs. We explore inconsistencies between these different approaches to the study of overconfidence and explore a theoretical reconciliation. We close with discussion of the circumstances under which it might be beneficial to be overconfident.

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Plous (1993) wrote that "No problem in judgment and decision making is more prevalent and more potentially catastrophic than overconfidence" (p. 217). His words ring true when we consider the role of overconfident beliefs in the events leading up to the economic crisis and stock market crash of 2008. Consumers fed a huge housing bubble by taking out larger mortgages than they could afford. Their willingness to take such risks was based on their optimism about the housing market continuing to go up. Mortgage brokers quickly came up with innovative mortgage products to serve the growing market. They made NINA (no income, no assets) and then NINJA (no income, no job, and no assets) loans, apparently confident that the big banks would keep buying these loans and packaging them into CDOs (collateralized debt obligations). Brokers realized that these loans were risky, but many believed that if the market began to unravel, they would be able to get out more quickly than would others.

The banks continued to buy CDOs, behaving as if they understood how risky they were. And insurers like AIG continued to sell insurance against default by borrowers, in the form of credit default swaps. But the risk models on which the banks and insurers were basing their risk estimates were obsolete. They estimated rates of mortgage default using historical data that did not include NINJA loans. These historical data grossly underestimated the actual rate of default, yet large and sophisticated financial institutions, in setting prices for CDOs and credit default swaps, behaved as if they were very confident that these faulty risk estimates were actually correct. These examples demonstrate the magnitude of the problems overconfidence can produce. But overconfidence is a phenomenon with many facets. This paper will attempt to differentiate and elucidate them.

Three Faces of Overconfidence

Overestimation. Consumers' optimism about a housing market in which values only go up represents one form of overconfidence, which we will refer to as overestimation. The majority of empirical research papers on overconfidence examine overestimation. These studies document overestimates of personal abilities, performance, chances of success, or level of control. Some findings from this literature include the following: investors overestimate the performance of their holdings (Moore, Kurtzberg, Fox, & Bazerman, 1999), students overestimate their performance on exams (Clayson, 2005), physicians overestimate the accuracy of their diagnoses (Christensen-Szalanski & Bushyhead, 1981), people overestimate how much control they have (Presson & Benassi, 1996), and people overestimate the speed with which they can get work done (Buehler, Griffin, & MacDonald, 1997). The tendency to overestimate the speed at which we can get work done has been called the planning fallacy (Buehler, Griffin, & Ross, 1994), and helps explain why nine out of ten major infrastructure projects go past deadline and over budget (Flyvbjerg, Skamris Holm, & Buhl, 2002).

Overplacement. Mortgage brokers' belief that they would be more nimble than would other mortgage brokers in anticipating the market downturn would be an example of the belief that one is better than others, or what Larrick, Burson, and Soll (2007) called overplacement. Sample findings from this literature include the following. In one study, 37% of one firm's professional engineers placed themselves among the top 5% of performers at the firm (Zenger, 1992). In a survey of high school seniors, 25% rated themselves in the top 1% in their ability to get along with others (College Board, 1976-1977). People believe they are more likely to experience positive events and less likely to experience negative events than are others (Weinstein, 1980). But perhaps the most frequently cited result from this literature is that 93%

of a sample of American drivers and 69% of a sample of Swedish drivers reported that they were more skillful than the median driver in their own country (Svenson, 1981).[1] Research on overplacement often refers to it as the "better-than-average" effect (Alicke & Govorun, 2005).

Overprecision. The third approach to the study of overconfidence examines what we will call overprecision. This research finds that people tend to be excessively certain of the precision of their private beliefs. Researchers typically assess certainty by asking people questions with quantitative answers (e.g., How tall is Mt. Everest?) and then asking them to specify a 90% confidence interval around their best guess. These 90% confidence intervals often contain the correct answer less than 50% of the time (Alpert & Raiffa, 1969/1982; Klayman, Soll, Gonzalez-Vallejo, & Barlas, 1999; Soll & Klayman, 2004). Excessively narrow confidence intervals suggest that people are inappropriately confident they have the right answer. Overprecision could have contributed to the excessive confidence among banks that they knew the risk of default among the mortgages they were buying and insuring.

Researchers often assume that the three different types of overconfidence are produced by the same underlying psychological causes (e.g., Alba & Hutchinson, 2000; Barber & Odean, 2001; Belsky & Gilovich, 2000; Daniel, Hirshleifer, & Subrahmanyam, 1998; Dunning, 2005; Juslin, Winman, & Olsson, 2000; Kirchler & Maciejovsky, 2002; Malmendier & Tate, 2005; Moore et al., 1999; Odean, 1998; Plous, 1993; Stone, 1994; Stotz & von Nitzsch, 2005). In this paper we differentiate the three varieties of overconfidence and discuss the motives and biases that can contribute to each one. But first, we must address three problems with the overconfidence literature (see Moore & Healy, 2008). As we will see, some of these problems arise from the assumption that the three types of overconfidence are the same when they are not.

[1] While it is possible for the majority to be either above or below average (in skewed distributions), it is statistically impossible for the majority to be above (or below) the median.

Three Problems

Problem 1: Confounding

The first problem with overconfidence research is that the most popular research paradigms confound overestimation and overprecision. These paradigms measures confidence of correctness at the level of the individual item by reporting their confidence (usually the probability) that they got a specific problem right. For instance, when participants in Fischhoff, Slovic, and Lichtenstein's (1977) study estimated at least a 99% chance they had gotten a question correct, they were actually correct only 87% of the time, on average. In this paradigm, overestimation and overprecision are one and the same, since being excessively sure you got the item right indicates both overestimation of your performance and excessive confidence in the precision of your knowledge.

One way to distinguish the two is measuring perceptions of performance over a set of items. It is easy to see how measuring beliefs about performance over a set of items can reduce the confound between overprecision and overestimation. It is possible, for instance, for someone to underestimate how well he has done, yet be excessively confident that his low estimate is correct. Estimating performance over a set of items usually entails making a frequentistic judgment (such as the number of items correct), whereas estimation of performance at the item level is more often elicited as a probabilistic judgment. There is a vigorous debate over frequentistic vs. probabilistic judgment. A number of researchers have found that overconfidence is reduced or eliminated when people are given frequentistic judgment tasks, such as estimating performance across a set of items (Gigerenzer, 1993; Gigerenzer & Hoffrage, 1995; Gigerenzer, Hoffrage, & Kleinbölting, 1991; Juslin, Olsson, & Björkman, 1997; Sniezek & Buckley, 1991). While other researchers argue that frequentistic judgments are not necessarily more accurate than probabilistic judgments (Griffin & Buehler, 1999), there is consensus that frequency judgments across a set of items are less prone to overconfidence than are judgments of correctness at the item-level.

Some have suggested that the difference between frequentistic and probabilistic judgments may be due to the human mind being better adapted to reason frequentistically (Cosmides & Tooby, 1996; Gigerenzer & Hoffrage, 1995). While that may be so, another possibility is simply that overconfidence in item-confidence judgments is attributable to overprecision. Item-level (probabilistic) confidence judgments will be biased upward by both overestimation and overprecision, whereas set-level (frequentistic) judgments will not necessarily be biased upward by overprecision.

The fact that most of the evidence for the existence of overconfidence confounds overestimation and overprecision raises important questions about which effect is responsible for the pervasiveness of apparent overconfidence in the results. It is possible that both causes share equally in the observed results, but it may be that one alone is primarily responsible. Prior data from item-confidence judgments cannot answer this question. We must ask it using different paradigms.

Problem 2: Underconfidence

The second problem with overconfidence is that in some contexts, the opposite is observed . Sometimes, people underestimate themselves, and sometimes they underplace themselves. We consider the evidence on each type of underconfidence in turn.

Underestimation

Underestimation of performance is most likely to occur on easy tasks, on easy items, when success is likely, or when the individual making the estimate is especially skilled (Fu, Koutstaal, Fu, Poon, & Cleare, 2005; Griffin & Tversky, 1992; Kirchler & Maciejovsky, 2002; Koriat, Sheffer, & Ma'ayan, 2002; Lichtenstein & Fischhoff, 1977; Lichtenstein, Fischhoff, & Phillips, 1982; Sniezek, 1990; Stankov & Crawford, 1997). It is those individuals with the best performances on any given task who are most likely to underestimate their actual performances (Klayman et al., 1999; Krueger & Mueller, 2002; Kruger & Dunning, 2002; Larrick et al., 2007).

Erev, Wallsten, and Budescu (1994) offered what has been called a Thurstonian explanation for the so-called hard/easy effect: the fact that overestimation occurs on hard tasks but underestimation occurs for easy tasks. Their theory, following in the tradition of Thurstone (1927), takes into account the fact that any judgment is likely to include some error component. When people have imperfect knowledge of their own performances, the error in their estimates will make those estimates regressive (Burson, Larrick, & Klayman, 2006; Krueger & Mueller, 2002). It is, after all, easier to underestimate than overestimate your score on a test when you get everything right. As a result, people underestimate their performance when it is high.

Underestimation has also been documented in domains other than beliefs about one's own prior performance, including the illusion of control, the planning fallacy, and optimism about future events.

The illusion of control. Research on the illusion of control has generally shown that, when people have no control over some event, they frequently act as if they have some sort of control (for reviews see Presson & Benassi, 1996; Thompson, Armstrong, & Thomas, 1998). While these results make it appear that people overestimate their control, the research paradigms have generally focused on situations in which people have very little control. Just as overestimation of performance is most likely to occur when performance is low, overestimation of control is most likely to occur when control is low. It is, after all, difficult to underestimate one's control if one has none. Studies find that people actually tend to underestimate their control when it is high (Alloy & Abramson, 1979; Gino, Sharek, & Moore, 2009; Jenkins & Ward, 1965).

The planning fallacy. The planning fallacy documents the tendency for people to underestimate how long it takes to get things done, or overestimate their own productivity (Buehler et al., 1994). Again, it is easiest to underestimate how long it will take to get something done when the task will be time-consuming. When the task doesn't take long to complete (i.e., it's easy), people are more likely to overestimate completion times—thereby underestimating their future performance (Boltz, Kupperman, & Dunne, 1998; Burt & Kemp, 1994).

Pessimism about the future. While people prefer to imagine bright futures for themselves (Markus & Nurius, 1986), they sometimes evince pessimism. For instance, shortly after September 11th, 2001, a sample of Americans estimated they had a 20% chance of being injured in a terrorist attack in the coming year (Lerner, Gonzalez, Small, & Fischhoff, 2003). This is clearly a radical overerstimate. In another study, smokers estimated their risk of dying of lung cancer at about 33%, when in fact the actual base rate among smokers is below 10% (Viscusi, 1990). Women estimate their chances of falling ill with breast cancer by as much as eight times the actual risk (Woloshin, Schwartz, Black, & Welch, 1999). Chinese people overestimated their actual chances of falling ill with Severe Acute Respiratory Syndrome (SARS) during the disease's outbreak in China (Ji, Zhang, Usborne, & Guan, 2004). People overestimate their risk of dying in the coming year (Fischhoff, Bruine de Bruin, Parker, Milstein, & Halpern-Felsher, 2006). Carnegie Mellon undergraduates estimated their chances of being struck by lightening at about 20%, when the actual chance is closer to .009% (Moore & Small, 2008). It is notable that all these overestimates of risk occur in domains where the outcome has a low probability. All of these are also "easy" tasks, in the sense that the positive outcomes (*not* being the victim of a terrorist attack or *not* contracting cancer) is by far the most likely outcome. Again, when success is likely, people tend to underestimate it.

Underplacement

It is also common to find situations in which people underplace their performances, reporting that they are worse than others (Kruger, 1999). As a rule, this underplacement tends to occur on difficult tasks where success is rare (Blanton, Axsom, McClive, & Price, 2001; Chambers & Windschitl, 2004; Krizan & Windschitl, 2007b; Moore, 2007a; Radzevick & Moore, 2008).

Comparative pessimism. Weinstein's (1980) findings are the most frequently cited evidence of comparative optimism. Comparative optimism is the belief that one is more likely to experience positive events than are others, and that one is less likely to experience negative events than are others. However, it just so happened that Weinstein asked his participants about positive common events (such as owning your own house) and rare negative events (such as attempting suicide). When event commonness and valence are unconfounded, results reveal that while both influence judgments of comparative likelihood, the effect of event commonness is roughly four times the size of valence (Kruger & Burrus, 2004). That is, people believe that common events (even undesirable ones) are more likely to happen to them than to others and they believe that rare events (even desirable ones) are less likely to happen to them than to others (Chambers, Windschitl, & Suls, 2003).

Underprecision

Results showing underprecision are rarer than results showing underestimation or underplacement. Since Alpert and Raiffa's (1969/1982) original demonstration, numerous studies have examined the tendency for people's judgments to reflect excessive confidence that their beliefs are true and accurate. As described earlier, participants asked to create 90% confidence intervals around their point estimates typically err by creating intervals so narrow that the true answer is included only 30% to 50% of the time (Teigen & Jorgensen, 2005). Soll and Klayman (2004) note that the standard paradigm tends to overstate the true size of the overprecision effect somewhat, but that they find that overprecision is nevertheless robust. Some research has found that overprecision is sensitive to exactly how the question is asked of participants, with some methods producing less overprecision than others (Budescu & Du, 2007; Juslin, Wennerholm, & Olsson, 1999; Winman, Hansson, & Juslin, 2004), and overprecision tends to be stronger for unfamiliar tasks (Block & Harper, 1991). Despite the work on these moderating factors, overprecision lacks a demonstration of its underprecision counterpart the way that underestimation and underplacement have been shown to mirror their positive counterparts.

Problem 3: Apparent Inconsistency

The third problem with overconfidence is one that should be obvious after the preceding review: Overestimation and overplacement are seemingly inconsistent with one another. Easy tasks produce *under*estimation and *over*placement. Hard tasks produce *over*estimation and *under*placement (Larrick et al., 2007; Moore & Small, 2007). Evidence of overestimation tends to come from difficult domains (Campbell, Goodie, & Foster, 2004; Fischhoff et al., 1977; Hoffrage, 2004). Overplacement is most likely to arise in easier domains (College Board, 1976-1977; Svenson, 1981).

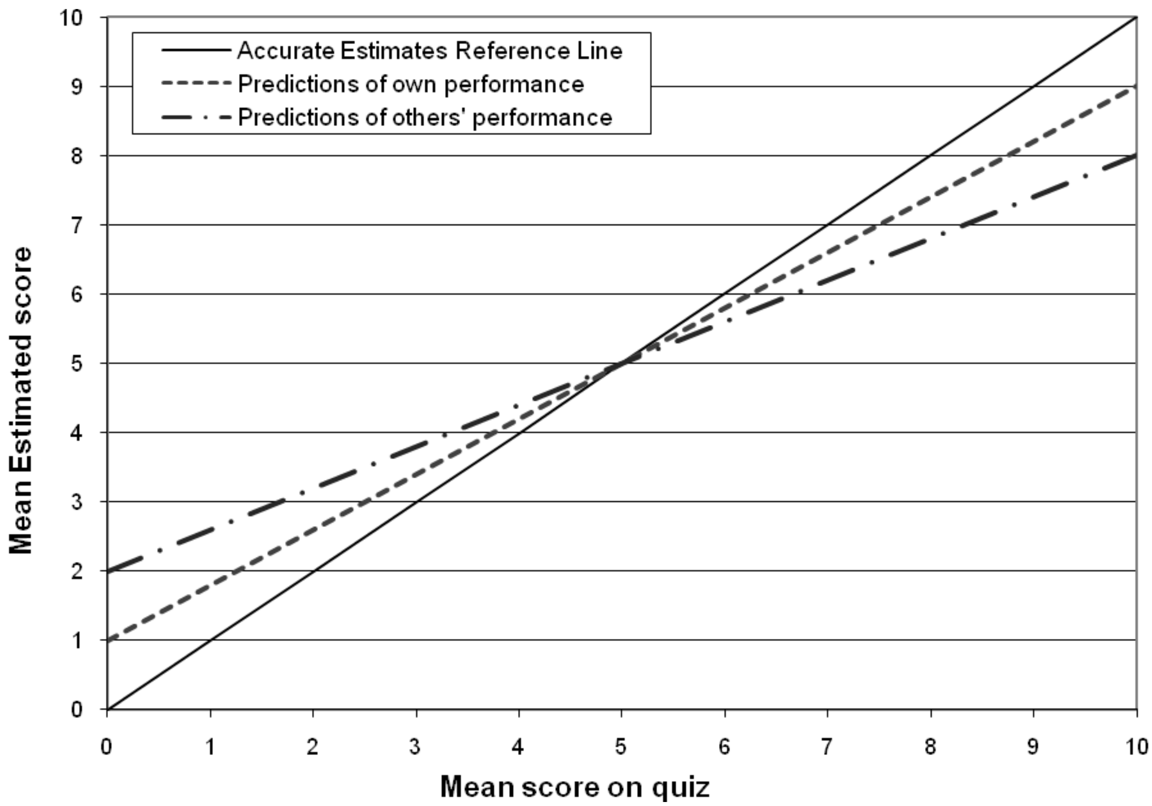
These apparent inconsistencies have produced some serious disputes. For instance, Viscusi (1990) asked smokers to estimate their chances of contracting lung cancer and found that they overestimated this small risk. On the other hand, when Weinstein (1998) asked smokers whether they were more or less likely than other smokers to get lung cancer, they told him they were less likely than others to fall ill. Slovic (2000) and Viscusi (2000) have argued bitterly on the question of whether smokers are overconfident or not.

In this paper, we review a theory that can help address the three problems identified above. Our work builds on that of Larrick, Burson, and Soll (2007), who present an insightful analysis of the statistical relationships between overestimation, overplacement, and actual performance. Our theory goes beyond theirs by considering the underlying beliefs regarding own and others' performance that produce these relationships, and by considering overprecision. Furthermore, we explore some implications and open questions that arise from the theory, which focuses on differences in the quality of information people have about themselves versus others.

Differential Information Theory

Moore and Healy (2008) present a theory that can help resolve these three problems in the overconfidence literature . Put simply, their differential information theory is this: People often have imperfect information about their own performances, abilities, or chances of success, but even worse information about those of others. Consequently, people's estimates of themselves are regressive, and their estimates of others are even more regressive. Both estimates are regressive in the sense that, because they are known to be imperfect, they will tend to regress toward baseline expectations (i.e., a Bayesian prior). It follows that when performance is exceptionally high, people will underestimate their own performances, underestimate others even more so, and thus believe that they are better than others. When performance is low, people will overestimate themselves, overestimate others even more so, and believe that they are worse than others. The theory's predictions are illustrated in Figure 1.

Figure 1. An example of the theory's prediction of beliefs about performance by self and others on a ten-item trivia quiz as a function of the actual score of the person doing the predicting, assuming the person expected a score of five prior to taking the quiz.



The theory makes some clear predictions regarding overestimation and overplacement:

Estimation: People will overestimate their performances on hard tasks, but underestimate their performances on easy tasks.

Placement: People will overplace their performance on easy tasks, but underplace their performances on hard tasks.

The theory is agnostic with respect to the origins of overprecision. None of the hypotheses described above depend on the accuracy in people's estimations of performance. However, the theory implies that the precision with which people are able to estimate performance should moderate the effects of task difficulty on both estimation and placement. In particular, those individuals who are least confident in their estimations of their own performances should make estimates that are most regressive toward the prior and will also show the least precision (i.e., the greatest variance). If this effect holds, then the hard/easy effect will be associated with greater precision in estimates of one's own performance.

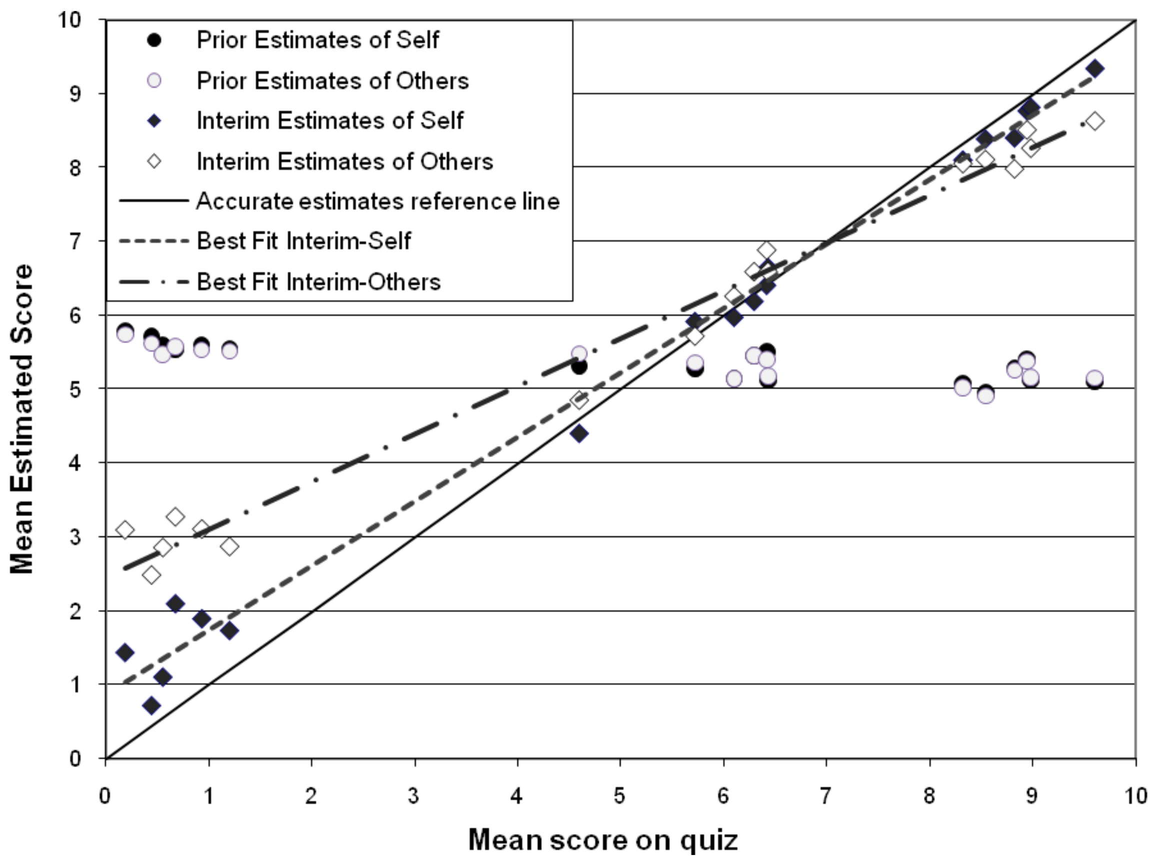
Likewise, the theory implies that accuracy in beliefs about others will result in both more precision of estimates and also in less overplacement on easy tasks and underplacement on hard tasks. On the other hand, individuals who are least confident in their estimations of others' performance will make the most regressive estimates of others. If this effect holds, then greater precision in the estimates of others will be associated with less overplacement on easy tasks and underplacement on hard tasks.

Experimental Evidence

Moore and Healy (2008) devised an experiment to test the differential information theory. They gave 82 participants in their experiment a series of 18 ten-item trivia quizzes covering six topics, each topic with a quiz that was easy, medium, and hard. Quiz difficulty was manipulated within subjects by using quizzes of varying difficulty. However, quizzes were not explicitly labeled with respect to ease. Participants estimated their scores and the scores of another randomly selected previous participant (RSPP) at two phases: (1) before they took the test and (2) again immediately after they took it. These are the prior and interim measures, respectively. In addition, participants estimated the RSPP's score a third time (the posterior measure) after they had graded their own quizzes. Participants were rewarded for scoring well on the quiz, and received other (smaller) payments for accurately estimating their own scores and the scores of an RSPP.

The results of the experiment were consistent with the predictions of the theory. On easy quizzes, people underestimated their scores but believed that they were better than others. On hard quizzes, people overestimated their scores but believed they were worse than others. For the quizzes of medium difficulty, people were fairly accurate in estimating both self and others. As it happened, there were not main effects for overestimation or overplacement. That is to say that, on average, people did not overestimate (or underestimate) their own scores or believe that they were better (or worse) than others. The results are shown in Figure 2.

Figure 2. Estimated scores for self and other on the 18 different quizzes.



Overprecision. Moore and Healy employed a novel method for eliciting beliefs. Instead of just asking people to make point estimates of the quiz scores, they asked participants to report their full subjective probability distributions across the range of scores. Participants estimated the likelihood of each of the eleven possible outcomes, from getting zero quiz items correct to getting all ten correct. Participant's responses were constrained such that their probability estimates of the eleven possible outcomes always summed to 100%. This belief elicitation allowed Moore and Healy to also assess not only the overestimation and overplacement effects discussed above, but also the precision in people's beliefs. It also represents a methodological advance over previous methods used to assess overprecision, avoiding some of the problems identified by Soll and Klayman (2004). Unlike overestimation and overplacement, participants' judgments *do* appear to show systematic overprecision. Indeed, as we discuss below, the evidence of overprecision in the data are quite strong. These results are particularly interesting for three reasons: (1) overprecision emerges clearly as the most robust form of overconfidence in the Moore and Healy data; (2) overprecision is likewise more robust (in the sense it shows few reversals with underprecision) than either overestimation or overplacement; and (3) overprecision is the most poorly understood of the three varieties of overconfidence, since we still lack a good theory to account for it that is consistent with the key empirical results. We will analyze the overprecision results in more depth than were possible in Moore and Healy's (2008) paper.

The overprecision in participants' judgments begins at the prior stage. The entire sample of 1476 quiz scores has variance of 16.97. But participants' prior judgments have a smaller variance, suggesting they were inappropriately sure they knew what their scores would be. The variance of participants' estimates of themselves is 6.37 and of the RSPP is 6.51, both of which are significantly smaller than 16.97, ps < .001. But that could just be because the distribution of actual quizzes was more strongly bimodal than they were expecting, as the quizzes included so many surprisingly easy and surprisingly difficult quizzes, which drove up the variance on actual quiz scores.

More interestingly, their estimates of the RSPP show lower variance (and imply greater precision) than the actual set of scores on each specific quiz, both at the interim and the posterior phase. Across the 18 quizzes, the average variance in scores is 5.19. However, at the interim phase, the variance in the average participant's estimate of the RSPP's score is only 2.86 and this shrinks to 2.67 at the posterior phase. Both of these represent significant underestimation of the actual variance, *p*s < .001. Note that it does not make sense to perform this analysis on participants' estimates of their own scores because they observe useful private signals that ought to produce more precise estimates of their own scores.

The tendency toward overprecision in estimation of the RSPP's score is moderated by test difficulty. We computed an index of interim overprecision[2] by subtracting the variance of each participant's estimate of the RSPP from the actual variance on that quiz. When this measure is subject to a 6 (test block) X 3 (difficulty) within-subjects ANOVA, the result reveals a significant main effect for difficulty, F (2, 162) = 1647, $p < .001$, $\eta^2 = .95$. Participants' judgments reveal greater overprecision for medium quizzes (*mean variance difference* = 6.63) than for easy quizzes (*mean variance difference* = 2.17), and underprecision for difficult quizzes (*mean variance difference* = -1.78). Neither the main effect for block, F (5, 405) = 1.56, $p = .17$, nor its interaction with difficulty, F (10, 810) < 1, $p = .96$, attains significance.

The reason for the significant difference across quiz difficulties is that the precision implied by participants' estimates of performance is not sufficiently responsive to changes in the variance of actual quiz scores. Because the variance in medium quizzes is quite large (*mean*

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[2] Note that we observe the same results if we compare the variance of posterior (rather than interim) estimations of the RSPP with actual quiz variances. We think these analyses are less interesting, however, if performed on prior estimates because these priors are based on so little information and we do not know what that information is. Also, the comparison of variances between beliefs and the actual distribution of scores does not make sense for the self at either the interim or posterior phase, because then people have excellent knowledge about their own particular quiz performances, and so the variance in each person's estimate ought to be smaller than the variance across all participants.

variance = 9.87), participants' estimates (*mean variance* = 3.12) appear too precise. Because variance in the difficult quizzes is so small (*mean variance* = 1.48), participants' estimates (*mean variance* = 3.05) appear insufficiently precise.

The differential information theory offers a hint regarding why we might be most likely to observe underprecision in participants' estimates of others' scores on difficult quizzes. We have argued that overestimation occurs on difficult tests in part because when performance is low, it is easier to overestimate it than undererstimate it. Just so, when variance on a quiz is exceptionally low, it is easier to overestimate it than to underestimate it. As with estimations of performance, the precision of those estimates is insufficiently sensitive to reality (see Budescu & Du, 2007).

An additional measure of overprecision. We should admit that the comparison of variances is an incomplete measure of overprecision, because it fails to take actual accuracy into account. Not all precision is overprecision. There is, in fact, a positive correlation between precision and accuracy. The smaller the variance in people's interim estimates of their own scores, the smaller the error in their estimates ($r = .55$, $p < .001$). The same is true for people's estimates of the RSPP: the smaller the variance in their interim estimates, the smaller the error in those estimates ($r = .25$, $p < .001$). Consider, for instance, a quiz on which no one gets anything right. An individual who reports that he is sure (100% confidence) that the RSPP has score of 0 would not be overestimating the precision of his beliefs. An alternative approach is to examine the one score an individual estimates is most likely. When takers of a difficult quiz report that a score of 2 is most likely, how often did they, in fact, get just 2 correct?

At the interim phase, participants report being, on average, 73% confident that they know their own scores but are correct only 59% of the time, t (1476) = 18.84, $p < .001$. They report being 43% sure they knew what the RSPP had scored, but are only correct 31% of the time, t (1476) = 17.86, $p < .001$. When averaged across all rounds and all belief elicitations for both self and the RSPP, participants reported, on average, being 44% confident that they had correctly identified the score. In actuality, they were only correct 29% of the time, and participants' 44% estimate is significantly greater than this figure, t (81) = 8.64, $p < .001$. Overprecision measured this way is greater than zero for all five belief elicitations (all ps < .001), all quizzes (all ps < .005), all levels of difficulty (all ps < .001), and all blocks (all ps < .001).

Does difficulty moderate the degree of overprecision we observe by this measure, as we observe above? To answer this question, we computed the difference between confidence and accuracy for each participant at each level of difficulty.[3] We then subjected this measure to a three-level within-subjects ANOVA. The results do indeed reveal a within-subjects effect of quiz difficulty, F (2, 162) = 13.55, $p < .001$, $\eta^2 = .14$. However, the effect runs in the opposite direction as that above. Instead of finding the greatest underprecision for the hard quiz, we observe that the difference between confidence and hit rates is greater for the hard (M = 22%) and medium (M = 23%) quizzes than the easy quizzes (M = 16%). While this appears to be a contradiction, its explanation is straightforward.

The explanation is two-fold. First, because participants' estimates of hard quiz scores were so much more regressive than easy quiz scores, their estimates are systematically off, pushing down their it rates. In other words, they overestimate hard quiz scores more than they underestimate easy quiz scores. The second reason has to do with floor effects. The variance in scores on the hard quizzes is so small that floor effects (variances don't go below zero) made it difficult for people to exhibit underprecision by underestimating the variance.

[3] To be specific, we computed the percentage confidence accorded to the score rated as most likely, and subtracted from this the actual hit rate. We averaged this across all five elicitations in each round and all six blocks for each level of difficulty.

The relationship between overprecision, overestimation, and overplacement. As expected, the precision of participants' judgments are related in interesting ways to overestimation and overplacement. These associations are most fruitfully examined at the interim phase, where participants have some information about performance on that quiz and we have measures of beliefs for both self and others.

We predicted that precision in estimates of one's own score would be associated with less underestimation on easy quizzes and also with less overestimation on hard quizzes. Indeed, this was the case. On the easy quizzes, the correlation between variance (i.e., lack of precision) and *under*estimation is positive ($r = .45$, $p < .001$). Participants' tendency to underestimate their scores on easy quizzes was smaller among those who reported narrow confidence intervals. On the hard quizzes, the correlation between variance and *over*estimation is also positive ($r = .46$, $p < .001$), because the more precise the estimate, the less the overestimation. The tendency to overestimate one's score on the hard quiz was associated with narrower confidence intervals.

We also predicted that greater precision in estimates of the RSPP's score would be associated with less overplacement on easy quizzes and also with less underplacement on hard quizzes. Indeed, this was the case. On easy quizzes, the correlation between variance (i.e., lack of precision) and *over*placement is positive ($r = .34$, $p < .001$). The broader the confidence interval in estimating others, the more the overplacement. On hard tests, the correlation between variance and *under*placement is also positive ($r = .26$, $p < .001$) because the broader the confidence interval in estimating the RSPP, the less the overplacement. In other words, precise estimates decrease the tendency to underplace one's own performance on hard quizzes.

Individual differences

There have been some attempts to examine individual differences in the propensity to be overconfident. While not every study that looks has found a relationship (Jonsson & Allwood, 2003), there are some that claim to have identified the traits that predict overconfidence. It is particularly interesting to examine the influence of individual differences in the Moore and Healy data, given that their study is the first to have examined all three varieties of overconfidence simultaneously.

For this reason, Moore and Healy collected some measures that prior research has found to be related to overconfidence: the "big five" dimensions of personality (Schaefer, Williams, Goodie, & Campbell, 2004), gender (Niederle & Vesterlund, 2007; Pulford & Colman, 1997; Soll & Klayman, 2004), narcissism (Ames & Kammrath, 2004; Campbell et al., 2004), and cognitive abilities (Kleitman & Stankov, 2007; Stankov & Crawford, 1996). In addition, there were three measures related to self-enhancement: overclaiming (Paulhus, Harms, Bruce, & Lysy, 2003), self-esteem (Rosenberg, 1965), and the generalized sense of power (Anderson, John, & Keltner, 2005). Because they could be related to individuals' willingness and ability to understand others, there were the empathy and perspective-taking subscales of the Interpersonal Reactivity Index (Davis, 1983) and social comparison orientation (Gibbons & Buunk, 1999). Finally, because it might be related to confidence in one's judgments and willingness to endure uncertainty there were measures of political conservatism (Jost, Glaser, Kruglanski, & Sulloway, 2003). This last measure included two questions: "*How liberal or conservative do you tend to be when it comes to social issues?*" and "*How liberal or conservative do you tend to be when it comes to economic issues?*" Participants were provided with a 7-point scale on which to respond, with endpoints labeled, "*very liberal*" and "*very conservative*." Space constraints did not allow analyses of the individual differences data in Moore and Healy's (2008) paper, so we present these analyses here.

These 17 measures allow us to test whether individual differences between participants are correlated with any of the overconfidence measures. But first, it makes sense to ask whether any of the three types of overconfidence are consistent within-individual. If measures of overconfidence do not vary consistently between people, then the search for individual-difference correlates of overconfidence is likely to prove fruitless. We have multiple measures of overconfidence for each person. What is the test-retest reliability of these different measures?

The alpha reliability for the 18 measures of overestimation is .21. Clearly this falls short of satisfactory reliability. The situation is much the same with overplacement: its alpha reliability is only .29. Overprecision is different, however. The average overprecision measure yields an alpha reliability of .95. We were concerned that this last result was the consequence of some lazy participants simplifying their jobs by reporting 100% confidence of a single score for each quiz and so moving more quickly through the experimental task. So we examined the length of time it took participants to complete the experiment, and found that it was not significantly correlated (r = .06) with the degree of overprecision.

Correlations between their measures of overconfidence and a variety of individual difference measures appear in Table 1. While three correlations in this table are significant at the .05 level, that criterion is not sufficiently stringent given that we're casting about for possible associations between our 17 individual difference variables and our three overconfidence measures. After the Bonferroni adjustment to our significance criterion for these 51 tests, none of the correlations is significant.

Table 1. Correlations across the 82 individuals between measures of overconfidence and measures of individual difference. Alpha reliability measures for the three different types of overconfidence also appear.

	Overestimation	Overplacement	Overprecision
Overestimation	$\alpha = .21$		
Overplacement	0.06	$\alpha = .29$	
Overprecision	0.24	-0.03	$\alpha = .95$
Extraversion	-0.15	-0.02	-0.08
Agreeableness	0.13	0.01	0.12
Conscientiousness	-0.02	-0.09	0.11
Neuroticism	-0.08	-0.15	0.04
Openness	-0.11	-0.26	-0.08
Social comparison orientation	0.03	0.14	0.05
Narcissism	-0.01	0.09	-0.19
Self-esteem	-0.13	0.03	-0.10
Overclaiming	0.21	0.07	-0.12
Generalized sense of power	-0.16	0.01	-0.12
Perspective-taking	0.12	-0.11	-0.07
Empathy	0.13	0.00	-0.13
Cognitive reflection	-0.19	0.08	-0.19
Social conservatism	-0.10	-0.01	0.17
Economic conservatism	-0.10	-0.01	0.20
Male	0.18	0.13	0.02
Age	0.18	-0.08	0.10

The failure of the individual differences we measured to account for differences between people in their tendency to display overconfidence is noteworthy. We do not have a good explanation for the failure to replicate findings from prior studies. It is probably not because participants became fatigued filling out the many surveys and started responding without much thought. If that had been the case we would expect the different measures to show poor reliability. In fact, inter-item alpha reliability measures are satisfactory (above .8) for all the multi-item scales. We can only speculate that the failure to replicate prior findings has to do with differences between the experimental procedures Moore and Healy used and those used in prior studies.

What differences in procedures led to our failure to replicate prior results? It is hard to know without varying each systematically and comparing the results to prior findings. But our failure to replicate does make us wonder how sensitive prior findings are to the exact experimental paradigms those studies employed. At the very least, our failure to replicate those results makes us more skeptical about the robustness of earlier findings of individual difference. We are forced to consider the example of gender, which experimenters routinely test for, but only report when they find an effect. If the presence of gender effects is taken as evidence for real gender differences and the absence of gender effects is ignored, we run the risk of overestimating the importance of gender differences that arise due to chance or idiosyncratic features of particular research designs.

Strengths of the Differential Information Theory

The differential information theory has a number of virtues. First, it posits a parsimonious explanation for the negative relationship between overestimation and overplacement across tasks. Second, it is consistent with most of the evidence on overestimation and overplacement, including the complex results of Moore and Healy's (2008) experiment. Third, it can help explain a number of otherwise incongruous research findings. Fourth, the theory can accommodate moderators of overconfidence previously documented in the literature.

Reconciling Incongruous Results

Smoking. For instance, the theory may be able to reconcile the Slovic-Viscusi debate about whether smokers are overconfident. Smokers do indeed overestimate the probability of contracting lung cancer, as Viscusi (1990) shows. But they also believe that others are more likely than they are to experience this rare event, as Weinstein (1998) shows. The theory can accommodate these findings if people have imperfect information about their own risky behavior and its consequences, but have better information about their own behavior than that of others. Likewise, when it comes to predicting whether they are going to die in the coming year, people tend to overestimate this small probability. Nevertheless, because people have better information for themselves than for others, they overestimate others more than self and consequently believe they are at less risk than others.

False consensus and false uniqueness. Our results reveal the simultaneous co-occurrence of both false consensus (thinking that others are more like you than they are, Ross, Greene, & House, 1977) and false uniqueness (believing that others are more different from you than they are, Perloff & Brickman, 1982) on the same dependent measures (see also Moore & Kim, 2003; Moore & Small, 2007). Participants' judgments reveal false uniqueness because participants reported believing that their scores were more exceptional than they actually were—.48 points higher than those of others on the easy quiz and 1.36 points lower on the hard quiz. At the same time, participants' judgments reveal false consensus because people believed that others would perform more like them than they actually did. Performance by participants and their RSPPs were uncorrelated within quiz (r = -.05). However, participants believed that others were like them—estimations of performance by self and other are strongly correlated within quiz (r = .48).

As Dawes (1989) pointed out, there is a rational basis for the so-called "false consensus" effect. If the only source of information participants had about quiz difficulty was their own performance, then they would do well to assume others would perform as they did (Krueger, 2003; Krueger, Acevedo, & Robbins, 2005). Indeed, people who assume others are like them will, on average, make more accurate estimates of others than will people who ignore the information they have about themselves and do not update their prior beliefs (Dawes & Mulford, 1996). And false uniqueness effects arise quite naturally from the fact that people possess better information about themselves than about others, as Fiedler (1996) has shown. Differential information theory accounts for the co-occurrence of these seemingly contradictory findings by explaining both phenomena as functions of the information available about the reference population.

Moderators of Overconfidence

The Moore and Healy theory is consistent with empirical results demonstrating a number of key moderators of overconfidence. We mention a few of them here.

Controllability. Research suggests that the tendency to believe that one's performance will be better than that of others is stronger for outcomes under personal control than for chance outcomes (for reviews see Harris, 1996; Klein & Helweg-Larsen, 2002). This result makes perfect sense since, when performance is entirely determined by chance, it is not possible for people to have better information about their own future performances than about others'.

Observability. People believe they are more likely than others to be honest (difficult to observe). They are less likely to believe they are more friendly than others (friendliness is easier to observe) (Alicke, 1985; Allison, Messick, & Goethals, 1989; Paunonen, 1989). As differential information theory would predict, this effect reverses itself for rare behaviors (Kruger & Savitsky, 2006). These results follow from the fact that people have better information about others for observable behaviors.

Personal experience. Personal familiarity with some event or outcome seems to increase comparative optimism (Weinstein, 1980). This contrasts with the effects of observability:

Observability increases information about performance or outcomes, particularly for others. Personal familiarity with one's own chances of experiencing an event, on the other hand, is likely to increase the disparity between the quality of information about self vs. others.

Absent/exempt. When people have exposed themselves to some risk but haven't experienced a negative outcome, they sometimes conclude that they are immune to that risk. For instance, young women who have unprotected sex and do not get pregnant may incorrectly conclude that they are infertile (Downs, Bruine de Bruin, Murray, & Fischhoff, 2004); or sexually active college students who have had unprotected sex but who haven't contracted AIDS may come to believe think they're less vulnerable to getting AIDS than are others (Weinstein, 1982). Basically, their personal experience with (the absence of) a rare negative event leads them to reduce their estimates of their own personal risk, and they wind up believing that they are less likely than others to experience it (see Hertwig, Barron, Weber, & Erev, 2004). People remain quite clueless about the low actual risk of contracting AIDS (roughly 1 in 500 chance of becoming infected from a single act of unprotected coitus with an infected partner, Hearst & Hulley, 1988), and so overestimate this small probability. This result is obviously consistent with our theory.

Debiasing. Metcalfe's (1998) review discusses debiasing methods that work to reduce or eliminate overestimation where it does occur. These are all strikingly consistent with our differential information theory. Most of Metcalfe's recommendations involve giving people better information about themselves or others. Indeed, Metcalfe (1998) argues that what evidence exists for overestimation is more consistent with poor information about one's own performance (and the causes of it) than with self-deception.

Limitations of the Differential Information Theory

We cannot claim that the patterns we observe here and elsewhere (Klar & Giladi, 1997; Kruger, 1999; Moore, 2005; Moore & Cain, 2007; Moore & Healy, 2008; Moore & Kim, 2003; Moore & Klein, 2008; Moore, Oesch, & Zietsma, 2007; Moore & Small, 2007, 2008; Windschitl, Kruger, & Simms, 2003) would hold regardless of context, task domain, or subject population, although the differential information theory does not suggest that these factors should matter. The theory is, however, not meant to account for all overconfidence effects. Here, we specify four key limitations to what the differential information theory can explain.

What constitutes performance? We have implicitly assumed that it is easy to specify what constitutes performance. Sometimes, there is little ambiguity about how many items each participant answered correctly on each trivia quiz. However, a substantial proportion of the evidence showing overplacement employs tasks on which performance is largely subjective. Svenson (1981), for instance, did not tell his participants exactly what constituted driving skill—he asked them how their driving skills compared with those of other drivers and left it up to them to determine how to assess driving skill. Indeed, Dunning, Meyerowitz, and Holzberg (1989) showed that the more subjective the domain, the more latitude people have to claim that they are better than others. This may be because the motivation to claim undeserved distinctiveness is unleashed in domains where people know that nobody can expose their exaggerations. It could also be the consequence of varied and idiosyncratic definitions of what constitutes performance (Santos-Pinto & Sobel, 2005; Van den Steen, 2004).

We should note that when the performance criterion is vague, it becomes difficult to assess the accuracy of estimations of performance. Consequently, it is not easy to measure the relationship between overestimation and overplacement in vague domains. This is why these vague performance domains did not provide a useful context in which to test our theory.

Direct vs. indirect measures. Indirect comparative judgments are computed using the implicit comparison between individual judgments of self and other. For example, a direct measure of overplacement would be asking people to give themselves a percentile ranking relative to all other test-takers. An indirect measure of overplacement would be to compute the difference between people's estimates of their own scores and their estimates of the scores of others. The Moore and Healy data rely exclusively on indirect comparisons.

The leading explanation for above- and below-average effects is differential weighting: When making comparative judgments, people overweight self-knowledge and underweight knowledge about others (Chambers & Windschitl, 2004; Giladi & Klar, 2002). Research has generally found that both overplacement on easy tasks and underplacement on difficult tasks is stronger when comparisons are elicited directly than indirectly (Chambers & Windschitl, 2004). The Moore and Healy theory cannot account for this difference in elicitation formats.

However, some research suggests that discrepancies between direct and indirect elicitation methods are an artifact of question format, and that parallel question formats can eliminate the discrepancy (Burson & Klayman, 2005; Moore, 2007b; Radzevick & Moore, 2009b). And while the differential weighting explanation is useful for accounting for some important results in direct comparative judgments (Kruger, Windschitl, Burrus, Fessel, & Chambers, 2008), it cannot account for the presence of overplacement or underplacement effects in indirect comparative judgments, such as those we present.

The self-selection problem. Even if, as our theory implies, people believe just as easily in their own inferiority as in their superiority, it does not follow that we should expect to see unbiased judgment most of the time. In life, people are not randomly assigned to the universe of all possible tasks. Instead, people self-select based, in part, on where they believe they can distinguish themselves from others (Tesser, 1988). This fact has two important consequences. First, easy tasks, on which more people feel competent, will attract too many competitors (Moore & Cain, 2007; Moore et al., 2007). It is, after all, industries such as restaurants, bars, and hobby shops that see the highest rates of entry, most intense competition, and, consequently, the highest rates of failure (Geroski, 1996; U.S. Small Business Administration, 2003). Second, we should expect overplacement to be the rule if we sample the beliefs of only those who have chosen to enter or compete (Cain, Moore, & Chen, 2009).

Motivational effects. Moore and Healy's theory is clearly a cognitive one. It explains over- and under-confidence not as the product of bravado or humility, but as the natural consequence of rational judgments with imperfect information. We have emphasized the virtues of the theory and the many things it can parsimoniously explain. However, we would be remiss if we did not note the fact that most theories invoked to explain overconfidence (and underconfidence) in the past have invoked motivation as a key cause, and there is some support for these theories that our theory cannot explain. Some have found that overestimation increases with the personal importance of the task domain (Ross, McFarland, & Fletcher, 1981; Sanbonmatsu, Shavitt, Sherman, & Roskos-Ewoldsen, 1987; Sanitioso, Kunda, & Fong, 1990). Other research has found that people are more likely to believe that they are better than others with whom they expect to compete vs. cooperate (Klein & Kunda, 1992). Then there is evidence showing that estimations of future performance are reduced when the moment of truth draws near (Carroll, Sweeny, & Shepperd, 2006; Gilovich, Kerr, & Medvec, 1993; Nussbaum, Liberman, & Trope, 2006). The differential information theory cannot account for these effects.

It is easy to imagine that there are many circumstances in which overconfidence can be adaptive. Self-confidence can increase your chances of success (Stajkovic & Luthans, 1998); self-perceived abilities predict actual performance over and above actual abilities (Greven, Harlaar, Kovas, Chamorro-Premuzic, & Plomin, 2009); optimism is correlated with positive health outcomes (Scheier & Carver, 1993); and high confidence makes you more persuasive to others (Anderson & Brion, 2008; Zarnoth & Sniezek, 1997). However, it is not the case that overconfidence is always adaptive. There are, of course, situations in which increased motivation can lead to defensive pessimism (Norem & Cantor, 1986; Norem & Illingworth, 1993) or even choking (Ariely, Gneezy, Loewenstein, & Mazar, 2005; Beilock & Carr, 2001; Benoît, Dubra, & Moore, 2009; Markman & Maddox, 2006). A number of researchers have examined the effect of event desirability on optimism and found no effects (Helweg-Larsen & Shepperd, 2001). As Krizan and Windschitl's (2007a) review of the literature shows, the evidence for wishful thinking, in which optimism is influenced by event desirability, is not strong.

Future Research

Overprecision. We think that the greater robustness of overprecision is interesting, but we are reluctant to conclude that overprecision is a universal tendency. Research clearly shows that overprecision is sensitive to the situational context (Block & Harper, 1991) and the elicitation method (Budescu & Du, 2007; Juslin & Persson, 2002; Juslin et al., 1999). Furthermore, important questions remain about the causes for overprecision. Some research has suggested that anchoring and insufficient adjustment might be at work in causing overprecision (Block & Harper, 1991; Juslin et al., 1999). If people anchor on an initial answer and adjust insufficiently from it when building a confidence interval around it, that would produce apparent overprecision. Other researchers have suggested that confirmation bias or biased information retrieval may be at work (Hoch, 1985; Klayman et al., 1999; Koriat, Lichtenstein, & Fischhoff, 1980). Some research suggests the same memory processes that give rise to confirmation bias may lead to anchoring (Mussweiler & Strack, 1999; Strack & Mussweiler, 1997), and maybe also to overprecision. Some of the most promising evidence highlights the role of faulty statistical intuitions surrounding the construction of confidence intervals (Juslin, Winman, & Hansson, 2007).

Despite the many studies that have shown overprecision, it has been examined primarily in just two ways: (1) using interval estimates of numerical answers to trivia questions and (2) using the item-confidence paradigm, which confounds it with overestimation. Overprecision deserves to be studied with a greater variety of methods and in a greater variety of contexts than it has been in the past. Mamassian (2008) has developed a promising new research approach that could be used to infer precision in judgment without forcing people to state it explicitly. Mamassian's approach could even be used for studying overprecision in animals, children, or other populations who have difficulty understanding confidence intervals and probabilities.

The benefits of overconfidence. There are a number of interesting open questions surrounding the issue of when it might be in the individual's interest to be overconfident. If believing in your own self-efficacy can increase motivation, effort, and performance, then it might be in your interest to fool yourself into being overconfident (Benabou & Tirole, 2002). Believing that you can succeed does, at least sometimes, increase work performance (Pajares, 1996; Stajkovic & Luthans, 1998). Indeed, merely visualizing success can even contribute to future performance (Taylor, Pham, Rivkin, & Armor, 1998). And Scheier and Carver have documented some positive health correlates of optimism (Scheier & Carver, 1993, 2003).

However, Baumeister, Campbell, Krueger, and Vohs (2003) argue that high self-confidence is more a consequence than a cause of success. It is also the case that believing in your own success can undermine that very success, such as when the student who is sure she will ace the test fails to study (Goodhart, 1986; Stone, 1994). And as explanations for the high rate of teenage deaths in auto accidents have often noted, belief in one's invincibility leads to actions that increase the risk of injury and death (Johnson, McCaul, & Klein, 2002; Williams, 2003).

If overconfidence isn't always good for individual performance, maybe its effects on well-being are more salutary. Many have argued that "positive illusions" of our own superiority over others are individually beneficial, in the sense that they increase well-being and psychological adjustment (Taylor & Brown, 1988). Certainly, belief in a positive future allows one to savor anticipated pleasures (Loewenstein & Thaler, 1997). But excessively optimistic forecasts undermine satisfaction when reality intervenes on our pleasant illusions (McGraw, Mellers, & Ritov, 2004). Indeed, the salient upward counterfactual provided by an unfulfilled expectation is likely to contribute to disappointment, frustration, and attempts to change one's behavior (Roese, 1999; Roese & Olson, 1995).

Then maybe the benefits of overconfidence accrue in social situations where people who are most overconfident are those most likely to attain status and influence in social settings (Anderson & Brion, 2008; Radzevick & Moore, 2009a). Indeed, high degrees of confidence increase your persuasiveness to others (Sah, Moore, & MacCoun, 2009; Zarnoth & Sniezek, 1997), but arrogance can also alienate others. Those individuals who overestimate their status within groups are prone to ostracism (Anderson, Srivastava, Beer, Spataro, & Chatman, 2006). And those who claim the greatest confidence are at the greatest risk of undermining their credibility when they turn out to be wrong (Tenney, MacCoun, Spellman, & Hastie, 2007; Tenney, Spellman, & MacCoun, 2008).

Conclusion

There are clearly many adaptive benefits of having accurate information about yourself—your ability to jump across the crevasse, your probability of winning the promotion, your probability of getting the grant over other contestants, your chance of seducing the attractive stranger, or the accuracy of your estimate regarding the value of the stock you are thinking about buying. When individuals, groups, companies, and markets display overconfidence, they will make some predictable mistakes. The research we discuss in this paper helps advance our understanding of what causes overconfidence, and in this way it should help us predict when we will observe the different sorts of overconfidence and in what contexts.

What can it tell us about the role of overconfidence in the growth and subsequent collapse of the subprime mortgage market? Our work would suggest that banks' excessive confidence that they knew how to price collateralized debt obligations and credit default swaps was likely to have been the real culprit. That is where overprecision came into play. Without that overprecision, there would have been little supply of capital for subprime mortgages. Banks' willingness to buy and insure these speculative investments created the opportunity for markets to select those home buyers who were either so optimistic or so risk-seeking that they were willing to take out mortgages that they could not afford. It would be nice to think that the implosion in the subprime mortgage market might have corrected the overprecision in banks' valuations, but the data suggest otherwise. There can be little doubt that the financial crisis has led to more pessimistic valuations of subprime mortgages. But market prices and trading volumes suggest that individuals and institutions are still behaving as if they were excessively confident that these newly pessimistic beliefs are accurate, and that the mortgages that were once so valuable are now worthless.

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