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Commentary: Comments on "Getting Scarred and Winning Lotteries: Effects of Exemplar Cuing and Statistical Format on Imagining Low-Probability Events," By Newell, Mitchell, and Hayes (2008)

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ABSTRACT

Newell, Mitchell, and Hayes (NMH) conduct three experiments designed to test whether exemplar cuing (EC) theory or a statistical format theory provides a more accurate account for how people make judgments about low-probability events. They report finding support for the statistical format theory and little or no support for EC. However, NMH misstate the requirements for the production of exemplars in EC theory. As a result, they confuse non-exemplar conditions with exemplar conditions in their experiments, and find results that are virtually irrelevant to EC theory. Copyright © 2009 John Wiley & Sons, Ltd.

KEY WORDS exemplar cuing; low-probability events; imaginability; exemplars

INTRODUCTION

Newell, Mitchell, and Hayes (NMH) (2008) conduct three experiments designed to test whether exemplar cuing (EC) theory (Koehler & Macchi, 2004) or a statistical format theory provides a more accurate account for how people make judgments about low-probability events. They find support for the statistical format theory and claim no support for EC. However, NMH did not actually test EC theory. They tested a different exemplar theory that makes predictions that are inconsistent with EC theory. NMH then mistakenly attribute those predictions to EC en route to drawing their conclusions.

We organize our comment as follows. First, we review EC theory. Next, we review the purported EC predictions and experiments in NMH. Finally, we explain why the stimuli used in those experiments do not identify exemplar conditions and therefore do not test EC theory.

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WHAT IS EXEMPLAR CUING THEORY?

EC is a theory for how people assign weight to low-probability statistical evidence (Koehler & Macchi, 2004). The theory holds that the weight people attach to a low-probability event depends, in part, on the cognitive availability of event exemplars. Event exemplars are affected by how the statistical evidence is described. When the description of the statistical evidence makes it easy for people to imagine examples in which the low-probability event will occur, people will be less dismissive of the unlikely event.

In our papers (Koehler, 2001a, 2001b; Koehler & Macchi, 2004), we explain that statistical evidence descriptions vary in terms of *target* (a narrow focus on a single target vs. a broader focus on multiple targets), *form* (frequency or probability description), *reference class size* (small vs. large), and incidence rate or statistic (e.g., 0.001%). EC theory proposes that event exemplars are generated in the minds of decision makers when particular combinations of particular factors are present. Specifically, exemplar generation is facilitated in multiple target situations in which the product of the reference class size and the incidence rate is greater than one (Koehler & Macchi, 2004). In those situations, the theory predicts that decision makers will attach relatively more weight to the rare event in question.

To illustrate, Koehler and Macchi (2004, Experiment 1) provided mock jurors with the details of a murder case in which statistical DNA evidence recovered from the crime scene matched a suspect. We varied the target, reference class size, and form associated with a 1 in 100 000 DNA incidence rate. The target was the individual suspect (single) or ‘‘people in the city’’ (multiple); the reference class size was the population of the city in which investigators believed the murderer resided (500 or 5 000 000); the form of the incidence rate was 1 in 100 000 (frequency) or .001% (probability). For example, jurors in the ‘‘multiple target/large reference class/frequency form’’ condition received the following description of the DNA-match evidence: *1 in 100 000 people in the city who are not the source would nonetheless match the blood drops*. This description meets the exemplar requirement specified above: it appears in a multiple target situation where the product of the reference class size (5 000 000) and the incidence rate (1/100 000) is greater than one (the product is 50). The theory predicts that jurors who heard the match evidence presented this way would give some thought to others in the city whose DNA might also match and, as a result, would question the strength of the match evidence (‘‘if the DNA profile matches lots of people in the city, maybe the evidence isn’t dispositive after all’’).

Now consider what jurors in the ‘‘single target’’ condition heard. After learning the size of the city, these jurors were told: *the chance that the suspect would match the blood drops if he were not their source is 1 in 100 000*. In the single target condition, the target was ‘‘the suspect’’ rather than ‘‘people in the city.’’ According to EC theory, multiple targets promote exemplar generation but single targets do not. Consequently, in a single target situation where there are no readily available match exemplars, jurors will be relatively more impressed by the match evidence (‘‘it’s almost certainly his DNA’’).

In sum, EC theory claims that when the set of conditions associated with target, reference class size, and incidence rate is such that people can easily generate examples in which the low-probability event will occur (e.g., a coincidental DNA match with someone other than the suspect), people will attach more weight to the possibility that the event may occur. A multiple target in combination with a sufficiently large ‘‘reference class X incidence rate’’ product achieves this exemplar state.

NMH’S EXPERIMENTS

NMH set out to test the predictions of EC theory against those of a simpler theory based entirely on question format (frequency vs. probability format). They use four different scenarios (lottery, game show, vaccine, and laser treatment) across three experiments. The key independent variables in these experiments are number of exemplars cued (>1, <1) and question format (probability, frequency). The key dependent measure is participants’ willingness to take a relevant action (e.g., purchase a lottery ticket, contact a game show, or participate in clinical trials).

NMH manipulate the number of exemplars by varying reference class size while holding the incidence rate fixed. For example, in the lottery scenario, participants in the ‘‘<1 exemplars cued’’ condition were told: ‘‘50 tickets are sold each day and it is estimated that you have a 1% chance of buying a winning ticket.’’ NMH treat this as a no-exemplars-cued condition because the product of 50 and 1% is less than 1. Participants in the ‘‘>1 exemplars cued’’ condition were told that 5000 tickets (rather than 50) are sold each day. NMH treat this as an exemplars-cued condition because the product of 5000 and 1% is great than 1.

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In general, NMH claim to find strong support for the effects of question format on willingness-to-take-action decisions and no support for whether exemplars were or were not cued. They conclude: ‘‘our results present some clear challenges to the specific formulation of EC theory provided in Koehler and Macchi (2004). In particular, we found little evidence of the multiplicative mechanism that they propose’’ (p. 333).

THEORETICAL MISCONSTRUAL

Unfortunately, NMH misstate the fundamental conditions for EC. Consequently, the experiments they conduct do not test predictions that EC theory actually makes.

NMH say that Koehler and Macchi (2004) ‘‘discuss two separate mechanisms for the facilitation of exemplar generation. The first—‘multiplicative’—mechanism cues exemplars when the product of the size of the reference class for the event and the incidence rate of the event is greater than 1.’’ NMH's use of quotation marks notwithstanding, neither the word multiplicative nor mechanism appears anywhere in Koehler and Macchi (2004). More significantly, NMH ignore an important qualifier to the claim that exemplars are cued when the product of the reference class size and incidence rate exceeds 1: this is only true in a multiple target situation. According to the theory, exemplars are never cued in a single target situation. Indeed, the 2nd condition identified in Table 1 in Koehler and Macchi (2004, p. 542) explicitly indicates ‘‘no exemplars’’ for a state where the product of the reference class size (5 000 000) and incidence rate (.001%) exceeds 1.

NMH's failure to appreciate the role that target plays in the encouragement and inhibition of exemplars leads to a flawed set of experiments where the authors attribute exemplars to conditions that EC theory would treat as ‘‘no exemplar’’ conditions. Consider the lottery scenario in Experiment 1 in which half of the subjects were told:

> ‘‘You are offered the opportunity, today, to buy a ticket in the new ‘‘Sydney Lottery.’’ Five thousand tickets are sold each day and it is estimated you have a 1% chance of buying a winning ticket.’’

The target in this description is single because attention is directed to the single ticket that you are about to purchase. According to EC theory, this is not an exemplar condition. Yet NMH treat it as one that cues exemplars and then mistakenly conclude that their study finds results opposite those predicted by EC theory.

In the General Discussion, NMH concede that the targets in their experiments were ‘‘arguably’’ single (p. 332). If true, then *none* of NMH's ‘‘>1 exemplars cued’’ conditions were actually exemplar conditions because, again, EC theory says that exemplars are not cued in single target situations.

NMH attempt to resolve this contradiction by belatedly claiming saying that they were merely testing ‘‘a simple interpretation of EC theory’’ rather than the ‘‘slightly more subtle prediction of the theory’’ (p. 332) that Koehler and Macchi (2004) offered. They also say ‘‘we do not feel that it [the use of an arguably single target] undermines the logic of our test of the multiplicative mechanism—namely, testing that when the reference class and incidence rate are presented, exemplars will be generated if their product exceeds one’’ (p. 332). In other words, NMH did not test ‘‘the *specific formulation* of EC theory provided in Koehler and Macchi (2004)’’ (p. 333, emphasis added) after all. NMH tested a different version of the theory that no one subscribes to and that makes predictions that are inconsistent with the very theory they set out to test.

Relatedly, NMH are mistaken when they contend that their scenarios provide an appropriate test of EC theory ‘‘regardless of any potential ambiguity about the multiple/single nature of the targets’’ (fn 2, p. 332). The essence of EC theory is that the way decision makers think about low-probability events depends critically on whether their attention is directed narrowly on the instant case or broadly on a population. When this attention manipulation is ignored or is ambiguous, one cannot claim to have tested the theory.

THE PROBLEM OF PROBABILITY LEVEL

EC was designed to predict responses to very low-probability events. Koehler and Macchi (2004) said that exemplar effects were ‘‘probably greatest for very low-probability events because in such cases the thoughts [about event exemplars] may cause an event that would otherwise be ignored to receive attention’’ (p. 540). With this in mind, the

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Table 1. Description of DNA match statistic, exemplar state, and predictions in eight conditions in Experiment 1

Target	Form	Reference class size	Description of DNA match statistic	Exemplar state and predictions
Single	Probability	Small (500)	The chance that the suspect would match the blood drops if he were not their source is 0.001%.	No exemplars Evidence is more convincing
Single	Probability	Large (5 000 000)	The chance that the suspect would match the blood drops if he were not their source is 0.001%.	No exemplars Evidence is more convincing
Single	Frequency	Small (500)	The chance that the suspect would match the blood drops if he were not their source is 1 in 100 000.	No exemplars Evidence is more convincing
Single	Frequency	Large (5 000 000)	The chance that the suspect would match the blood drops if he were not their source is 1 in 100 000.	No exemplars Evidence is more convincing
Multiple	Probability	Small (500)	0.001% of the people in a town who are not the source would nonetheless match the blood drops.	No exemplars Evidence is more convincing
Multiple	Probability	Large (5 000 000)	0.001% of the people in a town who are not the source would nonetheless match the blood drops.	Exemplars Evidence is less convincing
Multiple	Frequency	Small (500)	1 in 100 000 people in a town who are not the source would nonetheless match the blood drops.	No exemplars Evidence is more convincing
Multiple	Frequency	Large (5 000 000)	1 in 100 000 people in a town who are not the source would nonetheless match the blood drops.	Exemplars Evidence is less convincing

experiments we reported used incidence rates that ranged from 1 in one billion on the low end (Koehler, 2001b, Experiment 4) to 1 in one thousand on the high end (Koehler & Macchi, 2004, Experiment 2). There is no objective cutoff for what constitutes ‘‘low’’ or ‘‘very low.’’ However, even if NMH had devised a proper test of EC theory, the 1% probability levels they used are probably too high. For many people, events that occur as often as one time in 100 are not hard to imagine or presumed to be so rare that they can be ignored. But this state of affairs should be the starting point for EC research efforts.

EMPIRICAL MISSTATEMEMTS

Finally, it is important to correct other misimpressions of the empirical results in Koehler and Macchi (2004) that may have been created by the review NMH provide. For example, they report that we found that ‘‘jurors were relatively less impressed by the evidence when a fractional numerator was used’’ (NMH, 2008, p. 319). In fact, we found the opposite. Jurors were significantly *more* impressed by the evidence when a fractional numerator was used on all of our key dependent measures (Koehler & Macchi, 2004, p. 544). NMH also say that the key result in support of exemplar cueing theory was a finding that the statistical evidence was less convincing when the perpetrator was in a large town than a small one (NMH, 2008, p. 333). This is not an accurate representation of the predictions of EC or of our data. In some conditions, the theory predicts that the large town will facilitate exemplar generation and, in other conditions, it does not. We obtained results consistent with these more complex predictions. Finally, NMH say that the form manipulation in our study ‘‘did not have a significant effect on judgments’’ (NMH, 2008, p. 319). Though technically true, a more complete

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characterization of our data would have noted that we found a "marginally significant" ($p = .077$) effect for form on key dependent measures. The direction of this effect was the same as that hypothesized by NMH. It may well be that, in some instances, frequency forms also encourage exemplars due to the presence of a competing, albeit arbitrary, sample space. We agree with NMH that future research should seek to specify the relationship between problem format and outcome imaginability.

CONCLUSION

The authors claim that their findings discredit the central mechanism EC theory proposes for enhancing the imaginability of low-probability events. This claim is mistaken. The findings in NMH are virtually irrelevant to EC theory because the theory is misstated and the experiments provided in this paper mistake non-exemplar conditions for exemplar conditions.

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